Architects hired to create designs for $100 million plan to modernize and expand learning spaces

The University of Illinois has hired a Chicago design firm to begin planning the $100 million Altgeld Hall and Illini Hall project to modernize learning spaces and increase capacity in data science and other mathematical sciences.

During their March meeting, the Board of Trustees approved CannonDesign to conceptualize and create schematic designs for the project, which will include the construction of a new building on the site of Illini Hall, and the renovation of Altgeld Hall. Campus officials expect the new building to be constructed by 2022, and for the renovation of Altgeld to be complete by 2024.

Once the schematic designs are complete—which will provide basically an overall visualization of the project—they will be brought back to the Board of Trustees for review. If the board approves, CannonDesign will proceed with planning the details of the project. The total design contract amount is estimated to be $4.4 million.

Illini Hall (upper right corner) will be replaced with a larger, world-class facility for learning and discovery, including a data science center. Altgeld Hall (center) will undergo restoration of historic features and the addition of increased energy efficiency and accessibility. Photo circa 1970; courtesy of the University of Illinois Archives.

CannonDesign is the same firm that designed the renovation of Lincoln Hall, which was completed in 2012. It has also designed projects at several other universities, including the student union at the University of Florida, a residence hall at Boston University, the law school library tower at the University of Chicago, a chemistry laboratory renovation at Yale University, and many more.

"We are very pleased that the trustees approved CannonDesign for the Altgeld Hall and Illini Hall project," said Derek Fultz, director of facilities for the College of LAS who also served on the selection committee that recommended the firm. "We fully expect the buildings to display the same, high levels of creativity and practicality that CannonDesign has provided in the past."

Campus is still raising money for the Altgeld Hall and Illini Hall project. The new building will be constructed on the site of Illini Hall, which is scheduled to be razed at the corner of South Wright and East John streets beginning in fall 2020. It will be replaced with a larger, world-class facility for learning and discovery, including a data science center that does not currently exist on campus.

The new building will be an advanced classroom and research facility focused on creating knowledge through mathematics, statistics, data analysis, and machine learning. The departments of Mathematics and Statistics will continue to use space in the new building.

The new building will be funded in part with a portion of the $500 million in state capital funding that was approved last spring to launch the Illinois Innovation Network and Discovery Partners Institute. The university will also contribute to the new building.

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ILLINOIS

From the Chair

Dear friends,

As another academic year winds to a close, I've been reflecting on our department's past, present and future. In writing this note I looked back at the remarks offered by my predecessor, Matt Ando, five years ago on these pages. Five years ago, our newly released Strategic Plan targeted a number of priority areas, including excellence in faculty research and scholarship, world-class facilities for collaborative research and teaching, innovative opportunities for undergraduate education and mentoring, and novel approaches to training graduate students for leadership in both academic and non-academic venues. Thanks to the collective efforts of many people, we've made tremendous progress on all of these fronts.

Our faculty continue to produce compelling scholarship of international repute, and are being recognized at every level for their research, their teaching, and their leadership in the profession. In particular, Philipp Hieronymi is a winner of this year's LAS Dean's Award and Campus Award for Excellence in Undergraduate Teaching, the latest in a long line of math department faculty to win one or both of these awards. During the upcoming academic year, three faculty members (Pierre Albin, Steve Bradlow and Chelsea Walton) are part of the organizational committees of semester-long programs at the Mathematical Sciences Research Institute in Berkeley.

A decade of patient and foundational preparation bore fruit this past year, as the University moved swiftly to initiate an extensive renovation and rebuilding plan for Altgeld and Illini Halls. You can find out more about the architectural design firm selected to visualize our new facilities in this issue's cover story.

Our primary undergraduate research program, the Illinois Geometry Lab, welcomed record numbers of students this year into an astonishingly diverse array of projects and outreach activities. We've also launched a new undergraduate research program focused on Actuarial Science, the I-Risk Lab. As I remarked recently to another audience, we are national leaders in facilitating high-quality undergraduate research in the mathematical sciences on a broad scale.

Finally, we've also been pioneers in training graduate students---primarily through the department's pathbreaking PI4 grant---to apply the advanced analytic skills gained during their time at Illinois to problems and projects addressed at top government, industrial and business locations.

As with all that we do, these initiatives have a cost, and our alumni continue to provide generous support. We are extremely grateful for the many ways in which you recognize the importance of and contribute to the department's mission, both financially and otherwise. In particular, the Mathematics Development Advisory Board has been a key force in implementing the vision provided by the Strategic Plan.

Finally, best wishes to our long-time Communications Director, Tori Corkery, who retires this month. This issue of Math Times will be the last one published under her editorship. Tori retires from the University of Illinois after 36½ years of service, including 20½ years with the Department of Mathematics. She has been an indispensable member of our staff, and her presence will be greatly missed.

I wish all of you a happy and productive summer. Keep in touch, and let us know what you are doing.

Jeremy Tyson
Professor and Chair
Department of Mathematics

George Akst

By Abby Paeth, LAS News

Forty years ago George Akst was offered a tenure-track professor position, but he decided that he was meant to pursue a new calling that resonated more deeply with him. Akst left academia and began a career in military operations research.

Today, Akst (MS 1972; PhD 1974 Mathematics) serves as the director of the Operations Analysis Directorate for the U.S. Marine Corps, where he performs studies and analysis to help the Marine Corps make sound policy decisions.

George Akst (MS 1972; PhD 1974 Mathematics) is the director of the Operations Analysis Directorate for the U.S. Marine Corps. (Photo courtesy of George Akst)

"While we are located in one particular unit, Marine Corps Combat Development and Integration Department, we support the entire Marine Corps," Akst said. "Anybody across the Marine Corps, if they have an analytical question, can come to us and if we think that the question is a high priority one and amenable to analysis, then we will help them."

Akst has performed research and analysis for several major operations including Desert Storm. He's analyzed a wide variety of questions, including some high-profile ones, such as whether women should be permitted in ground combat arms and infantry units. Following the analysis and recommendations from senior leaders, the Marine Corps opened the door to women in all military units for the first time in history.

"We did a lot of quantitative analysis to address the ability of females to succeed in these various combat arms and professions," Akst said, and found that while female typically lacked the upper body strength of males, some could perform the tasks needed for combat arms. Further, their different perspectives measurably enhanced decision-making skills to certain types of problem solving."

Analysis for the Marine Corps wasn't always in Akst's career plans. From 1970 to 1978, he served in the Corps of Engineers in the Army Reserve, and graduated from the Engineer Officer Basic Course at Fort Belvoir in 1972. In 1974, while in the Reserves, Akst earned his PhD in mathematics from the University of Illinois.

Choosing to attend Illinois was quite a change for Akst. "I grew up in New York City and went to (undergrad) in New York City and I thought after graduating college it was probably time to leave," Akst said. "Illinois had a very good reputation."

During his time at Illinois, Akst was very involved in the scuba diving club, which he said was a fairly prominent group on campus during his time here despite the apparent lack of water. They would drive to scuba dive in Lake Kickapoo, near Danville, Illinois.

Each year, the club would also take trips to the Bahamas for a week to go diving. Akst met his wife, Barbara, on a charter scuba diving trip, while he was working as part of the boat's crew.

"She came aboard. I was crew and she was a paying passenger and we met and hit it off," Akst recalled. "The captain and his wife saw that, and the captain said, 'Hey, do both of you guys want to stay on? Barbara can help in the kitchen and you can pull up the anchor and do the things you are doing.' And, so we both stayed on for a third week. That was 43 years ago."

After graduating from Illinois, he went on to become a professor of mathematics at New Mexico State University from 1974 to 1976. He took another job at California State University at San Bernardino from 1976 to 1979. It was during this time that Akst felt the need to try something different and, to some, maybe even a little bit unexpected, even though he received a tenure-track offer to teach math at Morehead State University.

In 1979, Akst joined the Center for Naval Analyses, a nonprofit organization that serves the U.S. Department of the Navy, which began his career in operations and research. Since that time he has held various other positions and worked on several important projects including Cost and Operational Effectiveness Analyses on Sea-Based Tactical Ballistic Missile Defense, Tomahawk Baseline Improvement Program, Unmanned Aerial Vehicles, and Advanced Amphibious Assault Vehicle.

He directed analyses of Marine Corps Ground Operations in Desert Storm, and led all of CNA's efforts in 1996-1997 to support both the Navy and Marine Corps in the Quadrennial Defense Review, which is a study conducted every four years by the United States Department of Defense. He also served as the scientific analyst to Headquarters, Marine Corps, which is the headquarters staff of the Marine Corps, located in the Pentagon, and as the field representative to the Fleet Marine Force, Pacific, which is the headquarters for all Marine forces in the Pacific.

In 1998, he became a federal civil servant for the Marine Corps at Quantico, Virginia. He started as the deputy director of the Operations Analysis Directorate, and was ultimately promoted into the senior ranks of government as the director. Akst said his team works on a broad variety of questions ranging anywhere from determining appropriate bonuses for recruits to analyzing combat action. They look at the relationships between cost and effectiveness and make recommendations based on their findings.

Akst loves that his job allows him to work on so many different projects. No two days are ever the same, he said, and he has no regrets about his career change 40 years ago. Sometimes, he said, a leap of faith is necessary to get on the path you were meant to pursue.
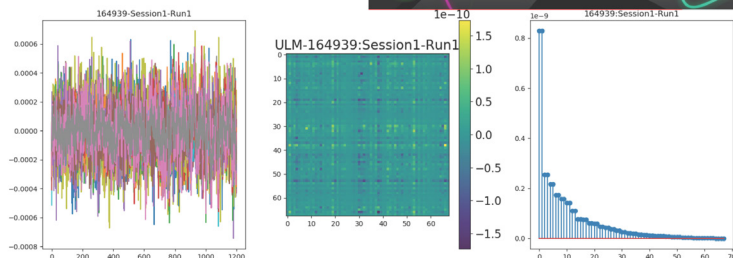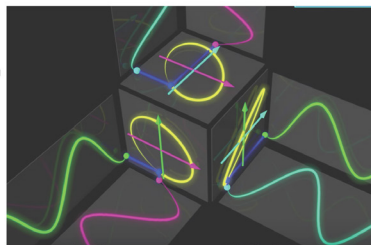
Time series and iterated integrals

by Yuliy Baryshnikov

Time series data are one of the most frequent types one encounters in the practice of data analysis: from economics to health to ecology to meteorology: whenever you have a collection of numbers with timestamps, you got a time series. And not surprisingly, there are myriads of tools to analyze time series.

Right: screenshot from R. Ghrist's online multivariate calculus course using the ideas presented here as an example of application of differential forms in data analysis (reproduced with permissions).
Below: typical output of the *cyclicity* algorithm, shoving strong leader-following relations between certain ROIs (regions of interest) in brain in the rest state.

One problem though, is that almost all of these tools use Fourier analysis, in one guise or another: as cosine transform, FFT or power spectrum. And this spells trouble, because almost by definition, these methods lack reparametrization invariance: if you relabel your timestamps in a non-linear fashion, the results of your analysis will change.

One area where such lack of reparametrization invariance is detrimental is the analysis of cyclic yet aperiodic phenomena. Examples are abound: economic cycles are notoriously hard to predict; your heartbeat rhythm is anything but fixed; ecological cycles are slowing down or accelerating depending on the weather patterns.

So, if we need reparametrization invariant algorithms for time series, what can we do? Surprisingly, a pretty complete answer was presented by K.-T. Chen (while working at the U of I in the 1950s). He essentially proved that everything one can extract from high-dimensional time series (that does not depend on the parametrization of the timeline) is a function of the iterated path integrals, a fancy name for a class of functionals going back to Volterra and Wiener. Iterated path integrals have proven to be an enormously useful tool in algebraic topology, and now make another appearance in applied mathematics.

We introduced recently a computational tool, Cyclicity, that relies on the iterated path integrals of second order—the simplest nontrivial ones. The intuition behind the approach is quite transparent. Consider two waves, one (follower) slightly behind another (leader). If one plots, parametrically, the leader against the follower, the resulting curve encircles some area, positive (circumvented counterclockwise) if the (leader,follower) frame is positive.

Given several time series, one can build a skew-symmetric matrix of those areas, one for each pair of series. A bit of spectral analysis allows one to extract cyclic order in which the time series will lead, or follow, one another, even for high-dimensional and noisy traces.

This method has been applied to several real-life scenarios. We analyzed, for example, the performance of stock aggregates known as economy sectors—known to investment folks to show markedly different behaviors at different stages of the business cycle. It turns out that our method was reproducing the financial analysts' knowledge on the cyclic order in which these sectors follow each other almost perfectly.

As a more serious application, we tested the same techniques on functional MRI measurements, showing at granularity of about one cubic millimeter per one second the rate at which areas of the brain are supplied with oxygen, interpreted as a proxy for brain activity at the region. Teaming with our colleagues at Beckman Institute (Dr. Fatima Husain's lab), we looked for physiological markers of tinnitus, a common condition which is poorly understood and for which no diagnostic tools other than self-reporting exist today. First results are encouraging—and we are working on expanding our study to a much larger sample of fMRI measurements.

Reparametrization invariant methods of time series analysis, in particular iterated integrals, constitute a new area, but it is growing fast (a systematic push in this direction, under the name of "signatures" was initiated also by the group of Prof. Terry Lyons of Oxford). Their intrinsic properties, and broad applicability guarantee that you will hear about them more and more.

Yuliy Baryshnikov graduated as an applied mathematician from the Railroad Engineering Institute in Moscow, then worked until 1990 at the Institute for Control Sciences. The next decade he worked in Germany, the Netherlands and France, first as a Alexander von Humboldt research fellow, then as a Habilitandedstipendiat of the DFG, and, finally, as a professor at the mathematics department of UVSQ.

In 2001 he joined Bell Labs (then at Lucent Technologies), first as a member of technical staff; later as a department head. He joined the University of Illinois in 2011, as a professor of mathematics and electrical and computer engineering. His research interests lie in analytic combinatorics, applied topology, probability and geometric control.

Quivers in Mathematics

by Kevin McGerty

One of the joys of mathematics is the way in which seemingly simple concepts can unfurl to reveal surprising depth and beauty. The study of quivers is, as least for the author, an example of exactly this phenomenon. A quiver is a directed graph, which consists of a set Q_0 of vertices, along with a set Q_1 of directed edges. (An edge is sometimes also called an arrow, hence a quiver is, loosely speaking, a bunch of arrows, hence the name!) Such objects arise naturally, for example, as models for transport or communication networks, but they also play an important role in algebra via the notion of a *representation* of a quiver: If $Q = (Q_0, Q_1)$ is our quiver, a representation of Q is a collection of vector spaces $(V_i)_{i \in Q_0}$ (over the complex numbers let us say) indexed by the vertices of the quiver, along with a collection of linear maps $(x_a)_{a \in Q_1}$ indexed by the edges, where if an edge a starts at vertex i and terminates at vertex j, then $x_a : V_i \to V_j$ is a linear map from V_i to V_j.
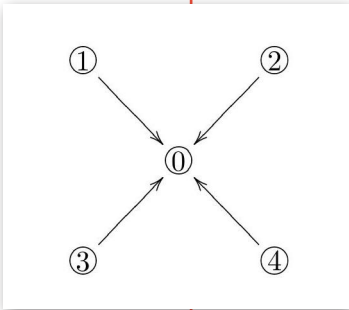
The basic problem we are then presented with is to try to classify such representations. Of course to begin to answer this question, we have to decide when we should consider two such representations to be equal! We do this in the most natural way: if (V_i, $x_a)_{i \in Q_0, \, a \in Q_1}$ and (W_i, $y_a)_{i \in Q_0, \, a \in Q_1}$ are both representations of Q, we say they are equivalent (or isomorphic) if there are isomorphisms of vector spaces $\alpha_i : V_i \to W_i$, which are compatible with the edge maps, in that for every edge a, $\alpha_j x_a = y_a \alpha_i$ (where as before the edge a goes from vertex i to vertex j). A fundamental fact about such representations is that they break up into uniquely determined atomic *indecomposable* pieces.

To get a better sense of what our classification problem involves, let's consider a very simple example: take Q to be the quiver with a single vertex v and single edge a, a loop from v to itself. A representation of Q is then simply a vector space V equipped with a linear map $T : V \to V$. Classifying such representations is then (once you pick a basis of V) equivalent to classifying square matrices up to conjugation. One solution to this is the famous Jordan canonical form, and our single-loop quiver is thus known as the "Jordan quiver".

Another natural class of quivers are the "star-shaped" quivers. A star-shaped quiver Q_k has a single central vertex v_0 and a corona of vertices $\{ v_1, v_2, \ldots, v_k \}$ each of which has an arrow pointing to the central vertex.

By considering the images of the edge maps, you can show that the classification of representations of these quivers is essentially equivalent to classifying arrangements of subspaces in the vector space at the central vertex, a classical problem in linear geometry.

Beyond providing a unifying context for many classical problems, quiver representations have many surprising connections to other parts of mathematics. For example, Pierre Gabriel in the 1970s discovered a remarkable connection between quivers and Lie theory, the theory of continuous symmetries (such as the collection of rigid motions in 3-space): the quivers which have only infinitely many indecomposable representations turn out to be in a natural correspondence with certain simple Lie algebras. The ramifications of this relationship led to remarkable insights in Lie theory, for example, the theory of canonical and crystal bases. Moreover, the techniques developed in this work have played a major role in important interactions between mathematics and theoretical physics in recent years, in the work of Maxim Kontsevich and others on mirror symmetry and derived categories. Indeed quiver theory now plays a key role in this area as a testing ground for new ideas—rich enough so that interesting phenomena reveal themselves, but simple enough that they can be understood in relatively concrete terms.

Professor Kevin McGerty is the Fisher Visiting Professor of Mathematics working in the Illinois Department of Mathematics during Spring 2019 semester. McGerty, a Professor in the Mathematical Institute of the University of Oxford and a fellow of Christ Church College, Oxford, received his PhD from MIT in 2002 under the direction of George Lusztig and went on to a Dickson Instructorship at the University of Chicago. McGerty subsequently was awarded a prestigious Royal Society University Research Fellowship, which he held at Imperial College from 2006 to 2010 before moving to Oxford in 2010.

Executive training and internship in China

Learn the fundamentals of the insurance business and market in China. A new program, created and organized by our Actuarial Science Program in collaboration with a partner institute in China, has been established through the University of Illinois College of LAS International Programs to provide executive training and internships aimed at Chinese-speaking students majoring in actuarial science, finance, economics, mathematics or statistics who wish to gain practical experience working in the insurance industry in China. The program is open to juniors, seniors and master's students.

This six-week summer program consists of a two-week intensive session at Nankai University in Tianjin, China, followed by a four-week internship placement with an insurance company in Beijing, Shanghai, Shenzhen, or Tianjin.

The purpose is to develop professional competencies and experience in China's insurance industry. Students will develop multiple aspects of professional development including: critical thinking/problem solving, global/intercultural fluency, teamwork/collaboration, oral/written communications, professionalism/ work ethics, career planning and management.

Visit the website for more information: https://go.illinois.edu/internship-china

2018 Ignacio H. de Larramendi research grant awarded

Cyber risk is a rising concern for organizations in both the public and private sectors. The World Economic Forum's Global Risks Report 2018 names cyberattacks and cyber warfare as a top cause of disruption in the next five years. After years of development, the cyber insurance market is still in its infancy. Cyber insurance products are less than satisfactory and often criticized for high premiums, low capacity and obscure policy language.

A research project, led by professors Runhuan Feng, Alfred Chong, Daniel Linders and Jay Kesan, won the Ignacio H. de Larramendi research grant from the MAPFRE Foundation in Spain. The Larramendi grant is awarded each year to research projects around the world in areas related to insurance and social protection.

The research will be conducted with the Illinois Risk Lab and aims to develop technology to address issues impeding development in cyber insurance and seeks to provide potential solutions in several aspects including better data and modeling for cyber risk assessment; developing mechanism to incentivize stakeholders to participate in the market; utilizing capital markets to share risks and spur the growth in insurance market; and raising awareness of cyber insurance as risk management tools.

Illinois Risk Lab hosts new research projects

The Illinois Risk lab hosted a total of six new research projects led by four faculty members and attracted 24 students to join in Spring 2019.

The topics range from consulting projects to theoretical endeavor, including:

• Playbook for 21st century retirement planning
• Do blue skies drive away pollution?
• Risk Margin under Solvency II
• Data driven study of the Herd Behavior Index
• Statistics for monitoring the healthiness of a portfolio
• Paratus: third-party liability claims management

On-going projects from fall 2018 semester included:

• Forward and Backward preferences
• Northwestern Mutual Fixed Income Project

I Risk Lab members visited Northwestern Mutual in Milwaukee, WI, for the research project "Evaluating the performance of an active manager in institutional fixed income portfolios." Pictured from left to right: Klara Buysse, Titan Wibowo, Prathamesh Padhye, Samuel Woessner, Tristan Boyles.

Student-led Consulting Project for Paratus LLC. Paratus Partners LLC is a provider of third-party liability claims management for healthcare service providers (mainly hospital systems). Paratus and the IRisk Lab are working closely together to address research questions with regards to claims management. Students will create a model the will help Paratus develop predictive data that they will be able to use to (a) provide better predictability to their clients and (b) enhance the efficiency and effectiveness of their workflow processes.

Data driven study of the Herd Behavior Index. Market crashes and major sell offs have already shown their devastating impact on the variable insurance business. A market crash is characterized by falling stock prices, skyrocketing volatility and evaporating liquidity. All these ingredients were present during the financial crash in September 2008 and have put several insurers and financial institutions at risk.he past has learned that monitoring financial stability is of utmost importance for it allows market participants to take the necessary cautionary actions. In this research project, we focus on dependencies between stock prices. The Herd Behavior Index (HIX) is a measure for the degree of co-movement between stock prices composing a stock market index, such as the Dow Jones or the S&P 500. Monitoring the HIX from day to day may help to detect a market where stock prices are likely to tumble all together.

Risk Analytics Symposium brings together practitioners and University of Illinois alumni

The landscape of data analytics is fast changing. The insurance industry is facing unprecedented challenges and opportunities in this digital age. Disruptive technologies have brought new opportunities for innovative businesses and will drive to extinction companies who fail to adapt. While the industry needs to integrate classical theory with new technologies, the academia provides a fertile ground for interdisciplinary innovations.

The Risk Analytics Symposium, held May 16, 2019, at the Illini Center in Chicago, provided a venue for showcasing research at the new Illinois Risk Lab, and bringing together industrial professionals, academics and students interested to discuss latest technological development and discoveries in risk analysis and predictive analytics.

Following the symposium, an Illinois Actuarial Science Reception was held at the Deloitte Office Building in Chicago. Alumni caught up with classmates and learned about what's new with in the Illinois Actuarial Science Program and its expansion to risk analytics, data science and other new campus initiatives including a new mathematical sciences building.

Awards

DEPARTMENT AWARDS

ALUMNI AWARDS

Mathematics Alumni Award for Outstanding Professional Achievement

Howard Aizenstein
James Donaldson
Christine Heitsch
Edwin Perkins

Actuarial Science Alumni of the Year Award
Jonathan Ankney

TEACHING AWARDS

N. Tenney Peck Teaching Award in Mathematics
Partha Dey

Distinguished Teaching Award in Mathematics for Tenured Faculty
Chris Leininger

Distinguished Teaching Award in Mathematics for Non-Tenure-Track Faculty
April Hoffmeister

NON-INSTRUCTIONAL AWARDS

Exceptional Merit Award in Mathematics for Non-Instructional Staff
Ann Byers

NetMath Award for Outstanding Service
Zac Schoenrock

GRADUATE AWARDS

Bateman Prize and Fellowship in Number Theory
George Shakan

Wolfgang Haken Prize in Geometry and Topology
Xinghua Gao

Irving Reiner Memorial Prize
Shiyu Shen

Irving Reiner Fellowship
Emily Heath
Heejoung Kim

Philippe Tondeur Dissertation Prize
Ruth Luo

CAMPUS AND LAS AWARDS

Philipp Hieronymi

Associate Professor Philipp Hieronymi has been awarded both the LAS Dean's Award for Excellence in Undergraduate Teaching and the Campus Award for Excellence in Undergraduate Teaching. Philipp places emphasis on active learning and creates a welcoming environment for all students. Students note that his lectures make challenging topics seem easy, with lessons making a lasting impact on their college career. He has also been instrumental in curriculum development, including designing lectures, assignments, exams, and instructional aids. He has been included in the Incomplete List of Teachers Ranked as Excellent each semester he has taught in the past five years.

Phillip is also currently the director of the, very success, Illinois Geometry Lab, which facilitates undergraduate research in mathematics. He was appointed to this position in 2018 , and the IGL has continued to grow at a remarkable rate under his leadership. In the Spring semester of 2018 alone, over 80 undergraduate students participated in 19 different projects mentored by 18 faculty members and 23 graduate students.

Hieronymi (PhD Oxford 2008) joined the department in 2010. His research interest in logic focuses on ordered structures and their potential applications in analysis and geometry.

Brahana TA Instructional Award
Elizabeth Field

Department TA Instructional Award
Vaibhav Karve
Nigel Pynn-Coates

Dr. Lois M. Lackner Mathematics Fellowship
Sarah Mousley

State Farm Actuarial Science Scholarship
Ivan Wu

State Farm Mathematics Doctoral Scholarship
Longhao Jin
Chongda Liu

Simone Sisneros-Thiry

Simone Sisneros-Thiry has been awarded the LAS Award for Excellence in Undergraduate Teaching by Graduate Teaching Assistants. Simone is a fifth year graduate student working with Professor Bruce Reznick. Simone has not only taken on some of the most challenging teaching assignments, but has gained experience with multiple instructional styles. In addition to teaching the typical active learning discussion sections which accompany our large lecture calculus courses, Simone has extensive experience teaching in our Merit Program which offers discussion sections targeted toward underrepresented students. Through the Education Justice Program, Simone has also taught calculus and calculus preparation courses to students incarcerated at the Danville Correctional Center.

In addition to her teaching responsibilities she has organized department-wide professional development sessions for around 100 graduate TAs on issues such as equity, the teaching of students with disabilities, and other pedagogical topics. She is also active in the Illinois graduate student chapter of the Association for Women in Mathematics where she has co-organized the Teaching and Diversity Seminar; a seminar which is aimed to help graduate students become more effective teachers.

Iris Tong

Iris Tong, a Mathematics and Statistics undergraduate major with a minor in Secondary Education, has received a 2019 Edward W. Collins and Doris Strickland-Collins Intern Award, LAS 101. LAS 101 Freshman Seminar Interns are accomplished juniors and seniors who are willing to share their college experiences with first-term students.They each lead a section of the LAS 101 Freshman Seminar. She was ranked an Outstanding Teacher for teaching LAS 101 in the fall of 2018.

"An LAS 101 intern is tasked with many duties, such as acting as a peer mentor, design thinking guide, and facilitator. I am incredibly honored to have received this award, because I wanted to give my students the same invaluable experience I had when I came to college, and I believe I was successfully able to do so. I enjoyed my experience so much that I will be returning as an LAS 101 intern next Fall," said Tong.

Tong is a member of the Illinois Geometry Lab, where she is working on a project called Developing Exciting Outreach Material. This project focuses on creating lesson plans based on discovery-driven mathematics activities in hopes that they will inspire kids from kindergarten through high school. She serves as a Mathematics Ambassador, assisting the Department of Mathematics at outreach events and events for incoming freshmen. She is also a member of Alpha Phi Omega, and a James Scholar.

UNDERGRADUATE AWARDS

H. Roy Brahana Prize
Jared Krandel

Most Outstanding Major in Actuarial Science
Alexander Bienduga

Most Outstanding Major in Mathematics
Xiaomin Li

Most Outstanding Major in Mathematics and Computer Science
Thien Le

Most Outstanding Major in Teaching of Mathematics
Jamie Rush

Salma Wanna Memorial Award
Kieran Kaempen

Elsie Thomas Fraser Award
Eric Ko

E. Graham Evans Jr. Scholarship
Quentin Wetzel

Dr. Lois M. Lackner Mathematics Scholarship
Anna Chlopecki

Vincent O. Greene Scholarship in Mathematics
Jonathan Martin

Elizabeth R. Bennett Scholarship
Baihe Duan

Awards

UNDERGRADUATE AWARDS, continued

Actuarial Science Alumni Scholarship
Eric Bayer

Actuarial Science Fund Scholarship
Eric Bayer
Ian Copple
Carina Su

Axis Risk Management Academy Actuarial Science Scholarship
Sonia John

Bradley M. and Karen A. Smith Scholarship
Carrie Wang

DW Simpson Actuarial Scholarship
Clara Yam

Milliman Actuarial Science Scholarship
Michelle Liu

Northwestern Mutual Scholarship
Mohit Monga
Jingying Luo
Zifeng Lin

State Farm Actuarial Science Scholarship for Academic Excellence
Andrew Dlugos
Shirley Liu
Qiqing Xu

State Farm Actuarial Science Scholarship for Diversity
Daniel Chen
Ahmad Abdel-Motaleb
Wilson Jonathan Phurwo

State Farm Actuarial Science Scholarship for Freshmen and transfer students
Sarah Derango
Kara Wong
Jesse Yan

MATH CONTESTS

2018 U of I Freshman Math Contest
Jason Xia, 1st Prize
Albert Cao, 2nd Prize tie
Letian Zheng, 2nd Prize tie

2018 U of I Mock Putnam Exam
Ziyi Chen, 1st Prize
Jason Xia, 2nd Prize
Samuel Guo, 3rd Prize tie
Alan Hu, 3rd Prize tie

2019 U of I Undergraduate Math Contest
Zihan Wang, 1st Prize
Alan Hu, 2nd Prize
Kyungmo Ryu, 3rd Prize

ILLINOIS GEOMETRY LAB AWARDS

Illinois Geometry Lab Research Award
Project: Mathematical model of gender bias and homophily in professional hierarchies
Sara Clifton (faculty mentor); Elizabeth Field (graduate student); Alan Zhou, Patrick McMahon, and Grace Yu Sun (undergraduate students)

Susan C. Morisato Illinois Geometry Lab Scholarship
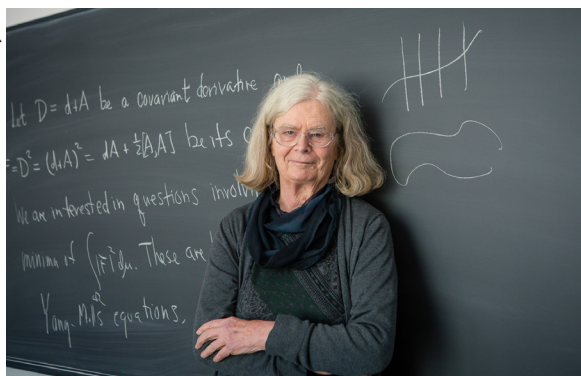Ravi Donepudi

OTHER AWARDS

Max Beberman Scholarship, College of Education
Simone Sisneros-Thiry

Pi Mu Epsilon Speaker Award
Bridget Mueller-Brennan, for her talk "New Songs in the Deep: A Passive Acoustic Analysis of the Temporal and Spatial Distribution of Omura's Whales (Balaenoptera omurai).

Karen Uhlenbeck is the first woman to win the prestigious Abel Prize.

Karen Uhlenbeck wins Abel Prize

In March 2019, mathematician Karen Uhlenbeck became the first woman to win one of the field's most prestigious awards, the Abel Prize, which is awarded by the Norwegian Academy of Science and Letters. Uhlenbeck, who is current a Visitor in the School of Mathematics at the Institute for Advanced Study and Professor Emerita of Mathematics and Sid W. Richardson Regents Chair at the University of Texas at Austin, has done revolutionary work across several disciplines. The academy lauded "her pioneering achievements in geometric partial differential equations, gauge theory and integrable systems, and for the fundamental impact of her work on analysis, geometry and mathematical physics."

Uhlenbeck was on the mathematics faculty at the University of Illinois at Urbana-Champaign from 1971–1977. She has received many awards and honors which include the National Medal of Science in 2000, and the Leroy P. Steele Prize from American Mathematical Society in 2007, MacArthur Fellow (1983) and Fellow (1985) of the American Academy of Arts and Sciences. She was elected as a member of the National Academy of Sciences in 1986. She was the Noether Lecturer of the Association for Women in Mathematics in 1988, and in 1990, she was a plenary speaker at the International Congress of Mathematicians, as only the second woman (after Emmy Noether) to give such a lecture.
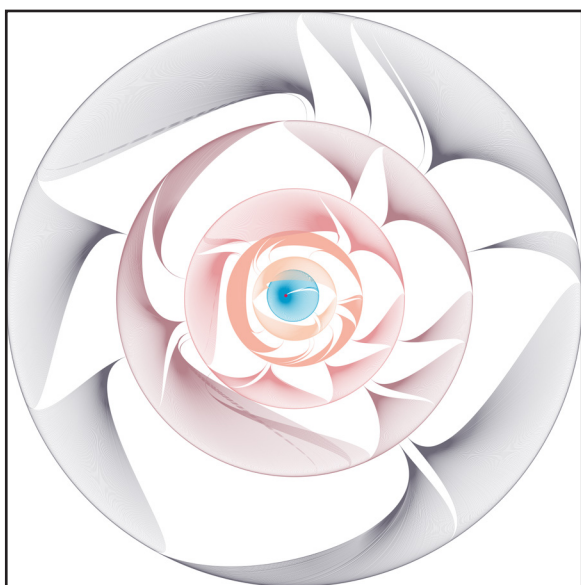
Vaibhav Karve's entry "6174 — Visualizing Kaprekar's Process," received honorable mention in the Graduate College Image of Research competition

Karve competes in Image of Research Competition

Vaibhav Karve received Honorable Mention for his entry in the University of Illinois Graduate College's Image of Research 2019 competition. Karve, a fourth year PhD student studying under the guidance of Professor Anil Hirani, also received the 2019 Department TA Instructional Award for his exemplary teaching. His research is primarily focused on Computational Mathematics.

His entry "6174 — Visualizing Kaprekar's Process" is shown at left. Here's how he accomplished this image:

1. Pick a 4-digit number, using at least two different digits.

2. Arrange the digits in descending and then in ascending order to get two four-digit numbers, adding leading zeros if necessary.

3. Subtract the smaller number from the bigger number.

4. Go back to step 2. and repeat.

The above process will always reach its fixed point, 6174. Thus spake D.R. Kaprekar (1905-1986) — school teacher, recreational number theorist and Indian mathematician.

The resulting image is a graph of the process. Every four-digit number is a point on one of the circles. Every iteration outlined by Kaprekar is a path. His algorithm might be mechanical but the patterns emerging from it are anything but. At the center is the number 6174 (indicated by the red dot) to which all others are inexorably drawn. This plot itself was generated algorithmically using a combination of Python, TikZ, and LaTeX.

Department celebrates alumni achievements

This is the second year of the Department of Mathematics Alumni Awards Program, celebrating contributions of our alumni through outstanding professional achievement in academia, research, and industry. Nominations are reviewed by our Alumni Awards Committee comprised of current faculty, staff and alumni. This year's committee selected four recipients to receive the Alumni Award for Outstanding Professional Achievement, given to alumni who, by outstanding achievement, have demonstrated the value derived from a mathematics education. The awards were presented on April 2, 2019, at the department's annual awards ceremony held at the Alice Campbell Alumni Center.

Howard Aizenstein
Alumni Award for Outstanding Professional Achievement

Howard Aizenstein received his bachelor's degree in mathematics in 1986. His masters and PhD degrees in Computer Science and MD degree are also from the University of Illinois. An internationally recognized expert in computational neuroscience, Dr. Aizenstein has made significant contributions to the analysis of neuroimaging data and to the translation of this research to improve the lives of individuals with cognitive impairment and depression.

Dr. Aizenstein holds the Charles F. Reynolds III and Ellen G. Detlefsen Endowed Chair in Geriatric Psychiatry at the University of Pittsburgh, where he is also Professor of Bioengineering and Clinical and Translational Science as well as the founder and director of the Geriatric Psychiatry Neuroimaging Laboratory. He also cares for elderly patients at the Alzheimer's Disease Research Center as well as the UPMC Benedum Geriatric Center inpatient unit, where he also supervises residents.

Depression in the elderly is a leading cause of lost years of healthy life and a major public health concern. As a physician-scientist, Dr. Aizenstein's research has substantially increased our understanding of the neural mechanisms associated with geriatric depression and has improved prevention and treatment. He has used his training in computational science to identify the neural pathways involved in implicit and explicit learning using both structural and functional MRI, and he has developed new computational methods which continue to advance the field of neuroimaging research.

Dr. Aizenstein's contributions as a skilled educator, as a thoughtful mentor, and as a compassionate clinician are equally impressive. He serves as Director of a federally funded program for Clinical Research Training in Late-Life Mood Disorders. He has mentored numerous undergraduates, postdoctoral fellows, residents and junior faculty members who have gone onto successful careers. He developed and co-directs a unique BioEngineering/Psychiatry training fellowship that encourages doctoral students to apply mathematical concepts to highly complex mental health questions.

One nominator wrote: "... there is something that makes Howard truly extraordinary: his predilection for engaging the world with humility, curiosity, and kindness. Howard's characteristic, unassuming stance is to try to better understand other people's ideas, to appreciate their perspectives and the reasons underlying those perspectives. For the world of science, the benefits of this disposition are clear: over 200 published manuscripts, multiple highly competitive grants, and scores of productive collaborations. The benefits to humanity are equally impressive—serving as a role model for how to treat people as genuine colleagues (be they students, post-docs, fellow faculty, or others)."

My BS in Math&CS at Illinois is the foundation for all of my professional accomplishments. It is where I learned the fundamentals of computation and symbolic representation. Now, even more than when I was a student, the Illinois Math&CS education is ideal for a research career in the health sciences.

James A. Donaldson

Alumni Award for Outstanding Professional Achievement

James Donaldson received his master's degree in mathematics in 1963 and his PhD in Mathematics in 1965 with faculty advisor Ray Langebartel. He is currently Professor Emeritus at Howard University. Professor Donaldson served as Chair of the Department of Mathematics at Howard University from 1972 to 1990. During his tenure as chair, the department underwent a transformation that built a strong research program and led to the development and inauguration of the first PhD degree program in mathematics at a Historically Black College and University. This program has become a major producer in the U.S. of African American holders of the PhD in Mathematics.

From 1999 to 2012, Professor Donaldson served as Dean of the College of Arts and Sciences, the largest college at Howard University. During his tenure as Dean, he ushered in substantial growth in the college curriculum. He expanded special programs, developed new initiatives, and supported faculty members and students' pursuit of excellence. Professor Donaldson also fortified relationships with alumni, and increased donor activity among friends of the College and University community.

Among the many initiatives introduced through the College of Arts and Sciences and completed during his tenure as Dean are the publication of a seven volume report on the New York African Burial Ground Project, the development of more than ten summer study abroad programs, the re-imagining of the Freshman Seminar Program, and the launching and expansion of the Undergraduate Research Program.

Professor Donaldson's scholarly interests include analysis, differential equations, applied mathematics, the history of mathematics, mathematics education and the training of mathematics teachers. He has held national offices in the American Mathematical Society and the Mathematical Association of America, and has consulted for the National Science Foundation, the National Research Council, the Sloan Foundation, the Educational Testing Service, several state boards of Education, many mathematics departments, and the Washington D.C. Public School System. He has held visiting positions at the Courant Institute, the University of Victoria (Canada), the University of Ferrara (Italy), and Duke University. He was a member of the Science and Technology Commission of the Sixth Pan African Congress. In May 2017, he was awarded an honorary Doctoral Degree by his undergraduate alma mater—Lincoln University in Pennsylvania.

One of his nominators wrote: "Jim's rise in academia is well documented, from professor and visiting scholar to mathematics department head, dean, and college president. Likewise, Jim's publications and honors are many. But what has made the deepest impression on me are Jim's personal qualities, including his lifetime support of educational opportunities for struggling students in America and Africa, the Civil Rights movement, and a world without war."

Nominate someone for a Department of Mathematics alumni award! Deadline: November 1, 2019. Visit our website for more information.

math.illinois.edu/alumni-awards

Professor Christine Heitsch

Alumni Award for Outstanding Professional Achievement

Christine Heitsch received her bachelor's degree in Mathematics with Highest Distinction and Magna Cum Laude in 1994 from the University of Illinois. She received her PhD from the University of California at Berkeley in 2000. She is a Professor in the School of Mathematics at the Georgia Institute of Technology and is Director of the Southeast Center for Mathematics and Biology, an NSF-Simons Research Center for the Mathematics of Complex Biological Systems.

Professor Heitsch leverages mathematics, especially geometric combinatorics, to answer questions in molecular biology on the secondary structure of RNA. Her work on theoretical aspects of RNA structure and its analysis by discrete mathematical models, as well as computational and experimentally testable aspects of RNA challenges, have established a novel interdisciplinary research program in this area.

Dr. Heitsch's research focuses on different representations of geometric features of RNA such as base pairing, branching, and the distribution of low-energy states towards the goal of predicting RNA secondary structure. She has developed sophisticated approaches based on probability and geometric combinatorics that quantify the extent of sub-motifs in RNA secondary structure. These approaches are especially valuable for large RNA molecules, such as viruses, where functional behavior depends on the entire energy landscape. Another area of her research involves the analysis of branching patterns in RNA secondary structure. Such work has potential for understanding the limitations of thermodynamic optimization methods for predicting RNA secondary structure.

Professor Heitsch has been supported by the National Institutes of Health, Burroughs Welcome, and the National Science Foundation. The Southeast Center for Mathematics and Biology, where she serves as Director, has recently been established with support from NSF and the Simons Foundation.

Professor Heitsch is also a dedicated teacher and a mentor to young scientists. She regularly teaches Analysis and Algebra courses including a key Fundamentals of Mathematical Proofs course in the undergraduate program at Georgia Tech, that she devised. Besides reshaping the undergraduate program, the course serves as a recruitment tool for new mathematics majors. Professor Heitsch also serves as Associate Chair for Postdoctoral Mentoring at Georgia Tech, leading a comprehensive professional training program in interdisciplinary research for postdocs.

In the words of one of her nominators: "In the 24 years since Christine Heitsch's undergraduate degree at Illinois, she has devised an entirely original research program [which has become] the encompassing vision for a nationally important Mathematical Biology center … she is reshaping what is possible to do as, and more importantly, who and what it means to be, a mathematician."

Edwin Perkins

Alumni Award for Outstanding Professional Achievement

Edwin Perkins received his PhD in Mathematics in 1979 under the direction of Frank Knight. He is Professor and Canada Research Chair in Probability in the Department of Mathematics at the University of British Columbia.

Over the past forty years, Professor Perkins has made deep contributions throughout the field of stochastic analysis, ranging from the study of Brownian motion to measure-valued processes, to stochastic partial differential equations and to interacting particle systems.

Over the last two decades an increasing body of evidence has confirmed that superprocesses are universal scaling limits of critical interacting particle systems above a critical dimension. Professor Perkins pioneered this direction of research. In particular, in collaboration with Ted Cox and Rick Durrett, he has shown that super-Brownian motion arises as the scaling limit of (among others) the voter model, the Lotka-Volterra model, and long-range contact processes.

The 'Perkins stochastic calculus', an analogue of Ito's stochastic calculus in which individual Brownian paths are replaced by Brownian trees, provides a natural approach to the study of measure-valued stochastic processes with interactions. In 2013 Professor Perkins, in collaboration with Cox and Durrett, developed a general methodology for determining the long-time behavior of a large class of spin systems. The results apply to a range of important examples from physics and biology. The methods give sufficient, and often asymptotically sharp, conditions for coexistence or extinction.

Professor Perkins' research has received widespread recognition. His awards include the Rollo-Davidson Prize, the NSERC Canada Steacie Fellowship, and the CRM-Fields Prize. He is a fellow of the Royal Society of London and the Institute of Mathematical Statistics. He gave an invited lecture at the 1994 International Congress of Mathematicians and has been regularly invited to the most prestigious conferences in probability and statistics. Among other keynote lectures, he gave a special invited lecture at the World Congress of the Bernoulli Society in 1994, and the Doob Lecture at the Conference on Stochastic Processes and their Applications in Berlin 2009.

One of his nominators writes "Ed has shaped a large part of the international research effort in stochastic analysis over the last forty years, both through his own deep contributions and through his selfless commitment to supporting others." He is widely recognized in the mathematics community for his leadership and, perhaps especially, for the generous support and encouragement that he offers to young people as they embark on their careers. His work continues to open new promising directions and to have a strong influence on the development of probability theory.

"I spent 1975-1979 obtaining my PhD at the UI Mathematics Department because it was the best place in North America to learn probability theory. At the time I didn't realize that the training I was receiving was extraordinary—it is only after spending a career in the field that I now realize how fortunate I was.

Jonathan Ankney
Actuarial Science Alumni of the Year Award

Jonathan Ankney received his bachelor's degree in Actuarial Science and Finance in 1996. He currently serves as COO for Human Capital at Deloitte Consulting, where he is accountable for the financial and operational performance of a $1.2 billion annual revenue offering portfolio. Along with 20 years of consulting experience and 3 years of insurance industry experience, he is an associate of the Casualty Actuarial Society and a member of the American Academy of Actuaries.

He has exceptional experience in the areas of property and casualty loss reserving, due diligence, regulatory support, litigation support, predictive modeling, management consulting, practice management, and financial forecasting.

He has served on the Mathematics Development Advisory Board and the Actuarial Science Advisory Board, and has been a leading recruiter for Deloitte for the past 15 years. He has also been a strong advocate of the Illinois Actuarial Science Program in recent years, and has been instrumental in organizing many alumni events including the Deloitte alumni visit and the Actuarial Science Reunion in Chicago.

The Actuarial Science Alumni of the Year Award, new in 2019, is given to alumni who majored in actuarial science and who have made outstanding contributions in a variety of ways, including exceptional accomplishment in the actuarial profession or in non-traditional areas of actuarial practice, exceptional service in local, state or national affairs, and exceptional service in support of the advancement and continued excellence of the Illinois Actuarial Science Program. This year's recipient was selected by actuarial science faculty and student members of the Actuarial Science Club.

"I am grateful to the Department of Mathematics for this recognition. My University of Illinois actuarial science degree prepared me for a successful career in business and consulting, which has afforded me the opportunity to give back and support the department and university."

Nominate someone for a Department of Mathematics alumni award

University of Illinois Mathematics alumni have made significant contributions in academia, research, and industry. Each year, the Department of Mathematics recognizes exceptional alumni. The application process is simple and open to all. We encourage you to nominate someone you know for this honor. The four award categories are:

Alumni Achievement Award
Outstanding Recent Alumni Award
Alumni Humanitarian Award
Actuarial Science Alumni of the Year Award

Deadline November 1, 2019 | math.illinois.edu/alumni-awards

Three faculty named 2019-2020 Simons Fellows

Philippe Di Francesco, Rinat Kedem, and Xiaochun Li have been named 2019-2020 Simons Fellows in Mathematics by the Simons Foundation.

Philippe Di Francesco, who is the Morris and Gertrude Fine Distinguished Professor of Mathematics, received a PhD in Theoretical Physics from Universite Paris 6, under the supervision of J.-B. Zuber, at the Service de Physique Theorique in Saclay, France. His specialty is in two-dimensional conformally invariant field theory, with applications to continuum limits of statistical models. He gave an invited lecture at the 2018 International Congress of Mathematicians (ICM).

Rinat Kedem received her PhD in physics from Stony Brook in 1993, and joined the department in 2001. She was an invited speaker at the ICM in 2014 and a Lois Lackner Faculty Scholar

for 2014-2016. Her research interests are in representation theory, integrable systems and combinatorics.

Xiaochun Li (PhD 2001 University of Missouri at Columbia) joined the department in 2005. His research interests are in Hilbert transform along the vector field, multilinear oscillatory integrals, and multilinear Carleson theorem.

Simons Fellowships are awarded based on the applicant's scientific accomplishments in the five-year period preceding the application and on the potential scientific impact of their work. Simons Fellows in Mathematics receive support to provide research leaves from teaching and administrative obligations to provide opportunities for increased creativity and productivity in research.

News from NetMath

New NetMath courses

We are excited to announce online versions of two new courses: Marius Junge's Math 442 and Bruce Berndt's Math 453 are being offered through NetMath this semester. Both courses are available for registration in the Academic Year term.

NetMath events

The annual NetMath retreat was held at the iHotel in April. Teri Karpman, Assistant Director at University Administration, was the guest speaker and led discussions on student interest in online courses at all three University of Illinois campuses. Other topics included an update on student-facing Nexus, an in-house tool developed by NetMath IT to track student progress in all NetMath courses; discussion by Director Randy McCarthy on new initiatives that will be undertaken over the next year; and team-building activities.

In recognition of excellence

Zac Schoenrock received the 2019 NetMath Award for Outstanding Service. Zac joined NetMath in 2013 and currently serves as Senior Instructional and Advising Specialist and oversees the NetMath mentor program. Over the years Zac has advised and taught thousands of students in our online math courses. Since taking over the mentor program in 2015, Zac has improved every aspect of the program's infrastructure. He finds, hires, trains, and manages NetMath mentors. He has introduced several successful initiatives to revitalize the program—a mentor promotional pathway with

regular feedback, reviews and time for mentors to reflect on their performance, mentor development sessions and informational workshops every semester, and mentor awards and certificates to reward mentors for their contributions. Advith Govindarajan has received the Spring 2019 TA Award for Excellence in Online Instruction. Mentor Awards were given to Michael Guaglianone (Superior Effort in Mentoring), Ted Lietz (Most Positive Student Reviews), Kayla Sarantakos (Outstanding Grading Pool Performance), Kendra Chee (Exemplary Communication with Students), Maxim Lunin (Excellent Mentor Thoughts), and Jaclyn Nickerson (Amazing Lead Mentor Performance).

The NetMath Program staff at their annual retreat to discuss new initiatives that will be undertaken over the next year and participate in team-building activities.

Tserunyan named LEAP Scholar

Anush Tserunyan

Anush Tserunyan been recognized as a Lincoln Excellence for Assistant Professor (LEAP) Scholar. Tserunyan is one of six assistant professors recognized by the College of LAS as a LEAP Scholar for their contributions and potential in teaching and research. The LEAP Award is granted to faculty early in their career based on scholarly productivity and contributions to the educational mission of their departments and the College of LAS. LEAP Scholars retain the title for two years and each scholar receives $5,000 in discretionary research funding for each of those two years.

Tserunyan joined the Illinois Department of Mathematics in 2013. Her research interests include descriptive set theory, dynamical systems, ergodic theory, and combinatorics. She received the 2015 Emil Artin Junior Prize in Mathematics, and she serves as an editor for the journal *Archive for Mathematical Logic*. In teaching, she has become well-recognized for graduate instruction and student mentoring, with her lecture notes being used by faculty at Illinois and other universities. Anush is also working with NetMath, a distance learning program of the Department of Mathematics, to develop online versions of her graduate courses.
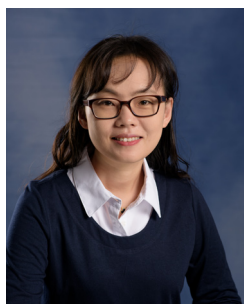
Bradlow named CAS Associate

Steve Bradlow

During his Center for Advanced Study (CAS) Associate appointment, professor Steve Bradlow will co-organize one of the featured programs for Fall 2019 at the Mathematical Sciences Research Institute (MSRI) in Berkeley. Entitled Holomorphic Differentials in Mathematics and Physics, the program will bring together mathematicians and physicists with diverse backgrounds and perspectives but with a common interest in the central objects of the program.

Holomorphic differentials first appeared in late 19th-century mathematics. The simplest examples—differential 1-forms on a two-dimensional plane—are part of the basic machinery of calculus. More exotic versions of such differentials can be constructed on curved surfaces. After 150 years of study intricate links have been established between the resulting holomorphic differentials and geometric and analytic properties of the underlying surfaces. Participants in the MSRI program include experts on the role of holomorphic differentials in settings as diverse as geometric structures on surfaces (Teichmuller theory), the evolution of complex systems (dynamical systems), string theory and quantum field theory, and moduli spaces in algebraic geometry. Bradlow's main interest has so far been in the relation between holomorphic differentials and moduli spaces of Higgs bundles. While at MSRI he plans to expand his research in directions championed by the other participants. Bradlow joined the department in 1992. He was named a Fellow in the American Mathematical Society in 2018.

Vera Hur named CAS Associate

Vera Hur

During her CAS Associate appointment, Vera Hur will put together rigorous analysis, numerical computation, and modeling to address fundamental issues in the mathematical aspects of water waves. In particular, she will focus on global regularity versus finite time singularities, the existence of traveling waves and their characterization, and the stability and instability of traveling waves. She will expand the use of computational methods to support theoretical advances.

Hur (PhD 2006, Brown Univ) joined the Illinois Department of Mathematics in 2009. She is an associate professor in the Department of Mathematics and a faculty affiliate of the Computational Science and Engineering program. Hur's research interests are in analysis (pure and applied) and partial differential equations. She has received many awards and recognitions for her work including a Sloan Research Fellowship in 2012, an NSF CAREER Award in 2014, a Beckman Fellow of the Center for Advanced Study in 2014-2015, an invited plenary address at an AMS Sectional Meeting in 2015, and was designated as a Simons Fellow by the Simons Foundation in 2016. The Department of Mathematics appointed Hur as the Philippe Tondeur Scholar in 2016 and in 2018 she was named by the College of LAS to a three-year term as a Brad and Karen Smith Scholar.

Discovery Partners Institute announces first round of seed funding recipients

Three projects in the College of LAS selected to tackle "grand challenges"

Real-time monitoring of indoor air quality, creating scholarly gaming environments, and developing sustainable solutions for cities are among the projects funded in the Discovery Partners Institute's (DPI) first round of seed grants.

As part of establishing its academic and research activities, DPI announced nine recipients of its first round of seed funding awards, including three headed by professors in the College of LAS. These projects represent the types of work that DPI will undertake, seeking solutions to grand challenges that produce real-world impact.

The project "Air quality in the home: from smart sensing to action" will be directed by Richard B. Sowers, professor of mathematics at the University of Illinois at Urbana-Champaign; Paul Francisco, senior coordinator at the Applied Research Institute; and Charles Catlett, University of Chicago. This proposal aims to develop the technology for real-time monitoring of indoor air quality, building on a collaboration with the Indoor Climate Research & Training group at Urbana-Champaign's Applied Research Institute and the Chicago Array of Things team. The project will produce a proof of concept, a data stream and prototype dashboard, an understanding of data analytics and a literature review, and a workshop discussing the findings.

The project "Air quality in the home: from smart sensing to action," one of the first projects to receive a seed grant from Discovery Partners Institute (DPI), will be directed by Richard B. Sowers, professor of mathematics at the U of I; Paul Francisco, senior coordinator at the Applied Research Institute; and Charles Catlett, University of Chicago.

DPI is a pioneering new research institute led by the University of Illinois System that will create breakthrough discoveries to drive economic growth and prosperity in Chicago, the state of Illinois, and beyond. Currently operating in downtown Chicago, DPI plans to construct a facility in the South Loop that will be home to thousands of students and more than 100 top researchers who will work alongside academic, business, and tech partners in the city and around the world.

All of the projects will receive funding, staff support and use of the DPI facility in Chicago — intended to fuel development of these early-stage initiatives into full-scale research and education programs.

Read more at *las.illinois.edu/news/2019-04-01/discovery-partners-institute-announces-first-round-seed-funding-recipients*

Architects, continued from page 1

The Altgeld Hall renovation will receive funding from campus in addition to funding from donations and other sources, some of which has already been secured. The building's inclusion on the National Register of Historic Places means that certain historic features will be restored, while new features will be added to increase energy efficiency and accessibility. State-of-the-art classroom space will be created to improve the learning environment for the thousands of students who take classes in Altgeld Hall each semester.

The renovation of Altgeld Hall will begin when construction of the new building is complete. Built in 1897, Altgeld Hall is the second oldest building on campus. It was named for former Illinois Governor John Altgeld and served as the original university library and law school before becoming home to the Department of Mathematics. It was last renovated in 1956.

Please visit the project website *altgeldillini.illinois.edu* for more information about the plan and how to be involved.

Bruce Berndt

Bruce Berndt

Fifty-two years ago, Professor Bruce Berndt joined the Department of Mathematics at the University of Illinois. He'll retire at the end of May 2019. He received an AB degree from Albion College (Michigan) in 1961. Applying to the University of Illinois for graduate school, he was rejected. He therefore studied at the University of Wisconsin, receiving a PhD in 1966. One of his professors at Wisconsin, Marvin Knopp, received his PhD at the University of Illinois under the direction of former head, Paul Bateman. Knopp encouraged Berndt to apply once again to the University of Illinois, but now for a tenure-track position. This time, he was accepted. He delayed his position for one year by taking a visiting position at the University of Glasgow, where he was mentored by Robert Rankin, the last PhD student of G.H. Hardy.

While spending a sabbatical year at the Institute for Advanced Study, in February 1974, he discovered that his research had connections with theorems found by India's greatest mathematician, Srinivasa Ramanujan. In particular, when Ramanujan died at the age of 32 in 1920, he left behind three notebooks containing over 3000 results without proofs. For over 20 years, with the help of several of his graduate students, Berndt devoted his research to proving these claims. His fifth and final volume on Ramanujan's notebooks was published by Springer in 1998. In the meantime, George Andrews (Penn State) discovered a "lost notebook" of Ramanujan at Trinity College Library, Cambridge, in the spring of 1976. For over 20 years, Berndt and Andrews devoted their attention to proving the claims in the lost notebook, with their fifth and final volume published by Springer in 2018.

Naturally, through Hardy, Rankin also had a strong interest in Ramanujan. In particular, Berndt and Rankin published two volumes on Ramanujan of an historical nature with the American Mathematical Society. Despite the unusual thrust of Berndt's research, he has always received strong support from the mathematics department, especially from his colleagues in number theory. He is particularly grateful to Alexandru Zaharescu for his many collaborations (24).

Berndt's greatest joy at the University of Illinois has been his supervision of 37 doctoral students. Many have collaborated with him in proving claims from Ramanujan's notebooks, and he has enjoyed their friendships over many years. Berndt has also mentored about a dozen postdocs and other visitors in the mathematics department.

Berndt received the Steele Prize for Mathematical Exposition from the American Mathematical Society in 1996. Two of his papers published in the *American Mathematical Monthly* received Ford awards. He was a Guggenheim Fellow in 1998-99. For the past ten years, he has had an appointment at the University of Illinois Center for Advanced Study.
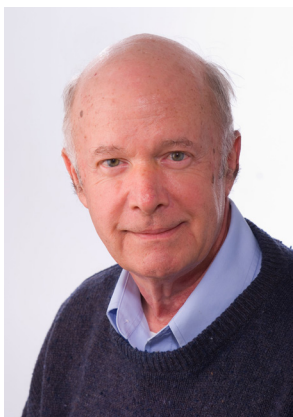
Julian Palmore

Julian Palmore

Julian Palmore, who retired in December 2018, received his PhD in Astronomy from Yale University in 1967, and his PhD in Mathematics from the University of California Berkeley in 1973. He joined the Illinois Department of Mathematics in 1977. He has also held appointments at Illinois in the Department of Aeronautical and Astronautical Engineering, Department of General Engineering, and the Campus Honors Program. He served as Director of the Program in Arms Control & Domestic and International Security (ACDIS) from 2005-2007 in the University of Illinois Center for Global Studies.

Palmore served on the Board of Directors of the Military Operations Research Society 1996-2000, was editor of *PHALANX*, The Bulletin of Military Operations Research 1995-2000, and has been the North American editor of *Defense & Security Analysis* since 2005. He is a Life Fellow in the American Institute of Aeronautics and Astronautics.

His mathematical research interests are dynamical systems theory – especially discrete time dynamics, chaos theory, celestial mechanics, applications of probability and vortex dynamics. His interests in defense policy and national/international security are assessment of defense strategies, use of game theory and probability in strategy development and risk assessment, protection of critical infrastructure, and operations research. Applications include ballistic missile defense, counterterrorism and WMD.

He has advised 12 PhD students and published over 100 articles and book chapters. He received the Military Operations Research Society Award for Excellence in 2000, and was appointed a Fellow at the Center for Advanced Study at the University of Illinois in 1979.

Zhong-Jin Ruan

Zhong-Jin Ruan

Zhong-Jin Ruan retired in May 2019 after 31 years at the University of Illinois. Ruan was born in China. He received a BA degree in mathematics from Nankai University in Tianjin, China, in 1982. That same year, the Department of Mathematics at Pennsylvania State University admitted him to graduate school where he studied functional analysis and operator algebras from Professors Joel Anderson and Richard Herman. He became interested in this field and transferred to UCLA in 1984 after receiving his Master's degree in mathematics. Professor Edward G. Effros at UCLA was his thesis advisor. He had a far-reaching influence on Ruan's career development.

In spring 1986, Ruan discovered a matricial norm characterization for operator spaces (i.e. subspaces of C*-algebras). This turned out to be a foundational result in operator spaces. He was awarded with an Alfred P. Sloan Doctoral Dissertation Fellowship in 1986-1987 and completed his PhD in 1987. He spent 1987-1988 as a visiting Assistant Professor at University of California at Berkeley before joining the University of Illinois in 1988. He has learned tremendously from leading mathematicians in the field like William Arveson, Edward G. Effros, Vaughan Jones, Marc A. Rieffel, Masamichi Takesaki, and Dan-Virgil Voiculescu.

During his 31-year career, Ruan devoted attention to operator algebras, operator spaces, and their applictions to related fields, through publishing 65 papers and a book entitled *Operator Spaces*, co-authored with Effros and published by Oxford University Press in 2000. The book is a summary of his long-time collaboration with Effros. Their work along with the work of Vern Paulsen and David Blecher established the foundation for operator spaces. He was recognized with Mahlon M. Day Award for Distinguished Mathematical Research, Department of Mathematics, University of Illinois (2003-2005).

He held many visiting positions including a Fellow at the Center for Advanced Study, Visiting Professor at the Fields Institute at Waterloo, Canada, Visiting Professor, IHP Paris, Visiting Professor, MSRI Berkeley, Visiting Professor, Université de Franche-Comté, Besançon, France, and Qiushi Chair Professor, Zhejiang University, China.

Ruan has served as journal editor for the *Journal of Mathematical Analysis and Applications* (2002-2007), *Illinois Journal of Mathematics* (2002-2007), *Frontiers of Mathematics in China* (2008-present), and *Operators and Matrices* (2012-present).

Ruan has organized and co-organized numerous conferences and workshops. Among them, the most notable one is the National Science Foundation-funded Wabash Seminar and Mini-conference, co-organized by the University of Illinois at Urbana-Champaign, Indiana University, Purdue University, and Indiana University Purdue University at Indianapolis.

Throughout his 31 years at Illinois, Ruan enjoyed teaching and supervising students. Ten PhD students successfully completed their thesis under his supervision. He also enjoyed recent teaching at ZJU-UIUC Institute (ZJUI) in Haining, China.

Share your Altgeld or Illini Hall story

Have a life-changing moment while the chimes played from the Altgeld Bell Tower? Or a fond memory inside Altgeld or Illini Hall? As the University of Illinois campus works to renovate Altgeld Hall and replace Illini Hall, we're collecting stories of those who have fond memories of these buildings.

Please share a brief description of your story and some information about yourself. The University of Illinois may follow up to learn more about your experience. Your story could be shared on our website or in other materials related to this campaign. Share it with us at *https://illinois.edu/fb/sec/7282989*

Jang-Mei Wu

Jang-Mei Wu

After 48 years at the University of Illinois, Jang-Mei Wu retired in December 2018. Wu was born in Hangzhou in 1948, and moved with her parents to Taiwan in 1949 soon after the beginning of communist rule in mainland China. After graduating from National Taiwan University in 1970, Wu came to Illinois for graduate study. She received her PhD in Complex Analysis in 1974 under the direction of Maurice Heins.

Besides mathematics, Professor Heins instilled in her the idea that two mathematicians in one family is a crowd. Despite his warning, off she went to begin her mathematical journey at Indiana and Purdue (1976-1979). At Purdue, Richard Hunt, Allen Weitsman and David Drasin, each had a long-lasting influence in her mathematical career.

Wu joined the faculty at Illinois in 1979. The relaxed atmosphere and the professional freedom of that time allowed her to follow wherever her interests led. So, with Walter Hayman she proved the so-called Hayman-Wu Theorem on level sets of conformal mappings, and with John Lewis, she proved a Littlewood conjecture on the value distribution of entire functions. And with Robert Kaufman (her husband), she worked on the peculiarities of parabolic potential theory.

While she was at Michigan, Juha Heinonen and Wu showed how the quasiconformal world may be enriched by classical geometric topology. Together, they worked on the geometrization of the stabilized Whitehead quotient and other Bing-type spaces. Continuing to pursue Finnish-style mathematics, she has been working with Pekka Pankka on geometrical deformation and parametrization in the quasi-world, for the last ten years.

To many other unmentioned collaborators, Wu thanks them for sharing ideas. While at Illinois, Wu was a Beckman Fellow at the Center for Advanced Study (1982), and held visiting positions at the University of Paris VI (1983) and University of Canterbury NZ (1992), and a Gehring Professorship at University of Michigan (2006). She is a frequent visitor to Finland—home of several of her collaborators.

Wu met her husband Robert in the Mathematics Department. Their daughter, Julie Kaufman, is an architect in NYC and has been an illustrator for some of Wu's recent papers. After 48 years, Wu says that she is finally ready to graduate, but not retire.

Champagne problems

About 25 years ago, Professor Bruce Reznick worked on the "Champagne Problem", so-called because Professor Eberhard Becker of the Dortmund University offered a case of champagne to anyone who could exhibit an explicit concrete realization of his theorem that for every even integer 2k, $(1+t^2)/(2+t^2)$ can be written as a sum of 2k-th powers of rational functions with coefficients in $\mathbb{Q}$. Reznick did this for 2k=4 and gave a realization with coefficients in $\mathbb{R}$, and got the bottle of champagne which lives on his mantel at home. Professor Vicki Powers of Emory University wrote an article covering this for the *American Mathematical Monthly*.

In March 2019, Reznick was contacted by the brewmaster of Champion Brewing Company in Charlottesville, VA, who was a mathematics graduate student somewhere back in the 90s, and who wanted to put a caricature of Reznick on the cover of their new product: Champagne Problems, a Brut-style Double IPA. Reznick said yes, and the resulting label is shown here.

Reznick has been on the Illinois Department of Mathematics faculty since 1979. His research interests are in combinatorial number theory and computational algebraic geometry.
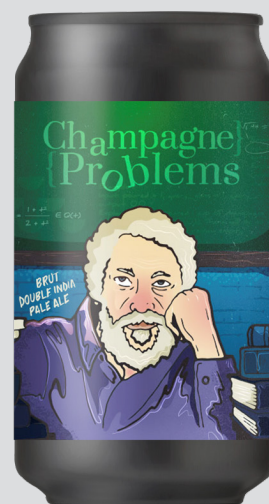
UI alumnus Justin Wozniak part of Argonne research team to earn R&D 100 Award

Justin Wozniak

University of Illinois alumnus Justin Wozniak (BS Math&CS 2000) is part of an Argonne research team that received an R&D Magazine 100 Award. The elite competition, long considered the "Oscars" of scientific innovation, is sponsored by *R&D Magazine* to recognize the 100 most innovative technologies of the previous year.

Wozniak's team was recognized for their project "Swift/T: Dataflow Programming for Scientific Supercomputing Workflows." Swift/T is a software system that scientists use to run calculations on very large supercomputers. It has been successfully by used by cancer scientists and combustion engine designers, among other application collaborations both at Argonne and elsewhere. The technology allows researchers to distribute the computational work of scientific studies and make good use of parallel computing systems. The system was created by Argonne's Wozniak, Jonathan Ozik, Nicholson Collier, Michael Wilde and Ian Foster in addition to two outside collaborators, Tim Armstrong (Cloudera) and Dan Katz (National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign).

"We are greatly appreciative of this recognition," Wozniak said. "It's great to see that the research, technology and scientific applications put together by the team are valued by the greater R&D community."

Swift/T allows researchers to distribute the computational work of scientific studies and make effective use of the large scale computing systems available at Argonne, such as Mira, Theta at the Argonne Leadership Computing Facility (ALCF), a DOE Office of Science Facility, and external systems like Summit.
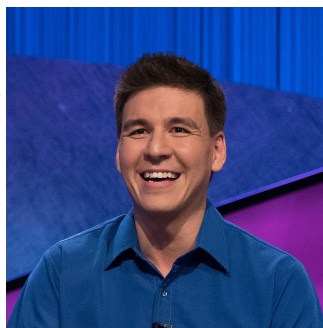
Math alumnus James Holzhauer becomes a "Jeopardy!" phenomenon

Photo courtesy of Jeopardy!

James Holzhauer

How do you achieve success? One way is to go to college, get a degree, get a job, work hard, and get promoted. Another way is to go to college, get a degree, become a professional sports bettor, and read children's books until you know the basics about, well, as far as anyone can tell, everything. Then you get on "Jeopardy!", play it like nobody's ever played before, break all kinds of records, and become a household name and a millionaire virtually overnight. That's James Holzhauer's way.

Holzhauer (BS 2005 Mathematics) has taken an unconventional career path, to put it mildly. While Holzhauer, 34, traces some significance to his days at Illinois, he joked to *LAS News* that nobody in his line of work checks him for a college diploma.

What has put Holzhauer in the public eye this spring is that he's winning money, and fast. Since April 4 (Holzhauer will next appear on the show on May 20), he has won $1.7 million on "Jeopardy!", second only to Ken Jennings, who amassed $2.5 million in winnings on the show in 2004. What's more remarkable than the total number, however, is the speed at which Holzhauer has won the money. Through just 22 games, the Naperville native holds the top 12 spots for the show's highest single-game winnings, including a record $131,127 on April 17.

Mathematics was a natural fit for Holzhauer at Illinois, and he picked up a job as an actuary after graduation. He became interested in sports betting, however, which led him to Las Vegas. He is now married with a child, but he still bets on sports for a living. He does it well; Holzhauer told the *New York Times* that half the casinos in Las Vegas won't take a bet from him.

Read the full story at *https://las.illinois.edu/news/2019-05-09/going-all.*

Bauer named PIMS Site Director

Kristine Bauer has been named the new Site Director of the Pacific Institute for the Mathematical Sciences (PIMS) at the University of Calgary. Bauer is an associate professor in mathematics at the University of Calgary. She received her PhD from the University of Illinois in 2001 under the direction of Randy McCarthy.

Her primary research area is algebraic topology and she is one of the founding members of the Women in Topology network, which seeks to increase the visibility and retention of women in the field by involving them in high-quality collaborative research projects. Bauer has been recognized with the Faculty of Science Excellence in Teaching Award and the GREAT Supervisor Award at the University of Calgary.

Photo: JodiO photography.

Kristine Bauer

Yeung among five Illinois graduates on Crain's Chicago Business' 40 Under 40

Ann Yeung has been named to the Crain's Chicago Business' 40 Under 40. She earned a B.S. in Math&CS from the University of Illinois in 2001. Currently she is Vice President of Technology at Northwestern Mutual, where she heads software engineering teams in imagining and building the next generation digital solutions to enable 7000+ financial advisors; helping create financial security for Americans.

Yeung is also the Chicago director of Women Who Code, a national nonprofit that helps women advance in tech careers. Prior to her new position at Northwestern Mutual she was head of technology, global retirement and workplace solutions division at Morningstar. With Yeung taking the lead, Morningstar sponsored a STEM event this year for 70 Chicago Public Schools students and their parents. "Many people can be good at their jobs, but she goes above and beyond and finds ways to give back to the community," says Alaina Percival, CEO of Women Who Code.

Yeung's parents immigrated to the U.S. from Guangdong, China, with Yeung and her younger brother in 1983, when she was 3 years old. Growing up in Chinatown and later Bridgeport, Yeung was a top student at Lincoln Park High School. Later, she says, she was "average" at the University of Illinois at Urbana-Champaign. Unhappy with pre-med studies, she shifted to math and computer science, overcoming a department head's misgivings about her preparedness: Yeung had never coded and didn't have a computer. "It was very challenging, so I think that got me really engaged because it was something I could solve," she says.

Her degree in math and computer science led to tech roles at major U.S. companies, including IBM, US Foods, Health Care Service Corp., Capital One, Morningstar, and Northwestern Mutual.

Ann Yeung

Toprak receives 2019 AWM Dissertation Prize

Ebru Toprak

Ebru Toprak (PhD 2018) received the 2019 Association for Women in Mathematics (AWM) Dissertation Prize at the AWM Reception and Awards Presentation at the 2019 Joint Mathematics Meetings held in Baltimore, MD. Toprak obtained her PhD in 2018 from the University of Illinois at Urbana-Champaign under the direction of Burak Erdogan. Her work has been recognized through numerous awards, including the 2017 James D. Hogan Memorial Scholarship Fellowship and the 2017 Waldemar J., Barbara G., and Juliette Alexandra Trjitzinsky Fellowship, both from the Department of Mathematics at Illinois. Ebru was a postdoctoral researcher at the Mathematical Sciences Research Institute in Berkeley during fall 2018 and currently, she is a Hill Assistant Professor at Rutgers University.

Toprak's research interests include spectral theory, harmonic analysis and dispersive PDE's. Her dissertation provides new decay estimates for the linear Schrödinger and linear massive Dirac operators in endpoint Lebesgue spaces setting, in dimensions 2 and 3 and under suitable assumptions on the threshold energies. Toprak's work has led to several publications, including the single-authored paper Schrödinger and wave equations with resonance of the first kind at zero, *J. Spectr. Theory* 7 (2017), 1235-1284, and the paper Dispersive estimates for Dirac operators in dimension three with obstructions at threshold energies, with B. Erdogan and W. Green, to appear in the *American Journal of Mathematics*.

Her results are deemed "surprising," her collaborators acknowledge that "[they] have benefitted and continue to benefit greatly from working with [her]," that she has already made "several important contributions on notably difficult problems in PDEs."

Math, stats alumni report highest average salary after graduation

New graduates from the College of LAS continue to be successful at securing a first destination after graduation, according to a campus initiative studying alumni within six months of commencement.

Those who have landed jobs are also drawing larger salaries for their work. According to the Illini Success initiative, a campuswide effort to gather career-related information about recently graduated bachelor's degree recipient, 92 percent of mathematics alumni reported landing a first destination and employed mathematics and statistics alumni reported the highest average salary within six months of graduation, at $70,342. Read more in the recent LAS News article at *las.illinois.edu/news/2019-03-08/study-las-graduates-are-successful-landing-first-destinations*.

Homecoming 2019

Please plan to attend the Department of Mathematics Homecoming Party on Saturday, Octobr 19, 2019. Look for our tent out front of Altgeld Hall. This event is a great opportunity to visit with old friends, make new ones and learn what's new in the department.

In memoriam

Jean Bourgain, pioneering mathematician, dies at 64

Jean Bourgain, IBM von Neumann Professor in the School of Mathematics at the Institute for Advanced Study, passed away in Bonheiden, Belgium, on December 22, 2018, at the age of 64. Bourgain held the named faculty position of J. L. Doob Professor of Mathematics at the University of Illinois from 1985 to 2005. He joined the Institute for Advanced Study at the Princeton School of Mathematics as a Professor in 1994, the same year he received a Fields Medal, and has been an IBM von Neumann Professor since 2010.

Bourgain was a giant in the field of mathematical analysis, which he applied broadly and to great effect. In many instances, he provided foundations for entirely new areas of study and in other instances he created new techniques to resolve the most difficult long-standing problems in mathematics. In addition to his many awards, his most recent was the Steele Prize for Lifetime Achievement awarded in 2018 by the American Mathematical Society.

Jean Bourgain

In memoriam: Richard Timoney (1953-2019)

Richard Timoney, a longtime member of the faculty at Trinity College, Dublin, died January 1, 2019 at the age of 65. He received his PhD from the University of Illinois at Urbana-Champaign in 1978 under the direction of Lee A. Rubel and taught at Indiana University before moving to Trinity in 1980. His research interests were in complex analysis, mainly in several complex variables, more specifically in functional analysis including operator algebras, operator spaces and Jordan triples. Timoney became a Fellow at Trinity in 1989, served as head of the department from 1999 to 2002, and was president of the Irish Mathematical Society from 1990 to 1991. Timoney was a member of the American Mathematical Society since 1975.

Richard Timoney

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Look for "Illinois Department of Mathematics" on Facebook and LinkedIn to get the latest news and learn about upcoming events.

Check out our YouTube channel (https://www.youtube.com/user/MathMediaIllinois) where you'll find a variety of videos about the department including the 2019 Departments of Mathematics and Statistics Convocation ceremony.

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Students explore abstract algebra and group theory at Sonia Math Day 2019

On April 6, the Illinois graduate student chapter of the Association for Women in Mathematics (AWM) hosted the 12th biannual Sonia Math Day—this semester titled "Adventures in Algebra." Sonia Math Day is one of the longest-running activities planned by the chapter, and it serves to introduce 8th-12th grade girls to higher-level mathematical concepts in accessible ways.

The event introduced group theory using visual, hands-on examples. The first activity introduced students to the mathematical concept of a group by having them find symmetries of various regular polygons. The students were able to compare composing such symmetries with addition and multiplication, eventually arriving at the definition of a group.

The second activity introduced braid groups, which built upon the students' colloquial knowledge of hair braiding. What should we count as a braid, and how should we draw them? They discovered the group structure by considering how two braids can be concatenated to get larger braids, and how two braids can undo each other. With the braid groups as an example, they learned about infinite groups, and what it means for a group to be finitely generated.

The third activity returned to symmetries by focusing on wallpaper groups and symmetries of the plane. How are symmetries of the plane different than symmetries of polygons, and how can we determine which symmetry maps points to other points? After learning about the four kinds of plane symmetries, they were prepared to try and match different examples of patterns based on which wallpaper group they belonged to.

The students also heard a short talk by professor Bruce Reznick about decimal expansions of fractions, and the conditions for which they will be fully repeating decimals.

Pictured from top: Dania Morales, a first-year graduate student, uses examples to introduce braid groups. Two high school-aged participants work to discover a transformation of the plane that maps two points to two specific images.