



Math Times

Department of Mathematics — Spring/Summer 2017

Department of Mathematics receives national award for excellence

The American Mathematical Society (AMS) recently awarded the 2017 AMS Award for an Exemplary Program or Achievement in a Mathematics Department to the University of Illinois Department of Mathematics. This nationwide honor recognizes the department for its effective innovations helping students succeed at all levels, from introductory courses to mathematics majors to Master's and PhD students.

The department maintains an excellent international reputation in research while teaching 26,000 student-classes per year. It is the academic home for 1,200 undergraduate majors, including 400 students in a highly successful actuarial program, and awards nearly 2 percent of the PhD degrees in mathematics across the U.S.

The AMS award cites our activity across a broad spectrum, including

- Merit Program
- Engineering Calculus Project
- active learning discussion sections reaching more than 8,000 students each year across calculus and linear algebra courses
- Actuarial Science Program
- NetMath
- Illinois Geometry Lab
- Program for Interdisciplinary and Industrial Internships at Illinois (PI4)
- strength of our local chapter of the Association for Women in Mathematics (AWM)

The Illinois Geometry Lab (IGL) exemplifies the department's commitment to actively engaging students in mathematics as a living, developing discipline. Teams of undergraduate students collaborate with a graduate student and faculty member on semester-long research projects and community outreach activities. IGL students become enthusiastic evangelists for mathematics, participating in outreach activities that have reached thousands of people in the community.

The mathematics graduate program at Illinois leads the nation on several fronts. One recent innovation is the NSF-

supported Program for Interdisciplinary Internships at Illinois (PI4) that connects graduate students with internships in private companies, government labs, and scientific labs on campus. It is the first program of its kind in a top U.S. research department, and it has attracted national attention.



Mathematics faculty, staff and students gather in front of Altgeld Hall.

Another success is our progress on graduate student diversity. The percentage of women in our PhD program has increased from 25 percent ten years ago to 40 percent today, and the percentage of U.S. underrepresented minority students has risen from 5 percent to 25 percent of all U.S. students over the last six years. Nationwide the picture is quite different: the percentage of women in PhD programs nationwide has been stuck around 30 percent for the last decade, and in 2015, only about 6 percent of new PhDs awarded to U.S. citizens in mathematics went to students from underrepresented minorities.

Many faculty, students, alumni, and friends have contributed to the success of the department. With your support, we continue to move forward, planning new online courses, a wider selection of courses for majors, and new Master's degrees. The future is bright for mathematics at Illinois.

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From the Chair

Dear friends,

It has been an outstanding year for the department; here are a few highlights. Three of our faculty—József Balogh, Philippe Di Francesco, and Lou van den Dries—have been invited to speak at the International Congress of Mathematicians in Rio de Janeiro in 2018. Held once every four years, the ICM brings together mathematicians from all over the world to speak on the most important developments in research since the last ICM. Invitations to speak at the ICM are among the most prestigious honors in mathematics. We are on a roll: three of our faculty were invited to speak at the 2014 ICM. These six ICM speakers exemplify the breadth of exciting research going on in the department.

Our faculty and PhD students together were awarded six college or campus awards for excellence in teaching. We are proud of their accomplishments and grateful for their work. In recent years, no department on campus has as strong a record of college and campus awards for teaching. The commitment of our graduate students and faculty to their students is truly inspiring.

We are strengthening our Actuarial Science Program, adding courses and exploring new programs in data analytics and risk management to reflect the evolving needs of our students and of the profession. Thanks to support from alumni and from the National Science Foundation, we have expanded the capacity of the Illinois Geometry Lab (IGL), our undergraduate research community, and this spring the IGL hosted research opportunities for more than 70 students. Our PhD program is leading the nation on multiple fronts. We have made important progress in recruiting women and U.S. underrepresented minority students to our PhD program, and thirty of our PhD students participated in internships through our path-setting internship program, PI4.

These are just a few of the activities mentioned in the citation of the award to the department from the American Mathematical Society, which you can read about in the cover story.

With so much to offer, we are strongly committed to enabling promising students to study at Illinois, and to providing the resources and facilities to enable students and faculty to do great mathematics. In 2016 and 2017 we awarded a record number of departmental scholarships to promising undergraduates. Our success presents us with the enviable challenge of raising the funds to continue this compelling program. With so many wonderful things already going on, we are even more excited by the potential that the renovation of Altgeld and Illini Halls will unleash, creating new spaces for collaborative instruction and research. The campaign for Altgeld and Illini Halls has a website, <http://altgeldillini.illinois.edu>, and we are looking forward to great things as the university's 150th anniversary campaign gets under way later this year.



Matthew Ando
Professor and Chair, Department of Mathematics

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Address corrections should be sent to:
mathtimes@math.uiuc.edu
or

Math Times c/o Tori Corkery
Department of Mathematics
University of Illinois
263 Altgeld Hall
1409 W. Green Street
Urbana, IL 61801

Matthew Ando, Chair
Department of Mathematics
273 Altgeld Hall (MC-382)
1409 W. Green Street
Urbana, IL 61801

Telephone: 217-333-3350
Fax: 217-333-9576
Email: math@illinois.edu
Website: www.math.illinois.edu



College of
Liberal Arts & Sciences
AT ILLINOIS

Charles Morris

by Jim Dey

Charles E. Morris Jr.'s father never got to pursue the career in education that he had planned, but the senior Morris and his wife made sure the opportunity denied to him was not lost to his children.

"The influence they had on my younger sister and me inspired us to go to college," said the 85-year-old Morris, who earned his doctoral degree in mathematics from the University of Illinois in 1966 and then went on to a decades-long career as a professor and administrator at Illinois State University.

Acquiring an advanced degree was no easy feat for any young man in the 1940s and '50s, but it was even more difficult for a young African-American man from Big Stone Gap, Va., during the era of Jim Crow segregation.

Fortunately, Morris' father was a graduate of Hampton University and his mother had two years of college. Intending to be a teacher, the senior Morris was forced to take over his father's shoe repair business to help support his mother and sisters after his father died. Morris also learned the shoe-repair trade before leaving home for college. "He stayed with it until his own death in 1986," Morris said.

Like most parents, the senior Morris wanted a better life for his children. That's why he emphasized to them the importance of getting a good education that would give them an alternative to life in a typical southern town of the era. "Our parents wanted us to get an education and get out," Morris recalled.

How does one get from Big Stone Gap, a community in the southwest corner of the Virginia near Kentucky and Tennessee to Illinois? It was a combination of hard work, luck and opportunity.

Denied the opportunity because of his race to attend predominantly white public colleges and universities in Virginia, Morris attended Swift Memorial Junior College in Tennessee and, after graduating as valedictorian there, attended Johnson C. Smith University in North Carolina. Both institutions were affiliated with the Presbyterian Church and provided opportunities for scholarships and other financial assistance.

Morris said his initial interest was in the hard sciences, but that he ultimately selected mathematics as a major for reasons that he can't quite explain. "I'm not sure I can verbalize what caused me to like it," Morris said, although indicating that he was drawn to "things that needed to be solved." "I'm a



Charles Morris (PhD 1966) and his wife Jeanne will be honored in June 2017 by the McLean County Museum of History as McLean County History Makers.

great mystery fan. One of my favorite fictional characters is Sherlock Holmes," he said of the famous literary sleuth who relied on logic and deduction to solve murders in the same manner mathematicians use those tools to solve mathematical problems.

Whatever the motivation, Morris excelled in mathematics and, after receiving his bachelor's degree, became a teacher in North Carolina. He thought he would spend his career in the classroom. But then Morris enrolled in summer mathematics institutes that

were funded by the National Science Foundation as part of an effort to keep pace with the Russian space program.

Dr. Marjorie Browne, who taught Morris mathematics in a summer institute at North Carolina College, suggested Morris enroll in a year-long NSF program at a research university. Morris considered his options and chose the University of Illinois. Starting with an NSF grant, he eventually became a graduate assistant and researcher, earning his master's degree in 1959 and doctorate in 1966.

"For me, Illinois was the right choice in more ways than one," Morris said, citing members of the math department who helped him in his studies and in his personal life. Dr. John Walter accepted him as an advisee for doctoral study. Dr. Max Beberman, Director of the University of Illinois Committee on School Mathematics, (UICSM) "new math" project, hired him as a project staff member. In the latter capacity, Morris taught mathematics classes at the University High School. He felt fortunate to have as an additional mentor, Dr. Mahlon Day, Head of the University of Illinois Department of Mathematics.

"Segregation was very much alive at the UI. Housing was a problem," he recalled. Morris said Joseph Landin, Director of the 1958-59 NSF Mathematics Institute at the UI, arranged housing for all the students in the program, a move that made life easier for Morris and his wife. While Morris studied mathematics, his wife, Jeanne, who had an undergraduate degree in music, enrolled in graduate classes in education. Both earned doctorates from Illinois.

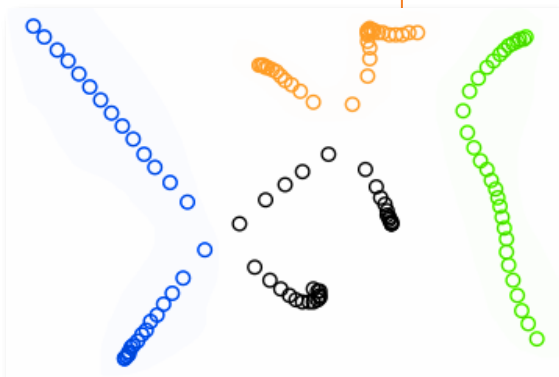
After completing his doctorate at the UI, Morris joined the ISU math faculty, living in Normal and raising two children. Ultimately, he moved into administration, retiring in 1995 from the position of Vice Chancellor for Academic and Student Affairs for the Illinois Board of Regents, then the oversight body for ISU, Sangamon State University and Northern Illinois University.

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Calogero-Moser particle systems

by Tom Nevins

The motion of particles in space under the influence of forces like gravity has obvious practical significance. When force between particles is conservative (meaning, essentially, that it satisfies a conservation law for energy), the force, and thus particle dynamics, is determined by a potential energy function.



Consider now potential energy that is proportional to 1 over the square of the distance between particles: this is like studying gravity in 4-dimensional space. If one also confines particles moving under such a force to live along a specified line, one arrives at the so-called Calogero-Moser (or CM) particle system. Atypically for particle systems, its time evolution can be exactly solved.

Notice, however, that the potential energy in the CM system approaches infinity as the distance between two particles shrinks to zero. It was thus a surprise when it was discovered, via wave/particle duality and computer calculations of wave motion, that CM particles can, mysteriously, actually collide and continue on through the collisions unharmed. How can this make sense?

To describe dynamics through the collisions, one should keep track of some data more sophisticated than the usual list of particle positions and momenta. The data describing all possible states, allowing collisions, of the system should naturally assemble into a space, the completed (N -particle) CM phase space. “Most” of the space—as long as particles have distinct positions—admits traditional position-and-momentum coordinates, but when particles collide those coordinates break down, a little bit like the degeneracy of the longitude coordinate at the north and south poles. This explains the apparent infinity in the potential energy: it is an artifact of the breakdown of the coordinate system.

In fact, the completed N -particle CM phase space has a beautiful and useful description by algebra: a possible state of the system is encoded in a pair (X, Y) of $N \times N$ -matrices for which $XY - YX$ is an “almost-identity matrix” (it is the identity plus a rank one matrix); the positions of the particles are the eigenvalues of X . Two such pairs of matrices describe the same state of the CM system if and only if they are related by a linear change of coordinates in N -dimensional space. Expressing the CM phase space this way—as pairs of matrices that satisfy the appropriate polynomial equations (technical keywords: an algebraic variety), up to an equivalence relation (technical keywords: Hamiltonian reduction)—allows one to easily compute dynamics of CM particles: the particle positions at time t are the eigenvalues of $X + tY$. It also opens the study of the CM system to techniques from the geometric study of polynomial equations, i.e., the mathematical field of algebraic geometry.

In spite of their unusual appearance, the CM system and related systems are ubiquitous. Indeed, the CM phase space was shown, from a totally different point of view, to also parameterize the possible vacuum states of a basic supersymmetric quantum gauge theory. Gauge theory is used to formulate the standard model of particle physics, and thus the CM phase space is of unexpectedly fundamental importance. From an apparently completely different direction, the contemporary algebraic study of symmetry—i.e., the mathematical field of “representation theory”—is deeply concerned with the geometry of phase spaces of quantum particle systems. The emerging paradigm of representation theory is that the study of symmetry is really about physics: a major share of the structures of importance to representation theory in the twenty-first century naturally arise independently in the context of supersymmetric quantum field theories. The insight provided by playing off these distinct sources of the same spaces and structures against each other promises rich rewards for algebraic geometry, representation theory, and mathematical physics. I and other researchers are striving to turn that promise into reality.

Tom Nevins (PhD 2000, University of Chicago) joined the department in 2004, and was promoted to Professor in 2016. He is an internationally known researcher at the interface of algebraic geometry, geometric representation theory, and mathematical physics. His accomplishments have been recognized by regular NSF grant support, senior visiting research positions at Oxford, MSRI, and Oberwolfach, a 2017-2018 Simons Foundation fellowship, and designation by the College of LAS as a Helen Corley Petit Scholar.

1977-2017: 40th anniversary of the proof of Four Color Theorem

FOUR COLOR FEST

To celebrate the 40th anniversary of the proof of the Four Color Theorem, and as a part of the 2017 sesquicentennial celebration of the founding of the University of Illinois, the Illinois Mathematics Department will hold a Four Color Festival. The multi-day event celebrating the mathematical, historical and cultural significance of Appel and Haken's achievement will be held November 2-4, 2017.

Two public lectures will be given: Andrew Appel is Eugene Higgins Professor of Computer Science at Princeton University and a well-known expert on machine verification of formal proofs. Robin Wilson, Professor Emeritus of Pure Mathematics at the Open University and at Gresham College, London, is former President of the British Society for the History of Mathematics and author of the popular science book *Four Colours Suffice: How the Map Problem was Solved*. There will also be a musical performance by Rudolf Haken, internationally renowned violist and composer, and Associate Professor of Music at the University of Illinois. The Illinois Geometry Lab will hold an open house with Four Color Theorem-related activities for K-12 students and community.

Event details are on the web at math.illinois.edu/fourcolorfest/.



FOUR COLOR THEOREM

In 1976, two mathematicians at the University of Illinois, Kenneth Appel and Wolfgang Haken, announced the solution to the Four Color Problem. Originally posed by Francis Guthrie in 1852, the Four Color Problem conjectures that four is the smallest number of colors needed to color the regions of an arbitrary map in such a manner that any two adjacent countries are painted with different colors.

Appel and Haken's resolution of the Four Color Problem was remarkable both for its mathematical and historical significance as the solution to a long-standing problem with an extremely simple formulation, and also for the method of proof. In fact their proof, which made extensive use of computing technology, was the first mathematical proof to rely in an essential fashion on the use of computers.

Published in 1977 in the *Illinois Journal of Mathematics*, the Appel-Haken Four Color Theorem is one of the signature achievements of the University of Illinois Department of Mathematics and a landmark result in geometry, graph and network theory, and computer science.



FOUR COLORS SUFFICE

The Department of Mathematics at Illinois created the "four colors suffice" postmark in 1976, when Wolfgang Haken and Kenneth Appel proved the Four Color Theorem. This replaced the previous postmark which showed the Mersenne prime $2^{11213} - 1$ discovered in the mid-1960s by Don Gillies of the Computer Science Department at the University of Illinois.



Sapir brings expertise to campus as a G.A. Miller Visiting Professor

Mark Sapir, Centennial Professor of Mathematics at Vanderbilt University, has been on campus during spring 2017 semester as a George A. Miller Visiting Professor in the Department of Mathematics. Sapir's appointment was supported in part by the Center for Advanced Study and the generosity of our alumni.

Sapir is one of the world's leading group theorists, with an outstanding record of research including more than 100 publications and spanning almost 40 years.

He has made fundamental contributions to geometric group theory, and is particularly well-known for his work on constructing finitely presented groups with prescribed isoperimetric functions, using abstract computational devices called S-Machines. Sapir was an invited speaker at the International Congress of Mathematicians (ICM) in 2006. He continues to produce high level mathematical research with a recent paper published in the prestigious *Journal of the American Mathematical Society*. Sapir is the Editor-in-Chief of a new high-profile journal called *Journal of Combinatorial Algebra*, published by the European Mathematical Society.

This semester Sapir taught a semester-long topics graduate course "Asymptotic Invariants of Groups" presenting his cutting-edge work using asymptotic cones to study various versions of relative hyperbolicity. The course concentrated on several aspects of Sapir's current research, including asymptotic cones, relatively hyperbolic and acylindrically hyperbolic groups and Dehn functions of groups. He also gave a lecture about Tarski numbers for the department's

Mathematics Colloquia as well as a presentation in the Geometry, Groups and Dynamics/GEAR Seminar series. This lecture generalized similar work by Illinois Professors Sergei Ivanov and Paul Schupp.

In May 2017, the department held a "Conference on geometric and combinatorial methods in group theory" in honor of Sapir's 60th birthday. Conference organizers included his

daughter Jenya Sapir, a J.L. Doob Research Assistant Professor in the Illinois Department of Mathematics since 2014.

Sapir has a distinguished record in outreach and educational activities. He has written research articles on K-12 education, co-authored four books on computer science education for high school students, produced K-12 educational materials, and developed educational mathematical software for high school and college-age students. He has also been involved in outreach activities, such as mathematical circles and mathematics camps for middle and high school students.



Mark Sapir, George A. Miller Visiting Professor at Illinois for spring 2017 semester.

The Department of Mathematics identified the establishment of a visitors program as one of its high priorities in its 2013 Strategic Plan. The purpose of the visitors program is to inform the department of cutting-edge research, create opportunities for collaboration and networking with faculty and graduate students, and raise our profile. Following this semester's productive visit by Sapir, the department is now actively seeking funding for the visitors program to continue.

Alumni Profile: Charles Morris, continued from page 3

After retiring, Morris continued associations with ISU as a Senior Associate Director with the Center for Mathematics, Science and Technology and Associate in the Center for Higher Education.

Over the years, Morris has received many awards and been appointed to many educational panels. One of his proudest activities is one he continues to this day, acting as a mentor for students high school age and younger who have an interest in science, technology, engineering and mathematics. "It's still fun for me. I've worked quite a bit in programs that provided mentoring, and I've never gotten away from it," he said.

One of Morris' other great interests is computer-related activity. He said that as a staff member of the UICSM math project in the 1960s he was on the ground floor of the "discovery method" of teaching mathematics and the sciences and is amazed by some of the positive results. He also notes "Computations that once would have required decades to accomplish by individuals can now be done in minutes or less with computers. The computer revolution has been most interesting to me," he said.

Throughout his career, Morris has worked to promote racial equity on campuses across Illinois. He is the founding chair of both the Illinois Consortium for Educational Opportunity Program Board and the Illinois Committee on Black Concerns in Higher Education. In 2014, the Dr. Charles Morris Annual STEM Fair for Underrepresented Students was established by several ISU departments and organizations, and on June 15, 2017 Jeanne and Charles Morris will be honored by the McLean County Museum of History as McLean County History Makers.

Jim Dey is a columnist and editorial writer for The News-Gazette in Champaign-Urbana.

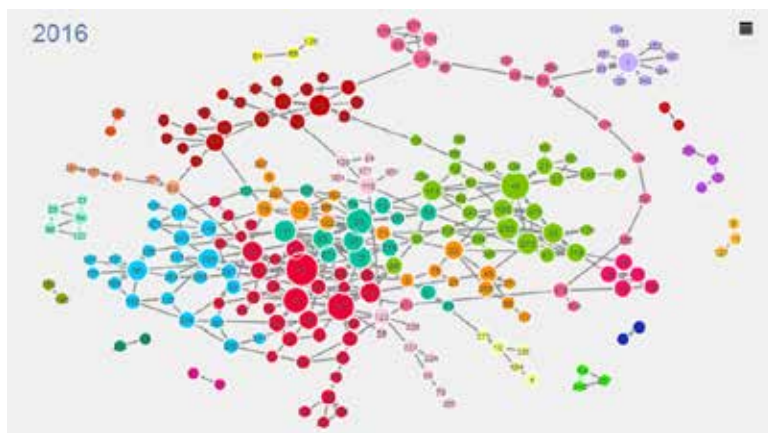
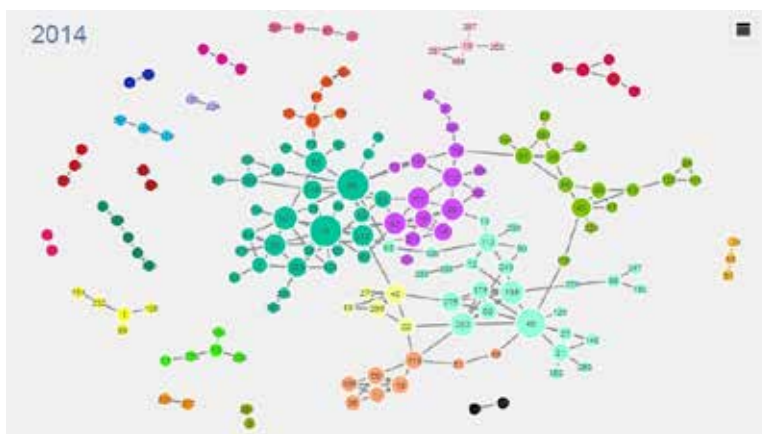
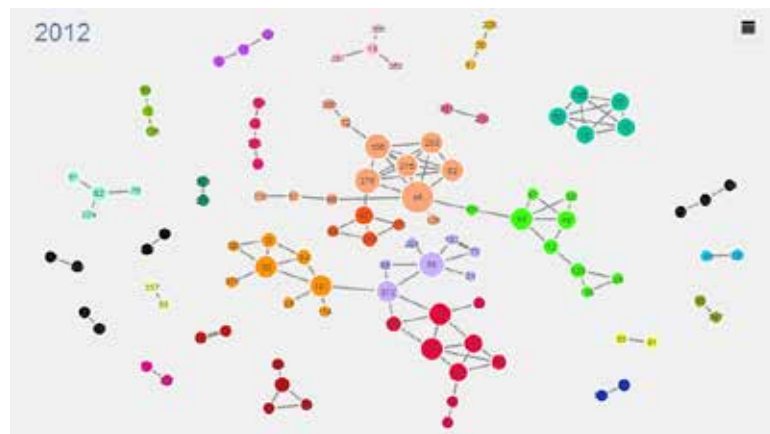
A Collaboration Graph for the GEAR Network

by Steven B. Bradlow, Konstantinos Kapenekakis, Georgios Kydonakis, Xinwei Li and Jiarui Xu

Can cluster analysis on graphs reveal useful information about research interactions within a network of mathematicians? This is what a group of undergraduates set out to discover in an Illinois Geometry Lab (IGL) project started in Spring 2015 under the direction of Professor Steve Bradlow and graduate students Georgios Kydonakis and Ruth Luo.

Professor Bradlow is Director of GEAR, an NSF-funded Research Network that brings together over 350 researchers at 108 nodes around the world. The acronym GEAR stands for **GE**ometric structures **And** **R**epresentation varieties. This describes the central focus of the scientific agenda but the network encompasses several distinct research communities with varying perspectives and diverse backgrounds, all of whom—in some cases unbeknownst to each other—had converged around similar mathematical questions. The central purpose of the network is to bridge the gaps between these groups.

Hoping to highlight the relationships between these different subgroups within GEAR, Professor Bradlow proposed to his IGL group that they should build a graph theory model of the network and apply cluster analysis. Their goal was not only to identify the different boundaries between the groups but to track how these boundaries evolve in time and, ultimately, to detect fruitful emerging points of intersection.



Evolution in time of the GEAR Collaboration Graph.

The IGL team (Xinwei Li, Jing Mu, and Jiarui Xu) constructed Collaboration Graphs in which each GEAR member is represented by a vertex and edges between vertices indicate joint authorship on a research paper. They used algorithms from a software package called *Gephi* to detect clustering among the vertices, and with help from Konstantinos Kapenekakis

(a colleague of Georgios Kydonakis) created visually appealing displays using models in which the vertices and clusters are allowed to behave like charged physical particles.

The colorful results can be seen on the GEAR website [gear.math.illinois.edu/members/signin/collaboration]. The sequence of graphs, one for each year since the inception of the GEAR Network, shows clearly how the different research communities have coalesced.

Team members Li and Xu, together with Georgios Kydonakis and Konstantinos Kapenekakis have continued to work on this project and are now hoping to build graphs which detect more subtle interactions between network members. In one example, called a Co-Citation graph, the edges indicate that the authors at the vertices are both cited in the same paper (not necessarily authored by either of them).

Math Carnival draws hundreds from community to learn to love math

Hundreds of local adults and children converged on Altgeld Hall on Saturday, January 28, 2017 for Math Carnival: Gathering for Gardner. As they participated in the numerous puzzles, games, riddles, magic tricks, and other hands-on activities, they discovered that math is more than just figures

and formulas. According to Melinda Lanius, a mathematics PhD student who, along with Assistant Professor Philipp Hieronymi, organized this year's event, "Math is play!" So numerous volunteers from Illinois' Department of Mathematics, Illinois Geometry Lab, and local chapter of the Association for Women in Mathematics spent the afternoon showing members of the community that play can indeed be math—and that it's fun.

The event was extremely successful with over 750 people showing up throughout the afternoon. The turnout was fantastic," said Hieronymi, "it was above anything I could have imagined. This shows that there is a great demand for such activities in the Urbana-Champaign community."

Visitors could participate in a variety of math-related activities spread out in stations over several different rooms in Altgeld, ranging from hands-on activities to riddles, to magic tricks, to games, to estimation activities.

For example, one popular hands-on activity was the Snowflake Station, where kids learned about snowflakes, how they're six-sided, and how falling through clouds with different temperatures and moisture levels shapes each one in a unique way. The youngsters then proceeded to use scissors and paper to create their own unique snowflake which they got to take home.

Another popular station was the Tile Emporium, where a variety of wooden puzzles of different colors and shapes called on students' mathematical reasoning and problem-solving skills.

Kids could also try to solve a couple of riddles at the Riddle Mania station. One was a kind of shell game where they were to guess, based on logic clues, which colorful box had an object underneath.

Another was a classic math riddle, Crossing the River (with a lion, a goat, and a tin can). Here's the scenario: A man comes to a river with a boat. He has with him a lion, a goat, and a tin can. The man can only carry one single passenger besides himself in the boat. How can he get them all to the other side without the goat eating the tin can, or the lion eating the goat?

Did they succeed in recruiting any kids into STEM? "While probably few children become scientists just because of a single event," Hieronymi says, "I do strongly believe that such experiences (in particular, when repeated) can make a huge difference in the attitude of children towards STEM fields and may encourage them to pursue a career in such fields."

Photos (from top): Mathematics graduate student Hadrian Quan gives a visitor to the Estimation station pointers on how to estimate the number of nuts in the three jars.

Graduate student Emily Heath works on a tile puzzle with a local youngster at the Math Carnival's Tile Emporium station.

A local student tries his hand at a rope trick on graduate student Joseph Rennie (at left) at the Magical Wonders and Secrets station.



Kirkpatrick and Nevins named 2017 Simons Fellows

Kay Kirkpatrick and Tom Nevins have been named Simons Fellows in Mathematics by the Simons Foundation.

Kay Kirkpatrick, an associate professor and Blackwell Scholar in the Department of Mathematics, works in the area of statistical mechanics, and more recently, theoretical computer science. She received an NSF CAREER award in 2013 to study rigorous connections between the microscopic models of interacting particles from first principles and the macroscopic descriptions of phenomena, a big challenge in condensed matter physics. Superconductors, for instance, have essentially zero resistivity at low temperatures, and magnetic fields can bend around them, allowing levitation and applications to particle accelerators and MRI machines. Another object of study is the ultra-cold quantum phenomenon called Bose-Einstein condensation, a phase of matter in which quantum particles called bosons can condense into the



Kay Kirkpatrick

same one-particle state and behave as if they are one macroscopic quantum particle—and the one-particle state solves a cubic nonlinear Schrödinger equation.

Tom Nevins is a professor in the Department of Mathematics. He has held a Visiting Fellowship at All Souls College, University of Oxford, and a Research Professorship at the Mathematical Sciences Research Institute in Berkeley. In 2017 he received both the LAS Award and the Campus Award for Excellence in Undergraduate Teaching. Nevins's research applies techniques from algebraic geometry—the geometric study of polynomial equations—to address problems about symmetry and to elucidate structures of mathematical physics. He has applied algebraic geometry to explain certain experimentally-discovered wave/particle dualities. His recent work develops new structural principles for the “phase space,” the space of positions and momenta, in classical and quantum mechanical systems and exploits those principles



Tom Nevins

to resolve questions about the “shape” of a phase space and how new types of symmetry can arise from phase spaces.

The mission of the Simons Foundation is to advance the frontiers of research in mathematics and the basic sciences by sponsoring a range of programs that aim to promote a deeper understanding of our world. Simons Fellows in Mathematics receive support to provide research leaves from classroom teaching and administrative obligations to provide strong intellectual stimulation and increased creativity and productivity in research. 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.

Hieronymi receives NSF CAREER Award

Philipp Hieronymi has been awarded the prestigious Faculty Early Career Development (CAREER) Award from the National Science Foundation. This award supports early-career faculty who have the potential to serve as academic role models in research and education to advance the mission of their department or organization.



Philipp Hieronymi

In his research project “The geography of tame ordered structures” Hieronymi continues his program of identifying and analyzing tame classes of structures that are amenable to model-theoretic methods. At the heart of logic and model theory lies the observation that within mathematics there are certain objects that have to be considered tame,

and others that have to be considered complicated (or wild). Indeed, many celebrated results in logic from the first half of the 20th century, like Gödel's incompleteness theorem, concerned the existence of objects that are complicated (or wild) from a logical viewpoint. Such results are negative in spirit as they point to the limitations of mathematical reasoning. However, in the second half of the century model theorists found a vast number of mathematical structures that exhibit no such wildness, and for often very different reasons can be thought of as being tame.

Hieronymi's award funds a large scale investigation of the precise dividing lines between such tame and wild behavior. His proposal outlined challenging new projects on the cutting edge of our understanding of what logical tameness is and what its geometric consequences are. Through this work, Hieronymi aims to develop new connections between model theory and other areas of mathematics such as geometric group theory, fractal geometry, geometric measure theory and number theory.

Hieronymi (DPhil Oxford 2008) is an Assistant Professor in the Department of Mathematics at the University of Illinois at Urbana-Champaign. Before joining the department in 2010 as a Doob Postdoc, he spent one year at the Fields Institute at the University of Toronto and at McMaster University funded by the German Academic Exchange Service.

Van den Dries gives prestigious Tarski Lectures at UC-Berkeley

Lou van den Dries, Professor of Mathematics at Illinois, gave the Tarski Lectures at the University of California Berkeley in April 2017. His first lecture, "Model theory as a geography of mathematics," was addressed to a general audience of mathematicians and mathematically oriented philosophers.

The other two lectures focused on his joint work on transseries with Matthias Aschenbrenner (UCLA) and Joris van der Hoeven (Ecole Polytechnique, Paris). Their book on the subject, published by Princeton University Press, is scheduled to appear in May. They have also received a joint invitation to give a lecture at the International Congress of Mathematicians (ICM) being held in Rio de Janeiro in August 2018.

Professor van den Dries is also the 2016 recipient of the Shoenfield Prize from the Association for Symbolic Logic (ASL) for outstanding expository writing in the field of logic for his article "Lectures on the model theory of valued fields. In: *Model theory in algebra, analysis and arithmetic*, (Cetraro, Italy 2012, Editors: H. Dugald Macpherson and Carlo Toffalori), Lecture Notes in Mathematics (CIME Foundation Subseries), volume 2111, Springer-Verlag Berlin Heidelberg, 2014, pp. 55-157. The Shoenfield prizes will be awarded formally at a ceremony at the 2018 ASL North American Annual Meeting in Macomb, Illinois.

News from NetMath

NetMath Excellence Awards

Mentors, TAs, and academic hourlies perform several essential roles in NetMath. Mentors are the first line of contact for most students in our online courses; in addition to grading homework assignments and providing feedback on performance, mentors build a connection with their students by maintaining regular communication and helping students stay on track to complete their course. TAs and academic hourlies also perform multiple functions – in addition to mentoring duties they help us develop instructional materials, beta-test new technology prior to full implementation in NetMath, and work with our instructional, IT, and administrative teams to improve the program.

NetMath Mentor Excellence Award recipients for Spring 2017 were Aamodini Gupta, Jiayin Lu, Allison Pierce, and Shiyuan Sheng.

The TA Excellence Award recipient was Amelia Tebbe, and Michael Dobbs received an Academic Hourly Excellence Award.

New Addition to NetMath

Andrew Nygard joined NetMath in April as our new Visiting Academic Media Specialist. Andrew will direct and assist with digital audio and video productions (including videotaping live lectures and events, and productions in studio settings), prepare media content for distribution, ensure accessibility of NetMath media, and contribute to long-term strategic planning for media creation and distribution.

Partner High School Program

In May NetMath hosted a breakfast for high school math teachers from all across Illinois during the ICTM State competition on campus. Later in May we hosted the annual Partner High School Jamboree for teachers and administrators from schools in the NetMath PHS Program. The event was held at William Fremd High School in Palatine. Three new high schools will join the PHS Program in the fall: Naperville Central HS, Cary Grove Community HS, and Prairie Ridge HS.



Members of the NetMath team at the April 2017 retreat (from left): Dave Watson, Bruce Carpenter, Kerry Butson, Faisal Whelpley, Anu Murphy, Zac Schoenrock, Janasia Sumlar.

Traffic visualization research helps cities make data-driven decisions

By Emily Scott, Industrial and Enterprise Systems Engineering

A research project co-led by Professor Richard Sowers from the Departments of Mathematics and Industrial and Enterprise Systems Engineering and Professor Dan Work from Civil and Environmental Engineering and the Coordinated Science Laboratory has been awarded a seed grant from the Siebel Energy Institute. The grant, titled “Quantifying the Predictability of City-scale Urban Traffic,” could help cities better analyze traffic data and solve traffic-related problems.

The effort builds on some prior results of Work, who had previously analyzed New York City traffic data from the aftermath of Hurricane Sandy. He requested a comprehensive dataset of taxi behavior in New York City, and realized that a number of interesting questions were now within reach. The data, which spans across four years, shows traffic speeds along with the pick-up and drop-off locations of taxi trips.

Sowers, whose interests are in Big Data, became interested because of the immediate impact of these problems. “We started to try and understand what the big picture is,” Sowers said of the start of his collaboration with Work.

Through collaboration with students in the Program for Interdisciplinary and Industrial Internships at Illinois and the Illinois Geometry Laboratory in the Department of Mathematics, they’ve developed data visualizations that give meaningful insight into traffic patterns.

“We convert the taxi data into traffic conditions similar to what you can find on Google Maps, and from there, we can answer all kinds of interesting questions about the city,” Work said.

Such as — how does a bike lane influence traffic speeds on neighboring roads? What happens when the city-wide speed limit is changed? How would this impact accidents and traffic fatalities?

These are policy questions faced by departments of transportation in many cities, but they’re difficult to answer, usually because of the algorithms, computing and visualization resources needed to process the data into relevant information.



A visualization showing traffic patterns on New Year's Eve in Manhattan.

For Work and Sowers, turning the data into relevant visualizations has always been a challenge, partly due to the fact that a map can only display what’s happening at a specific moment in time.

“Another challenge that we’ve been facing is how to take this huge amount of data and boil it down to something that’s small enough to wrap your mind around,” Sowers said.

They’ve started to use algorithms that can produce lower-dimensional representations of the data. Work said these representations allow them to determine what’s relevant in the data, which can provide insight for cities.

Recently, Work and Sowers met with transportation departments in several cities, including New York City, Los Angeles and Chicago, to learn the common themes in these cities’ concerns about traffic.

But finding these similarities and differences is just one part of their goal.

“Part of our goal is to start to develop the techniques and the tools that can help these cities create data driven answers to their questions,” Work said.

Moving forward, they’ll continue to analyze the data in order to deeply understand the insights it can provide. So far, they’ve seen not only how traffic often behaves similarly, but often, how it behaves in irregular and unexplained ways.

CAMPUS AND LAS AWARDS

Campus Award for Excellence in Undergraduate Teaching

Robert Murphy
Tom Nevins

Campus Award for Excellence in Undergraduate Teaching
by Graduate Teaching Assistants

Cara Monical

Campus Award for Excellence in Graduate and Professional
Teaching

Richard Laugesen

Campus Executive Officer Distinguished Leadership Award

Matthew Ando

LAS Dean's Award for Excellence in Undergraduate Teaching

Tom Nevins

LAS Award for Excellence in Undergraduate Teaching
by Graduate Teaching Assistants

Cara Monical

LAS Staff Award

Liz Vonk

DEPARTMENT AWARDS

TEACHING AWARDS

N. Tenney Peck Teaching Award in Mathematics

Patrick Allen

Distinguished Teaching Award in Mathematics for Tenured
Faculty

Zoi Rapti

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

Ivan Contreras
Rebecca Tramel

NON-INSTRUCTIONAL AWARD

Exceptional Merit Award in Mathematics
for Non-Instructional Staff

Marci Blocher

GRADUATE AWARDS

Bateman Prize and Fellowship in Number Theory

Amita Malik (prize)
Xianchang Meng (prize and fellowship)

Kuo-Tsai Chen Prize

Byron Heersink

Wolfgang Haken Prize in Geometry and Topology

Matthew Romney

Irving Reiner Memorial Award and Fellowship

Neriman Tokcan (award)
Bolor Turmunkh (award)
Hao Sun (fellowship)

Philippe Tondeur Dissertation Prize

Allen Gehret

Brahana TA Instructional Award

Melinda Lanius
Simone Sisneros-Thiry

Department TA Instructional Award

Matthew Mastroeni
Nima Rasekh

Dr. Lois M. Lackner Mathematics Fellowship

Darlayne Addabbo
Sarka Petrickova

State Farm Actuarial Science Prize

En-Yu Chang
Shu Wang

State Farm Mathematics Doctoral Scholarship

Samal Abdikerimova
Chongda Liu

UNDERGRADUATE AWARDS

H. Roy Brahana Prize

Haidong Gong

Most Outstanding Major in Actuarial Science

Siqi Chen
Saumil Padhya

Most Outstanding Major in Mathematics

Zhaodong Cai

Most Outstanding Major in Mathematics and Computer Science

Hao Gao

Most Outstanding Major in Teaching of Mathematics

Mathew Garcia

Salma Wanna Memorial Award

Alex Mendez

Elsie Thomas Fraser Award

Anna Chlopecki

Emily Mann Peck Scholarship

Sijia Huo

Dr. Lois M. Lackner Mathematics Scholarship

Sarah Allen

Gail V. Kellogg Scholarship

Jonathan Alvarez

Susan C. Morisato Scholarship

Clara Yam

Ruth V. Shaff and Genevieve I. Andrews Mathematics Scholarship

Alice Chudnovsky

Illinois Mathematics Excellence Scholarship

Zhaohan He

Broderick Portell

Vincent O. Greene Scholarship in Mathematics

Justin Black

Lucas Trojanowski

Elizabeth R. Bennett Scholarship

Junghyun Hwang

Yingying Ren

Qile Zhi

Merit Fellows

Nina Tandle

Matthew Welch

Kenneth Sprague

Bradley M. and Karen A. Smith Scholarship

Gabrielle Kane

Casualty Actuarial Society (CAS) Trust Scholarship

Chloe Marshinski

CAS Midwestern Actuarial Forum Scholarship

Chloe Marshinski

CNA Foundation Scholarship

Jacob Akstins

Anushka Desai

DW Simpson Actuarial Scholarship

Dominic Dillingham

Tyler Steele

Northwestern Mutual Scholarship

Arailym Amangeldiyeva

Ameen Hemani

Peng Jin

State Farm Actuarial Science Scholarship

Phillip Alpern

Adam Bruyere

Sarah Derango

Devin Kelly

Andre S. Kohn

Yang Lyu

Titan Bambang Wibowo

Fan Yang

Willis Towers Watson Award

Yufei Hou

Zhuoxuan Wu

Yanlei Yuan

2016 U of I Freshman Math Contest

Mark Cao, 1st Prize

Zhekun Zhang, 2nd Prize

Ki Wang, 3rd Prize

2016 U of I Mock Putnam Exam

Phillip Harris, 1st Prize

Ki Wang, 2nd Prize

Thien Le, 3rd Prize

2017 U of I Undergraduate Math Contest

Yewen Fan, 1st Prize

Junghyun Hwang, 2nd Prize

Illinois Geometry Lab undergraduates excel at research

The Illinois Geometry Lab (IGL) is the primary undergraduate research lab in the Department of Mathematics. In the IGL, teams of undergraduates work on research problems under the supervision of faculty and graduate student mentors.

The IGL Research Award, offered for the first time in spring 2017, is made to one or more IGL research groups from the preceding calendar year whose project makes a substantial contribution to mathematical knowledge and contributes to the professional development of both undergraduate and graduate students.

The 2017 Illinois Geometry Lab Research Award was made to two Fall 2016 projects:

➤ **Traffic Patterns in Manhattan**, mentored by Professors Rich Sowers (Mathematics) and Dan Work (Civil and Environmental Engineering), with graduate students Vaibhav Karve and Derrek Yager, and undergraduates Xinyu Liu, Yicheng Pu, Gabriel Shindnes, Ziyang Wang, Dajun Xu, Zeyu Wu and Yu Wu.

Members of the team created visual representations, including online animations and videos, which illustrated the mathematical analysis of the dataset previously completed by graduate students Karve and Yager in a 2016 research project. Karve won the People's Choice Award of the Graduate College Research Live! Competition for his three minute presentation "Recognizing patterns in New York taxi traffic." Other members of the team have given talks at a variety of conferences. Urban traffic planners in several major U.S. cities have expressed interest in using information of the type generated in this project to improve traffic flow and safety.

Honorable Mention was made to the Spring 2016 project Synchrony and Plasticity in the Kuramoto Model, mentored by Professor Jared Bronski, with graduate student Seth Wolbert, and undergraduates Yizhang He, Xinye Li, Yue Liu and Danielle Sponseller. This project investigated a model for the synchronization of synaptic neurons via a coupled set of difference-differential equations. Students compared the stability of fixed points for the model with constant or variable coupling strengths. The project resulted in a preprint which is currently in the final stages of review at the journal *Chaos*.

Spring 2017 semester brought tremendous expansion in the research branch of the IGL. IGL administered 17 projects involving over 70 undergraduates and well over 100 individuals. Work done in the IGL continues to be recognized, both locally and nationally: Vaibhav Karve's People's Choice Award mentioned above, Daan Michiels' work on Pierre Albin's Fall 2014 virtual reality project was mentioned in an article in *Nature*, and Jared Bronski's Spring 2016 IGL team has a paper accepted in the journal *Chaos*.

The Spring 2017 Illinois Geometry Lab Open House was held on Reading Day, Thursday, May 4. Due to the tremendous growth in the IGL this semester, the event was held in a new location. Faculty and students gathered in a large hall on the third floor of the Illini Union to present posters, video clips and interactive computer demonstrations about their research projects. Mark Bell's research group exhibited a set of intricate jigsaw puzzles designed using the mathematics of translation surfaces and Veech groups. The event was a great success, attracting a large audience both from within the department and from the wider campus community.

➤ **Quantum Mechanics for Graphs and CW Complexes**, mentored by J.L. Doob Research Assistant Professor Ivan Contreras, with graduate student Sarah Loeb, and undergraduates Chengzheng Yu, Zhe Hu, Boyan Xu and Michael Toriyama.

This project developed a combinatorial model for quantum mechanics in graphs and networks. This research has applications to the diffusion of heat in metallic structures. Students wrote code to implement the evolution of quantum states for randomly generated network structures and investigated combinatorial and topological features of graph Laplacians. Several papers have resulted from this research, and presentations at local and regional conferences, as well as at the December 2016 conference *Mathematics by Students* at the University of Los Andes in Bogota, Columbia.



Some of the members of the award winning research teams in front of their posters at the IGL open house. From left: Director of IGL Jeremy Tyson, students Boyan Xu, Claire Merriman, Chengzheng Yu, Ziyang Wang, Haozhe Wang and Jing Wang, and faculty member Richard Sowers.



Pictured above at the IGL open house are undergraduate student Julia Spina with the Veech jigsaw puzzles (top); Graduate students Nick Kosar and Nima Rasekh at the 3D printer.

IGL is extremely grateful for the support, both moral and financial, received from numerous sources. Financial support for the Illinois Geometry Lab this semester comes from the Department of Mathematics, the University of Illinois Office of Public Engagement, the Mathematical Association of America, the National Science Foundation, and a generous gift from a private donor.

Project NExT a launch pad for rising mathematician

Rosemary Guzman has been busy with research in addition to serving as the Assistant Director of the Illinois Geometry Lab. Before joining the department in 2015, she was an NSF Alliance Postdoctoral Fellow and Visiting Assistant Professor at the University of Iowa. She remains a Visiting Scholar at the University of Illinois at Chicago where she earned her PhD in 2011 under the direction of Professor Peter B. Shalen. Her research interests are in hyperbolic 3-manifolds and low-dimensional topology.

Guzman was named a Project NExT Fellow in 2016. Project NExT is a professional development program for new and recent PhDs in the mathematical sciences. It addresses all aspects of an academic career: improving the teaching and learning of mathematics, engaging in research and scholarship, and participating in professional service. It also provides the participants with a network of peers and mentors as they assume these responsibilities. Since 1994, over 1600 Fellows have appeared in all capacities in the academic mathematical profession. Many Project NExT Fellows have gone on to be leaders in the mathematical community.



Rosemary Guzman, Assistant Director of the Illinois Geometry Lab.

In May 2017 Guzman attended the Institute for Advanced Study at Princeton Women and Mathematics Program. Also attending from Illinois were Visiting Assistant Professor Funda Gultepe, and graduate students Heejoung Kim and Elizabeth Field. Guzman moderated two panels—one on Women in Academia and an informal evening discussion—and she also gave a research talk.

Guzman has worked to promote diversity in mathematics. In Fall 2016, she facilitated a workshop for undergraduate students at the Math Alliance Field of Dreams Conference in St. Louis. Also at the conference were Professor Matthew Ando, and graduate students Stefan Klajbor and Alyssa Loving. She also attended the Modern Math Workshop at SACNAS last fall, along with Professor and Director of Graduate Studies Richard Laugesen.

Guzman will be on leave during the 2017-2018 academic year to pursue research at the University of Chicago on a fellowship from the American Association of University Women (AAUW).

CAS brings together academics and actuarial profession



The president elect of the Casualty Actuarial Society (CAS), Brian Brown, visited campus to give a presentation to students on the Property & Casualty (P&C) insurance industry. Brown spoke to many students who were interested in working in the P&C field. The availability of new data from sources such as GPS and social media has the potential to help actuaries more accurately predict risk. Demand for actuaries with the skills to manage and analyze this data is strong.

Brown is a principal and consulting actuary with the Chicago office of Milliman. He was very impressed with our Actuarial Science Program and our students. "You have certainly built a great program. The students seemed fully engaged. I thought the group also asked a lot of very good questions," said Brown.

Also at the event were Michael Suess, Country Financial in Bloomington, IL, and Jennifer Bostedt, Kemper in Chicago, the University Liaisons from CAS. The program

helps facilitate the partnership between the academic community and the actuarial profession. Suess and Bostedt, both alumni of our actuarial science program, were able to provide advice to students from the perspective of someone early in their career.

Pictured (from left): Alumni Michael Suess and Jennifer Bostedt, and Director of Actuarial Science at Illinois Runhuan Feng.

Course introduces students to data management tools



Actuarial employers increasingly value employees who can manage and analyze large datasets. Our Actuarial Science Program is continually looking for ways to prepare our students to meet this demand. During the spring of 2017 we offered a new course designed to teach these skills to aspiring actuaries. The course was so popular that we offered an additional section to meet the demand.

Undergraduate Lee Drinkwater taught the class to over 50 students. The course introduced students to Excel, VBA, SAS and SQL. "My favorite part about the course was taking notice of the students who really wanted to be there and to learn. Students who would ask good questions or ask for advice or make comments reminded me of myself—eager to learn and apply this technical knowledge," said Drinkwater.

Junior Joanna Surowka has benefitted from this course. She had limited experience with these tools before and she feels much more prepared now. "I feel like I learned a lot in the class. He taught in a way that anyone would be able to understand."

Surowka will be an intern at CNA in Chicago this summer and hopes to put the skills she's learning to use. "The best thing about the class was expanding your knowledge on a variety of different codes so if you go into a job, you'll know something about the tools they use."

Because the course was so successful the department will offer it again in the fall and hopes to expand offerings in this area in the future.

Expanded actuarial exam reimbursement program



Thanks to the generous donations from alumni, the department has been able to expand our actuarial exam reimbursement program to provide partial reimbursement for all of Society of Actuaries and Casualty Actuarial Society exams to both undergraduate and graduate actuarial students. While the reimbursement amount per exam is limited, the program continues to provide much needed support and encouragement to our future actuaries.

Faculty research engages with insurance industry

Today's computing power makes nested stochastic modeling a possibility, where just a few years ago it was an actuary's dream. However, as the insurance industry's regulatory requirements move more towards dependence on stochastic approaches, it has become increasingly difficult to run nested modeling. While the insurance industry continues to rely heavily on hardware innovations, trying to make brute force methods faster and more palatable, we are approaching a crossroads about how to proceed.

The Society of Actuaries commissioned a research team from our Illinois Actuarial Program led by Professor Runhuan Feng in Fall 2015 to conduct an industry survey on current market practices of nested stochastic modeling and to perform a research study on computational methodologies to accelerate run time and improve efficiency.

The research study will serve as a resource for financial reporting actuaries to better understand the pros and cons of emerging techniques. Companies considering implementing a nested stochastic model will better understand the technical challenges and the tools available to address these issues. Our researchers hope that the findings of this research can eventually contribute to the development of industrial best practice on nested stochastic modeling in the future.

Both the survey and the research study were successfully concluded in Fall 2016. We are very proud to contribute to this critical development in the insurance industry. Research findings can be found at <https://www.soa.org/research-reports/2016/nested-stochastic-modeling/>.

Undergraduate research projects seek to connect actuaries to growing field of predictive analytics

In the actuarial community, predictive analytics is a hot topic. Three undergraduate research projects at Illinois aimed to demonstrate the differences between traditional statistical methods and predictive analytics and provide an introduction to these methods for actuaries who wish to integrate predictive analytics into the models they use.

Professor and Director of Actuarial Science Runhuan Feng and Actuarial Science Master's student Siva Karthik Boddapati guided nine undergraduates in three research projects this past academic year, each focusing on a different method of statistical analysis. One approach used minimized the error in the predictions, another maximized the information gain, and the third approach used a more traditional, probability-based model. This research can help actuaries understand the differences among the three methods and assess the strengths and weaknesses inherent in each methodology.

The undergraduate research teams were

- Error Based Learning: Wanli Zhang, Qinxue Liu, Zhengrui Fu
- Information Based Learning: Pranav Bharadwaj, Tyler Steele, Wayne Tao
- Probability Based Learning: Wenjing Zhao, Olafur A. Olafsson, Longhao Jin

Undergraduate student Tyler Steele said of his project: "The machine learning research project that I was involved in this year was one of my favorite experiences. Not only was I able to learn a lot about a huge field in data analytics, but I was also able to be a part of a great team. I really enjoyed working with my group members because we all had different strengths and we were able to teach each other a great deal."

In addition to the research, the students gave presentations at a midterm review that Steele said, "was valuable because we were able to hear Professor Feng's and our mentor, Siva's, ideas about what areas we did well and what areas we could improve on. Also, we were able to witness the other groups presentations which were very interesting."

Future research is planned to explore in detail the difference in output that each model produces. Such information will help actuaries when they are selecting models to predict future events to manage risk effectively.

The Undergraduate Research Program at Illinois is sponsored by the Society of Actuaries. It is the first such program in the nation that aims to provide actuarial science undergraduate students with an opportunity to perform and disseminate research, develop students' skills in research methodology, project management, writing, and presentation.

Improved career services for actuarial science students



The Department of Mathematics Actuarial Science program is actively improving the career services and industry connections for actuarial science students with several new initiatives. We have a new blog (go.illinois.edu/actsclublog) designed to keep students informed of career opportunities and other events in and around campus.

Actuarial Science Advisor Corrie Proksa plans to hold new career-focused events such as resume and interviewing workshops this fall, as well as bringing speakers from industry to talk with students about career opportunities.

Harnessing technology to evaluate risk for the future



Two of our undergraduate actuarial science majors, Peng Jin and Guanzhong Tao, put their creativity, computing skills and actuarial knowledge to use in the inaugural ORMIR / AXIS Re Future of Insurance Hackathon held April 9, 2017, at the Thomas M. Siebel Center for Computer Science on the University of Illinois campus.

Axis Reinsurance and the University of Illinois College of Business and the Office of Risk Management and Insurance Research sponsored the event. Students were given the task of developing a visual tool that would show the financial impact to an insurer of risks in a region such as fire, hurricane or flood. The benefits of such a tool in industry would allow an underwriter to quickly see the impact of such a catastrophe or the impact of covering more property in the region.

Students had one day from 9 am to 6 pm to complete their projects. The students were instructed to incorporate (and interpret) cutting-edge technology into their solutions. The students took this to heart and used virtual and augmented reality, drones, and machine learning algorithms all while running applications on both web and mobile platforms. "We feel our project can definitely be applied in the catastrophe modeling industry. We are currently still improving our model with better visualizations," said Jin.

The event was not only an opportunity for students to develop their technical skills. Teamwork was also important. Tao said, "I used not only programming skills but also teamwork skills to make sure everyone in the team contributed."

The Hackathon was open to all University of Illinois undergraduate or graduate students. "The (re)insurance industry is comprised of individuals with diverse educational and professional backgrounds, and we saw great thinking from students in computer science, mathematics, and even linguistics during the hackathon," said Spencer Guerrero, Technical Analyst at the AXIS Research Center.

AXIS, a Bermuda-based (re)insurer with 1400 employees and 30 offices worldwide, established a partnership with the University of Illinois in 2012 through the College of Business' Office of Risk Management and Insurance Research (ORMIR). "Our goal is to promote and educate students about the (re)insurance industry through these challenges and our partnership with ORMIR," said Guerrero.



Stay connected with Illinois mathematics

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 2017 Departments of Mathematics and Statistics Convocation ceremony.

Moved recently? Update your contact information at www.las.illinois.edu/alumni/contact/form/.

Erin Compaan

by Jim Dey

Erin Compaan hopped aboard the math train as a 15-year-old college freshman in Florida with no idea where it was headed. Ten years later, she's looking forward to completing her doctoral degree at the University of Illinois in spring 2017 followed by National Science Foundation postdoctoral work at the Massachusetts Institute of Technology.

"I still don't know where I'm ultimately going. But that's OK. It's been fun," said the 25-year-old Compaan, who grew up in Jacksonville, Fla. and was home-schooled by her mother from kindergarten through high school.

The youngest of five children, Compaan said she had no particular interest in any academic field or even in going to college when she enrolled at her hometown-based University of North Florida. She decided to pursue math because she thought it represented the quickest route to graduation.

But Compaan found then that it "was more interesting than I thought it would be" because there is so much to learn. "There are so many problems. There is so much we don't know and so many ways to think about math," she said.

Compaan's aptitude for math caught the attention of her North Florida professors, who encouraged her to pursue a graduate education. That advice was reinforced when she attended a 2011 summer program for women in mathematics at the George Washington University in Washington, D.C.

Compaan was skeptical of the idea of attending graduate school but said she was "sold enough" to apply to a number of institutions. She described herself as impressed by the UI math department's "welcoming" atmosphere and its many research areas, but thought it was a "long-shot" that she would be accepted because of its elite academic standing. "I didn't think I'd last here very long," Compaan said.

Her studies here have been highlighted by assignments teaching calculus to undergraduates, scholarship awards by the U.S. Departments of Defense and Education and even stints as a volunteer tutor to local high school students.

Compaan also has held summer internships with the Department of Defense, the Institute for Defense Analyses and the Software Engineering Institute.

Now working with math department advisor Professor Nikolaos Tzirakis, Compaan's research is in the "dynamics of nonlinear dispersive partial differential equations," focusing on "deriving smoothing estimates on various manifolds." She described herself as "fortunate" to have "an excellent advisor who is so helpful and patient."



Erin Compaan will be an NSF postdoc at MIT this fall.

Like many people with an impressive talent, Compaan downplays her achievements in math by insisting it's not as difficult as many people perceive.

"There's a mystique associated with math. I think it's a skill. I think many people could be good at math," she said.

Although devoted to her math studies, the Florida transplant said she's enjoyed her time in Illinois. The change of seasons was something new but enjoyable to her. "I enjoy the weather unless it gets to April and it's still snowing," she said.

One of her favorite pastimes is taking long walks -- "at least 15 miles on weekends" -- armed only with her camera and her thoughts. She recently decided to take a walking tour of all of Champaign-Urbana's parks. "I just pick some to visit on a given day," Compaan said.

With time at the UI drawing short, Compaan said she's ready for her next math adventure at MIT. That's another opportunity she didn't expect to have, but intends to take full advantage of. Compaan insists she doesn't "have goals," even though she sees herself on a path to an eventual university faculty post.

Until then, she'll ride that math train wherever it takes her. The next stop is Cambridge, Mass.

Jim Dey is a columnist and editorial writer for The News-Gazette in Champaign-Urbana.

Fisher gift honors wife and endows their legacy

When Scott Fisher (BS Psychology '72, MS Computer Science '76) received his second degree from Illinois, inflation was rampant and job prospects were dim. However, he and all of his fellow graduates had interviews with the major computer and electronics corporations. "I asked one recruiter why they came to the cornfields of Champaign," Fisher recalls, "and she said, 'Our relationship with Illinois is critical, and we get great employees from here.'" After graduating in 1972, along with his full time job, Fisher spent two years taking additional math and computer science classes.



Illinois alumnus Scott Fisher gives back.

To acknowledge the critical role Illinois has played in his life, a seven-figure estate gift will establish the Scott H. and Bonita J. Fisher Endowment, which also honors his late wife, Bonnie, who passed away in 2013. The Fisher Endowment will fund a professorship in both mathematics and computer science, as well as provide funding for the university's main library and the Grainger Engineering Library.

When asked why he chose to leave his legacy at Illinois, Fisher said, "When I was at Illinois, we had some of the giants in computing. They taught, did research, but more importantly, they challenged us. They helped us wonder about how things work and gave us the guidance to figure it out. Bonnie and I believe that Illinois must remain a leader in all these areas—and it must excite the next group of students. We must continue to have the best faculty, staff, and facilities."

Fisher is committed to doing his part to ensure the same level of inspiration and teaching excellence for future generations. The ability to give back is especially gratifying for Fisher because he came from modest family means and started working at age 14. "My parents wanted me to do well and helped me financially. They also encouraged me to save for my education," he said. "I've probably achieved more than they ever thought possible."

Fisher lives in Minneapolis and recently retired from Ecolab. "I managed a great group of people who developed applications for R&D and our business," Fisher said. "To this day, my U of I experience helps me provide an exciting and productive environment."

Fisher also gives back by volunteering his time. He serves on the Mathematics Development Advisory Board, an advisory group to the Department of Mathematics comprised of U of I alumni. He has also been a mentor at the University of Colorado and University of Minnesota, and at Ecolab.

Campaign for Altgeld and Illini Halls ramps up

CAMPAIGN FOR
ALTGELD
AND ILLINI
HALLS

The renovation of Altgeld and Illini Halls took on a new urgency this winter, when the legendary Altgeld Hall chimes tower was closed for repairs. We hope that they will soon implement immediate repairs that will return the chimes to action.

The condition of the chimes tower and playing room are exemplars of the need for a comprehensive renovation of Altgeld Hall, and the temporary loss of the chimes concerts reminds us of the essential role that Altgeld Hall plays in the life of the university and in the campus's sense of place.

The campaign to raise funds for the renovation of Altgeld and Illini Halls has begun, and we are working with the College of Liberal Arts and Sciences and the University to make fundraising for the project a centerpiece of its 150th anniversary campaign, which will launch later this year. The renovation will transform the Departments of Mathematics and Statistics, creating new spaces for collaborative learning and discovery and providing space for growth during an era of phenomenal growth in mathematics, statistics, and data science. This will profoundly benefit the 19,000 students who take classes in these buildings each year. To learn more, visit the campaign's web site, altgeldillini.illinois.edu.



altgeldillini.illinois.edu

Sue Wood celebrates 45 years of chiming the bells of Altgeld Hall

Sue Wood has played the chimes in Altgeld Hall for the past 45 years. She stepped down as chimesmaster this past fall and she was honored at a reception held in Altgeld Hall in April 2017. Wood started playing the Altgeld chimes with former chimesmaster Albert Marien in 1971 when she was a graduate student here at Illinois. She later became associate chimesmaster and took over full time as chimesmaster in 1995.

Wood has played *Hail to the Orange* thousands of times—it is the one piece required in the daily concert—and she has led thousands of people on a tour of the playing chamber and bell tower. Some 2,000 children and adults stopped by each year for the free daily concert and tour at 12:45 pm weekdays. She also occasionally played on Saturdays to entertain those on the quad and has had wedding requests from couples who wanted to hear the chimes as they came out of nearby Wesley United Methodist Church.

And all of it was volunteer. “The whole thing was sort of a labor of love,” she said. Her only compensation was a parking place.

Music has been a lifelong pleasure and avocation for Wood.

She spent many of her school years as a member of the youth choir at a church in western New York where she learned to play the organ. Later, living in Philo, Illinois, she played the organ monthly at the Philo Presbyterian Church. As a graduate student at Illinois she was recruited to play the 25-bell carillon at the University Lutheran Church, which led her to the chimes at Altgeld Hall. Over the years she also took lessons from Karel Keldermans on the 66-bell (now 67-bell) Rees Memorial Carillon in Springfield, Illinois.

Originally from Buffalo, New York, Wood earned her PhD in plant pathology from the University of Illinois in 1976. She worked as a professional scientist at the Illinois Natural History Survey where she supervised the Analytical Chemistry Laboratory. After it was closed, she took a similar position at the College of Veterinary Medicine until her retirement.

As reported recently in the news, the bell tower in Altgeld Hall is temporarily closed for repairs. A safety inspection earlier this year found a number of issues that will need to be addressed before chimes players can return, hopefully by this fall. In the meantime, a virtual chimes player on the university’s website (<http://altgeldillini.illinois.edu/virtual-chimes-player/>) allows users to hear *Hail to the Orange* or play their own tunes, and the campus hopes to install cameras and develop an audio-visual tour.



Sue Wood playing the chimes in Altgeld Hall.

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University of Illinois celebrates 150 years

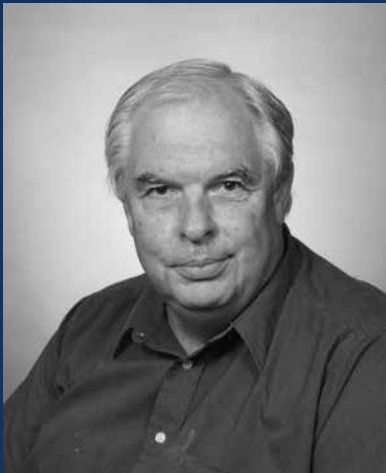
A land grant institution established in 1867, the University of Illinois has a long record of commitment to public engagement and to the discovery and application of knowledge. Over the past 150 years, U of I faculty, staff, and students have transformed the social and economic landscape of our world. As a leading institution of higher learning, the U of I will continue to expand our global presence through supporting public policies that address the grand challenges of a global society, to lead advancements in information and medical technology, and to catalyze economic development. A fifteen month long celebration will highlight the accomplishments of the University of Illinois and our vision for shaping the future through teaching, research, and public engagement.

Visit the website and check out the timeline for Department of Mathematics firsts. The department will host a variety of lectures and events throughout the sesquicentennial.

<http://150.illinois.edu/>

In Memoriam

Larry Dornhoff, 1942-2017



Larry Dornhoff passed away February 10, 2017, at Carle Hospital in Urbana, IL. Dornhoff was born on April 13, 1942, in Heartwell, NE, growing up the eldest of three children on the family farm. He completed his PhD at the University of Chicago in 1966 and was an Instructor at Yale from 1966-1968. He met his wife-to-be while pursuing post-graduate work at Yale University, and moved to central Illinois to accept a position at the University of Illinois following his marriage on June 8, 1968. He worked in the Illinois Mathematics Department until his retirement in 2005.

From an early age, Larry was an avid scholar, tutor and classroom speaker. He authored two well-regarded books on group representations and a series of interactive math-teaching programs, which were licensed to NovaNet (now Pearson) and distributed around the world. He taught calculus for many years at Illinois, generously devoting time to helping students one-on-one as well as to classroom instruction, and mentoring teaching assistants.

In 1986 he received two campus grants almost simultaneously and became manager of PLATO and PC classrooms for the department, and he was the founder and director of the department's EXCEL Lab. He made a substantial contribution to mathematics education through interactive computer lessons, writing educational mathematics lessons for upper-level high school math (algebra, trigonometry and early calculus) using the PLATO system that was developed at the

University of Illinois. He received Honorable Mention in 1999 for the U of I Campus Award for Innovation in Undergraduate Instruction.

Dornhoff was fond of radio programs, sports (baseball especially), folk music, and comedy; he seldom missed an episode of *Midnight Special* or *Prairie Home Companion*. He bicycled extensively during his student days, and continued biking to and from work for many years. He was fond of dogs and enjoyed pampering his Brittney with walks and treats. He also liked to travel, bringing his family on numerous cross-country vacations – zoos especially, a favorite of his daughters – and escorting his wife on trips to England, Germany, and Japan.

A loving father and devoted husband, Dornhoff spoke by phone weekly with his daughters, and took great pride in their achievements. At the time of his passing, Larry was looking forward to celebrating his 75th birthday in the company of his loved ones. Now, it is they who will honor, remember, and miss this gentle, intelligent, honest, and wonderful man. Donations can be made to the American Diabetes Foundation or the American Cancer Society.

Irmgard Haken, 1929-2017



Anna-Irmgard Haken passed away at home on April 4, 2017 after a long illness. Irmgard was born in Berlin, Germany, on November 11, 1929, to Lippold Freiherr von Bredow and Irmgard (Reichel) Freifrau von Bredow. She married Wolfgang Haken in Flensburg, Germany, on November 23, 1953. In 1959, she earned a PhD in mathematics from the University of Kiel. The couple immigrated to the U.S. in 1962 with their three children so that Wolfgang could take a position as professor of mathematics at the University of Illinois Urbana-Champaign. Three more children were born in the U.S.

Besides a brief stint teaching mathematics at the University of Illinois in the mid-1970s, Irmgard devoted her life to taking care of her large family, making all of her children's clothes, teaching them to swim, and ensuring that they practiced violin daily. The family spent many weeks each year camping all over the U.S. She was an expert at preparing meals for large groups and regularly had friends and extended family over for dinner. The hard German bread she baked was especially popular. She was featured in Nina Rubel's 1981 book "Heartland Beat."

From 1993 to 2005, Irmgard led the Saturday Hike—a group of mostly university people who spend Saturday afternoons hiking and picnicking in the woods in every kind of weather—and continued to hike with them until illness prevented her. Her family will hold a memorial hike for her in the near future.

In honor of Irmgard's love for the great outdoors, the family requests that memorial contributions be made to the Champaign County Forest Preserve.

We count on the generosity of alumni and friends to support students as they embark on earning a world-class education and to fund faculty members as they conduct world changing research and train students. Your investment makes a difference.

☐ Yes! I believe in the importance of excellence in mathematics and wish to show my support!

\$_____ **Mathematics Partnership Fund** (332346 default)

Your gift to the Partnership Fund will have the widest impact as it supports a range of activities including student awards and travel, distinguished lecturers, the recruitment of excellent faculty, and alumni events.

\$_____ **Actuarial Science Fund** (330225)

Support Actuarial Science through scholarships, fellowships, graderships, and faculty support.

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Support research experiences for undergraduate students (REUs).

\$_____ **Fund for Altgeld and Illini Halls** (338168)

Support our bold plan to renovate Altgeld and Illini Halls to create a collaborative environment for mathematics learning and discovery.



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Department of Mathematics
University of Illinois at Urbana-Champaign
273 Altgeld Hall
1409 W. Green Street
Urbana, IL 61801

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Reconnect with classmates and teachers at the mathematics PhD reunion this fall

The Department of Mathematics at Illinois will hold a reunion for PhD alumni on Friday, Sept. 15 - Saturday, Sept. 16, 2017. Wondering who's coming to the reunion? Check out the list of participants on the website. Visit the reunion website for registration and accommodation information.

Activities will include

- tour of campus
- opportunities to talk with current faculty and students
- talks by graduate students
- career panel by alumni for current graduate students
- breakfast and a keynote lecture by Lee Deville, an associate professor in the Illinois Department of Mathematics
- annual department picnic

www.math.illinois.edu/reunion