



Math Times

Department of Mathematics — Spring/Summer 2016

WIM symposium highlights cutting edge research in mathematics

The fourth Midwest Women in Mathematics Symposium (WIMS) took place April 2, 2016, on the University of Illinois at Urbana-Champaign campus. More than 100 women—mostly graduate students, early career researchers, and faculty at small institutions—came from Illinois, Indiana, Iowa, Ohio, Minnesota, and Wisconsin.

The symposium was a resounding success. It highlighted women working in cutting edge research, stimulated collaborations, strengthened the network of female mathematicians in the Midwest, and facilitated mentoring at all career stages.



Symposium participants at roundtable discussion.

The symposium featured two plenary lectures and eight short lectures, thirteen poster presentations, plus open problem sessions—from algebra and number theory to mathematical biology and to mathematics education. The plenary lectures were given by Gloria Mari Beffa (University of Wisconsin-Madison) and Barbara Keyfitz (Ohio State University).

Roundtable discussions explored issues facing women in mathematics including work-life balance, professional development, career track options, and ways to get involved in research collaborations. Wendy Heller, Illinois professor of psychology and gender and women's studies, delivered brief but intriguing opening remarks. The full schedule of the symposium, including some slides and videos, is online at www.math.illinois.edu/wims/.

Attendees were keenly engaged in all activities throughout the day. In some problem sessions, small working groups developed new collaborations, while in others peers and experienced researchers discussed future directions. The atmosphere was light and supportive.

The organizing committee consisted of Illinois Department of Mathematics faculty Elena Fuchs, Vera Hur, Rinat Kedem, Zoi Rapti, and Susan Tolman. The symposium was partially funded by the National Science Foundation and the Institute for Mathematics and its Applications. Additional support from the Department of Mathematics provided travel support and other amenities for participants with young children.



Zoi Rapti at poster session.



Spring trees in front of Altgeld Hall.



From the Chair

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College of
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AT ILLINOIS

Alumni and Friends,

This issue of *Math Times* showcases the extraordinary range of activity of our department, including our faculty, current students, and alumni.

The WIMS symposium (our cover article) brought together women mathematicians from across the Midwest. It was an opportunity to celebrate the work of women mathematicians at all stages of their careers and also to discuss and study issues facing women in the mathematics.

The organizers of the symposium are achieving success at the highest level of the profession, and some of those successes appear elsewhere in these pages. For example, Elena Fuchs has just been awarded a Sloan Fellowship (see p. 15), and Vera Hur, a Sloan Fellow in 2012, has just been named a Simons Fellow (p. 15). Kay Kirkpatrick, whose NSF CAREER award among other things has provided support to the outreach activities of our AWM chapter, was recently an organizer of a semester program at the Mathematical Sciences Research Institute in Berkeley, and has just won the N. Tenney Peck Teaching Award (p. 6). Rinat Kedem, the Lois M. Lackner Scholar in Mathematics, was a speaker at the 2014 International Congress of Mathematicians.

Our faculty and graduate students are doing outstanding work as teachers, both in and out of the classroom. Lee DeVille has won the LAS Dean's Award for Undergraduate Teaching. He is in good company: Mathematics faculty have won this award in 11 out of the past 12 years, a record matched by no other department in the college (he also won a campus award, for good measure). Nick Andersen and Sarah Yeakel both won college and/or campus awards for their work as graduate student TAs.

Scholars like these make the department a wonderful place to do mathematics, and so it is very important to recruit and retain outstanding faculty and students. In recent years, our alumni and friends have provided tremendous help in support of our faculty and students. To pick only one example, this spring we were able to recruit six outstanding undergraduate students to join the class of 2020, thanks to undergraduate scholarships made possible by alumni and friends of the department. This is the largest yield so far in our undergraduate scholarship program! I am grateful to the many friends of the department who play such an important role in our work.

Matthew Ando
Professor and Chair
Department of Mathematics



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Allen Butler

by Jim Dey

Almost from his earliest days, Allen Butler thought mathematics was fun. He discovered later that it also was highly functional, that it could be used to unlock mysteries related to everything from helping individuals prepare financially for their retirements to assisting the federal government with drug interdiction efforts.

Those dual qualities—fun and functionality—have become the basis of Butler's life work as President and CEO of Daniel H. Wagner Associates, an employee-owned consulting firm that develops math-based solutions for public- and private-sector clients.

It wasn't supposed to be that way. Butler (he goes professionally by C. Allen Butler) said he expected to spend his entire career as a professor and researcher. But after graduating in 1987 with his doctorate in mathematics (adviser Tom Morley) from the University of Illinois, he attended the Employment Center at the Joint Math Meetings in San Antonio, Texas, where he was introduced by one of his UI math professors to Dr. Daniel H. Wagner. Butler ended up going to work at the "company of mathematicians" Wagner ran.

Founded by Wagner in 1963 to address complex problems in naval operations analysis, the firm has since expanded to serving both public- and private-sector clients, including the U.S. Defense Department as well as companies in the health, transportation, and oil and gas industries.

Butler said his firm develops "mathematical models and software implementation of those models" to solve clients' operational problems.

"That's where I started, and I've been there ever since," said Butler, who's 60 and lives in Richmond, Va.

A widower who has five children and five grandchildren, Butler moved around a lot as a child. He finally landed in Austin, Texas, where his father, Charles Butler, taught economics at the University of Texas.

During his moves, Butler said one constant in his life was his love both for mathematics and the teaching of mathematics.

"Before I even attended elementary school, my father used to give me pages of addition and multiplication problems to do. He recognized that I enjoyed doing things like that," said Butler.

When he became old enough to go to school, Butler recalled that he enjoyed helping his fellow students with the subject.

"Math was always really easy for me, and I always liked explaining it to others," Butler said.



Allen Butler (PhD Mathematics 1987)
President and CEO of Daniel H. Wagner
Associates.

What is it about math Butler finds so appealing? "I really like the idea of knowing that my answer is exactly correct. I also enjoy using math to solve real world problems," he said.

After graduating from high school in 1972, Butler enrolled at Texas Tech in Lubbock, where he studied math and computer science.

After graduating from Texas Tech, Butler said he chose the UI for graduate school because "of all the schools that offered me financial aid, it was the highest ranked."

The UI provided a new experience for him, one he enjoyed immensely.

"We had a strong class. It was the first time I was among peers in my math skills, and that was fun," he said.

Butler said his relationship with both fellow students and faculty members was especially gratifying.

"I really enjoyed the camaraderie among the math students," he said. "I made several close friends among the faculty as well."

It wasn't all math all the time at the UI. Butler described himself as a "billiard room aficionado" who maintained his headquarters in the basement of the Illini Union.

"If I wasn't doing math, that's what I was doing," he said.

These days, Butler likes to spend his time golfing.

"I like to see how golf architects build courses in different topographies and for different climates. There's not much math in that," he said. "But I also enjoy playing poker, and there's certainly math in that."

Butler and his colleagues save the heavy-duty math for big projects pursued by their clients.

For instance, data fusion—the process of integrating multiple data and knowledge representing the same real-world object into an accurate representation—is key to the development of autonomous unmanned vehicles. And search theory—the application of Bayesian statistics to the search for lost objects—is a tool for finding sunken ships, enemy submarines, or smugglers trying to avoid detection.

When he's not using those mathematical tools, Butler said he likes to teach them at three- and four-day seminars held at various universities.

"I take vacation and go teach the classes. If I didn't really enjoy teaching, I wouldn't use my vacation time that way," he said.

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

Descriptive set theory and classification

by Anush Tserunyan

My research pivots around descriptive set theory (DST) and applications of techniques from logic to ergodic theory and combinatorics. DST combines techniques from set theory, topology, analysis, recursion theory and other areas of mathematics to study *definable* subsets of \mathbb{R} or, more generally, of any Polish space (separable, completely metrizable topological space). Examples of such sets include Borel, analytic (projections of Borel), co-analytic (complement of analytic), projections of co-analytic, etc.



At its earlier stage, a central interest in DST was investigating the regularity properties of definable sets such as the perfect set property (being countable or containing a Cantor set), measurability and the Baire property (a topological analogue of measurability). As it turned out, all these properties are satisfied by analytic sets, but curiously enough, whether they hold for the projections of co-analytic sets is already independent from ZFC!

Modern DST is a multi-granular subject, whose subfields include definable equivalence relations, Polish groups and their actions, topological dynamics and Ramsey theory, Borel and measurable combinatorics (e.g., coloring a Borel graph on \mathbb{R} using a Borel/measurable coloring map).

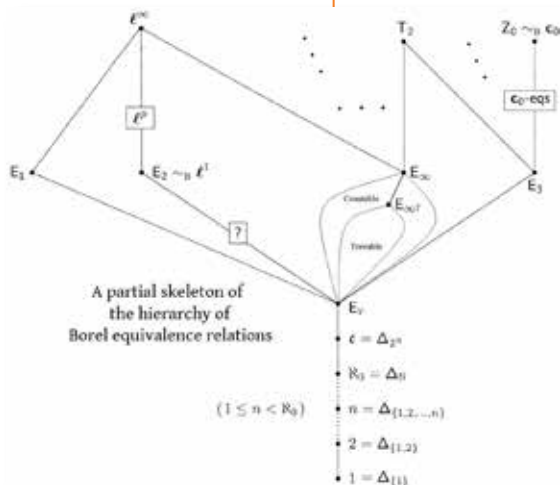
Here, I will focus on *the study of equivalence relations* on Polish spaces that are definable when viewed as sets of pairs; e.g., orbit equivalence relations induced by continuous actions of Polish groups are analytic. This study concerns the foundational question of *classification* of mathematical objects (e.g., unitary operators, dynamical systems, Riemann surfaces) up to some notion of equivalence (e.g., conjugacy, isomorphism, conformal equivalence). The separable/countable nature of these objects allows us to encode them as points in some Polish space, thus creating a mathematical framework for *measuring the complexity* of such classification problems. Indeed, there is a Polish space X of “all” separable Banach spaces (i.e. for every separable Banach space B , there are, typically many, points in X encoding isomorphic copies of B), and their isomorphism is an analytic equivalence relation on X ; the same goes for countable groups, Riemann surfaces, measure-preserving actions of a countable group, separable C^* -algebras, etc. Due to its broad scope, the study of definable equivalence relations has natural interactions with many other areas of mathematics, such as ergodic theory and topological dynamics, functional analysis and operator algebras.

We now make precise what it means for one classification problem to be no harder than another. Let E and F be equivalence relations on Polish spaces X and Y , respectively. We say that E is *Borel reducible* to F and write $E \leq_B F$ if there is a Borel map $f: X \rightarrow Y$ such that for all $x_0, x_1 \in X$, $x_0 E x_1 \iff f(x_0) F f(x_1)$; we write $E \sqsubseteq_B F$ if f is injective. $E \leq_B F$ says that there is a “Borel” injection of the quotient space X/E into Y/F . The requirement of f being Borel is crucial; without it such a map always exists, due to the Axiom of Choice, as long as the cardinality of X/E is no more than that of Y/F .

We call E *concretely classifiable* (or *smooth*) if it is Borel reducible to the equality relation Δ_Y on some (equivalently, any) Polish space Y . An example of such an equivalence relation is similarity \sim of $n \times n$ complex matrices; indeed, the map assigning to each matrix A its Jordan canonical form is a Borel reduction of \sim to equality on \mathbb{C}^{n^2} .

However, many equivalence relations that appear in mathematics are not concretely classifiable. For example, using basic measure theory, it is not hard to show that the familiar *Vitali equivalence relation* E_V on \mathbb{R} , defined by $x E_V y \iff x - y \in \mathbb{Q}$, is not concretely classifiable. Turns out, containing E_V is the only obstruction to concrete classifiability for Borel equivalence relations: in 1990, Harrington, Kechris and Louveau proved a striking dichotomy saying that a Borel equivalence relation E is either concretely classifiable, or else $E_V \sqsubseteq_B E$, boom! Thus, E_V is at the bottom of the hierarchy of not concretely classifiable Borel equivalence relations and this dichotomy was only the beginning of its exploration, yielding a highly active and broadly interdisciplinary area of research.

Anush Tserunyan is an Assistant Professor in the Department of Mathematics at Illinois. She grew up in Yerevan, Armenia, where she received her undergraduate and Master’s degrees in computer science from Yerevan State University. She completed her PhD in Mathematics at UCLA in 2013 under the supervision of Alexander Kechris (Caltech) and joined the department first as a J.L. Doob postdoc, becoming an Assistant Professor in 2015. Her research lies in descriptive set theory and measurable dynamics, as well as ergodic Ramsey theory and combinatorics. Her research is supported by an NSF grant and she was the recipient of the 2015 Emil Artin Junior Prize in Mathematics. Website: www.math.illinois.edu/~anush.



CAMPUS AND COLLEGE OF LAS AWARDS

Campus Award and LAS Dean's Award for Excellence in Undergraduate Teaching



Lee DeVille (PhD 2001 Boston Univ) joined the department in 2007 following undergraduate training at Tulane University and postdoctoral positions at Rensselaer Polytechnic Institute and New York University's Courant Institute. His research is in stochastic analysis, dynamical systems, and applications, particularly in the life sciences. He is affiliated with the Carl R. Woese Institute for Genomic Biology.

Deville was the 2010 recipient of the N. Tenney Peck Teaching Award in Mathematics, and was well on his way to distinguishing himself through his consistently high student ratings. In 2015 he was awarded the Distinguished Teaching Award in Mathematics for Tenured Faculty. His teaching record strongly supports these awards, and is part of the reason that this year Lee also received the Campus Award and LAS Award for Excellence in Undergraduate Teaching. DeVille has appeared on the List of Teachers Ranked as Excellent for 11 out of the 18 courses he has taught. He is an effective teacher at all levels including graduate courses, upper level undergraduate math courses, mid-level mathematics courses for engineers, and large lecture Calculus II.

Campus and LAS Award for Excellence in Undergraduate Teaching by Graduate Teaching Assistants



Nickolas Andersen grew up in Southern California and received a BS in mathematics from Brigham Young University in 2011. He is now a fifth-year PhD student, completing a thesis on modular forms under the direction of Professor Scott Ahlgren. In Fall 2016, he will take a postdoctoral position at UCLA.

A 2015 recipient of the Department TA Instructional Award, Nick has appeared on the List of Teachers Ranked as Excellent for every semester in which he has taught. He stands out for his exceptionally clear lectures and superb class materials, his effective use of technology in the classroom, and his approachability and friendly demeanor. Outside the classroom, Nick has served as a graduate mentor for a project in computational number theory at the Illinois Geometry Lab and as a volunteer judge for the ICTM high school math contest. He is currently a one-on-one mentor to two undergraduate students under the department's Merit Fellows Program.

LAS Award for Excellence in Undergraduate Teaching by Graduate Teaching Assistants



Sarah Yeakel received her BS (2008) and her MS (2010) in mathematics from Wayne State University before entering our graduate program in Fall 2010. She is currently in the final year of her PhD program, working on a thesis in homotopy theory under the direction of Professor Randy McCarthy. Following graduation, she will take a position as Visiting Assistant Professor at the University of Maryland at College Park.

A recipient of the 2013 Brahana TA Instructional Award, Sarah stands out for exceptionally high student evaluations that have placed her on the List of Teachers Ranked as Excellent for thirteen classes, with a median instructor rating of 4.7 out of 5. Outside the classroom, Sarah is an active member of the local chapter of the Association for Women in Mathematics (AWM), and serves as a regular volunteer and session leader for outreach events to middle and high school girls organized by the local Illinois AWM chapter.

LAS Academic Professional Award



Karen Mortensen (PhD 1989 Univ of Chicago) is the Associate Director of Graduate Studies and Director of TA Mentoring for the Department of Mathematics. She provides dedicated mentoring of new teaching assistants, insightful screening of PhD applicants, and successful grant-writing that has garnered close to \$1 million in student fellowship funding.

Karen's contributions benefit each of the 200 graduate students in our department, and through them, thousands of undergraduates. She selects mentors each year from among our experienced Mathematics teaching assistants. She organizes regular in-semester training and ongoing supervision for the mentors. She recruits and evaluates applicants to our Masters programs, and decides who will be admitted.

She works individually with graduate students to prepare strong applications for prestigious awards that will provide vital fellowship funding and she was also recently awarded funding from the Department of Education program "Graduate Assistance in Areas of National Need." These fellowships will have a major impact upon the research trajectory of our student recipients.

Karen has also served as Site Coordinator for Illinois Council of Teachers of Mathematics State Math Contest Finals. This contest attracts more than 3000 students to Altgeld Hall, coming from more than 200 schools across Illinois. Karen's task in ten of the last fifteen years was to oversee the logistics of this massive event.

FACULTY AND STAFF DEPARTMENT AWARDS

N. Tenney Peck Teaching Award in Mathematics



Kay Kirkpatrick (PhD 2007 UC Berkeley) is an effective and conscientious teacher both in and out of the classroom. Especially noteworthy is her work in mentoring students: she has advised four undergraduate research projects (resulting in several publications and awards); she advises two doctoral students (one in mathematics, one in physics) and four postdocs. On top of this, Kirkpatrick co-organizes the Sonia Kovalevsky Math Days

for Girls, and serves as the faculty mentor for the Illinois chapter of the Association for Women in Mathematics. She has been nominated in the past for the Illinois Student Senate Teaching Excellence Award.

Kirkpatrick is also active in outreach, having served for several summers as part of Stanford's summer math camp program for high school students; this has carried over into her work with Sonia Math Days. Funding from Kay's NSF CAREER grant has allowed the department to greatly increase the number of participants in the program. Kirkpatrick recently organized a special semester-long program at MSRI, which provided her the opportunity to recruit and mentor the best young people in her field.

Kirkpatrick has taught a broad spectrum of classes since arriving at Illinois in Fall 2011, including Differential Equations and Probability Theory at the undergraduate level, and Probability Theory I, II and Applied Stochastic Processes at the graduate level. Kirkpatrick fosters an atmosphere in which students pay attention and are engaged, and ask questions during class.

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



Ikemefuna Agbanusi (PhD 2013 Boston Univ) joined the department in 2013 as a J.L. Doob Research Assistant Professor. His research is in partial differential equations and general applied mathematics. At Illinois, Agbanusi has been teaching classes in Elementary Real Analysis, Ordinary Differential Equations, Partial Differential Equations, Dynamical Systems and Chaos, and Business Calculus. He is

an exceptionally gifted teacher, with outstanding student evaluations across the board. A nominator described his teaching style as "masterful," noting in particular the high level of interaction and communication he maintains with students in his classes.

Distinguished Teaching Award in Mathematics for Tenured Faculty



Richard Laugesen (PhD 1993 Washington University) joined the department in 1997. Rick is a deeply engaging instructor, and his teaching was recognized early in his tenure with a Campus Excellence in Undergraduate Teaching Award in 2003. Graduate students also admire his teaching: his 20 appearances on the List of Teachers Ranked as Excellent include 12 appearances for graduate classes.

Since taking over as Director of Graduate Studies in 2012, his recruiting and retention efforts have contributed to an increase in underrepresented minority student numbers, from 5 percent to 20 percent among U.S. doctoral students. He has played a key role in dropping the median time to degree from 6.4 years to 5.75 years. He meets individually with the department's 160 PhD students each year to monitor progress, determine goals, and offer guidance to help students stay on track. Laugesen has developed and implemented several advanced topics classes, as well as a professional development class "Preparing Future Mathematicians," which introduces graduate students to teaching issues, ethical and decision-making skills, and preparation for non-academic careers. Laugesen is also an Investigator on two major grants to improve graduate student education, one dedicated to increasing the number of underrepresented minorities in STEM, and the other preparing doctoral students in mathematics for careers outside academia through mini-courses in applied areas, networking with other scientific areas, and internships in industry and government.

Exceptional Merit Award in Mathematics for Non-Instructional Staff



Adrienne Harris has been with the department since 2014. She is a member of our Business Office and also serves as the lead staff member for the GEAR Network, which includes more than 200 researchers at over 80 locations worldwide. As a member of Business Office she played a crucial role in ensuring that the complicated renovations of both Coble Hall and 14 Illini Hall were completed in a timely fashion. For the GEAR

Network, Harris has improved several business procedures, has taken the lead in establishing new ones and has taken on the management of the GEAR program's online application system.

GRADUATE DEPARTMENT AWARDS

Bateman Prize in Number Theory

Nickolas Andersen is a fifth-year PhD student working with Professor Scott Ahlgren. His research involves coefficients of modular forms, which encode data for sophisticated problems in number theory and algebraic geometry. He has written twelve papers, and will graduate this summer, starting a postdoctoral position at UCLA in the Fall.

Kuo-Tsai Chen Prize

Seth Wolbert is a fifth-year graduate student studying symplectic geometry with Professor Eugene Lerman. Seth has authored two papers involving diffeologies, a type of mathematical structure co-developed by K.-T. Chen in the late 1970's.

The Chen Prize is named after Professor Kuo-Tsai Chen, a member of the Illinois faculty from 1967–1987 and an outstanding mathematician of international reputation for his contributions to the qualitative theory of ordinary differential equations and to algebraic topology.

Wolfgang Haken Prize in Geometry and Topology

Grace Work is a sixth-year PhD student working with Professor Jayadev Athreya on the dynamics of translation surfaces. She has also been a participant in the Illinois Geometry Lab from its inception in 2011, working as a project mentor and then research manager. In the Fall she will start a postdoctoral position at Vanderbilt University.

The Haken Prize is named after Professor Emeritus Wolfgang Haken, who was a member of the department from 1965 until his retirement in 1998, and a member of the Center for Advanced Study from 1993 to 1998. Haken is a renowned topologist, famous for his contributions to 3-manifold topology and the proof, together with Ken Appel, of the "Four Color Map Theorem." The prize is awarded to a mathematics PhD student for outstanding research in geometry and topology.

Irving Reiner Memorial Award

Anna Weigandt is a fourth-year PhD student in algebraic combinatorics. With her advisor, Professor Alexander Yong, she introduced the "prism tableau" model for Schubert polynomials. This summer, she will visit the Mathematical Sciences Research Institute for a graduate summer school on chip firing and tropical curves.

The Reiner Award is named for Professor Irving Reiner, a long-time member of our department who died in 1986. He was a leader in the field of integral representation theory. The award is given in recognition of outstanding scholastic achievement in the field of algebra.

Philippe Tondeur Dissertation Prize

Meghan Galiardi is a fifth-year PhD student working with Professor Lee DeVille on probabilistic models in evolutionary dynamics. Meghan did her undergraduate work at Stonehill College, Massachusetts, majoring in both mathematics and computer science. She recently accepted a full-time position at Sandia National Labs in Albuquerque, New Mexico, and will start there in July after graduation. As an avid runner, Meghan says she will enjoy exploring the outdoors of New Mexico.

Oliver Pechenik researches Schubert calculus and algebraic combinatorics with his advisor Professor Alexander Yong. His thesis focuses on the combinatorial structures underlying K-theoretic geometry of flag varieties. Oliver came to Illinois from Oberlin College. At Illinois, Oliver has been an Illinois Distinguished Fellow and a National Science Foundation Graduate Research Fellow. For the next four years, Oliver will hold postdoctoral positions at Rutgers University and the University of Michigan.

The Philippe Tondeur Dissertation Prize is being given for the first time in 2016 and was established to recognize students in their final year of the mathematics PhD program. This award is provided through the generosity of Professor Emeritus Philippe Tondeur and his wife, Dr. Claire-Lise Tondeur.

Brahana TA Instructional Award

Andrew McConvey is a fourth-year PhD student in combinatorics working under Professor Alexandr Kostochka. He has taught calculus and pre-calculus extensively, and is continuously looking for new ideas to improve his teaching. Andrew's favorite teaching styles focus on collaborative and group activities, and he enjoys having a lively classroom—although he admits that his semi-regular lectures on the importance of the "equals" sign sometimes have the opposite effect.

Cara Monical is a third-year PhD student studying algebraic combinatorics with Professor Alexander Yong. She received a BS in mathematics and computer science from Centre College in 2013, and at Illinois has received an outstanding rating on the List of Teachers Ranked as Excellent every semester she has taught. Her typical response to a student saying they are stuck on a problem is "have you thought about it?"—which often turns out to be enough of a hint!

Honors and Awards

Department TA Instructional Award

Caglar Uyanik is a fifth-year PhD student working with Professors Chris Leininger and Ilya Kapovich on topics at the intersection of geometric group theory, geometric topology, ergodic theory and dynamics. He has been on the List of Teachers Ranked as Excellent with an outstanding rating for every semester he has taught, and particularly enjoys teaching merit discussions and community outreach through the Illinois Geometry Lab.

Juan S. Villeta-García is a PhD student in algebraic topology working with Professor Randy McCarthy. He grew up in Puerto Rico, and studied at MIT, where he first fell in love with mathematics. At Illinois, he has taught calculus at various levels and formats, including technology-enhanced online learning. He has appeared on the List of Teachers Ranked as Excellent for all but one of his courses. He loves to crack jokes to his “captive” audience in the classroom.

Dr. Lois M. Lackner Mathematics Fellowship

The Dr. Lois M. Lackner Mathematics Fellowship was established by the department through a generous gift by U of I mathematics alumna Dr. Lois Lackner.

Neha Gupta is a sixth-year PhD student studying geometric group theory under the direction of Professor Ilya Kapovich. Her thesis addresses the problem of untangling closed curves on surfaces. Starting this Fall, Neha will be a Preceptor of Mathematics at Harvard University. Neha was born in Delhi, which is where she did her undergraduate studies. She then spent a year at Oxford getting her Master’s degree. At Illinois, she has also received a Master’s in the Teaching of Mathematics. When not doing mathematics, she is either reading fiction or dreaming about cricket—the best sport in the world!

Sarka Petrickova is a PhD student in combinatorics and graph theory. She grew up in the Czech Republic, and visited the University of Illinois for the REGS program in the summer of 2011, then started her PhD here in January 2012. She works under the direction of Professor József Balogh and focuses on graph coloring, Ramsey theory, and extremal combinatorics. During her spare time, she enjoys running, outdoor activities, and dancing.

Sarah Yeakel is a PhD student in homotopy theory, advised by Professor Randy McCarthy. Her thesis focuses on the calculus of functors, which describes a way to assign polynomial approximations to functors of spaces and spectra, with applications in K-theory and low dimensional topology. Her research both generalizes and streamlines existing papers on the subject. She has spoken on this research in seminars and conferences all over the U.S. and Europe.

State Farm Mathematics Doctoral Scholarship

The State Farm Mathematics Doctoral Scholarship is awarded to mathematics PhD students with research or career interests in actuarial science or financial mathematics.

Michael Livesay is a PhD student in partial differential equations working with Professors Lee DeVille and Vera Hur. In Fall 2015 he was part of an interdisciplinary team creating simulations and materials on financial problems for a new course in the Department of Industrial and Enterprise Systems Engineering at Illinois.

Andrew McConvey is a fourth-year PhD student in combinatorics working with Professor Alexandr Kostochka on structural properties of graphs. He and his collaborators recently strengthened a fifty year old result of Dirac and Erdős regarding disjoint cycles in a graph. In the summers, he works in the financial industry bringing advanced mathematical tools to bear on real-time market problems.

Vanessa Rivera-Quñones is a PhD student studying models in disease ecology under Professor Zoi Rapti. Vanessa obtained a minor in Finance as an undergraduate and has collaborated in a project for Standard & Poor’s as part of a Research in Industry program, and has interned at Santander Securities and investigated variable annuities with minimal benefits under the supervision of Professor Runhuan Feng.

Delcourt receives Graduate College’s Graduate Student Leadership Award

Michelle Delcourt received the 2016 Graduate Student Leadership Award given by the Graduate College. She is a PhD student in combinatorics working with Professor József Balogh. She obtained a BS in Discrete Mathematics from Georgia Tech before coming to the University of Illinois in 2011 as an NSF Graduate Research Fellow.

She has served in the University of Illinois Student Chapter of the Association for Women in Mathematics as Vice President (2012-2014), President (2014-2015), and Outreach Director (2015-present). In the Illinois Geometry Lab, she served as Associate Manager (2013-2014) and Outreach Manager (2014-Present). Michelle has organized three four-day Girls Engaged in Math and Science Workshops for middle school girls, six day-long Sonia Math Days for high school girls, over thirty field trips with local schools (reaching over a thousand participants), and five training sessions for local teachers. As part of her graduate studies, Michelle studied abroad in Hungary for six months. Her research accomplishments have earned her invitations to speak in research seminars, conferences, and workshops in the U.S., Canada, Hungary, Switzerland, Germany, and France.

UNDERGRADUATE DEPARTMENT AWARDS

H. Roy Brahana Prize

Boris Xu is a second-year math major who has already compiled a tremendous academic record. He has taken fourteen graduate math courses in the department. In addition, last summer, Xu studied algebraic geometry at the Park City Mathematics Institute and participated in a Research Experience for Undergraduates (REU) program at the University of Chicago in which he completed an original research project concerning the collection of all polynomials of a given degree with prescribed multiplicities of their roots. This summer, Boris intends to stay at Illinois to carry out research with University of Illinois faculty. Boris is also a 2016 winner of the prestigious Barry Goldwater Scholarship (see sidebar).

Established in 1961, the Brahana Prize is the department's longest running and most prestigious undergraduate award. It is named after H. Roy Brahana, a distinguished member of the mathematics faculty at Illinois from 1920 to 1963. The prize recognizes the student with "the most exceptional undergraduate mathematics career."

Most Outstanding Major Awards

These departmental awards recognize outstanding undergraduate students in each of the four majors offered by the department. A student may be selected only once in his/her career for one of these awards.

Most Outstanding Major in Actuarial Science

Yilin Zhou is a senior in our Actuarial Science Program. She will graduate with a double major in actuarial science and statistics and has a 4.0 GPA. Zhou has passed her FM and P professional exams, interned at SCOR Global Life Americas and won the Sam and Dubey Portnoy Memorial Scholarship in 2015. After graduation she will work on applying to graduate school and working on research, an internship or passing more actuarial science exams.

Most Outstanding Major in Mathematics

Yiming Peng is a graduating senior in mathematics with a minor in statistics. A recipient of an Elizabeth R. Bennett Scholarship in 2015, Yiming has maintained a perfect GPA while taking on a challenging course load that includes seven graduate courses in mathematics and statistics. He has been involved in multiple research projects in the areas of quantitative finance, applied probability, and stochastic modeling under Professors Runhuan Feng, Marius Junge, and Richard Sowers, and in an Illinois Geometry Lab project on polynomial complexity under Professor John D'Angelo and postdoc Ming Xiao. Starting in Fall 2016, Yiming will

Boris Xu wins prestigious Goldwater Scholarship

Boris Xu, a sophomore in Mathematics, has won a Barry M. Goldwater Scholarship for the 2016-2017 academic year. This premier undergraduate award was established by Congress to support aspiring researchers in science, mathematics, and engineering.

He is one of 252 students who have been selected from over 1,000 nominations by colleges and universities nationwide to receive this scholarship.

Boris is no stranger to receiving major awards: In 2015, he received the department's Salma Wanna Memorial Award, and this year he was chosen as recipient of the H. Roy Brahana Prize, the department's most prestigious undergraduate award.

Since his freshman year, he has taken mostly graduate courses, including upper level graduate courses and graduate reading courses. Last year, while still a freshman, he was accepted into the highly competitive University of Chicago Summer REU program, where he conducted research in algebraic geometry under Professor Benson Farb. At Illinois he has been involved in research and independent study projects with Professor Tom Nevins.

Boris plans to obtain a PhD and pursue an academic career, conducting research in geometry, topology, and number theory, and teaching at the university level.

be a PhD student in industrial engineering and management sciences at Northwestern University.

Most Outstanding Major in Mathematics and Computer Science

Ian Lee is a graduating senior in mathematics and computer science. He has a 3.97 GPA and is a Chancellor's Scholar. Ian served as a Mathematics Ambassador for two years. After graduation, Ian will start work as a Software Developer at Epic Systems Corporation in Madison, WI.

Most Outstanding Major in Teaching of Mathematics

Cameron Wieczorek is a senior in our Secondary Education Program with a double major in mathematics and statistics, with a 3.96 GPA. He completed his student teaching during the spring 2016 semester at Centennial High School in Champaign. Cameron received a Vincent O. Greene Scholarship in 2015. He is currently interviewing for jobs in the northern suburbs of Chicago.

Honors and Awards

Salma Wanna Memorial Award

A junior in mathematics, **Haidong Gong** has already taken not only all of the honors courses offered by the mathematics department, all with a grade A or better, he has also completed two graduate courses with great success. While his coursework alone is impressive, Haidong has also had success both with research and competitions in the department. He spent several semesters on a project on quantitative aspects of residual finiteness of free groups, mentored by Professor Ilya Kapovich. In this project he demonstrated not only a strong understanding of the theoretical material, he also carried out a great amount of programming for the project. He has also been the top performer in our math contests, with the potential of becoming the best in a generation by the time he graduates.

Elsie Thomas Fraser Scholarship

The Elsie Thomas Fraser Scholarship is awarded to a freshman demonstrating academic excellence in the Department of Mathematics.

Diana Kowalski is a freshman math major from Buffalo Grove, Illinois. She has a 4.0 GPA, earned an A in Honors Math 241 and took Math 347 during spring semester.

Gail V. Kellogg Scholarship

The Kellogg scholarship is made possible by Gail Kellogg, a University of Illinois alumna and a member of Mathematics Development Advisory Board.

John Haug is a sophomore in mathematics and was a student scholar in the Illinois Geometry Lab working on the Brownian motion and diffusion processes project during spring semester. He also received a Vincent O. Greene Scholarship in 2014.

Emily Mann Peck Scholarship

The Peck scholarship was established in honor of Emily Mann Peck, a former mathematics faculty member and LAS Associate Dean.

Yao Xiao is a junior with a double major in mathematics and economics and a minor in history. Yao has compiled an outstanding academic record across all three of these areas, and she has excelled in a research project at the Illinois Geometry Lab in calculus, geometry, and probability under Professor A.J. Hildebrand. Yao also has a keen interest in the law, she is a member of the University's Pre-Law Honors Society, and she serves as editor of the undergraduate law review journal at the University of Illinois. Outside the classroom, she has been involved in a variety of tutoring and volunteer activities. Following graduation in May 2017, she plans to enter a PhD program and pursue a career that combines her interests in mathematics, economics, and the law.

Dr. Lois M. Lackner Mathematics Scholarship

The Dr. Lois M. Lackner Mathematics Scholarship was established through a generous gift by Dr. Lois Lackner-Strong, a University of Illinois alumna with degrees in the teaching of mathematics and in education.

Sarah Allen is a first-year math major and James Scholar. She has a 4.0 GPA and has excelled in calculus. Due to her strong academic performance and commitment to the math major, she was chosen as a Merit Fellow beginning in Spring 2016. She is a member of the Actuarial Science Club. Outside of math, she is on the Illini Rowing Team, and plays the piano, finding time to play in a student-led musical during spring semester.

UI team receives honorable mention for Putnam competition

The 76th William Lowell Putnam Mathematical Competition, known as the "World's Toughest Math Test," took place December 5, 2015, with 4275 students from colleges from across the U.S. and Canada participating.

For the University of Illinois, the 2015 Putnam turned out to be the most successful such contest in a generation. Leading the twenty-four UI participants was Haidong Gong, a Junior in Mathematics, who placed 22nd among the 4275 participating students nationwide and was the only participant in the top 25 from a public institution. Haidong's rank is the highest Putnam rank by a UI student in nearly three decades.

The UI's performance in the team scoring category also was near record-shattering. The UI team, consisting of Haidong Gong, Zehan Chao and Yifei Li, received an honorable mention in the team competition, placing 9th among the

554 participating institutions. This is the highest UI Putnam team rank since the mid 1970s.

The breadth of individual performances turned in by UI participants was equally impressive: six of the 24 UI participants—Gong, Chao, and Li, along with Yewen Fan, Phillip Harris, and Qile Zhi—placed among the top 10% nationwide and made the "Top 500" list, a standard benchmark for excellence in performance on the Putnam. An additional nine UI participants placed among the top 25 percent.

The Putnam Competition is the annual highlight of the UI Math Contest Program whose activities include training sessions, several local math contests, and opportunities to participate in prestigious national and international competitions. This year's organizers were A.J. Hildebrand and Timur Oikhberg, with the assistance of graduate students Anton Bernshteyn and Hiram Golze, and undergraduate student Yifei Li.



Award recipients at the annual Department of Mathematics awards banquet held April 12, 2016 in the Illini Union.

Elizabeth R. Bennett Scholarship

The Bennett fund was established in 1974, a bequest from Elizabeth R. Bennett, who received her MS in 1908 and her PhD in 1910 in mathematics from the University of Illinois.

Qingci An is a sophomore with senior standing. She is a mathematics and computer science major with a 3.98 GPA. She has taken and excelled at honors upper level course such as Math 427 and has also taken graduate level courses such as Math 525.

Zhaodong Cai, a sophomore with senior standing, is a mathematics major with a 3.98 GPA. He has participated in several IGL projects concerning "Randomness in Number Theory" under the supervision of Professor A.J. Hildebrand, and has also excelled in math contest activities.

Yayu Zhou is a junior with a double major in mathematics and statistics. She has taken an impressive range of upper level classes in both areas and has a 3.98 GPA. She participated in an undergraduate research project involving an analysis of the predictions of college football games by columnists of the Daily Illini.

Yun Xie is a sophomore mathematics major with a perfect 4.0 GPA. He has taken several upper level honors courses and has also begun to take graduate math courses.

Illinois Mathematics Excellence Scholarship

Established by the department in 2012, the Illinois Mathematics Excellence Scholarship scholarship is designed to attract the best of the best of the incoming class to mathematics at the University of Illinois.

The 2016 recipients are **Andrew Kazenas** and **Aubrey Laskowski**, both freshmen in mathematics and computer science and Chancellor's Scholars. Andrew is a graduate of the Illinois Mathematics and Science Academy in Aurora, IL. Aubrey was a student scholar in a research project at the Illinois Geometry Lab in calculus, geometry, and probability led by Professor A.J. Hildebrand.

Vincent O. Greene Scholarship in Mathematics

The Greene Scholarship is given to undergraduate students based on academic merit, with a preference to students interested in teaching. Mr. Greene spent his career at the University, and provided this scholarship because of his lifelong interest in education.

Patrick Dong and **Jessica Veyette** are the 2015-2016 recipients of this scholarship. Patrick, a freshman in mathematics and computer Science, hails from San Jose, CA. Jessica Veyette, a freshman in mathematics, is a graduate of Oak Forest High School in Oak Forest, IL.

Bradley M. and Karen A. Smith Scholarship

This scholarship provides undergraduate scholarships to students in the UI Department of Mathematics who are studying actuarial science.

Elizabeth Wortman is a junior actuarial science major. She is also taking a minor in business and a minor in statistics. She is currently serving as the vice president of the Actuarial Science Club as well as an instructor for Math 370. She was a 2014 recipient of the Elizabeth R. Bennett Scholarship in Mathematics.

State Farm Actuarial Science Scholarship

The State Farm Actuarial Science Scholarships are awarded each year to ten first- and second-year actuarial students, based on the promise they show both in our program and in their future actuarial careers. The 2015-2016 recipients are first-year students **Adam Bruyere, Sarah Derango, Dominic Dillingham, Lucas Gliozzeris, and Andre Kohn**, who together have a median GPA above 3.8. Second-year student recipients are **Jacob Akstins, Justyna Czerniawski, Ameen Hemani, Gabrielle Kane, and Matthew Michelson**, with a median GPA above 3.75. Among these students, there are seven James Scholars and nine are members of the Actuarial Science Club.

Honors and Awards

Merit Fellows Program

The Merit Fellows Program, established in 2012, is a multidisciplinary program funded by the National Science Foundation, the Department of Chemistry, the Department of Mathematics, and the School of Integrative Biology. Students majoring in these fields are selected to be Merit Fellows their freshman year after a rigorous application process and interview. The program provides scholarship funds for some students as well as a variety of support such as mentoring, cohort-building activities, guidance in participation in undergraduate research, and general help in navigating these rigorous STEM majors.

The first mathematics Merit Fellow to graduate is **Christopher Formosa**. Chris graduated in May with a double major in mathematics and statistics. He was involved in the Illinois Geometry Lab for two semesters and presented both projects at the UI Undergraduate Research Symposium. He received the department's Elizabeth R. Bennett Scholarship in 2015. In addition to his accomplishments within the department, he has been a percussionist in multiple university bands, including the Illinois Wind Orchestra, is a member of Phi Eta Sigma Honor Society and participated in multiple student organizations. Chris will be working for Synchrony Financial in the data analytics track of their Business Leadership Program.

Undergraduate Math Contests

The University of Illinois Freshman Math Contest was held on September 26, 2015. The first place winner was Yunyi Zhang, a freshman in engineering physics. Shiliang Gao, a freshman in mathematics, placed second, and Yuchen Li, a freshman in computer engineering, placed third.

The University of Illinois Mock Putnam Exam, also held in September 2015, is a long-running local version of the Putnam Exam, a nationwide math contest for undergraduates. First place was won by Haidong Gong, a junior in mathematics (who also received the Salma Wanna this spring). Zehan Chao, a senior in mathematics, placed second, and Yewen Fan, a junior in mathematics and computer science, placed third.

Haidong has been dominating the local math contest scene since arriving here in Fall 2013. He has won nearly every local contest he entered, and he also achieved outstanding results in national competitions. At the 2015 Putnam Competition, Haidong placed 22nd nationwide and was the highest ranking participant from a public university.

The 2016 UI Undergraduate Math Contest was held in February. The winner was Yewen Fan, a junior in mathematics and computer science. Second Prize went to Phillip Harris, a sophomore in mathematics and computer science.

PDEs focus of MSRI program

Assistant Professor Kay Kirkpatrick is part of group of faculty who received Mathematical Sciences Research Institute (MSRI) funding for a research program "New Challenges in PDE: Deterministic Dynamics and Randomness in High and Infinite Dimensional Systems" held at MSRI during the fall 2015 semester. This was a semester-long program, including multiple seminar series. Other participants from the University of Illinois included Burak Erdogan, Vera Hur, Nikos Tzirakis, and Samantha Xu. In total there were over 100 participants from all over.

The organizers were Kay Kirkpatrick (University of Illinois at Urbana-Champaign), Yvan Martel (École Polytechnique), Jonathan Mattingly (Duke University), Andrea Nahmod (University of Massachusetts, Amherst), Pierre Raphael (Université Nice Sophia-Antipolis), Luc Rey-Bellet (University of Massachusetts, Amherst), Gigliola Staffilani (Massachusetts Institute of Technology), and Daniel Tataru (University of California, Berkeley).

The aim of this program was to bring together a group of mathematicians from the two overlapping communities of nonlinear dispersive equations and stochastic processes. There is a synergy between these communities with their different approaches to understanding some of the same underlying physical problems. In particular, this includes analyzing the dynamics of solutions arising from the flows generated by evolution differential equations, and analyzing the dynamical evolution of large physical systems.

In recent years there has been spectacular progress within both communities in the understanding of this common problem. The main efforts exercised, so far mostly in parallel, have generated an incredible number of deep results, that are not just beautiful mathematically, but are also important to understanding the complex natural phenomena around us. Hosting the program at MSRI was an effective venue to explore the specific questions at the core of the unifying theme and provided a focused and open exchange of ideas, connections and mathematical tools.

Students apply academics to real world problems in AXIS Challenge

The AXIS Research Center held a competition to develop models to predict the probability of security class action (SCA) lawsuits. Students from the Departments of Mathematics and Statistics were invited to participate. The results of the competition were to be used to improve a model AXIS was developing internally.

Students were given company financials and SCA data and formed four person teams. Twelve teams worked on the challenge during the fall semester. The AXIS Research Center held bi-weekly meetings to answer student questions and assist them working with the data. Students were asked to submit their code and a report on Nov 30, 2015. Three teams were then chosen to present their results.

Presentations were held in December at the AXIS Research Center in the University of Illinois Research Park. AXIS Insurance—Chief Actuary North America, Brian Kemp; Vice President Actuary II, Evan Glisson; Assistant Vice President Actuary, Uri Korn; Director of the AXIS Research Center, David Hays and Technical Analyst, Spencer Guerrero attended the presentations in person. Also attending presentations were Department of Mathematics Chair Matthew Ando, Statistics Department Head Doug Simpson, Actuarial Science Professor Rick Gorvett and Statistics Professor Darren Glosemeyer.

The presentations provided the students with the opportunity to support their work in front of industry experts and to interactively discuss their work and the AXIS Student Challenge in general. The AXIS Challenge also gave students the experience of applying their academic learning to a real world business problem and gave them the opportunity to have an impact on a model actually used in insurance.

The three finalist teams received a monetary award. Winning team member Anna Mitchell had this to say about the competition:

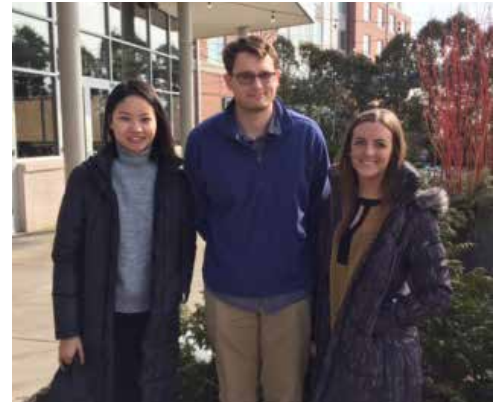
“The AXIS Student Challenge provided me with a hands-on actuarial experience that I am thankful to have been included in. The knowledge I gained while collaborating with the team at the AXIS Research Center helped me learn and apply new material to a much higher degree than any book could offer.”

Uri Korn who was primarily responsible for developing AXIS’s internal model was impressed with the results of the competition.

“The AXIS Student Challenge gave me several more pairs of eyes on the data and the project. One of the teams discovered a problem with the data that was previously missed and overall the challenge helped make the final model more robust. My model was relying primarily on market capitalization while the first place team’s model relied primarily on revenue. I was able to incorporate some of their variables into my final model. I was also very interested by the second place team’s use of the random forest technique.”

“The AXIS Student Challenge was a great opportunity for students to develop some of the skills they’ll need in the private sector, such as working with a team, communicating with a customer, and adapting their creativity, knowledge, and skills to the problem the customer brings to the table,” says Mathematics Department Chair Matthew Ando. “It was also an opportunity for the students to stretch themselves and see what they are capable of. AXIS’s support for the Student Challenge was great: they not only provided a problem, data, and prizes, they also provided on-going feedback and support on the substance of the work.”

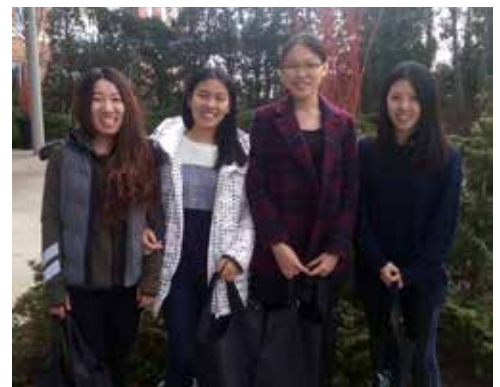
Congratulations to the Axis Student Challenge winning teams!



First Place: Yiwen Yin, Michael Rafferty, Anna Mitchell, Brad Sevcik (not pictured)



Second Place: Xiongfei Ding (not pictured), Xinlu Tu, (Sidney) Man Zhu, Yuhe Zhu



Third Place: He Jiang, Xinye Li, Zhen Qin, Chun Zhai

AXIS Capital is a Bermuda-based global provider of specialty lines insurance and treaty reinsurance with locations in Bermuda, the United States, Europe, Singapore, Canada, and Latin America. The AXIS operating subsidiaries have been assigned a rating of A+ by Standard and Poors and A+ by A.M. Best.

IGL under new leadership



The 2015-2016 academic year brings a new leadership team to the Illinois Geometry Lab (IGL). The new Director of the IGL is Jeremy Tyson and the new IGL Assistant Director is Rosemary Guzman.

Tyson (PhD 1999 Michigan), a Professor in the Department of Mathematics, has been a faculty member at the University of Illinois since 2002. His research focuses on analysis and geometry in nonsmooth metric spaces.

Guzman (PhD 2011 UIC) joined the department in 2015 following a postdoctoral position at the University of Iowa. Her research interests are in topology and low-dimensional geometry, specifically, hyperbolic 3-manifolds.

Tyson and Guzman have also been assisted during the current year by a number of graduate students holding leadership positions. Bill Karr manages the IGL's research program, while Michelle Delcourt, Claire Merriman and Melinda Lanius coordinate the IGL's numerous outreach and community engagement activities.

Pictured above: Rosemary Guzman, Assistant Director (left) and Jeremy Tyson, Director of Illinois Geometry Lab.

Illini Success results released



Thanks to a major campus undertaking, the University of Illinois and College of Liberal Arts & Sciences know a little more about one of its most important groups of people—its new graduates. The Illini Success initiative, which surveys new bachelor's degree recipients on their post-graduation plans, provides valuable insights into the career path of new graduates.

Career data has important implications, from addressing the questions and concerns of prospective students to answering accreditors who are measuring institutional quality. Federal and state governments are asking for more information about the value of a college education, and making comparisons that can potentially be tied to funding of higher education institutions.

The Career Center, with the help of all undergraduate colleges and numerous other units across campus, drove the effort, which, through a combination of surveys, employer and college reports, and LinkedIn data, obtained verifiable information on the early career track of more than 5,700 bachelor's degree recipients in the class of 2014-15. That number represents 74 percent of the total number of bachelor's degree recipients at Illinois over that time period.

In the College of LAS, information was obtained for 2,185 bachelor's degree recipients, or 71 percent of the college total. That data revealed that 77 percent of LAS alumni in the class of 2014-15 who participated in the study had secured a "first destination," which includes employment, continuing education, military service, or volunteer work. Full results of the study can be found at illinisuccess.illinois.edu.

Join us for Homecoming 2016



Mark your calendars for Homecoming 2016 on Saturday, October 29, 2016, when the Illini match up against Minnesota. The Mathematics homecoming party will be from 2-4 pm. Our tent will be out in front of Altgeld Hall again this year.

More information is posted at www.math.illinois.edu/homecoming/ or visit us on Facebook. We invite all mathematics alumni to join us for a complimentary buffet lunch.

Center for Advanced Study appointments

Each year University of Illinois faculty are invited to submit scholarly or creative proposals for consideration by the Center for Advanced Study (CAS) permanent Professors. Faculty members with winning proposals are appointed Associates and Fellows and awarded one semester of release time to pursue their projects in the coming academic year. These appointments provide an incentive to pursue the highest level of scholarly achievement and an opportunity to explore new ideas.

Professor **József Balogh** has been appointed a 2016-17 Associate in CAS. Balogh (PhD 2001 Univ of Memphis) joined the department in 2005. With a suitably defined notion of containment, the container theorem states that there exists a small collection of vertex subsets (containers) in an r -uniform hypergraph such that every independent set of the hypergraph is contained within a subset in the collection, with no subset in the collection inducing too many edges. He plans to spend time at Cambridge, UK, to further explore this theory by collaborating with local researchers. This theorem has led to new proofs of several classical results in graph theory and number theory, lower bounds on the list chromatic number of hypergraphs, a proof of the conjecture of Kohayakawa, Luczak and Rodl, and has become an important tool for obtaining additional results in these and other areas, such as probabilistic combinatorics. Balogh, jointly with Morris and Samotij, published their work in the article, "Independent Sets in Hypergraphs," in *Journal of the American Mathematical Society* 28 (2015).

Associate Professor **Chris Leininger** has been appointed a 2016-17 Associate in CAS. Leininger (PhD 2002 Univ of Texas Austin) joined the department in 2005. His research is in geometric group theory, a branch of pure mathematics that studies symmetries of spaces, interpreted very broadly, through the use of geometry. In his work, the symmetries involved arise from geometric considerations, especially through surfaces, like the surface of a doughnut, and from graphs. Thus geometry enters as both the source of the symmetries, as well as a tool for studying the group of symmetries. In the Fall 2016, the Mathematical Sciences Research Institute will host a semester program on geometric group theory, and Leininger will participate in a substantial portion of the activities.

The "mapping class group of a surface" and the "outer automorphism group of a free group" are the symmetry groups where most of Leininger's research takes place. Specific projects include the following: 1) continuing the study of the notion of "convex cocompactness" in the mapping class group. With Kent, Bestvina, and Bromberg, Leininger will look for simpler ways of describing this concept with the hopes that it will shed light on a long standing open problem of Gromov. 2) With Margalit, he will continue to study how long-term behavior of iteration of symmetries of surfaces is reflected in associated 3-dimensional spaces. 3) He will continue his work with Dowdall and Kapovich on "free-by-cyclic groups," building analogies between the theory developed for surfaces and the more mysterious theory for graphs.

Fuchs awarded Sloan Fellowship

Elena Fuchs has received a 2016 Sloan Research Fellowship from the Alfred P. Sloan Foundation. Chosen by senior scholars who select awardees from nominated candidates based on research accomplishments, creativity and leadership potential in the candidate's field, Fuchs is one of only five faculty at the University of Illinois to receive a Sloan Fellowship this year.



An assistant professor in the Department of Mathematics since 2014, Fuchs (PhD 2010 Princeton) work uses a combination of arithmetic and geometry to prove new number theoretic results about so-called thin groups such as the Apollonian group, central to the study of Apollonian circle packings. She also studies thin groups outside of the number theoretic setting, for example, proving that groups are generic in a natural sense.

Hur named Simons Fellow

Vera Mikyoung Hur has been named a 2016 Simons Fellow in Mathematics. The Simons Foundation's mission is to advance the frontiers of research in mathematics and the basic sciences by providing funding that allows faculty to take up to a semester-long research leave from classroom teaching and administrative obligations.



Hur (PhD 2006 Brown Univ) joined the Department of Mathematics in 2009. She is an associate professor in mathematics and a faculty affiliate of the Computational Science and Engineering program. She received an Alfred P. Sloan Research Fellowship in 2012, an NSF CAREER Award in 2014, and was a Beckman Fellow of the Center for Advanced Study in 2014-2015.

Her research interests are in analysis (pure and applied) and partial differential equations. Currently, she focuses on surface water waves and free boundary problems arising in fluid mechanics, geophysics and materials.

News from NetMath

Growth in Partner High School (PHS) program: NetMath welcomes a number of new high schools from Illinois, Texas and China into our Partner High School Program (PHS). Among our new additions are Tianjin Foreign Language School in China, West Lake HS in Texas, and Barrington HS, Crystal Lake Central HS, Crystal Lake North HS, Naperville Central HS, Naperville North HS, Cary-Grove Community HS, and Prairie Ridge HS in Illinois. A cohort of eight students from Tianjin FLS are progressing through our Calculus III course, preliminary to a larger suite of courses being offered later in the year to this and other institutions in that school system. Most schools in the PHS program currently offer Calculus III but some of our new schools plan to incorporate Calculus I & II and also a differential equations course into their suite of NetMath course offerings. Thanks to Joe Nance, our Coordinator of High School Programs, for his hard work in recruiting these schools.

New Mentor Promotion Path capping off professional development program: Mentors are a long-standing, vital component of the NetMath instructional team. In our academic year term courses, mentors are assigned to each new student at the start of a course and they work with the student by grading homework assignments, answering questions and helping the student finish their course on time. Mentors are charged with maintaining communication with students, motivating them, adding a personal touch with the University and acting in a peer role. In order to help our mentors develop professional skills during their time with NetMath we have added a new promotional path with a professional development component. The new program includes regular performance reviews and professional development workshops with associated pay raises. Each workshop explores relevant topics

to mentors, such as how to avoid procrastination, learning to motivate themselves and others, developing leadership skills, and so on. Thanks to our instructional and advising specialist, Zac Schoenrock, for his continued efforts in creating and maintaining this program.

REGS winners for 2016: NetMath offers 8-week Research Experiences for Graduate Students (REGS) summer support to qualifying graduate students on a competitive basis. These awards are available to both U.S. and international students and require at least three semesters of TA appointments with NetMath. Congratulations to the recipients of NetMath REGS awards for 2016: Sneha Chaubey, Euijin Hong, Andrew Hunte, and Michael Oyengo.

Electronic grading for NetMath exams: As the Partner High School program grows, our instructional resources are stretched at times with grading hundreds of handwritten exams that must be dealt with in a short period of time. NetMath is making great strides in improving exam handling by experimenting with an electronic exam grading system called Gradescope that allows us to tackle this task quickly and efficiently.

NetMath investment in Department of Mathematics: NetMath continues to invest in the needs of the mathematics department by supporting a growing number of mathematics graduate students as teaching assistants each semester. This summer approximately eleven mathematics graduate students will receive NetMath TA support. NetMath will also partner with the Illinois Geometry Lab to create new research opportunities for undergraduate students this summer.

Summer Illinois Math Camp: sun, fun and mathematics for teens

Summer Illinois Math (SIM) Camp is a free, week-long math day camp for middle and high school students hosted by the University of Illinois at Urbana-Champaign Department of Mathematics. Campers will see the creative, discovery driven side of mathematics. By showing them some of the ways mathematicians approach problems, SIM Camp hopes to encourage middle and high school students to continue studying math beyond the high school level.

SIM Camp Epsilon (July 18-22, 2016) is for rising 8th or 9th grade students who will begin geometry or algebra in the fall. Students will explore possible shapes of a two dimensional universe, with a strong focus on the topology of the torus, sphere, and Klein bottle, and they will learn how to write and read secret messages using modular arithmetic or “clock math” and the Vigenère square algorithm.

SIM Camp Delta (July 25-29, 2016) is for rising 9th through 12th grade students who have taken at least a year of algebra. Students will imagine living in hyperbolic or spherical space, discovering for themselves the challenges presented by these unfamiliar geometries, and they will use mathematics to create “models” to describe how systems in biology and social sciences behave over time.



Learn more about SIM Camp at <http://math.illinois.edu/SIM/>.

Nickolas Andersen

by Jim Dey

Nick Andersen jokes that it's a good thing that he likes mathematics because "it's the only thing I can do."

If that's so—a big if—Andersen's affinity for math reflects both his academic ability in and aesthetic appreciation of his field of study. "It's beautiful," said the 28-year-old Andersen. "You can compare it to art."

A doctoral student, the California native is in his final year of study at the University of Illinois. He came to Champaign-Urbana from Brigham Young University in Utah, where he majored in math and minored in physics.

It was at BYU that Andersen decided he "wanted to be a professor and teach and do research."

He'll fulfill that professional goal in fall 2016, when he's scheduled to start a three-year postdoctoral position at the University of California in Los Angeles.

As if often the case for students, Andersen's interest in math was inspired by a high school teacher whose enthusiasm he found infectious. "I had a teacher who was really awesome," said Andersen.

His concentration is on number theory. That's the study of integers, especially prime numbers. Andersen noted that German mathematician Johann Carl Friedrich Gauss called it the "queen of mathematics" because of its foundational role in the discipline. He describes it as "one of the most beautiful fields of mathematics" and said its practical value can be found in cryptography, the writing of codes.

"When you're buying something at Amazon, your computer and the servers at Amazon are doing number theory. That's the reason your credit card number is secure," he said.

Andersen said he's fascinated with math because it requires him to "look at things in many different ways."

"Math problems have multiple solutions," he said. "The goal is to come up with beautiful, elegant simple solutions."

A native of Laguna Niguel, Calif., Andersen acknowledged that "Illinois weather is not for me." Despite the snow and cold, he said his experience at the UI has been all he could have hoped for.

"I've really loved it here," he said. "My advisor (Scott Ahlgren) has been a good fit. We've done some good, collaborative



Nick Andersen (PhD Mathematics 2016); will be an Assistant Adjunct Professor at UCLA starting this fall.

papers together. I've had some great experiences teaching. I think it's easy to like a place where you've been successful.

Besides winning academic awards, including the 2016 Bateman Prize in Number Theory, Andersen has received multiple honors for his classroom interactions with students including the 2016 Campus and LAS Awards for Excellence in Undergraduate Teaching by Graduate Teaching Assistants.

He said one key to being a good teacher is "putting yourself in their shoes" and remembering that students can find mathematics frustrating.

"Just because you understand it doesn't mean it's not hard for them," he said.

Andersen is the oldest of three boys. His father, Doug, is a carpenter, and his mother, Kelly, is a homemaker.

Along with his mathematics background, Andersen also has had the unusual experience of going on a two-year, religious mission after his freshman year at BYU, a Mormon school. He said he worked all over Montana.

"You're just teaching people about God. I also did service work. I actually helped a guy build his house," he said. "I loved it. The highs were high, and the lows were low."

These days, Andersen has different kinds of demands on his free time. He and his wife, Emily, who graduated from BYU in biology, are the parents of a 2-year-old boy, Logan, and they are expecting a daughter in June.

He jokes that Logan "doesn't quite get calculus" yet but soaks up all kinds of information every day.

"You can tell children really enjoy learning. When you're part of that, it's fun," Andersen said. "We read a ton of books. We're into Legos. He's super into train sets."

As for his personal interests, Andersen said he enjoys computer programming, hiking and reading, particularly science fiction.

"I spend a lot of time in my head," he said. It all adds up to a busy life that just keeps getting busier.

"I have to finish my thesis, move, have a child. There are many things going on," Andersen said.

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

Teaching always at center of the big picture

George Francis retires after 48 years

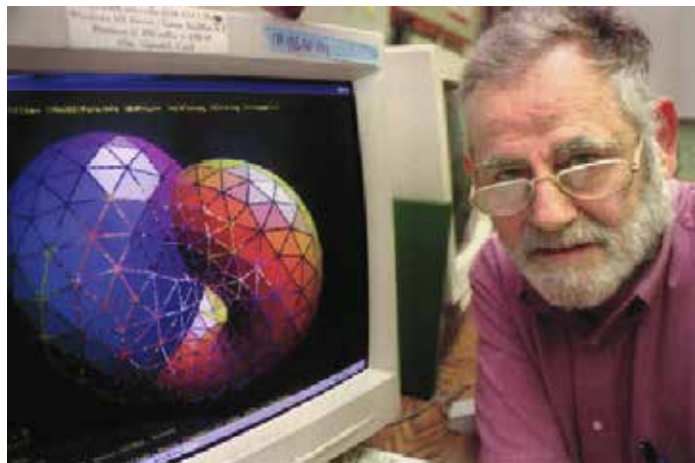
George Francis is a professor of Mathematics, and a member of the Campus Honors Program, the Beckman Institute for Advanced Science and Technology, and a senior research scientist at the National Center for Supercomputing Applications. He studied at Notre Dame (BSmcl 1958), Harvard (AM 1960), and Michigan (PhD 1967). He was a Woodrow Wilson Fellow at Notre Dame (1959), a Harvard graduate fellow (1960), a Lloyd Postdoctoral Fellow at Michigan (1967), and received an Amoco Award for Innovation in Undergraduate Instruction (1994) at Illinois. His "Topological Picturebook" (Springer Verlag 1987) has been republished in Russia, Japan and China, and is still in print as a Springer (2006) paperback.

His research in pedagogical innovations and illustrations in descriptive topology, numerical geometry, geometrical computer graphics, visual mathematics, low dimensional geometry, topology and group theory, dynamical systems, catastrophe and control theory, statistics, psychology, the history of the calculus and teacher education in science and mathematics, are contained in some four dozen papers and reports.

Together with his illiMath Collective (a collaboration with students and colleagues), Francis produced numerous videos and CAVE presentations beginning with the Interactive Image (1987-88) at the Chicago Museum of Science and Industry, continuing through the nineties at SIGGRAPH and Supercomputing conferences, and at the International Congress of Mathematicians (1998), and culminating with the Calcul*rt (2005-2008) exhibit at the Krannert Art Museum and the Denmos Museum Center, Traverse City, Michigan, which he co-curated with Hank Kaczmariski of the Illinois Simulator Lab. He was co-PI with Donna Cox for the donation by Silicon Graphics of the Renaissance Experimental Laboratory to the NCSA (1987). There he taught graduate and undergraduate courses until it closed.

In the Department of Mathematics, his home since 1968, summer NSF grants enabled his papers, conference travel, and networking. He collaborated with Felix Albrecht in control theory, Bob Bohrer in statistics, as well as with his colleagues in the Geometry and Topology group.

With Jerry Uhl, he developed undergraduate courses in History of the Calculus, Real Analysis and Linear Algebra for future teachers of Illinois. The security of tenure permitted him to greatly spread out his interest. He learned mathematical illustration in our superb math library, and applied this art to



Professor George Francis.

expositions in mathematical biology with Carl Woese, and to chaotic dynamical systems with Atlee Jackson from physics. He used a semester in the Study in a Second Discipline program in the School of Art and Design to draw the illustrations for his book and for numerous math papers by friends.

With Graham Evans, Peter Braunfeld, and Larry Dornhoff he developed and taught computer-based courses for in-service and pre-service math teachers in the UIMATH Apple Lab (1983-2015). Later he developed online and blended, computer-based versions of his Post-Euclidean geometry course. Since 1990 his "Hypergraphics" freshman seminar in the Campus Honors Program lived in 102 Altgeld Hall, as well as at the Beckman and Illinois Simulator Lab (ISL). During the summers, the lab hosted Eisenhower Grant in-service teacher institutes, and NSF-sponsored Research Experiences for Undergraduates (REUs). In the final years of the lab, Jayadev Athreya's Illinois Geometry Lab (IGL) shared the space.

Francis also served the department on the Executive Committee, the Promotion and Tenure Committee, and many years on the Computer Committee. In the university, he represented the mathematics department in the Academic Senate and the University Senates Conference. As interim director of Netmath he played a crucial role in modernizing our online program and he was the unofficial curator of the Altgeld mathematics model collection.



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Sonia Math Day: Games on Surfaces

This spring, the University of Illinois Student Chapter of the Association for Women in Mathematics (AWM) held its sixth Sonia Math Day for high school girls (8th-12th grade). Michelle Delcourt, Outreach Director for the local chapter of AWM and PhD student in the department, organized the event. This year the AWM chapter provided fun activities, lunches, shirts, and mathematical prizes with the theme “Games on Surfaces.” Lessons focused on various aspects of topology. In the morning Neha Gupta incorporated research from an Illinois Geometry Lab group project with Ilya Kapovich into a hands-on activity “untangling headphones on surfaces” with yarn and modeling clay. Juan Villeta-Garcia demonstrated properties of “non-orientable surfaces” and the girls explored Möbius strips using fruit by the foot. In the afternoon, Melinda Lanius taught a lesson on “games on surfaces” with a game of “Sonia Says” played on tori.

Sonia Math Day activities are made possible from a Public Engagement Grant through the Office of Public Engagement as well as financial support from the Department of Mathematics at the University of Illinois at Urbana-Champaign.

Photos at left from the top: 1) Rosemary Guzman and participants study non-orientable surfaces. 2) The girls learn to visualize different surfaces by playing “Sonia Says.” 3) Mark Bell and Juan Villeta-Garcia explore curves on surfaces with participants Polina Bondarenko and Pranali Vani. Photos by Vanessa Rivera Quiñones.