FALL 2016

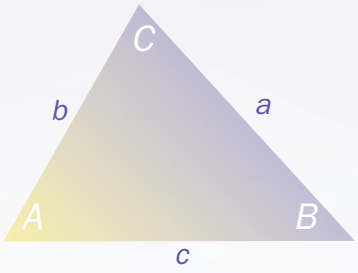
THE Common Denominator

UCLA DEPARTMENT OF MATHEMATICS NEWSLETTER

TENTH ANNIVERSARY ISSUE

UCLA Women in Math

The first documented accounts of a woman's contributions to the field of mathematics appear in descriptions of Theano during the 6th century, BC. A pupil, wife or daughter of Pythagoras, depending on the account, Theano reportedly wrote mathematical treatises and administered the Pythagorean School after the death of its founder.



$c^2 = a^2 + b^2 - 2ab \cos C$

Women's presence in academic mathematics is documented in the Enlightenment period. Of particular note is Elena Piscopia, who was born into a noble Venetian family in 1646. She is considered to be the first woman in the world to receive a doctorate of philosophy degree. In addition to languages and the arts, she was an avid student of the sciences, including mathematics. A century later, in 1748, mathematics prodigy Maria Gaetana Agnesi published an important work, *Analytical Institutions*, dealing with differential and integral calculus. This accomplishment, among others, is particularly notable because of her short career in mathematics, by her own choice.

In the 19th century, women began to emerge as public figures. Florence Nightingale famously revolutionized healthcare, and in doing so, introduced the idea that social phenomena could be objectively measured and subjected to mathematical analysis. She developed the polar-area diagram to dramatize the needless deaths caused by unsanitary conditions in hospitals.

During the first 30 years of the 20th century, an estimated two dozen American women received their PhDs in mathematics. As the century unfolded, the number of doctorates slowly increased; however, women mathematicians were often isolated, and once admitted to academia, had few good job opportunities, irrespective of their qualifications. Princeton did not start admitting women to its graduate program in math until the fall of 1968.

To address issues of opportunity and equality, the Association for Women in Mathematics (AWM) was founded in 1971, and today it is an international organization with 3,000 members. One of its goals is to encourage girls to study math and another is to support women mathematicians in their pursuit of active careers. The UCLA Department of Mathematics will proudly host the 2017 AWM Research Symposium in the spring.

The nascent years of the 21st century hold much promise for American women in mathematics as opportunities and support grow. According to the NSF, over 40 percent of bachelor's degrees in mathematics went to women in 2012, and according to the Council of Graduate Schools, almost 30 percent of 2014 PhD graduates in mathematics and computer science were women. By their hard work, perseverance and talent, the following UCLA women in math are helping to prepare the path for the next generation of mathematicians.

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INSIDE

UCLA

Association for Women in Mathematics Research Symposium 2017

The AWM Research Symposium 2017 will be held at the University of California Los Angeles April 8 -9, 2017. The symposium will showcase the research of women in the mathematical professions. It will feature four plenary talks, special sessions on a broad range of research in pure and applied mathematics, and poster sessions for graduate students and recent PhDs. Eight of the special sessions will be organized by ResearchNetworks and supported by the NSF AWM ADVANCE grant.

UCLA Women in Math

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Andrea Bertozzi

UCLA Professor of Mathematics

Chair, Betsy Wood Knapp Chair for Innovation and Creativity
Director of Applied Mathematics
PhD Princeton University, 1991

Andrea came to UCLA in 2003 following a distinguished career at Princeton University. Her applied research projects, together with her enthusiasm and outreach, contribute to society in immediate and significant ways, raising the prominence of math in the academic community and beyond.

Currently, Andrea is working on an associated project in crime modeling, funded by the National Institute of Justice, in collaboration with UCLA Professor of Anthropology Jeffrey Brantingham. The UCLA team is working with the Los Angeles Police Department to study raw data from body cameras. Andrea explains, "We are using statistical analysis, looking at officers' day-to-day routines – how patrols are conducted and how criminals are apprehended. We are also looking at activities around gang crimes." One of the purposes of the project is to identify patterns that may improve community policing. Another is to find ways of processing huge terabytes of information generated by body cameras, of which only a fraction may be of value. Andrea points out that this project is important for the UCLA applied math teaching program because as new research, it has problems for students working at different points in their studies, from mid-level undergrads to postdocs.

Another area of study involves a particle-laden flow project, which has an industrial application called a spiral separator that is used in the mining industry. Built like a theme park water slide, the spiral separator processes slurry flows containing two different types of particles. The goal was to develop a theory to separate the particles, which Andrea believes her team has accomplished. The next step is to separate three types of particles, which poses substantially more challenges.

Social media presents an interesting challenge for mathematicians, and Andrea's project in topic modeling via Twitter is one of them. Her team is identifying and analyzing tweets based on topic and location. Says Andrea, "It's a good project for undergrads as it's based on linear algebra. In summer 2015, we studied tweets on shopping and sports coming from Madrid, Spain. In a prior summer, we analyzed tweets from Los Angeles. It's a data fusion problem, trying to meld different types of information." The data analysis is driven by a topic, and within this topic, words relating to a theme are identified, along with a subset of tweets. This research carries a broad range of applications from marketing to city planning to intelligence gathering.

Much of Andrea's research is conducted with a large cadre of student researchers, from undergraduates to postdocs, and a significant component of this effort has been the NSF Research Experiences for Undergraduates (REU). Andrea and colleagues from local colleges and universities developed the UCLA math REU program a decade ago, admitting a handful of students. Now in its final year of NSF funding, it is a million-dollar program that has served over 300 students from universities across the country.

Says Andrea, "Not all of our projects lead to papers, but what is more important is that the students are immersed in an environment where that is the goal. This adds value to their education and provides a platform for academic growth."

Luminita Vese

UCLA Professor of Mathematics

PhD Université Nice Sophia Antipolis, 1997

Luminita's research career was set in motion by a woman mathematician at the Université Pierre et Marie Curie, who obtained support from the EU to recruit students from Romania. Luminita was among these students, earning a doctorate in applied math. She first came to UCLA as a postdoctoral scholar. Following that appointment, she was recruited as a C.A.M. postdoc and then to a faculty position and has since made her home at UCLA.

In graduate school, Luminita's research focus on image processing, traditionally an engineering field, led her to Stan Osher, whose work in this area greatly influenced her. Luminita is now an expert in image restoration and segmentation – removing artifacts like noise and blur and clarifying the boundaries of objects. Her work is particularly important for medical applications, especially as they relate to anatomy. She views image processing as a basic tool for reconstructing the relative order, geometry, topology patterns and dynamics of three-dimensional (3-D) images from two-dimensional slices.

Her approach to image restoration involves a variational PDE (partial differential equations) method, using techniques developed at UCLA. The ingredients of this approach include image modeling as an inverse problem solved by energy minimization and regularization. She explains, "We propose an energy that we minimize to solve the particular application we have in mind. We obtain a nonlinear PDE that does not have explicit solutions, which we have to solve by finding a numerical solution. For this, we write a computer program, then input the noisy image and output a clean image."

Luminita and Stan have developed many new techniques for image decomposition into cartoon and texture using total variation minimization (introduced in image processing by Stan and collaborators) and dual spaces of distributions. She also collaborates with John Garnett on extensions of this topic with support from an NSF grant.

In addition to research and teaching, Luminita has participated as a trainer for the UCLA team in the Mathematical Contest in Modeling, an annual international competition that serves applied math in the same way as the Putnam competition serves pure math. She has also participated as a mentor in IPAM's Research for Industrial Problems for Students (RIPS), a summer program that provides an opportunity for tal-

UCLA Distinguished Women in Math Lecture Series

Established in 2015, this program brings notable women mathematicians to UCLA to lecture about their research and to meet and mentor women graduate students and postdocs. During its inaugural year, the series hosted three speakers: Georgia Benkart (Walking on Graphs), Raman Parimala (Quadratic Forms Over Function Fields), and Ingrid Daubechies (The Monty Hall Problem).

ented undergraduate students to work in teams on real world research projects proposed by sponsors from industry and the public sector. Luminita is one of the organizers for the upcoming Association for Women in Mathematics (AWM) 2017 symposium that will be hosted by the UCLA Department of Mathematics.

Monica Visan

UCLA Professor of Mathematics

PhD University of California Los Angeles, 2006

Monica's interest in math dates from elementary school in Europe. She remembers, "I joined the Olympiads – most students were encouraged to participate – and they organized mini-math contests, which were fun. As we progressed, it became more competitive, and then only the most intent students, like me, stayed." Following her doctorate at UCLA in pure math, a postdoctoral appointment at Princeton, and a brief stay at the University of Chicago, Monica returned to UCLA in a faculty position in 2009.

Upon entering graduate school, Monica intended to focus on operator algebras but became fascinated with partial differential equations (PDEs) and harmonic analysis while working with her advisor, Terry Tao, who has famously demonstrated, through his own research, the importance of PDEs in explaining how the universe behaves.

Currently, Monica's research is focused on dispersive PDEs, which model many different physical phenomena, including light traveling in linear and nonlinear media, Bose-Einstein condensates, relativistic electrons, ferromagnets and water waves. Solutions to these equations exhibit a wide array of behaviors, ranging from global-in-time solutions that decay in the distant future/past, to solutions (non-decaying solutions that maintain their profiles) that blow up in finite time by accumulating a positive fraction of their mass/energy at a single point. The qualitative and quantitative analysis of such solutions has blossomed in recent years, benefitting from the introduction of powerful tools from harmonic analysis.

Because PDEs is such a huge field, Monica continually finds new topics and problems that lead her into new areas, and the grants follow her research path. In 2015, she expanded her interests to dispersive PDEs with random initial data, taking a sabbatical from UCLA to accept a semester-long research professorship at MSRI in Berkeley, followed by a three-month research program at the Institut des Hautes Études Scientifiques in Paris.

Inwon Kim

UCLA Professor of Mathematics

PhD University of Texas at Austin, 2002

Inwon was born in Hawaii but spent the first part of her life in South Korea, including undergraduate school, where she majored in math under some duress from her family who wanted her to be more practical. She says, "I always enjoyed thinking about math problems but did not believe it would lead to anything profitable. After entering college, I realized it could be a career." She returned to the United States for her doctorate, and following postdoctoral training at MIT, accepted a faculty position in the Department.

Her research in partial differential equations (PDEs) involves free boundary problems. She says, "I try to answer basic questions in physics, describing or explaining moving sets in situations where you cannot tell how the area you are studying might move under different conditions." She gives the example of movie-goers trying to exit a theater in a fire. "Engineers want to study how this interface between people and space during a jam might behave in order to build a theater that provides the greatest safety."

Inwon points out that math is very useful in the sciences when experiments cannot be conducted, for instance, when dealing with nanoscale. As well, she uses math to estimate how an event might turn out when there is such low probability that it is not realistic to employ laboratory resources for experimentation.

"I get to use a lot of tools and concepts from geometry and analysis, so it makes the work quite rich. It's fun to focus on a problem with all of these elements. The best possible outcome would be if you can explain something that the engineers, designers and physicists haven't been able to do."

Paige Greene

UCLA Assistant Adjunct Professor of Mathematics

MAT University of California Los Angeles, 1983

Paige began her lifelong teaching career when she was a junior in high school, and has never faltered from what she considers to be a distinct privilege and pleasure. She is one of the most popular instructors in the university, as evidenced by a college-wide UCLA Distinguished Teaching Award in 2015 – no small feat when you are teaching math. The award is given to both senate and non-senate faculty "who bring respect and

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UCLA Women in Math

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admiration to the scholarship of teaching." She was one of three non-senate faculty members to receive the award that year. She is also the recipient of the Department's 2010 Robert Sorgenfrey Distinguished Teaching Award.

After obtaining her undergraduate degree at UCLA, Paige taught math at community college for 12 years before embarking on a remarkable journey teaching and tutoring in Switzerland for the next decade. In addition to math, she is now versed in German. She came back to UCLA in 2007 as a lecturer. She is particularly effective with those students who need a firm but kind hand in math and in life as they transition to college. Paige states, "I believe that all students are truly capable of learning mathematics, despite whatever perceptions they may have developed earlier, and I believe that all of my students really need to know what I am teaching." *(Please see the full article on Paige in the faculty news section of the 2015 math newsletter.)*

Olga Radko

UCLA Academic Administrator

Director, Los Angeles Math Circle
PhD University of California Berkeley, 2002

In addition to her academic career as a UCLA instructor and researcher, Olga has chosen to enrich the lives of young, talented mathematicians using her own experience growing up with math in Russia. She says of her childhood, "We would gather in math circles at Moscow State University on weekends to solve problems and learn about advanced mathematical concepts. It was fun and stimulating."

To provide the same educational opportunities to young Angelenos, Olga established the Los Angeles Math Circle (LAMC) in 2007 with the support and encouragement of the Department. "We started with one small group of high schoolers, then progressed downward as their siblings became interested and wanted to join. Now our program serves students in grades 1 through 12." This year, the program attracted 250 participants during the academic year and over 100 during the summer, providing a unique opportunity for school children to interact with like-minded peers and learn exciting mathematics. UCLA graduate and undergraduate students serve as lead instructors and docents, gaining experience teaching and working with children.

The mission of the program is enrichment, and the list of topics goes well beyond the regular school curriculum. Says Olga, "The logic and critical thinking skills the students acquire through mathematical problem solving help them succeed in many other areas." Admittance is by application, and there is currently a waiting list. Through generous donations and support from funding agencies, participation is free of charge. To expand the benefits of the program, LAMC has supported the growth of other math circles in Los Angeles.

Olga commends the unique collegial atmosphere of the Department as the key to success. Department faculty and postdocs routinely give LAMC presentations, and recently, a math alumnus endowed the program with a $350,000 pledge.

When she is not directing LAMC, Olga teaches a wide range of undergraduate math courses and runs the Department's Teacher Assistant Training Program. In addition to her published work in the area of Poisson geometry, she has recently co-authored a book, *Breaking Numbers into Parts*, with Oleg Gleizer. The book was inspired by their work with LAMC and is geared to elementary school children.

Heather Dallas

UCLA Academic Coordinator

Director, UCLA Curtis Center
MEd University of California Los Angeles, 1999

It was her high school calculus and physics teacher as well as her father's background in mathematics and electrical engineering that solidified Heather's interest in math. "I realized mathematics was powerful. It was beautiful – theoretical and proof driven – and yet useful for solving real world problems."

At 17, she decided to pursue a career teaching high school mathematics, and after earning her BS degree, taught in Los Angeles public schools for more than a decade. In 2001, she was recruited to participate in the Department's Visiting High School Teacher program, and then invited to join the Department as a lecturer. In 2007, when the UCLA K-12 math programs and activities were collected under one umbrella – the Curtis Center – she was appointed director.

The Curtis Center continues the Department's tradition of preparing math majors for teaching careers through several programs: the Math for Teaching major and minor, the Subject Matter Waiver Program, and the Joint Math Education Program. In all cases, the objectives are to vigorously support and encourage students and fast track their path to the classroom. Heather teaches a senior capstone course central to all three programs.

Professional development for K-12 math teachers is another key component of the Center's mission. This investment is made through on-campus conferences and institutes as well as consultation and training at local schools and district offices. Unique to these efforts is an emphasis on collaboration between university and K-12 instructors. Heather explains, "Too often, activities to improve K-12 math education are driven by either university *or* K-12 instructors. While the two groups have many assets in common, we have found that the highest quality results, both mathematically and pedagogically, come from a collaboration between the two."

As the reputation of the Center grows, so does its impact on K-12 mathematics at the state and national levels. Heather has served as a principal investigator on a number of competitive state grants, and recently directed a project serving departments of education in 21 states. She has been appointed to K-12 committees and commissions, and she is regularly invited to speak at conferences across the country.

faculty news

NSF Grant for Topology Group

Michael Hill, **Ciprian Manolescu** and **Sucharit Sarkar** were awarded a three-year, $365K Focused Research Group (FRG) grant by the National Science Foundation for research on Floer homotopy theory. The Department's topology group will collaborate with colleagues from four other universities (Mohammed Abouzaid at Columbia University; Andrew Blumberg at the University of Texas, Austin; Tyler Lawson at the University of Minnesota; and Robert Lipshitz at the University of Oregon). The project aims to conduct research on applying techniques from homotopy theory to questions in low dimensional topology and symplectic geometry.

Reuters' 'Most Cited' Listing for Influential Scholarship

Andrea Bertozzi, **Stan Osher** and **Terry Tao** are among 29 UCLA faculty members joining the list of most influential scientists as determined by Thomson Reuters' compilation of Highly Cited Researchers. The listing identifies those scientists who have the distinction of writing the greatest numbers of reports officially designated as highly cited papers by Essential Science Indicators, a customized, citation-based research analytics tool. These researchers rank among the top one percent most cited for their subject field and year of publication, 2003 and 2013.

The Erdös Discrepancy Problem

Previously, this problem was tackled with the help of a computer, producing a proof the size of Wikipedia. **Terry Tao** used more traditional mathematics (combining recent results in number theory with some earlier, crowdsourced work) and has published a proof showing that Erdös was right. The problem is a puzzle about the properties of an infinite, random sequence of +1s and -1s. In the 1930s, Hungarian mathematician Paul Erdös wondered whether such a sequence would always contain patterns and structure within randomness. Terry's work proves that the discrepancy is infinite no matter the sequence chosen.

Faculty Honors

- **Artem Chernikov** received a **2016 Sloan Research Fellowship**, awarded to early-career scientists and scholars whose potential and achievements identify them as the next generation of scientific leaders. Artem's research interest is in model theory, specifically Shelah's classification (stability, simplicity, NIP, NTP2 ...) and its applications to algebra, geometry, combinatorics and computer science.
- **Will Conley** was the recipient of the **My Last Lecture Award** from the **UCLA Alumni Scholars Club (ASC)**, based on nominations from the student body. Fifty years ago, to honor an inspiring professor, the question was asked of UCLA faculty: "What would you tell your audience if you had but one lecture to give – your last lecture on this earth?" The tradition was resurrected by ASC this year. Will gave his "last lecture" at the awards ceremony.
- **Alan J. Laub** was selected as one of 30 new fellows of the **Society for Industrial and Applied Mathematics (SIAM)** for his contributions to the numerical solution of problems in control and filtering. The fellows program is an honorific designation conferred on members distinguished for their key contributions to applied mathematics and computational science.
- **Stanley Osher** was awarded the **William Benter Prize in Applied Mathematics 2016** for his significant contributions applying mathematics to real world problems. Stan's research has been highly influential in computational mechanics. He has created pioneering algorithms for image processing, and his work on capturing moving interfaces using implicit representation has brought about breakthroughs in movie animation.
- **Sorin Popa** was listed to the **2016 Simons Fellows in Mathematics**. The Simons Foundation supports basic or discovery-driven scientific research furthering an understanding of the phenomena of our world. Sorin's research focuses on a variety of problems at the crossroads of functional analysis (operator algebras), ergodic theory and group theory.
- **Mason Porter** won a **Young Scientist Award for Socio- and Econophysics** from the German Physical Society (DPG). The award recognizes outstanding original contributions that use physical methods to develop a better understanding of socio-economic problems. Socio-Economic Physics is a division of the DPG aiming to stimulate interest among young academics in economic, urban and social problems by fostering research on these topics.

faculty news

The After Math

Gregory Eskin

Gregory was born and raised in Kiev, Russia, and attended Moscow State University, receiving his PhD in 1963. He subsequently held academic and scientific positions at the Voronezh State University and the Institute for Problems in Mechanics of the Russian Academy of Sciences Mechanics, respectively. He immigrated to Israel in 1974, accepting a professorial position at the Hebrew University of Jerusalem. In 1982, he joined the UCLA math faculty. His recent research interests have focused on inverse scattering problems in several dimensions, inverse boundary value problems for hyperbolic equations, artificial black holes, and the Aharonov-Bohm Effect. Throughout his UCLA career, Gregory has consistently served the Department and the field of mathematics as a researcher on many NSF grants, a thesis supervisor for over a dozen doctoral candidates, and a reviewer for many academic journals and publishers. He has been a steadfast member of departmental and university committees, and an invited speaker at international conferences throughout the United States, Europe and Asia, most recently at the International Congress of Mathematicians (ICM). He was a long history of service to the American Mathematical Society (AMS) and was elected an AMS Fellow in 2014.

Alan J. Laub

Alan joined UCLA in 2005 as a distinguished professor in mathematics and electrical engineering. Previously, he was a professor of electrical and computer engineering at UC Santa Barbara, where he also served as department chair from 1989 to 1992 and as founding co-director of the Center for Control Engineering and Computation. He was appointed dean of the College of Engineering at UC Davis in 1996, and in 2002, he accepted a position as director of SciDAC (Scientific Discovery through Advanced Computing) at the U.S. Department of Energy Office of Science. During his tenure at UCLA, he was the inaugural director of the Institute for Digital Research and Education, a cooperative of faculty and technologists working to advance the existing body of knowledge and expertise at UCLA. Alan's research interests are in numerical linear algebra, scientific computation, and computer-aided control system design. He is especially noted for his use of invariant subspace methods for the reliable solution of Riccati equations. His algorithms and software enjoy widespread commercial use worldwide, and he has been instrumental in encouraging the use of numerically stable algorithms and reliable mathematical software in the control and systems community for over 40 years. In addition to serving on many editorial boards, he is the author of numerous books and more than 200 technical papers. After a long and distinguished membership in IEEE he was elevated to Life Fellow in 2014.

2015 – 2016 Distinguished Lecture Series

Every year, the Department brings eminent mathematicians to UCLA for a week or more to give a lecture series and to meet with faculty and graduate students. This year, UCLA math was honored to host two prominent lecturers. **Benedict Gross** (Harvard) covered the rank of elliptic curves, arithmetic of hyperelliptic curves, and pencils of quadrics and the Jacobians of hyperelliptic curves. **Donald Goldfarb** (Columbia) focused on the subject of optimization for learning and big data. The Distinguished Lecture Series is currently supported by the Larry M. Wiener Fund.

New Faculty

Wilfrid Gangbo

Fall 2016

Wilfrid's research interest lies in the areas of the calculus of variations and partial differential equations and their applications to geometry, physics and material science. He has recently developed basic tools and refined structural results in the area of optimal mass transport theory, and with Andrzej Swiech, discovered and exploited links between Monge-Kantorovich and mean-field games theories to prove the first existence result of the so-called master equation. He earned his PhD from the Swiss Federale Institute of Technology in 1992. Following postdocs at Carnegie Mellon University and MSRI, he joined the faculty of Georgia Institute of Technology and was promoted to full professor within nine years. He has a long-term interest in EcoAfrica where he is part of an interdisciplinary team of scientific consultants. Wilfrid was elected to the inaugural 2013 class of fellows of the American Mathematical Society.

Mason Alexander Porter

Fall 2016

Mason is an applied mathematician and occasional physicist who works on a diverse set of problems in networks, complex systems and nonlinear systems. He earned his PhD from the Cornell University Center for Applied Mathematics in 2002 with a thesis on quantum chaos in billiard systems. Following postdocs at Georgia Tech, MSRI and Caltech, he joined the Mathematical Institute at the University of Oxford in 2007, where he progressed to professor of nonlinear and complex systems. Recent awards include the Erdös-Rényi Prize in network science, a Whitehead Prize from the London Mathematical Society, and a Young Scientist Award for Socio- and Econophysics. In addition to scholarship, Mason's efforts are directed to scientific exposition, mentoring and outreach, including one project in which he helped to develop a networks literacy handbook for pre-university students and the public.

Sucharit Sarkar

Fall 2016

Sucharit's research areas are low dimensional topology, symplectic geometry and algebraic topology, with particular emphasis on knot theory and modern homological invariants like Heegaard Floer homology and Khovanov homology. He earned his PhD in 2009 from Princeton University under the guidance of Zoltan Szabo. During graduate studies, along with Manolescu, Ozsvath and Wang, he constructed the first algorithm to compute certain versions of Heegaard Floer homology. For this accomplishment, he was awarded the Clay Research Fellowship. Following graduation, Sucharit was a Ritt Assistant Professor at Columbia University. There he and Lipshitz constructed a stable homotopy refinement of Khovanov homology. In 2012 Sucharit returned to Princeton where he received an NSF Early Career Development (CAREER) Award.

Romyar Sharifi

Fall 2016

Romyar is an algebraic number theorist and arithmetic geometer whose research program aims, in part, to describe the structure of arithmetically interesting objects in terms of higher-dimensional geometric objects. The first instance of this is his conjecture that describes ideal class groups in terms of the homology of modular curve; this can be viewed as a refinement of the main conjecture of Iwasawa theory, proven by Mazur and Wiles. He is the recipient of a 2014 - 2015 Simons Fellowship and is currently editor of the *Proceedings of the American Mathematical Society*. Romyar received his PhD in 1999 from the University of Chicago. Following postdocs at MSRI, the University of Arizona, Harvard University, and the Max Planck Institute, he accepted a position as Canada Research Chair at McMaster University. Romyar joined the math faculty at the University of Arizona in 2009.

in memoriam

Heinz-Otto Kreiss
1930 – 2015

One of the great figures in numerical analysis and applied partial differential equations passed away December 16, 2015, at his home in Stockholm. Heinz joined the UCLA faculty in 1987, and returned to Sweden in 2001 following his retirement, but his influence on the UCLA's applied mathematics group far exceeds the time he spent here.

He was born in Germany, lived and worked on a farm during the war, and became an undergraduate in 1950. In 1955 he went to Stockholm, Sweden, where he began his stellar research career. He was a professor at the Chalmers Institute of Technology in Gothenberg from 1964 - 1965; Uppsala University from 1965 - 1978; Caltech from 1978 - 1987; and UCLA from 1987 - 2001.

Heinz visited the Courant Institute in the '60s quite often, and I was lucky enough to meet him in 1966. This meeting changed my research direction. He had just proven stability of finite difference approximations to hyperbolic equations in one space dimension with the appropriate numerical boundary conditions. I then came up with an elegant proof involving Toeplitz matrices after reading his paper. This resulted in a job at UC Berkeley and started my career in applied mathematics.

Heinz was a terrific, no nonsense mathematician, with an uncanny ability to get sharp estimates, usually involving families of matrices depending on parameters. There is the Kreiss matrix theorem, stability of difference approximation to hyperbolic equations, well-posedness of initial-boundary value problems for these equations, problems with different time scales, many results on numerical weather prediction and atmospheric science in general, and analysis of incompressible Navier-Stokes equation, to name a few of his contributions.

He was also a wonderful and caring person and totally unpretentious. For example, when he was inducted into the Swedish Academy of Sciences, the story goes that he had to borrow a tie and sport jacket from a waiter to get into the dinner and reception. Past and present UCLA faculty members who were influenced by his work include Bjorn Engquist, Andrew Majda, Daniel Michelson, Gregory Eskin, James Ralston, Eitan Tadmor, Moshe Goldberg and myself.

Heinz generated mathematical excitement, and he was always fun to be around. He loved his island retreat in Sweden, hated doing university administration, and had a life partner in his wife Barbro. His scientific legacy lives on. According to the Mathematics Genealogy Project, he has 26 students and 463 descendants.

He will be missed by everyone who knew him. He was great, both as a scientist and as a human being.

— Stanley Osher

Lloyd Shapley
1923 – 2016

Widely considered a father of game theory, Lloyd Shapley died in Arizona on March 12, 2016. His work in market design laid the foundation for advances in the matching of kidney donors with transplant recipients, in college admissions procedures, and in assignment of children to public schools. Lloyd joined the UCLA faculty in 1981 with joint appointments in economics and mathematics. His career at UCLA spanned 20 years until 2001 when he became an emeritus professor. His life-long achievements culminated in a 2012 Nobel Memorial Prize in Economic Sciences.

Lloyd defined game theory as "a mathematical study of conflict and cooperation." His far-reaching research included stochastic games, strategic market games, assignment games, cooperative and non-cooperative market models, voting games and power indices, potential games, cost allocation and organization theory.

Lloyd was born in Massachusetts, a son of renowned astronomer and Harvard professor Harlow Shapley. He began studying math at Harvard as the United States was drawn into World War II. He was drafted into the army in his third year. There he won a Bronze Star for breaking a Soviet weather code. After the war, he returned to Harvard and earned his AB degree in 1948. He subsequently worked at the RAND Corporation in Santa Monica for a year before entering a doctoral program at Princeton University where he earned his PhD in 1953. His thesis and post-doctoral work introduced the Shapley value and the core solution to game theory. He returned to RAND in 1954 where he stayed until 1981. At RAND, he became friends with UCLA math professor Tom Ferguson while playing chess, and Tom, along with other faculty members in math and economics, urged their departments to hire him. Tom stated that Lloyd's contributions to math and economics continue to be the subject of intense discussion, including a conference in 2013 in Istanbul that focused on the Shapley value.

math education

THE CURTIS CENTER

Supporting quality math education programs and content for the K-16 community

This year's Summer Institutes and Annual Conference for math teachers featured Yale Professor Roger Howe, well known for his contributions to representation theory.

A consortium representing 21 states sought out the Curtis Center to write mathematical modeling tasks for end-of-year exams after receiving disappointing results from other author groups. These exams are given to students in grades 3 - 8 and 11 and will assess their ability in meeting Common Core Standards. Mathematical modeling requires students to demonstrate math skills that incorporate real world contexts and realistic questions, providing a better teaching paradigm than the problem-solving math tasks of old, which went like this: Sally is two years younger than Sue who is three years older than Bill. The sum of Sally, Sue and Bill's ages is 23. How old are Sally, Sue and Bill? The Center began the $1.2 million project by assembling a team of university and K-12 math specialists to collaboratively author the tasks. In the coming year, the team will work with veteran and decorated teachers to develop, test and edit the tasks. Eighty-four unique tasks have been completed so far and will enter circulation in 2016 – 2017 exams.

In 2015 – 2016 the Mathematics Diagnostic Testing Project:

- scored 100,000 student diagnostic tests and sent detailed results back to teachers
- provided free materials, services and instruction to 1,000+ teachers across Los Angeles and Ventura counties
- conducted school site visits, conferences and Saturday morning workshops for hundreds of math educators to strengthen their pedagogical knowledge

LAMC

An enrichment program for K – 12 students

This year the Los Angeles Math Circle (LAMC) reached an even larger number of K-12 students through the establishment of two "satellite circle" initiatives. The first initiative provides mentoring to high-performing and experienced LAMC high schoolers who are teaching in afterschool programs in their neighborhood middle schools. Three such programs were conducted at Sequoia Middle School in Newbury Park, Immaculate Heart of Mary Middle School for girls, and the Emerson Middle school in Los Angeles. A second initiative is a partnership involving a group of West Los Angeles parents with advanced mathematics backgrounds who are piloting a program called Sputniks. These parents are drawing upon LAMC for advice and materials to teach math topics beyond the traditional school curriculum to two small groups of children. World Speak, a trilingual private school in Westwood, opened its own afterschool circle, utilizing LAMC curriculum.

IPAM

Institute for Pure and Applied Mathematics, funded by the National Science Foundation

This year concluded IPAM's 15th anniversary fund-raising campaign, which succeeded in its goal of $100,000 for building renovations and other expenses that cannot be met by grants. A highlight of the campaign was the offer to "name a seat" in IPAM's seminar room. Over 35 seats now bear name plaques.

The Green Family Lectures was led by Ingrid Daubechies, one of the inventors of wavelets. For her public lecture, she spoke on image processing tools that are used to verify the authenticity of original paintings. Her research lecture focused on mathematical methods for biological morphology – particularly for teeth – and their use in establishing evolutionary relationships.

Programs planned for 2016 – 2017 include two long programs. The fall 2016 long program, Understanding Many-Particle Systems with Machine Learning (ML), will feature a topic that has become amazingly successful at such tasks as voice recognition. It will bring together mathematicians, materials scientists and computer scientists to harness ML methods for identifying and understanding coherent or emergent phenomena in complex particle systems. Examples of this behavior are abundant in nature, manifesting themselves at all scales of matter, ranging from atoms to galaxies.

The spring 2017 long program, Computational Issues in Oil Field Applications, will focus on oil exploration and production operations. Major mathematical challenges include the multi-physics and multi-scale character of wave propagation and fluid flow, data assimilation for multiple properties over a range of scales, and model-based optimization for maximizing reservoir performance. This program will bring together mathematicians, computational scientists, geophysicists and petroleum engineers from both universities and industry.

The 2017 Green Family Lectures will be given by Edward Witten, a theoretical physicist working on elementary particle physics, including string theory and quantum field theory. He is the first and only physicist to be awarded a Fields Medal. His talks will focus on gauge theory and categorification.

10 Years and Counting

This 10th anniversary issue of *The Common Denominator* revisits UCLA math faculty, student and alumni achievements over the last decade. Go to www.math.ucla.edu/newsletter-archive for the complete issues.


UCLA DEPARTMENT OF MATHEMATICS
NEWSLETTER
The Common Denominator
IN HIS PRIME
TERRY TAO WINS THE FIELDS MEDAL

2006

Terry Tao received the **Fields Medal** and became a **MacArthur Fellow**; he was 31 years old then and had been a faculty member for 10 years.

Tony Chan was appointed assistant director for mathematics and physical sciences at NSF; he is currently a professor emeritus in the Department and president and professor at Hong Kong University.

The **California Mathematics Project** was awarded a $5.25 million grant to conduct teacher retention programs at 10 sites across the state, including UCLA. It is still going strong.

IPAM received its first NSF grant renewal after opening its doors in 2000.

An undergraduate summer research training program (REU) was launched under the direction of **Andrea Bertozzi**; this year, REU students won Outstanding Presenter awards at a poster session organized by the Mathematics Association of America.

2007

The **Philip C. Curtis Jr. Center for Mathematics and Teaching** (Curtis Center) was founded.

Terry Tao became the first scholar appointed to the **James and Carol Collins Chair** in the UCLA College of Letters and Science.

UCLA math received an **American Mathematical Society (AMS) award** for an Exemplary Program or Achievement in a Mathematics Department.

The Department hosted a **Fields Medalist Symposium**.

The **UCLA Math T-shirt** was introduced.

This issue marked the first time that our **generous donors** were listed by name (except for the anonymous ones, of course).

Matthias Aschenbrenner, **Paul Balmer**, **Chandrashekhar Khare**, **Yehuda Shalom**, **Benjamin Sudakov** and **Joseph Teran** joined the faculty.

2008

Terry Tao received the **Alan T. Waterman Award**, NSF's highest honor.

Tom Liggett was elected to the **National Academy of Sciences**.

An endowment for the **Financial Actuarial Program** was established by alumna **Patty Boyle.**

In a changing of the guard, **Mark Green** resumed his faculty position in the Department, and **Russ Caflisch** assumed the directorship of IPAM.

Christian Haesemeyer and **Ciprian Manolescu** joined the faculty.

2009

Applied math climbed to third place in the ***U.S. News & World Report*** survey of graduate school programs.

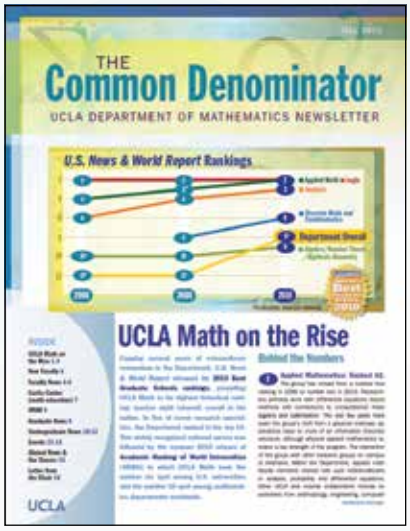
The Logic Center hosted its first public symposium since its founding in 2004: The Convergence of Logic, Mathematics and Computer Science.

Summer Schools in Analysis, a forum for promising young analysts across the U.S., celebrated its 10th anniversary.

Math Content Program for Teachers (MCPT), which focuses on professional development for teachers, celebrated its 10th anniversary.

Igor Pak and **Monica Visan** joined the faculty.


THE
Common Denominator
UCLA DEPARTMENT OF MATHEMATICS NEWSLETTER
UCLA Math Takes a Walk on the Applied Side
UCLA



2010

The Department rolled out the **UCLA Math Undergraduate Merit Track,** which allows talented freshmen to take upper division math courses by the end of their first year.

Alumnus **Alan Gillette** established the annual **Heaviside Wealth Management Award** for Outstanding Graduate Student Research.

The Simons Foundation selected the Department to host two prestigious **Simons Postdoctoral Fellows**.

Mario Bonk joined the faculty.

2011

NSF awarded a **$2 million California Research Training Program in Computational and Applied Mathematics** grant to the Department, under the direction of Andrea Bertozzi and Stan Osher; UCLA was ranked at the top of 35 workforce proposals.

UCLA math shared a **$2 million NSF Research Training Group grant in logic** with UC Irvine and Caltech under the direction of Itay Neeman.

Alumnus Glen Whitney launched the **Museum of Mathematics (MoMath)** in Manhattan.

Raphaël Rouquier and **Marcus Roper** joined the faculty.

2012

Terry Tao was awarded the **Crafoord Prize in Mathematics** and appointed as a Simons Investigator.

The **Chancellor's Award for Postdoctoral Research** went to the Department's **David Uminsky**, one of six across the campus.

An anonymous alum gave a **$100K gift** to support California Math Undergraduate Merit Scholars.

Itay Neeman and **Sorin Popa** each received a **Simons Investigator Award**.

New standards for undergraduate math and math/econ majors took effect; requirements included a higher GPA.

UCLA math achieved its highest ranking so far, at **#9 in the Academic Ranking of World Universities in Mathematics.**

Burt Totaro joined the faculty.

2013

Lloyd Shapley won the **2012 Nobel Prize in Economics.**

The **UCLA student math team** achieved its highest ranking so far at **#3 in the annual Putnam Competition.**

The **W.M. Keck Foundation** awarded a $1 million grant to **Andrea Bertozzi** and **Stan Osher.**

Andrea Bertozzi was named the inaugural holder of the Betsy Wood Knapp Chair for Innovation and Creativity.

The Chancellor's Award for Postdoctoral Research went to the Department's **Craig Schroeder**, one of eight awards across the campus.

The Department launched a new major, the **Financial Actuarial Mathematics degree.**

2014

Stan Osher received the **Gauss Prize**.

UCLA math reached its highest historical ranking so far at **#7 overall** in the *U.S. News & World Report Best Graduate Schools* listing.

Terry Tao was one of five recipients of the inaugural **Breakthrough Prize in Mathematics**.

An **NSF CAREER Award** went to **Marcus Roper.**

Stan Osher and **Terry Tao** were named as Highly Cited Researchers; among the top one percent most cited for their subject field and year of publication.

A Charles E. and Sue K. Young Graduate Student Award went to doctoral student **Kaitlyn Tuley Hood**.

2015

A **Simons Investigator Award** went to **Raphaël Rouquier.**

A **Charles E. and Sue K. Young Graduate Student Award** went to doctoral student Jaclyn Lang.

The **Curtis Center** won a **$1.4 million contract** to manage the writing of the "long answer" portion of the end-of-year mathematics exam given to 3rd - 11th graders.

Alumnus **Ron Fedkiw** won an Academy Award for developing software that helped "Hollywood's bad guys destroy things."

Paige Greene was one of three non-senate faculty members to receive the university-wide Distinguished Teaching Award.

Artem Chernikov, **Mike Hill**, **Andrew Marks** and **Georg Menz** joined the faculty.

graduate news

Department Awards

Every year the Department honors outstanding faculty and students. Here are the 2016 awards and recipients:

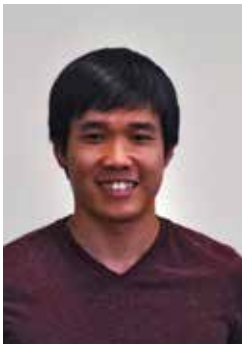
- **Sorgenfrey Distinguished Teaching Award** (Faculty) Rodolfo De Sapio
- **Distinguished Teaching Award** (Lecturers) Francesc Castella, Matthew Lafferty, Jukka Virtanen
- **Department Teaching Award** (Teaching Assistants) Anton Bobkov, Peter Cheng, Geunho Gim, Benjamin West
- **Horn-Moez Prize for Excellence in First-Year Graduate Studies** Ikshu Neithalath, Khang Huynh
- **Beckenbach Fellowship** Yehonatan Sella
- **Dissertation Year Fellowship** Ian Charlesworth, Julian Gold, Matthew Stoffregen, Jeffrey Wong, Ian Zemke
- **Pacific Journal of Mathematics Dissertation Prize** Nicholas Cook, Kaitlyn Tuley Hood, Jianfeng Lin
- **Girsky Student Award** Anton Bobkov, Mohammed Zuhair Mullath
- **Heaviside Wealth Management Award** Nicholas Cook
- **O'Neill Travel Stipend Award** Laure Flapan, Matthew Stoffregen

Ikshu Neithalath

Khang Huynh

Anton Bobkov

Mohammed Zuhair Mullath



Peter Cheng

Benjamin West

Nicholas Cook

Charles E. and Sue K. Young Graduate Student Award

For the third year in a row, a math student has been selected to receive a Charles E. and Sue K. Young Graduate Student Award. **Sudesh Kalyanswamy** was one of four students honored in the 2015 - 2016 academic year. Sudesh reports that numbers and their various patterns have fascinated him since childhood. While an undergrad at Cornell University, he visited UCLA during an open house and met with Chandrashekhar Khare, who became his advisor.

Sudish's recent research in number theory has focused on applying the techniques Wiles used to prove Fermat's Last Theorem to other situations involving Galois representations. After graduate school, he wants to continue in academia, pursuing teaching and research.

The Charles E. and Sue K. Young Graduate Student Award recognizes graduate students for their distinguished academic performance and service to the university and the community and includes a monetary prize.

2016 Graduate Students Take Flight

Kaitlyn Tuley Hood *to Massachusetts Institute of Technology*

In high school, Kaitlyn took all the math, physics and programming courses that were offered – 11 classes in all – and went on to major in math and physics at the University of Maryland. There she participated in undergraduate research in applied harmonic analysis, nonlinear physics and analysis on fractals. At UCLA, she studied fluid mechanics under Marcus Roper, combining perturbation theory with numerical methods for solving nonlinear partial differential equations. She uses these tools to study microfluidic devices – tiny circuits that flow fluids (like water or blood) instead of electrons. Her research as an NSF Mathematical Sciences Postdoctoral Research Fellow at MIT under Peko Hosoi will be motivated by the question: What happens at the intersection of systematic slow-moving fluids and turbulent fast-moving fluids? This question is central to her proposed research on the biomechanics of lobster sniffing.

Casey Jao *to University of California, Berkeley*

Casey's interest in math came by way of a high school calculus workbook that fortuitously distracted him from an upcoming piano competition. He studied math with an inspiring high school teacher, who taught all of Boyce and DiPrima in an annual course on ODEs. Casey is drawn to mathematics by both its intrinsic beauty and its incredible ability to describe the natural world. After undergraduate study at Caltech, he came to UCLA wanting to learn more about partial differential equations, an interest that was refined through exposure to the techniques and insights of harmonic analysis. He worked on non-linear Schrödinger equations under the guidance of Rowan Killip and Monica Visan. He is advancing to the University of California Berkeley under an NSF Mathematical Sciences Postdoctoral Research Fellowship.

Jaclyn Lang *to Université Paris 13*

Jaclyn became interested in number theory in high school. At Bryn Mawr College, she focused on this mathematical field under the mentorship of Helen Grundman, developing a preference for problems on the algebraic side of the subject. Following graduation with a dual AB/MA degree, she went to the University of Cambridge on a scholarship to do Part III of the Mathematical Tripos. Her favorite classes were elliptic curves and local fields. Building on these interests, she studied p-adic families and p-adic interpolation at UCLA, working with Haruzo Hida on a problem involving the images of Galois representations in p-adic families. Funded by an NSF Mathematical Sciences Postdoctoral Fellowship and a Fulbright Grant, Jaclyn will continue her work at the Université Paris 13.

Jianfeng Lin *to Massachusetts Institute of Technology*

Jianfeng enjoyed solving all kinds of math problems during his childhood in China. This fascination guided him through his early academic studies, culminating in a career as a mathematician. As an undergraduate at Peking University, he discovered the absorbing world of topology, which motivated him to earn a master's degree. At UCLA he worked with Ciprian Manolescu, pursuing his interest in gauge theory. He focused his efforts on distinguishing manifolds by counting the number of solutions for certain PDEs from physics. Richard Feynman once stated that all physics breaks down to the counting of beans in a pot, which aptly describes the philosophy of gauge theory from Jianfeng's perspective. He will continue his journey as a C.L.E. Moore Instructor at MIT.

undergraduate news

Awards for Outstanding Undergraduate Achievement

- **Basil Gordon Prize** Dillon Zhi
- **Daus Prize** Dillon Zhi
- **Outstanding Actuarial Science Student Award** Chen Liang
- **Richard F. Arens Putnam Scholars Award** Osman Akar, Emre Girgin, Konstantin Miagkov
- **Putnam Honorable Mention Award** Dillon Zhi
- **Sherwood Prize** Jing An, Yichen (Peter) Chen, Pax Kivimae, Hao Li, Man Cheung Tsui

From left are Sherwood Prize winners Pax Kivimae, Yichen (Peter) Chen, Man Cheung Tsui, Hao Li, and Jing An.

UCLA Students Win Outstanding Presenter Awards

Ritvik Kharkar, **Jessica Tran** and **Jason O'Neill** won Outstanding Presenter awards at a poster session organized by the Mathematics Association of America (MAA) during the 2016 Joint Math Meetings in Seattle. The project conducted by Ritvik and Jessica involved an analysis of UCLA math department course enrollment data. Jessica Tran is a UC LEADS student, and Ritvik Kharkar is supported by the California Research Training Program in Computational and Applied Mathematics. Their research was organized as part of the applied math NSF REU (Research Experiences for Undergraduates) program in summer 2015. Jason's project in pure mathematics, supported by a donation from Steve Girsky, was titled, "On asymptotics and combinatorics of Tesler matrices in diagonal harmonics." According to the MAA, the 2016 student poster session was the largest in the organization's history with only the top 15 percent of posters in each subject area selected for prizes.

UCLA Math Welcomes Back Alumnus Stephen Godfrey for Commencement

This year's commencement ceremony featured keynote speaker and UCLA math alumnus, Stephen Godfrey. As executive vice president and head of foreign exchange ecommerce for Wells Fargo Bank, Stephen oversees the firm's foreign exchange services electronically delivered to clients. Prior to joining Wells Fargo, he was a managing director at Bank of America Merrill Lynch. He has over 25 years of financial service experience.

Stephen is a long-time Bruin, earning both a bachelor's degree and an MBA at UCLA, and a strong supporter of mathematics both in education and as the foundation of a successful career. In his own experience, Stephen has seen how math grows business acumen by providing the necessary tools to dissect large and complex challenges into smaller, more manageable components. In life, he considers the greatest benefit of mathematics to be its logical framework for risk-taking and decision-making, especially in the face of imperfect information.

In his commencement speech, Stephen encouraged the graduates to embrace a world of imperfect information. "In financial markets, we often refer to this reality as risk. Risk can be good or bad, since many of these surprising events result in desirable outcomes. We want a certain amount of risk in our lives. In fact, it's hard to imagine that you will achieve your goals without taking risks. One lesson I've learned is that it can be very helpful to have a strategy in facing and perhaps embracing change and uncertainty." Stephen concluded his message by telling the students, "You have much to offer the world, and we encourage you to use your talents and skills to pursue your passions and to effectively handle the uncertainty. We have a room full of mathematicians and other logical thinkers, and I'm going to guess that this analytical approach to decision making resonates with everyone here."

Actuarial Students Take the Gold

Biggest Winner in CAL Competition

CAL Case Competition winners

The UCLA team – **Cullen Im**, **Dan Sui**, **Greta Xiong** and **Brandon Yu** – was the biggest winner in the final round of the **UC Berkeley 7th Annual Actuarial Case Competition**, beating over two dozen teams. The win was the culmination of seven weeks of effort analyzing data to design solutions in three different lines of business: health and group benefits, property and casualty insurance, and retirement benefits. The UCLA team submitted their findings, presented their conclusions, and defended them before professional actuaries, ultimately bringing home the Overall Grand Prize and earning accolades in two of the three categories. The competition was hosted by the CAL Actuarial League. The UCLA team was sponsored by the Department and supervised by the Bruin Actuarial Society (BAS).

First Place in BAS Competition

BAS Case Competition winners

Undergrads **Annie Thornton**, **Serena Wang**, **Greta Xiong** and **James Xu** won the **2016 Annual UCLA Actuarial Case Competition**, sponsored by the Bruin Actuarial Society (BAS). The competition was the first inter-UC event for the Department's Financial Actuarial Mathematics Program, providing an opportunity for students to tackle a real-life actuarial problem. The UCLA team was given a weekend to conduct actuarial analysis on a case provided by Kaiser Permanente, whose goal was to grow membership and increase profit margin. It was a challenging case, requiring the students to conduct new research and fresh analysis as a result of current changes in the healthcare industry.

For more on the Department's actuarial program, see the Alumni News section, page 16.

2015 UCLA Putnam Team Moves Up in Rankings

The UCLA Putnam team (**Emre Girgin**, **Ufuk Kanat**, **Dillon Zhi**) ranked first among all public universities and 6th out of 447 institutions (moving up from 10th place in last year's competition). Individually, Dillon Zhi was ranked #68 in North America and received an Honorable Mention. Other high scorers from UCLA (in the top 500 overall) were Ufuk Kanat, Osman Akar, Emre Girgin, Konstantin Miagkov, Joan Kim, Luke Harmon, Iris Cong, Ryo Kudo, Man Cheung Tsui and Wenjun Cai. A total of 22 UCLA students participated in this annual competition that tests students' originality, technical competence and familiarity with formal undergraduate mathematics theories. The competition is a highly regarded and arduous test of mathematics knowledge and ability, open to colleges and universities across the United States and Canada. Questions cut across disciplines and involve elementary concepts from group theory, set theory, graph theory, lattice theory, number theory or cardinal arithmetic, and often contain problems that do not fit into any of the usual categories.

Top Awards Winner

Graduating with a double major in math and computer science, Dillon Zhi is heading to Facebook as a software engineer this fall. He says, "One of my main interests at UCLA was programming language implementation and design – to make programming a better experience for developers."

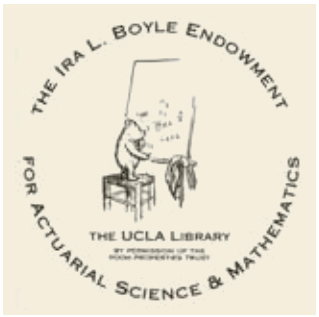
Dillon's undergraduate awards include an Undergraduate Math Scholarship, a Regents Scholarship Award, and a Rose Hills Foundation Undergraduate Science & Engineering Scholarship. This year he added the Basil Gordon Prize, the Daus Prize and a Putnam Honorable Mention Award to his list of outstanding achievements.

"My interest in math goes back as far as I can remember," says Dillon. "In particular, I liked doing contests, because to me, they were fun and competitive, but not high-pressure." He participated in the Putnam math competition as part of the UCLA team in all four years with this year producing his best result: He ranked #68 in North America and #1 at UCLA. In addition to math, music has been a long-time interest. He participated in the UCLA Chorale as well as the Game Music Ensemble at UCLA and the UCLA Symphonic Band.

For three of his undergraduate years, Dillon gave up some of his Sundays to work as an instructor in the L.A. Math Circle, a program for elementary school children sponsored by the Department. He says that this was his way of "paying it forward" for all of the opportunities he has been offered at UCLA.

alumni news

Ira and Patty Boyle



My involvement with the UCLA actuarial program has been a labor of love. The program was started by my husband, Ira. Following his untimely death, I have strived to realize his vision for the program and to make it a part of his legacy.

Ira and I were high school sweethearts, but decided to go to different colleges to expose ourselves to dating others. He went to UCLA and I to UCSB, and after one year of that, I transferred to UCLA. I loved the UCSB campus, but he loved the UCLA math program more, and so fortunately UCLA took me in. We married in September 1971, lived in UCLA married student housing, and both graduated with Phi Beta Kappa and Summa Cum Laude honors in June 1972.

Ira stumbled upon the field of actuarial science through my mother. She worked at Occidental Life Insurance Company (later Transamerica) in downtown L.A. and told him they had summer job openings. This led to Ira's working for the company full-time following graduation.

After passing a rigorous series of exams, Ira became a Fellow of the Society of Actuaries (FSA) in 1976. One of his responsibilities while Actuarial Director at Transamerica was to recruit new actuarial students. For this he crisscrossed the Midwest and East Coast in small commuter planes, as there were no college actuarial programs then in Southern California. Despite his efforts and his charm, and considering the high cost of housing, few candidates were willing to relocate to Los Angeles. So he approached Ronald Meich, a UCLA math professor, about offering actuarial science classes at UCLA. Together they began a training program in actuarial science using courses offered at the university. Ira at one time wanted to be a math teacher, so he especially enjoyed working with the students.

When Ira passed away at the age of 42 in 1993, I asked that tributes go to the UCLA actuarial program, creating the **Ira L. Boyle Memorial Fund** within the Department of Mathematics. The fund was developed to support the actuarial program, including study sessions and assistance with Society of Actuaries exam fees. In 1996, Transamerica Life Companies established the **Ira Boyle Transamerica Scholarship**, which was awarded annually for ten years to a student who demonstrated excellence in the pursuit of actuarial studies. The **Ira L. Boyle Endowment for Actuarial Science and Mathematics** was established in 1997 for the purchase of books, periodicals and other library resources in actuarial studies and related areas in applied mathematics for the UCLA Science and Engineering Library.

The need for study and other support materials in the actuarial program led me on a marvelous journey, reflected in the accompanying bookplate. Ira was a fan of Winnie the Pooh, a character we associated with math, as our calculus teacher in high school would read to us from Pooh books on Fridays if we had completed our work. Incorporating Winnie the Pooh into the bookplate design led to my viewing E. H. Shepard drawings carefully preserved in the depths of the UCLA Library Special Collections climate-controlled rooms, and working with the trustees of the Pooh Properties in England on design and copyright issues.

With the arrival of Loong Kong (FSA) in 2000 as adjunct professor, the Department's actuarial program began to rapidly expand. New courses were offered and additional instructors added. A dynamic student-run networking and support group, the **Bruin Actuarial Society (BAS)**, was formed. BAS hosts an annual banquet and career fair, a case competition formulated and judged by local employers, and numerous other activities to expose students to the actuarial science field.

The **Ira and Patty Boyle Endowed Actuarial Science Fund** was established in 2008 to support program growth. This effort was followed by the formation of the **UCLA Actuarial Advisory Council** in 2009, consisting of representatives from the Department, local employers, BAS officers and other stakeholders, with a mission to further the program. A Financial Actuarial Mathematics (FAM) major was approved, effective fall 2013. In June 2015, more students graduated with this major than with any other undergraduate major offered within the Department.

I am grateful to many for the realization of Ira's dream. This includes past and present administrators, faculty, staff and students in the Department without whose hard work and dedication this would not have come to fruition; past and present administrators, librarians and development staff in the Division of Physical Sciences and the UCLA Library for their insight and guidance; and past and present staff and fellow members of Women in Philanthropy at UCLA for their efforts and support.

The accompanying photograph was taken on a cruise during our last family vacation. Ira was diagnosed with acute myelogenous leukemia in January 1993 and passed away on May 5, 1993. Our son, David, is a UCLA alum, and our daughter, Rebecca, an actuary.

—Patty Boyle, BA '72, MA '76, P '96

Why I Donate

Numbers surround us all day long. One is the origin. Two is crucial to balance – positive and negative, yin and yang, sunrise and sunset, chaos and randomness. Newton's three laws of motion explain how things work here on Earth. Four describes the circle of seasons. The numbers help us to make sense of the world by finding order, patterns within patterns – all working together beautifully.

Through education, research and academics, it is our honor and duty to pass on knowledge from generation to generation. UCLA defines what a university can be. Supporting the math department not only connects me to the campus, but it allows me to experience something much larger than myself. Together with the scientists, scholars and leaders at UCLA, I want our young students to go above and beyond their talents and believe that they can reach extraordinary heights.

Sierra Chen, MA '93

The Department is pleased to announce a gift from alum Sierra Chen to establish the Sierra Chen Endowed Program Fund for the Los Angeles Math Circle. The endowment will underwrite costs for expenditures and enable the program to grow.

Catching Up with Moshe Kai Cavalin

Last year, Moshe Kai Cavalin put his undergraduate math degree – and his ability to fly airplanes – to good use. He accepted an internship with NASA to work on collision avoidance technology, which will be applied initially to drones and later to commercial aircraft. Catching up with him a year later, Moshe reports that he is still at NASA and still excited about this opportunity. "They thought my math and flying experience could be applied to the development of computer software, and it has worked out very well. I love being here." "Here" is Edwards Air Force Base in the California high desert. He drives home to Los Angeles on weekends to visit his family and indulge in his love of music. Moshe is a bit of a phenomenon, demonstrating a facility for math – and other subjects – at a young age. He earned his associate of arts degree from community college at 11 years old and graduated from UCLA last year at 17. He is also a published author of two books, which are not about math. With a NASA internship and a pilot's license under his belt, Moshe is heading to Arizona State University in the fall to earn his MBA.

World Universities in Mathematics – Academic Rankings

UCLA mathematics continues to rank **8th**, worldwide, and **5th** in the U.S., according to the 2015 Shanghai rating of World Universities in Mathematics.

World Rank	Institution	Country/ Region	Total Score
1	Princeton University		100.0
2	Stanford University		89.4
3	Harvard University		87.2
4	University of California Berkeley		82.6
5	Pierre and Marie Curie University - Paris 6		81.4
6	King Abdulaziz University		79.2
7	University of Oxford		72.1
8	**University of California Los Angeles**		**71.9**

Best Global Universities for Mathematics

UCLA math ranks **7th** in the world and **5th** in the United States.

#1 Stanford University – United States, Stanford, CA
#2 University of California Berkeley – United States, Berkeley, CA
#3 Princeton University – United States, Princeton, NJ 96.4
#4 Harvard University – United States, Cambridge, MA
#5 Pierre and Marie Curie University – Paris 6 – France (Tie)
#5 University of Oxford – United Kingdom (Tie)
#7 University of California Los Angeles – United States, Los Angeles, CA

UCLA graduate mathematics programs are ranked among the top 10 in *U.S. News and World Report's 2017 Best Graduate Schools* survey.

#1 Analysis
#2 Applied Math
#2 Logic
#5 Algebra/Number Theory/Algebraic Geometry
#6 Discrete Mathematics and Combinatorics
#10 Geometry
#10 Topology

our donors

We are pleased to thank and acknowledge our many supporters.

Gifts made after June 30, 2016, will appear in our fall 2017 newsletter. This listing does not include payments made on existing pledges.

Five Digits

Mr. Pei Kang and Ms. Shueh Huei Chen

Ms. Rhonda M. Sakaida

Four Digits

Mr. and Ms. Ervin Adler

Mr. and Mrs. Allen A. Arata

Mr. and Mrs. David B. Babbe

Mr. Matt Biel and Mrs. Dea Abruzzo

Mrs. Patty R. Boyle

Dr. Demetrios Brizolis and Mrs. Ann Brizolis

Mr. Phillip Cheng and Mrs. Amy Jan

Mrs. Natalie W. Crawford

Ms. Judith P. Edwards and Professor Robert D. Edwards

Mr. Bob English and Ms. Anna M. Zara

Mr. Steven J. Fasching and Ms. Katherine R. Mehl

Dr. Alan Gillette

Mrs. Virginia I. Gregory

Mr. and Mrs. Andrew P. Hahn

Mr. and Mrs. David Han

Mr. and Mrs. Andrew Jeffers

Mr. Ryutaro Kasuga and Mrs. Rie Fukuoka

Mr. William Ke and Mrs. Hong Xu

Mr. and Mrs. Harry C. Kraushaar

Ms. Katherine P. Layton

Mr. Eugene D. Lee and Ms. Soyoung Jung

Dr. Zili Liu and Dr. Dongming Jiang

Dr. Roger S. Lo and Mrs. Sandy H. Lo

Dr. Robert M. K. Lynn and Ms. Janet Braziel

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Mrs. Hope F. O'Neill

Mr. William C. Romans and Ms. Susan P. Barsamian

Mr. David A. Roth and Ms. Silla Lee

Mr. and Mrs. Andrey Rudenky

Dr. Roy R. Sakaida and Mrs. Dorothy W. Sakaida

Ms. Susana V. Salazar

Dr. Dean Salo and Mrs. Renata Salo

Mr. John Sasaki and Ms. Eda U. Suh

Dr. George H. Senge and Ms. Sandra L. Goldsmith

Mr. and Ms. Victor Shaburov

Mr. James Shin and Dr. So Young Kim

Mr. and Mrs. Dan Sion

Mrs. Melody Smolkin and Dr. Darren Smolkin

Mr. and Mrs. David H. Steinberg

Mr. Cass Swallow and Ms. Marilou G. Calara Swallow

Dr. Egbert S. Tse and Ms. Betty C. Tse

Mr. John C. Wang and Ms. Grace Wen

Drs. Richard and Ellen Wesel

Dr. Brad L. Wilson and Dr. Cao Hong-Wilson

Dr. Greg Wong and Dr. Agnes Vasco-Wong

Mrs. Xizhen Wu

Mr. and Mrs. Scott Zuber

Three Digits

Mr. Scott Abramowitz and Ms. Jie Zhang

Mr. and Ms. Michael S. Adler

Mr. and Mrs. Matthew L. Ahart

Mr. and Mrs. Youness Ahmadian

Mr. and Mrs. Shiraz Akmal

Mr. Gursel R. Aliyev and Mrs. Kamala Aliyeva

Mr. Jeffrey A. Alpert

Mr. and Ms. Chong S. An

Mr. Seoung Jin An and Ms. Ha Yon Lee

Mr. and Ms. Pete Andrew

Mrs. Connie Angland

Mr. Chris Argate

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405 Hilgard Avenue
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Los Angeles, CA 90095-1555

Dear Friends, Colleagues, Students and Alumni:

I would like to welcome you to this 10th anniversary issue of *The Common Denominator*. Inside, we invite you to browse through the academic highlights of the last decade.

This year the Department has enjoyed many successes. UCLA math continues to come in well above 10th place in national and international rankings of mathematics programs. Many of our graduates successfully progress to distinguished post-doctoral positions and sought-after jobs in industry. In the fall we will welcome four new faculty members who are coming to us from eminent universities here and abroad. In addition to individual faculty achievements, the topology group received a major NSF Focused Research Group grant, and three math faculty members were listed in Thomson Reuters' compilation of Highly Cited Researchers. We are saddened to acknowledge the loss of two major figures in mathematics this past year, Heinz-Otto Kreiss and Nobel Prize laureate Lloyd Shapley.

In 2015, our Putnam team brought UCLA to first place among public universities and 6th place overall among 447 institutions across the United States and Canada, the biggest accomplishment in our long history of Putnam competitions. Student teams in our newly minted major in actuarial studies won awards in important case competitions, which we anticipate to be the first of many. Their accomplishments coincide with our profile of two alumni who have been instrumental in the success of the UCLA actuarial program over two decades. The Curtis Center launched a million-dollar project to develop mathematical modeling tasks for primary and secondary school students in 21 states.

In each issue of *The Common Denominator*, we record our many donors in recognition of their contributions, which help us maintain important Department programs. I thank them once again. I also want to thank all of our math faculty, staff and students who are the engines for our success.

Sincerely,

William Duke

UCLA Department of Mathematics
Fall 2016 Newsletter

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Connie Jung
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UCLA Department of Mathematics
520 Portola Plaza
6363 Math Sciences
Box 951555
Los Angeles, CA 90095-1555
310-825-4701

http://www.math.ucla.edu/