THE
Common Denominator

UCLA DEPARTMENT OF MATHEMATICS NEWSLETTER

The Crafoord Prize in Mathematics 2012 Goes to Terry Tao

This spring, one of the world's largest and most prestigious scientific prizes acknowledged the extraordinary ongoing accomplishments of **Terry Tao**. Awarded by the Royal Swedish Academy of Sciences, the Crafoord Prize vies with the Fields Medal, which Terry received in 2006, as the highest honor attainable by a mathematician.

Terry shares the Crafoord Prize with Jean Bourgain (Institute for Advanced Study, Princeton). Both mathematicians were cited "for their brilliant and groundbreaking work in harmonic analysis, partial differential equations, ergodic theory, number theory, combinatorics, functional analysis and theoretical computer science." Their contributions to the fundamental results in the field of mathematical analysis, on their own and jointly with others, were particularly recognized. The ability of both laureates to change perspective and view problems from new angles has led to many remarkable insights.

Terry maintains that we are living in "a golden age for mathematics," creating opportunities with the potential to enhance and enlighten human existence. This is partly because mathematics, historically a solitary pursuit, has become collaborative and interdisciplinary, inviting new approaches to old problems.

Terry is a model of collaborative research. His work on prime numbers, conducted with Ben Green, a professor of mathematics at the University of Bristol in England, was cited by *Discover* magazine as one of the 100 most important discoveries in all of science for 2004. Along with his collegial collaborations, Terry credits feedback from his mathematical research blog for ideas and inspiration.
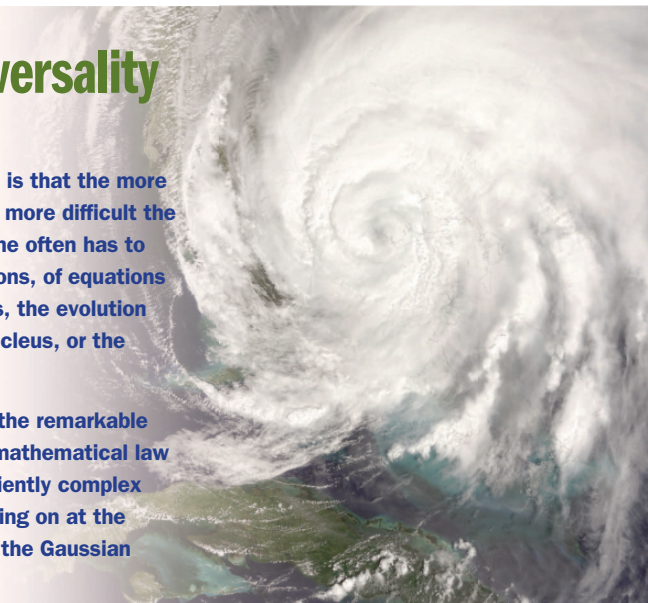
INSIDE

UCLA

Our Fascination with Universality

by Terence Tao

One thing we learn early on in our maths education is that the more equations and unknowns one has in a problem, the more difficult the problem becomes to solve. But in the real world, one often has to deal with systems that have thousands, if not millions, of equations and unknowns, whether it be modeling an ideal gas, the evolution of an ecosystem, the energy levels of an atomic nucleus, or the outcome of an election poll.

Nevertheless, for many complex systems we have the remarkable phenomenon of universality: that there is a single mathematical law that governs the macroscopic behavior of all sufficiently complex systems of a certain type, regardless of what is going on at the microscopic level. A well known example of this is the Gaussian

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Nurtured as a child prodigy, Terry has been working out math problems since he was a pre-schooler. Although he only began shaking up the field of mathematics at the age of 21 when he was recruited to UCLA fresh from his Princeton doctoral degree, he was, at that point, already a learned mathematician with almost 20 years of experience.

Since his arrival in the Department in 1998, Terry has accrued 29 national and international honors, including a Fields Medal; a MacArthur Fellowship; the Alan T. Waterman Award, the highest honor bestowed by the National Science Foundation; and along with the Crafoord Prize this year, a Simons Investigator Award. He is a Fellow of the American Academy of Arts & Sciences and holds the first James and Carol Collins Chair in the UCLA College of Letters and Science. Already, he has 182 publications, including research papers, books and book chapters and currently serves on the editorial boards of four academic journals. Says John Garnett, professor and former chair of the Department, "Terry is like Mozart; mathematics just flows out of him."

One of Terry's current research interests is the concept of universality. In a recent article published by the American Academy, "*E Pluribus unum*: From Complexity, Universality," Terry explores the phenomenon of universality in complex systems. The phenomenon in which macroscopic laws of nature emerge from a variety of different microscopic dynamics is widely observed empirically; however, it does not apply in all cases. For instance, no satisfactory universal laws for the movement of stock prices or weather prediction beyond two weeks have ever been discovered (as we all painfully know). It is a staggering challenge, but Terry is investigating this absence of a known rigorous mathematical foundation for universality.

UCLA Math Moves Up in the 2012 Academic Ranking of World Universities in Mathematics

UCLA Math now ranks ninth – moving up from 10th place in 2011 – according to researchers at the Center for World-Class Universities of Shanghai Jiao Tong University in their annual Academic Ranking of World Universities (ARWU).

ARWU is a prestigious annual survey of more than 1,000 universities, using six objective indicators to rank world universities by institution (top 500), by field (five fields) and by subject (five subjects, including mathematics). One of the factors for the significant influence of ARWU is its scientifically sound, stable and transparent methodology.

ARWU 2012 Rankings by Subject

www.shanghairanking.com/SubjectMathematics2012.html

World Ranking	Institution	Country	Total Score
1	Princeton University		100
2	Harvard University		93.1
3	University of California, Berkeley		88.9
4	University of Cambridge		86.9
5	Stanford University		80.3
6	University of Oxford		78.3
6	University of Paris Sud (Paris II)		78.3
8	Pierre & Marie Curie University (Paris 6)		77.6
9	**University of California, Los Angeles**		**75.0**
10	Massachusetts Institute of Technology (MIT)		73.9

Putnam Competition Results

UCLA's student math team ranks # 12 in U.S.A. and Canada (See page 12)

Our Fascination with Universality

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distribution (more popularly known as the normal distribution or bell curve) that governs an amazing array of statistics, ranging from the number of car crashes on a given day, to the error in an election poll, to the height of a human male or female. Another example is Benford's law that governs the first digit of many naturally occurring statistics (such as the population of a city, the market value of a company, or the value of a physical constant) and gives the unintuitive prediction that the digit 1 is about six times more likely to be the first digit of such a statistic as the digit 9. (This law is actually used to catch accounting fraud, since fraudulent statistics often do not conform to this law.)

In some cases, the mathematical explanation for universality is well understood. (For instance, the Gaussian distribution is explained by a fundamental result in probability known as the central limit theorem.) But there are other universal laws for which we only have a partial mathematical understanding. One such law that I am particularly interested in is the Gaussian unitary ensemble (GUE) law, which we believe governs an incredibly wide range of statistics, from the spectral lines of atomic nuclei to the zeroes of the Riemann zeta function (a fundamentally important function in number theory), and even to spacing between arrival times of buses at a bus stop! While we do not yet have a satisfactory explanation of this law in most contexts, in recent years there has been a lot of progress by many mathematicians (including me) on being able to rigorously establish this law (as well as several related laws) for some simple classes of mathematical models known as random matrix models. Among other things, we have discovered that the spectral statistics of random matrices are extraordinarily stable; for instance, one can swap a large number of entries (or even all the entries) of such a matrix with a different set of entries, and (under some additional hypotheses) still obtain almost the same universal spectral distribution afterwards. From this and other observations, we are beginning to get a better insight as to the true source of universality for these models, although there is still plenty of work to do, particularly in establishing universality for more realistic classes of models than the random matrix models.

No satisfactory universal law for weather prediction beyond two weeks has ever been discovered.

Faculty Additions

Passionate About Geometry

Burt Totaro joins the Department as professor in the geometry group. He is an algebraic geometer who has made significant contributions to many fields of mathematics, including topology, commutative algebra, differential geometry, algebraic geometry, number theory, group cohomology, Lie theory and representation theory in characteristic p. His use of topological ideas has been especially noteworthy: fruitful and influential. Many of his methods and ideas are aimed toward the famous Hodge conjecture in algebraic geometry. His manifold interests and expertise in numerous fields will complement the diverse research areas of the Department.

Burt received his PhD at the age of 21 in 1989 at UC Berkeley under the direction of Shoshichi Kobayashi. His first academic positions were as a Dickson Instructor and then an assistant professor at the University of Chicago. Since 1999, Burt has been at the University of Cambridge, first as a lecturer, then as the Lowndean Professor of Astronomy and Geometry. Because of his work on characteristic numbers on singular varieties, he was an invited speaker at the International Congress of Mathematicians in 2002. In 2000, he was awarded the Whitehead Prize by the London Mathematical Society, and in 2009, he was elected as a Fellow of the Royal Society.

Faculty News Highlights

Russel Caflisch and **Thomas Liggett** joined 220 national and international scientists, scholars, writers, artists and other professionals who were elected to the **American Academy of Arts and Sciences** in 2012. The honor recognizes preeminent contributions to a range of disciplines

> **Since its founding in 1780 as a center for independent policy research, the American Academy of Arts and Sciences has elected leading "thinkers and doers" from each generation.**

and to society at large. Russ and Tom are two of six UCLA professors named this year. Since its founding in 1780 as a center for independent policy research, the academy has elected leading "thinkers and doers" from each generation, including George Washington and Benjamin Franklin in the 18th century.

Jiun-Shyan (JS) Chen received a Computational Mechanics Award, given biannually by the **International Association for Computational Mechanics** to recognize significant contributions to traditional and new areas of the field. He has joint appointments in mathematics, environmental engineering, and mechanical and aerospace engineering. The award acknowledged his seminal contributions to nonlinear finite element and mesh free methods, arbitrary Lagrangian Eulerian finite element method for large deformation and contact mechanics, multi-scale materials modeling, and the stabilized Galerkin and collocation mesh free methods.

Mark Green was named a 2011 fellow by the **American Association for the Advancement of Science** (AAAS), the world's largest general scientific society and the publisher of the journal *Science*. He was among five UCLA scholars to be selected this year. Members are chosen for their distinguished efforts to advance science or its applications. Mark was honored for "outstanding research in several complex variables, commutative

> **Mark Green was honored for "outstanding research in several complex variables, commutative algebra, Hodge theory, and algebraic geometry, and for co-founding the Institute for Pure and Applied Mathematics."**

algebra, Hodge theory, and algebraic geometry, and for co-founding the Institute for Pure and Applied Mathematics" (IPAM). IPAM is a national research institute at UCLA, funded by the National Science Foundation.

Chandrashekhar Khare was named among 44 new 2012 fellows and eight foreign members elected to the **Fellowship of the Royal Society**. The society cited him as an "extremely original mathematician studying the relationship between Galois representations and modular forms. His forte is finding ingenious but relatively simple new ideas." Founded in 1660, the Royal Society is a self-governing fellowship of many of the world's most distinguished scientists drawn from

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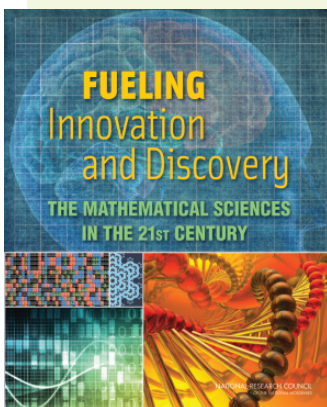
all areas of science, engineering and medicine, including more than 80 Nobel Laureates.

Ciprian Manolescu was awarded a **European Mathematical Society** prize at the 6th European Congress of Mathematics in Krakow, Poland. Prizes are awarded every four years to outstanding researchers under the age of 36. Ciprian was recognized for his deep and highly influential work on Floer theory (particularly for his key role in the development of combinatorial Floer theory), successfully combining techniques

Mathematical Sciences in the 21st Century

The National Research Council released its preliminary report *Fueling Innovation and Discovery: The Mathematical Sciences in the 21st Century* in advance of its final study *The Mathematical Sciences in 2025*. The report available now is intended for a broader public and comprises a series of vignettes about the impact of mathematics. The report committee, which includes **Mark Green** as vice-chair, was commissioned by the National Science Foundation to "produce a forward-looking assessment of the current state of the mathematical sciences and of emerging trends that will affect the discipline and its stakeholders."

The report is available at **www.nap.edu**.

The UCLA Division of Physical Sciences (including mathematics) placed ninth in The Times Higher Education 2011 – 2012 World University Rankings of 400 institutions.

from gauge theory, symplectic geometry, algebraic topology, dynamical systems and algebraic geometry to study low-dimensional manifolds.

Alexander Merkurjev was awarded the 2012 **Frank Nelson Cole Prize in Algebra** by the American Mathematical Society for his work on the essential dimension of groups. The prize citation notes that "Merkurjev's unique style combines strength, depth, clarity, and elegance, and his ideas have had broad influence on algebraists over the

> **The Cole Prize citation notes that "Merkurjev's unique style combines strength, depth, clarity, and elegance, and his ideas have had broad influence on algebraists over the last three decades."**

last three decades." Founded in 1928 in honor of Professor Cole, the prize is awarded every three years for outstanding contributions to algebra.

Itay Neeman and **Sorin Popa** each received a 2012 **Simons Investigator Award** from the Simons Foundation's Division of Mathematics & the Physical Sciences. This is the inaugural year for the award, which supports year-long academic leaves for dis-

tinguished scientists to facilitate advances in their research. Sorin will conduct research on a variety of problems at the crossroads of functional analysis (operator algebras), ergodic theory and group theory at the Institut de Mathématiques de Jussieu and the Collège de France in Paris. Itay will go to UC Berkeley to conduct research in set theory, with the goal of developing methods for establishing the consistency of set theoretic statements that involve large values for the continuum.

William Newman was invited to deliver the prestigious **Yuval Ne'eman Distinguished Lectures in Geophysics Atmospheric and Space Sciences** at Tel-Aviv University in Israel. The lecture is endowed by Raymond and Beverly Sackler. William holds joint appointments in the Department of Earth and Space Sciences, the Department of Physics and Astronomy, and the Department of Mathematics.

Sebastien Roch and **Marcus Roper** were awarded 2012 **Sloan Research Fellowships** in mathematics. The two-year fellowships from the Alfred P. Sloan Foundation are given to early career scientists and scholars whose potential and achievements identify them as the next generation of scientific leaders. Sebastien's research uses stochastic modeling and probabilistic analysis to develop new methods for solving large-scale statistical and computational problems – for instance,

in evolutionary genomics. Marcus is especially interested in studying the physical constraints on organisms that must disperse, grow or propel them-

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selves in challenging physical environments. Sebastien and Marcus are two of six UCLA 2012 Sloan Research fellows.

Terence Tao received three distinguished honors this academic year: ■ **The Crafoord Prize in Mathematics**, 2012, awarded by the Royal Swedish Academy of Sciences. Terry shares the award with Jean Bourgain (Institute for Advanced Study, Princeton University). ■ **Simons Investigator** appointment from the Simons Foundation. The award will provide significant research support to Terry over the next five years, with an anticipated renewal for an additional five years. ■ Election to the **American Philosophical Society**. The country's oldest learned society, founded in 1743 by Benjamin Franklin, recognizes extraordinary achievements in science, letters and the arts.

UCLA Math Postdoc Receives Chancellor's Award for Postdoctoral Research

David Uminsky was one of six recipients of the **2012 UCLA Chancellor's Award for Postdoctoral Research**. Of the approximately 1,000 UCLA postdoctoral scholars, 27 were nominated across disciplines in the basic and applied sciences, the professional schools, the social sciences and the humanities. David was recognized for his research in the mathematics of interacting particles in collaboration with UCLA applied mathematics professor Andrea Bertozzi. This research area has applications in biology and the complex phenomena observed in locust swarms and bacterial colonies, as well as in engineering in many areas of cooperative control, including applications to robotic swarming.

faculty news

UCLA Crime Group Goes Entrepreneurial

Futuristic research on predictive policing, conducted by the "UCLA Crime Group" (specifically mathematicians **Andrea Bertozzi** and **Martin Short**, anthropologist P. Jeffrey Brantingham, and former math postdoc **George Mohler**), has resulted in the establishment of a small business called PredPol. The UCLA scientists began six years ago with general research in the area of modeling crime. Their work led to a number of results, including a new software tool for crime mapping developed at Santa Clara University by George Mohler. The software was subsequently piloted by the Los Angeles Police Department, which continues to use it effectively in five divisions that protect and serve 1.3 million people across 130 square miles.

The software generates prediction boxes – as small as 500 square feet – on a patrol map, where, based on algorithms, crimes (especially property crimes) are likely to be committed. When officers have time, they are told to patrol "in the box." The goal is not to boost the number of arrests but to disrupt a crime in progress or deter would-be criminals. It also has labor-saving potential for law enforcement.

For more information about PredPol, visit **www.predpol.com**.

Basil Gordon, Professor of Mathematics Emeritus
In memoriam, 1931 – 2012

Basil's pursuit of excellence in the field of mathematics spanned his entire adult life. While still an undergrad, he spent a year in Hamburg, Germany, studying with the great algebraists Emil Artin and Ernst Witt. He received his master's degree in mathematics from Johns Hopkins University in 1953 and his PhD from Caltech in 1956, under the supervision of the number theorist Tom Apostol. Basil's thesis on Tauberian theorems set him on a course of continuing contributions to the field of number theory throughout his career. Following his education, Basil was drafted into the Army. His mathematical talents were employed on a new mobile battlefield computer (just small enough to fit on a truck). Later, the Army found a higher calling for him, moving him to Huntsville, Alabama, where his expertise in celestial mechanics was an asset in orbital calculations for Explorer I, America's first successful effort to launch a satellite.

Basil joined UCLA in 1959 and remained in the Department until his retirement in 1992. He was cultured, generous, gentle and above all, inspirational, to his students, his colleagues, and his collaborators. His academic career exemplified teaching, research and service. In 1967 he received the UCLA Distinguished Teaching Award. From 1960 to 1993, he supervised 26 doctoral students (more than almost anyone else in the Department), and he played an important role as coach of the William Lowell Putnam Mathematics Competition team for many years. Under Basil's direction, the UCLA team received its best national ranking of third place in 1968 – 1969.

Basil's research career focused on the areas of algebra, number theory and combinatorics. He wrote 74 research papers in total, about 20 on his own and the rest with 37 co-authors. He made fundamental and important contributions in many different areas, including combinatorics (difference sets) and coding theory, algebra, and group theory, but he is best known for his work in combinatorial number theory on partitions and partition identities.

Basil devoted a large part of his life to the profession through his service on mathematical journals. He was a founding editor of the *Ramanujan Journal* and the managing editor of the *Pacific Journal of Mathematics* for a number of years. Most importantly, he was a co-founder of the *Journal of Combinatorial Theory, Series A*, and co-managing editor for 32 years. His efforts played a key role in affirming its status as the world's premier combinatorial journal.

No remembrance of Basil would be complete without mention of his lifelong interests in history, poetry, literature, art, popular culture, and especially classical music. A talented pianist, he began studying at The Peabody Institute of the Johns Hopkins University starting at 8 years of age. He owned three grand pianos, which he played regularly by himself and in chamber music with others. He had a huge collection of recorded music and piano sheet music, an indicator of his love of music and his scholarship in the field.

Basil died on January 12, 2012, at the age of 80.

Research Conferences Honoring Faculty Milestones

The Department and the Institute for Pure and Applied Mathematics (IPAM) hosted three international research conferences to honor the service and academic accomplishments of distinguished faculty members who celebrated birthday milestones this year.

Tony Chan

Frontier of Computational and Applied Mathematics, honoring Tony Chan's 60th birthday, focused on fundamental theory and numerical analysis, numerics and applications in compressed sensing, imaging, optimal engineering design and networking. Tony has been a professor in the Department since 1986. He served as the Department chair 1997 – 2000 and as the Dean of Physical Sciences, 2001 – 2006. Subsequently, he served as the assistant director of the National Science Foundation Directorate for Mathematics and Physical Science, 2006 – 2009, and after retiring from UCLA in 2009, he has held the position of president of Hong Kong University of Science and Technology.

p-adic Modular Forms and Arithmetic, honoring Haruzo Hida's 60th birthday, provided a forum for researchers to present current work on the connection between (p-adic) L-functions, Shimura varieties, and (p-adic) Galois representations. Haruzo has been a professor in the Department since 1987.

Haruzo Hida

Stanley Osher

Advances in Scientific Computing, Imaging Science and Optimization, honoring Stanley Osher's 70th birthday, highlighted recent progress and new directions in several important aspects of scientific computing, imaging science and optimization, topics that have significantly benefited from Stan's many contributions. Stan has been a professor in the Department since 1976. He is concurrently the director of special projects at the Institute for Pure and Applied Mathematics (IPAM).
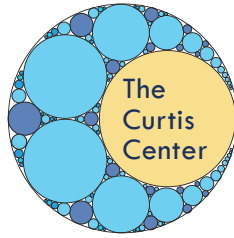

Joe Teran

Winter Salon: Scientific Computing for Movies, Video Games and Virtual Surgery

Presented by Dean Joseph Rudnick of the Division of Physical Sciences and former Chair Sorin Popa of the Department of Mathematics, the Winter Salon focused on the work of math professor Joseph Teran, a pioneer of virtual surgery. His research in computational geometry and many-core computing has allowed surgeons to practice on 3-D "digital doubles" of their patients before the actual procedure takes place. In addition, he uses the computer to solve equations that reproduce natural phenomena like burning fire and flowing water for movie and video game special effects.

math education

The Curtis Center

K-12 Outreach – Mathematics Institute for Young Scholars

The 2012 Mathematics Institute for Young Scholars had its third successful session. Led by Curtis Center instructors and UCLA graduate student David Taylor, the course covered a range of topics in knot theory, Bezier curves and cryptography. The students enrolled in the program attended an invited talk on robotics and a special two-day lecture series at IPAM, where they had a glimpse of undergraduate mathematics at UCLA.

A participant in the Young Scholars program examines a model after the robotics talk.

Mathematics Diagnostic Testing Project (MDTP)

The MDTP site at UCLA continues to serve secondary mathematics teachers and their students in Los Angeles and Ventura counties by distributing diagnostic testing materials and providing detailed reports that help identify students' math strengths and weaknesses. UCLA MDTP is currently working intensively with a low performing local high school and its feeder middle schools in a two-year project sponsored by the California Academic Partnership Program. Project goals include the development of formative assessment processes to help students pass algebra the first time and identification of successful teaching practices that can be scaled to the larger district.

Teacher Continuing Education

In spring 2012, over 300 elementary, secondary and university instructors attended the annual Curtis Center Math and Teaching Conference. The focus of the conference this year was the new Common Core Standards for Mathematics. Jason Zimba, lead writer of the standards,

Workshop participants focus on the new Common Core Standards for math.

Susie Håkansson and Bruce Rothschild to Retire

After 20 years as executive director of the statewide California Mathematics Project, Susie Håkansson will retire in December 2012. She has made essential contributions to the university, the Department and the teaching of mathematics in California and will be greatly missed.

Bruce Rothschild's eight-year commitment to the Department's teacher preparation program has been highlighted by his role as faculty director for the Curtis Center since 2008. He has been indispensable to the growth of math education and the center. In anticipation of his retirement next July, the Curtis Center Committee has been established to continue the center's faculty direction.

delivered the keynote address. The conference also offered talks on elementary, middle and high school Common Core preparation and featured a reunion for participants of the UCLA Joint Math Education Program.

Los Angeles Math Circle (LAMC)

Over 200 students participated in LAMC this year. In addition to weekly problem-solving sessions, some entered national competitions. Several students received top 1 percent and 5 percent scores on American Math Competitions (first of a series of high school math competitions that determine the U.S. team for the International Mathematical Olympiad); seven students won national and state awards in Math Kangaroo, a popular international not-selective competition; and eight students earned scholarships from Math Moves U, an innovative initiative sponsored by Raytheon to engage middle school students.

Enthusiastic Match Circle students

California Mathematics Project (CMP)

With an Improving Teacher Quality State Grant from the California Postsecondary Education Commission (CPEC) and the California Department of Education, CMP conducted a successful national Mathematics Teacher Retention Symposium, offering 25 sessions to 150+ researchers and practitioners. CMP will publish a monograph on mathematics teacher retention, available online in fall 2012.

IPAM

Institute for Pure & Applied Mathematics

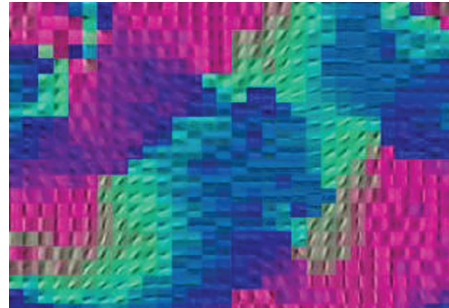## Machine Learning – Computer Intelligence Comes of Age

The promise of artificial intelligence (AI) has been with us for 40 years, but it is just in the last 10 years that machine learning has enabled computers to perform intelligent tasks, such as recognizing faces, speech and images and sorting through massive amounts of data to help us make decisions. IPAM's 2012 Graduate Summer School: Deep Learning, Feature Learning, presented the current status of machine learning and explored the next steps of its development.

"Our science advisory board felt that after making some solid achievements, machine learning has come of age and is poised to move rapidly across a range of disciplines," says Russ Caflisch, UCLA professor of mathematics and IPAM director. Stan Osher, UCLA professor of mathematics and one of the summer program coordinators, agrees: "I've never seen technology transfer so quickly."

Stan suggests that medicine has been the principal beneficiary of machine learning, especially in the area of imaging, and that its impact will grow exponentially in that field. The military is another area that is pushing the limits of machine learning, developing new ways to put machines instead of human beings in harm's way. Russ suggests that marketing will have the greatest impact on us as we go about our daily business, and it's already becoming a privacy issue as computers compile information on our preferences and habits.

The amazing progress of machine learning, especially deep learning, is enabled by the convergence of three scientific advances:

First is the development of a structure called a

"Machine learning is one of the most exciting things going on in applied mathematics today. We are finally realizing much of the promise of artificial intelligence."

– Russel Caflisch

neural net, which, in a simple way, mimics the processing structure of the human brain. Starting out as a blank slate, a neural net can be trained to make decisions based on exposure to massive amounts of data through application of probability and optimization.

Second, faster computers and networks have made it possible to digest and manage the very large data sets that are necessary for decision-making.

And third, improved mathematical methodologies have been tremendous force-multipliers for the algorithms of deep learning. A primary methodology is "sparsity," the ability to compress data to a point where it can be used intelligently. Says Russ, "It's a cliché, but we are awash in data – so much so that even computers can't handle it without help from mathematics." Spar-

sity is addressing this issue and constituted a significant part of the IPAM program.

Bringing together experts from many disciplines, including engineering, computer science and mathematics, the IPAM program sought to address a number of deep learning issues. Over the course of three weeks, 100+ graduate students and faculty members took advantage of some of the best researchers in their fields presenting state-of-the-art material. The mathematics included characterization of high-dimensional data sets, training of density models, geometry of non-convex and ill-conditioned loss functions for deep learning, optimization methods for inference and deep learning, representational efficiency of deep architectures, and advantages of high-dimensional and over-complete representations.

In addition to tutorials and lectures, a hands-on section featured demonstrations of cutting edge software packages, which participants were able to manipulate on their laptops through the cloud. Receptions and poster sessions provided opportunities to informally exchange and develop ideas. Student attendance and participation were extraordinary, right up to the last day. Russ observes, "The subject attracted people from many disciplines, which is what made this meeting exciting, and they were able to immerse themselves over an extended period of time, which will likely further the research – we'll know the impact of the program in a couple of years when news comes out and papers are published. This is what IPAM is all about."

Considering the future, Stan suggests, "Although the ultimate goal of all of this is to replicate human intuition, and we're getting close, it will not be like the movies; it's less mysterious. It will be 'yes' and 'no' calculations, but it will be beautiful mathematics."

Download a copy of IPAM's newsletter: http://www.ipam.ucla.edu/newsletter.aspx

2013 Green Family Lecture — Fields Medalist Wendelin Werner will present the second Green Family lecture in June 2013. A faculty member at the Université Paris-Sud 11/ CNRS, he was awarded the 2006 Fields Medal for his work in probability. The Green Family Lecture Series was established through a generous endowment by UCLA Emeritus Professor and Founding IPAM Director Mark Green.

graduate news

The fall 2012 incoming class of 43 graduate mathematics students was selected from over 500 applicants, a Department record for both the largest applicant pool and the most acceptances.

2012 Graduates Take Flight

Patrick Allen *to*
Northwestern University

Patrick's interest in math emerged in high school and only then through the encouragement of a teacher who gave him advanced problems. "I was good at math, but growing up in a small town has its limits – no special programs – and I was just doing things by rote. In fact, I got in trouble for letting my homework go; a note would be sent home. " Once intrigued, Patrick went on to succeed as a pure math major in his undergraduate and master's programs, both completed in Ontario, Canada, not far from where he grew up.

When he arrived at UCLA, he already knew what he wanted to study. "I guess that's the advantage of doing a master's beforehand." According to Patrick, studying algebraic number theory under Chandrashekkar Khare was a perfect fit, and that became his dissertation focus. He recalls the number theory group at UCLA as incredibly busy, but helpful and warm, and always willing to chat about math.

Los Angeles also turned out to be perfect for Patrick's interest in mar-tial arts, particularly Muay Thai, offering advanced training by high profile teachers. Now, he has brought his commitment to algebraic number theory (and his new sport) to a postdoc at Northwestern, where he hopes to pursue an academic career.

Tye Lidman *to the University of Texas at Austin*

Playing with math puzzles gave Tye an affinity for math at a young age. Spending most of his life in California, including an undergraduate degree at UC Berkeley, he looked forward to staying close to home and exploring all the possibilities in the UCLA math department. Says Tye, "At UCLA there were lots of different people doing lots of different things, so my time there was very productive, and it taught me academic independence."

Tye focused on topology at UCLA. His dissertation on low dimensional topology, specifically, three-dimensional spaces and knots inside the spaces, was done under the supervision of Ciprian Manolescu. What he didn't expect during his tenure was to develop an interest in mathematics education.

Tye's UCLA teaching experience prepared him well for the rigors of his postdoc at U of T. About teaching a course on matrices during his first semester, he jokes, "It's interesting being the sole provider of all knowledge for 100 non-math majors." His research is being nurtured by the rich curriculum at U of T, and as always, he is looking forward to research in topology.

Message from New Graduate Vice Chair Paul Balmer

Let me first of all thank my predecessor, Itay Neeman, for his remarkable work as graduate vice-chair over the last two years. Thanks to his dedication and that of his predecessors, our graduate program continues to thrive, following our Department's own rise to the very top of mathematical excellence. This section of the newsletter will provide ample evidence of the successes of our graduate program, maybe most remarkably in terms of our students' post-PhD placements in prestigious institutions. As the best mathematician of all time once said, "La fécondité se reconnaît à la progéniture, et non par les honneurs," which translates approximately into "Fecundity is recognized by offsprings, not by honors." Although my colleagues might have different mathematicians in their personal pantheon, they will all agree that our graduate program is a pillar of our Department's vitality. We view the large incoming class of new students with all the intellectual excitement associated with the prospect of sharing our most advanced knowledge and of exploring further scientific territories.

Davide Reduzzi *to the*
University of Chicago

Davide grew up in a "Renaissance" family in a small town in Italy with a range of talents from philosophy to ballet to architecture. Davide developed an interest in math in high school. "I don't know where I got my love of math, but I was always encouraged to read and think critically."

In college, Davide refined his mathematical focus – abstract algebra and number theory – an interest he maintained through his master's degree in Italy and his doctorate at UCLA. "I was lucky to find something I love right from the beginning."

Arriving in the Department with only "math English," he was surprised how helpful people were, not only at UCLA, but everywhere in L.A. Davide's research into number theory fortuitously coincided with the research interests of Chandrashekhar Khare. He became Davide's faculty advisor for his dissertation on congruences (mod p) between modular forms arising from different geometric settings.

A cross country road trip from L.A. to his postdoc position at the University of Chicago deepened Davide's dream to stay in America and pursue a career in academia. "Chicago has a great number theory department, and I'm teaching algebra; it's the best combination."

Laura Smith *to the*
University of Southern California

Being in a military family taught Laura to quickly adapt to new people and new environments. It also gave her an appreciation for the shifting sands of opportunity: "I was born in a country that no longer exists (West Germany) and in a city that no longer exists (closed military base turned into an airport)."

Arriving at UCLA after completing her bachelor's degree in three years followed by a master's degree, she already knew that she wanted to work in applied math, but she took advantage of the Department's academic diversity by "shopping" for a research focus. She reminisces, "I spent the first half of the PhD program taking a variety of courses and working on a few projects, which all had different demands. The program taught me how to do research across many platforms and how to present the information in varying formats."

One of those research projects led to her thesis advisor, math professor Andrea Bertozzi, and to crime mapping, which she incorporated into her dissertation on mathematical modeling of gang behavior and territory. In her postdoc position at USC, she will apply herself to a new canvas – social media networks.

2011–2012 Student Honors

Each year the Department honors outstanding graduate students with awards and prizes. This year Sorgenfrey Distinguished Teaching Awards went to Rachel Hegemann, Davide Reduzzi, Hayden Schaeffer, and Melissa Tong; The Horn-Moez Prize for Excellence in First Year Graduate Studies went to Jeffrey Lin and Shuang Wen; and Beckenbach or Dissertation Year Fellowship Awards went to Michael Hall, Bradley Rodgers, Hui Sun and Anush Tserunyan.

undergraduate news

Strengthening and Modernizing the Mathematics Major

New Standards for Math

The fall 2012 math undergraduate class is 607 strong! An increasingly popular choice by UCLA's incoming students, academic requirements in math have recently been strengthened by new standards. Beginning with the 2012 – 2013 academic year, math and math/econ majors must achieve a higher GPA in the pre-major mathematics sequenced courses, and all students in any major must obtain a higher grade in two critical courses, Linear Algebra and Analysis.

Peer Math Learning Project (PMLP)

Launched in 2012 – 2013 as a pilot program in Math 32A (calculus), PMLP replaces the Covell Commons Program. Adjunct to coursework, the program is designed to help students master valuable skills such as study strategies and time management; learn to apply these skills to current and future courses; and help them become better mathematics students throughout their academic careers. An experienced graduate student ("Mentor") will oversee undergraduate peer learning facilitators (PLFs) who, in turn, will conduct the sessions.

First Capstone Major in Mathematics

As part of UCLA's initiative to create more undergraduate capstone majors – akin to a dissertation in graduate programs – Mathematics for Teaching became the first of the Department's five majors to receive certification. To participate in the program, students complete a year-long course sequence that culminates in a paper, a portfolio and a model lesson presentation in a K-12 classroom.

2012 Logic Center Summer School

With support from an NSF grant, the UCLA Logic Center conducted a three-week summer school for undergraduates. The goal was to introduce future mathematicians to central results and techniques of mathematical logic. The intensive courses were designed to assume little if any prior experience with logic, yet reached highly advanced, graduate level material within three weeks. The program served as a good introduction to the kind of research work that math students can expect in graduate school.

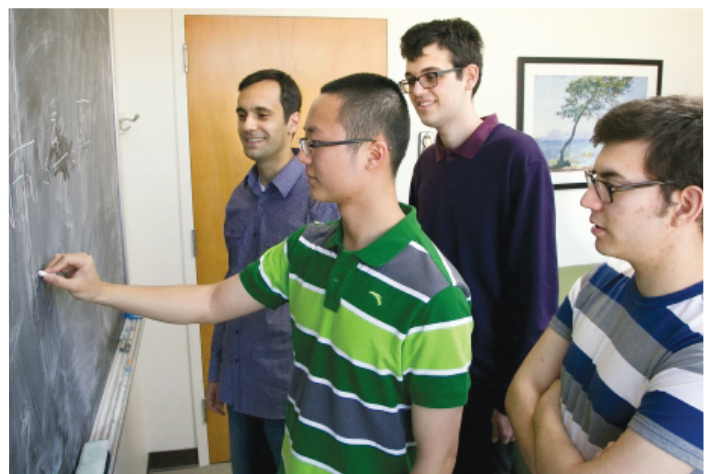# UCLA Putnam Team Ranks #12 in the U.S.A. and Canada

Over 500 U.S. and Canadian colleges and universities participated in the 2011 William Lowell Putnam Mathematical Competition. Upon conclusion of this arduous exercise, the UCLA team placed 12th, achieving its best ranking since 1970.

Math undergrads Francisc Bozgan, Cheng Mao and Tudor Padurariu made up the UCLA team, Tudor and Cheng receiving honorable mentions for their individual scores. Other high ranking UCLA students include Michael Burks, Daniel Montealegre and Bingfeng Lu. In all, 25 UCLA students participated in the competition.

"One reason we are doing better," explained the team's coach, Ciprian Manolescu, "is the UCLA Math Undergraduate Merit Scholarship." Established in 2010 by former Department chair Sorin Popa, the scholarship is intended to attract outstanding high school students to UCLA's undergraduate math program. Both Tudor and Francisc came to UCLA from Romania on this scholarship. Cheng, who is from China, came to UCLA as an engineering major but says he now prefers math. All three team members hope to become math professors.

Founded in 1938 to stimulate a healthy rivalry among undergraduate math programs, the six-hour Putnam exam consists of 12 problems in two back-to-back sessions.

Read more about UCLA's Putnam team at **http://newsroom.ucla.edu/portal/ucla/ucla-s-student-math-team-defeats-232241.aspx.**

Math Prof. Ciprian Manolescu (far left) and UCLA Putnam team members (left to right) Tudor Padurariu, Cheng Mao and Francisc Bozgan

Museum of Mathematics Founder Gives Hands-On Commencement Address

Bringing the spirit of America's only museum of mathematics (MoMath) to the Department's commencement address, Founder and Executive Director Glen Whitney (PhD 1994) engaged the class of 2012 in a coin toss game of probability to demonstrate a standard "betting" scam practiced legally from Las Vegas to Wall Street. Through the game, he offered this advice to graduates: "Don't push your luck" and "Stuff happens, so be ready." Prior to devoting himself to MoMath, Glen pursued an academic career at the University of Michigan and worked as a hedge-fund quantitative analyst. He discovered the power of hands-on math exploration as an elementary-school math club coach and uses it as a tool in MoMath exhibits.

Alumnus Glen Whitney gives the commencement address.

Moneyball: Math Alums with High-Scoring Careers

This spring, the Department partnered with the UCLA Career Center to showcase careers in mathematics: Careerflix: Streaming Your Future. Five math alums shared experiences from their academic and career choices, along with former Department Chair Sorin Popa.

The panelists were: **JJ Espinoza**, Economic/Statistical Analyst at Econ One Research Inc. (BS 2009 math/app sci & BA 2009 econ); **Jamie S. Glazer**, VP for Financial Analysis & Revenue Control at IPC The Hospitalist Company (BS 1993 math/app sci & EDM 1994 educ); Kevin Liu, Sr. Analyst for Equity Research in the Software and Business Services Sectors, Financial Modeling, at B. Riley & Co. (BS 2005 math/econ); **Aleka McAdams**, Sr. Software Engineer at Walt Disney Animation Studios (PhD 2011 app math); **Meghana Reddy**, Advisory Consultant in Forensic Technology Solutions at PricewaterhouseCoopers (BS 2011 app math & BS 2011 elect engr); and **Robert O. Young**, Exec. VP & Head of U.S. Insurance at PIMCO (BS 1989 app math).

Panelists and math alums (from left to right) Jamie Glazer, Kevin Liu and Aleka McAdams

Life After the Degree Lecture Series

To help students plan for their careers, the UCLA Division of Physical Sciences sponsored a spring lecture series highlighting career options beyond the scope of traditional academic research. Two programs were presented utilizing panels of successful alums who discussed the many opportunities available to graduates in the physical sciences. ■ **Science & Entrepreneurship: Getting Started & Succeeding** Participants heard from five panelists who have taken their ideas to market and started their own businesses. Math/computer science alum Dan Gutierrez (BS 1978) spoke of opportunities presented by FundaGeek LLC, a company for which he is CEO and co-founder. (See the Alumni News section of this newsletter for more information.) ■ **Science & Industry: Breaking In & Climbing the Ladder** Participants heard from six panelists who have honed their scientific expertise to achieve success in a variety of industries. Applied math alum John Donald (PhD 2003), Senior Data Insights Manager in the Network Quality Division of Yahoo! Inc., and math/computer science alum Thomas King (BS 1979), Process Improvement Project Manager and Lean Six Sigma Black Belt at Xerox Corporation, discussed their experiences and the importance of business acumen and communication skills.

Susan Baumgarten. Executive-in-Residence for Technology at the UCLA Anderson School, moderated both panels. Susan is a three-time alumna of UCLA with a BA in mathematics and biochemistry, an MS in electrical engineering, and an MBA from the Anderson School.

Department Prizes and Awards

Daus Prizes: Benjamin Irvine graduated in applied mathematics with a specialization in computing. He will pursue a master's in computer science at Stanford University. ■ Pure math major **Michael Royston** simultaneously earned his master's in math as part of the departmental scholars program. He will pursue a PhD in math at UCLA.

Sherwood Prizes: Pure math major **Daniel Agress** plans to receive rabbinic ordination before pursuing his PhD in math. ■ **Tawny Lin** graduated in applied math with a specialization in computing and a minor in accounting. She will pursue her graduate studies in applied math and probability at UC Santa Barbara. ■ **Jialiang Mo** majored in math-econ with a minor in accounting. She will practice accounting and pursue a career in professional investing for nonprofit organizations.

Outstanding Actuarial Science Student Award: **Jiren Pan** graduated with double majors in mathematics/applied science and a concentration in actuarial science. He will pursue a master's in financial engineering at Columbia University.

Basil Gordon Prize: **Tudor Padurariu** was the top UCLA scorer on the 2011 William Lowell Putnam Mathematics Competition, receiving honorable mention for his score. He is a recipient of the Department's Math Undergraduate Merit Scholarship.

Putnam Honorable Mention Award: **Cheng Mao** was part of the three-member team in the 2011 UCLA William Lowell Putnam Mathematics Competition, receiving honorable mention for his score.

alumni news

UCLA Alumni Day 2012

In May, thousands of UCLA alumni flocked to campus with their families and friends for a day of fun, good food, lectures, reminiscing and more. Representatives from the Curtis Center showcased math education programs in the K-12 community and discussed opportunities in teaching mathematics in elementary, middle and high school. Applied math was highlighted in the Department's Info Fair through presentations by two graduate students. Hayden Schaeffer presented an interactive "molecular gastronomy" lab to explore mean curvature flow. As we all know from our morning cappuccinos,

the bubbles in the steamed milk join together to make a foam. Each of the bubbles aligns to minimize their own surface tension, which creates interesting and predictable geometries. Alexey Stomakhin presented his research on "invertible elasticity," conducted under the supervision of math professor Joseph Teran. Using animation physics, Alexey demonstrated physically based simulation of elastic objects (jello, rubber) and soft tissue (human skin, muscles). Such investigations have implications in several fields, including virtual surgery, a primary research focus of Teran and his team.

Alums Honored with Prestigious Awards

Tom Goldstein (PhD 2010) was awarded the 2012 **Richard C. DiPrima Prize** by the Society for Industrial and Applied Mathematics (SIAM) for his doctoral dissertation, Algorithms and Applications for L^1 Minimization, conducted under the supervision of math professor Stan Osher, and for devising an algorithm, the split Bregman iteration. This algorithm is remarkably effective for L^1 minimization, especially for applications in compressed sensing and total variation-based image processing.

Adrian Ioana (PhD 2007) was awarded a **European Mathematical Society (EMS) Prize** at the 6th European Congress of Mathematics in Krakow, Poland, for his impressive and deep work in the field of operator algebras and their connections to ergodic theory and group theory. In particular, he solved several important open problems in deformation and rigidity theory, among them a long-standing conjecture of Connes concerning von Neumann algebras with no outer automorphisms. Adrian earned his PhD under the supervision of math professor Sorin Popa and is currently an assistant professor at UC San Diego.

Math Alums Strike Out for Something Different

Danica McKellar – *Girls Get Curves*

Math alum Danica McKellar (BA 1998) received the 2011 UCLA Alumni Association Award for Recent Graduate Achievement. An actress, author and mathematician, Danica is a passionate advocate for math education, writing three New York Times best-selling books aimed at encouraging girls in math. Her fourth book, *Girls Get Curves: Geometry Takes Shape*, was released in August 2012.

Dan Gutierrez – *FundaGeek*

Math alum Dan Gutierrez (BS 1978) co-founded FundaGeek as a crowd funding resource to further great ideas through micro-pledges from anywhere in the world without giving up equity interests or incurring debt. Fundageek projects run the gamut from technology, scientific research and inventions to education, outreach and community support. Read more at **http://www.fundageek.com/.** An example is Guerilla Science, an outreach program created by the Department's own postdoctoral scholar, Mark Rosin.

Stay in Touch! Our alumni are important to us, and we would like to keep in touch with you! Please update your contact and professional information here: http://alumni.ucla.edu/mathupdate.

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UCLA Math Alum Supports California Math Undergraduate Merit Scholars with $100,000 Gift

Inspired to support promising California undergraduate math scholars, a UCLA math alumnus (BA 1954) and native Californian gave this significant gift as a way to honor his appreciation for the Department and the career opportunities his UCLA math degree afforded him in the aerospace industry. The anonymous donor hopes that the gift will provide much needed support for California students who excel at mathematics. Former Department of Mathematics Chair Sorin Popa initiated this ongoing program during his tenure.

A Gift from UCLA's Sonia Luna Supports Young Mathematicians in the Putnam Competition

Sonia Luna, a director in the UCLA Office of Academic Planning and Budget, chose to use her gift to support the UCLA team competing in the William Lowell Putnam Mathematical Competition. Sonia came to UCLA 16 years ago after working in a variety of corporate environments. Her roles have encompassed finance, strategic planning and management.

Thank you, Sonia!

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We are pleased to thank and acknowledge our many supporters.

Gifts of three digits and above made after June 30, 2012, will appear in our fall 2013 newsletter

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Dear Friends, Colleagues, Students and Alumni:

It is a great pleasure to welcome you to the latest edition of our newsletter. This past year has been remarkably successful for the Department. We learned that UCLA math placed fifth in the nation (ninth worldwide) in the most recent rating by the Shanghai Academic Ranking of World Universities, an honor supported by multiple accolades for our programs, faculty and alumni. Research performed at UCLA continues to make major contributions to the field of mathematics and its applications.

Terry Tao (jointly with Jean Bourgain) was awarded the Crafoord Prize, one of the highest honors in mathematics. In addition, he was elected to the American Philosophical Society and received a Simons Investigator Award this year. Itay Neeman and Sorin Popa were named Simons Foundation Fellows, and Mark Green became a Fellow in the American Association for the Advancement of Science. Russel Caflish and Thomas Liggett were elected to the American Academy of Arts and Sciences and Chandrashekhar Khare to the Royal Society. Sebastien Roch and Marcus Roper were awarded prestigious Sloan Research fellowships; Ciprian Manolescu won the European Mathematical Society Prize; and Alexander Merkurjev received the AMS Cole Prize in Algebra.

We are very excited by several developments in our undergraduate program, including 12th place in the Putnam Exam—the best showing by our math team in half a century. Our graduate program continues to be one of our jewels, attracting and producing near record numbers of PhD students.

I want to take this opportunity to thank Sorin Popa, who recently finished a three-year term as chair. Among many achievements, his pioneering effort in establishing the Mathematics Undergraduate Merit Scholarship Program will enable us to offer support to promising undergraduate students. Moving into the new academic year, we are very pleased to welcome Burt Totaro, a world renowned mathematician with expertise in algebraic geometry and algebraic topology.

Well deserved thanks are also due to Itay Neeman and Bill Duke, who finished their terms as graduate and administrative vice-chairs, respectively, and to Paul Balmer and Richard Elman, who have kindly agreed to step in.

Finally, I want to express our deep gratitude and appreciation to many of you whose kind support has been instrumental in our success.

Sincerely,

Dimitri Shlyakhtenko