AUTUMN 2009

NEWSLETTER OF THE DEPARTMENT OF MATHEMATICS AT THE UNIVERSITY OF WASHINGTON

Mathematics NEWS

DEPARTMENT OF MATHEMATICS NEWS

MESSAGE FROM THE CHAIR

As you might imagine, 2009 brought unusual challenges to our department. There were uncertainties well into the spring regarding our 2009-10 academic year budget. Graduate student recruitment, which takes place across the nation during the winter, was conducted without knowing the level of our TA funding. Similar scenarios played out nationally as few educational institutions were spared by the financial crisis. In a survey conducted by the American Mathematical Society, mathematics departments reported about 900 expected faculty openings nationally, down from about 1,500 in a typical year, despite expecting to award 1,300 PhDs in 2009 as in recent years. We reported expecting one new postdoctoral appointment at best, but we remained in touch with some of the top candidates as the possibility of making several appointments emerged in subsequent months.

When the extent of the reduction in the state budget gained clarity late spring, our department's budget (TAs, staff and operations – everything besides faculty salaries) was reduced by about 18%. Fortunately, a significant part of the reduction was replaced by temporary money made available for the 2009-10 academic year. Coupled with an increase of about 10% in the sizes of some of our classes this fall, the temporary funding enables us to continue to serve the record number of students enrolled at the UW. In particular, enrollment in Math courses is even higher this fall than in recent years. The continuation of this funding will be critical to our ability to meet student demand for mathematics in future years.

The faculty component of the budget was not spared. The College of Arts and Sciences is having to eliminate most of the faculty positions vacated by faculty who retire or leave over a two or three-year period. There is ongoing discussion and planning, led by the Provost's Office and the Dean's Office, to develop a vision to ensure the leadership of the UW in research and education for the next two to twenty years.

We are pleased to report that, despite the uncertainties, the Department's work continued unabated. We have a string of good news to share with you in this newsletter, such as the UW Sophomore Medal awarded to Chad Klumb, the newfound success of our students in the Putnam Competition, the election of Gunther Uhlmann to the American Academy of Arts and Sciences, and the NSF CAREER award to Ioana Dumitriu. Our undergraduate degree programs set new highs at the end of the 2008-09 academic year with 368 Math majors, and with a total of 537 majors in Math and ACMS. Thirteen graduate students completed the PhD, continuing our recent trend of awarding significantly more PhDs than the Department's historical annual average of 6.5.

During the spring and summer, we received a boost of federal funding, thanks to the excellent research projects proposed by department faculty and, partly, to the availability of stimulus (ARRA) funds. The list of these awards is headed by a $2,000,000 NSF Research Training Group grant in Inverse Problems and PDE. We were able to proceed with seven postdoctoral (acting assistant professor) hires, with the funding for six appointments split between the Department and NSF grants. Each of these impressive recent PhD recipients comes here to work with faculty who are leaders in their research area, and together they will add tremendous talent and energy to our research and teaching. We are also delighted to welcome Max Lieblich as an assistant professor. With these appointments and assuming renewal of the (temporary) funding, we are optimistic that the excellent work of the Department will continue in the coming years.

– SELIM TUNCEL

CONTENTS

Pictured (front cover):

Upper left: Academy of Arts and Sciences Fellow Gunther Uhlmann – See page 7. *Photo by Mike Munz.*

Lower left: Putnam Mathematics Competition students and teachers: (from upper left) Igor Tolkov, Nate Bottman, Ben Hayes (from lower left) teacher Ioana Dumitriu, Michael Rutherford, Will Johnson and teacher Julia Pevtsova. – See page 4. Photo by *Kathy Sauber*

Right: UW Sophomore Medalist Chad Klumb – See page 9. *Photo by Mike Munz.*

PUTNAM COMPETITION

UW Lands Impressive Finish in Putnam Mathematics Competition

The following article was published in *University Week*, the faculty and staff newspaper for the University of Washington. We thank *University Week* and Hannah Hickey for permission to include the article.

A combination of raw talent and skilled coaching has landed UW mathematics undergraduates an unprecedented finish in the 2008 Putnam competition, whose results were recently announced.

William Johnson, a sophomore in the Department of Computer Science & Engineering who grew up in Kenmore, placed sixth among about 3,700 competitors. Johnson had the highest score for a student at a public institution.

Two other UW students finished in the top 500 published scores. They are Nate Bottman, a senior in mathematics and Russian languages, and Keyun Tong, a freshman.

Each institution also selects three students to compete as a team and the Putnam publishes rankings individually and by school. The UW team, comprising Johnson, Bottman and Igor Tolkov, a sophomore in mathematics, placed 15th among 405 schools that competed in 2008.

The William Lowell Putnam Mathematical Competition is put on each year by the Mathematical Association of America. The competition began in 1938, and is open to first-time undergraduate students in the United States and Canada. The six-hour test is administered at each school on the first Saturday in December. Students have three hours to complete the first six problems, then break for lunch, then have another three hours to tackle the second problem set.

In a typical year more than half of the roughly 4,000 keen math students who take the competition earn a grand total of zero points. So scoring a few points, as all eight competitors from the UW did this year, is an accomplishment.

Johnson's sixth-place finish is even more impressive because two more points added to his 99-point score would place him among the top five, who are all named Putnam fellows. The association does not rank the winners or publish who among the five got the highest score. And being named a Putnam fellow is, in mathematics circles, a big deal.

"[If you look at the list or winners] many of the stars of American mathematics are on that list," said Selim Tuncel, chair of the Department of Mathematics. "If you go back to the 1930s and look at the names [of the Putnam fellows] as you go through the years you recognize them as superstars who then became very famous mathematicians." Past winners include Nobel prize-winners Richard Feynman and Kenneth Wilson, and John Milnor, David Mumford and Daniel Quillen, all of whom are Fields Medalists, an international honor for young mathematicians.

Much of the credit for this year's performance, Tuncel says, goes to coach Ioana Dumitriu, an assistant professor in the Department of Mathematics. In 1996, while a student at New York University, Dumitriu was the first woman to be named a Putnam fellow. She is pictured on the Mathematical Association of America's "Women of Mathematics" poster, now proudly displayed outside the UW departmental office.

When Dumitriu arrived at the UW in 2006, she began informal coaching once a week during the fall quarter. This year she offered a course, The Art of Problem Solving, which doubled as preparation for the competition. Most winning schools, she said, offer such a class.

Dumitriu co-taught the course with UW assistant professor of mathematics Julia Pevtsova. The Russian native didn't compete in the Putnam, but was a silver medalist in the International Mathematics Olympiad.

"We knew we had the talent," said Tuncel. But the schools that place well every year—Harvard, Princeton, MIT—have traditionally claimed most of the top spots. "Until we had Julia and Ioana, who knew what this competition was about and how to train for it, we were not even on the map."

Four brave students registered in the class, and another four audited. (Johnson could not officially register, despite doing all the homework, because he was already taking the maximum number of allowed credits.)

The curriculum covered algebra, geometry, probability, calculus, combinatorics and number theory. One mathematics

Students who placed well in the Putnam Prize competition with the two teachers who helped them prepare. In the back row, left to right, are Igor Tolkov, Nate Bottman and Ben Hayes. In front are Professor Ioana Dumitriu, Michael Rutherford, Will Johnson and Professor Julia Pevtsova.

Photo by Kathy Sauber

student said in his evaluation that the breadth of material covered in this class was greater than in all his other courses put together.

"What we tried to do was expose them to the types of problems they would encounter in the competition, and teach approaches and mathematical tricks," Dumitriu said. She and Pevtsova also taught students to present their solutions, which is required to get full points.

Dumitriu also offered advice based on her own experience taking the Putnam. Some of it may sound familiar to competitors of all types. Sleep well the night before. Pace yourself. And if you feel yourself getting anxious, do a breathing exercise to calm down.

The coaches are not taking credit for Johnson's performance, which they say is highly unusual. But they are reassured by the fact that all the UW students they worked with got some problems on the contest. "That really made me feel we had achieved something," Dumitriu said.

Now Dumitriu and Pevtsova are in recruiting mode. They say they're convinced that more talented students are out there at the UW.

"If you're good at football, you know where to go. But with mathematics, you might not know how to find us," Pevtsova said. "We'd like to establish a [Putnam] tradition at the UW."

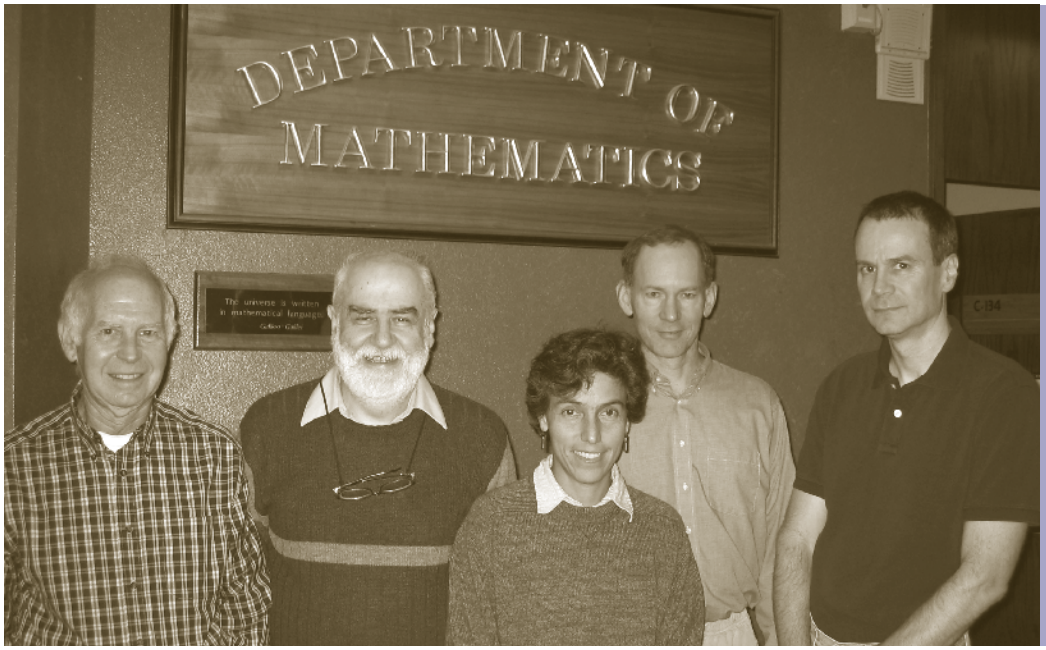
Having a larger group creates a bigger community to practice and discuss problems. They would especially like to recruit women. But they say the group is open to students of any major who enjoy mathematics and like to think creatively.

Any undergraduates interested in training for the Putnam next fall should contact Dumitriu or Pevtsova at dumitriu@math.washingon.edu or julia@math.washington.edu.

– HANNAH HICKEY, *UNIVERSITY WEEK*

NSF RESEARCH TRAINING GRANT

Department receives $2 Million Research Training Grant from NSF



The principal investigators of the Research Training Grant in Inverse Problems and Partial Differential Equations. From left to right: Professors Jim Morrow, Gunther Uhlmann, Tatiana Toro, Robin Graham, and Hart Smith.

The Department has been awarded a five-year Research Training Group (RTG) grant from the National Science Foundation. Funded in part through the American Recovery and Reinvestment Act of 2009, the total budget for the grant is $2,090,940. The RTG grants are one component of an NSF effort to increase the number of well-prepared U.S. citizens, nationals, and permanent residents who pursue careers in the mathematical sciences and other NSF-supported disciplines. They are meant to support the training activities of a group of faculty who have a common research interest. The research area of our grant is Inverse Problems and Partial Differential Equations (IPDE), and the principal investigators are Professors Gunther Uhlmann, Robin Graham, James Morrow, Hart Smith, and Tatiana Toro.

Inverse problems arise in practical situations such as medical imaging, geophysics, and non-destructive evaluation where measurements made at the frontier of a body are used to deduce properties of the inaccessible interior. For example, electrical impedance tomography involves the determination of the conductivity inside a body from knowledge of the currents that result from induced voltage distributions on the surface. In geophysical imaging, intense sound impulses are directed into the earth, and the seismic imaging problem is to determine the physical properties of the subsurface earth from recordings made of the resulting echoes. It is currently the key method for locating deep oil deposits. Each of these problems in turn is mathematically modeled by a partial differential equation, and a key step is to understand how the solutions to those model equations depend on the physical parameters of the medium.

The largest portion of funding in the RTG grant is to provide stipend support for graduate students and postdoctoral researchers. An average of seven graduate students each year will be supported as research assistants, providing time to focus on their thesis research free of teaching duties. The grant will provide partial funding for one or two postdoctoral researchers at any time, with half the teaching load of a standard Acting Assistant Professor.

In addition, the grant will support an array of activities that enhance the recruitment and success rate of students working in areas related to IPDE. A major new activity is a three-week summer school for advanced undergraduate students and beginning graduate students. These students will be selected from applicants across the country, and the summer school will be run in parallel to the highly successful Research Experience for Undergraduates program

run by James Morrow. The first Summer School will take place in June of 2010. Two mini-courses will be taught, by Gunther Uhlmann and Hart Smith, on the mathematics of x-ray imaging and signal processing. Guest lecturers will be invited each week, and labs will be run involving computer implementation of the algorithms discussed in the lectures.

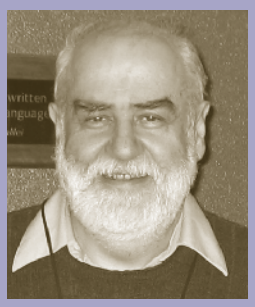
The RTG grant will also support the group's Visiting Academic and Industrial Internship Program, where the Department's own graduate students make extended visits to other academic departments in the U.S. and abroad and take part in industrial internship programs at research laboratories in the United States. In past years, students in IPDE have carried out internships at Lawrence Livermore National Laboratory and at Chevron Energy Technology Company in California. Students have also paid extended visits to universities across the country, as well as to Novosibirsk and Khanty-Mansiysk, Russia, and Helsinki, Finland.

Finally, RTG funds will support undergraduate research projects on campus in a range of mathematical topics. The involvement of undergraduates in research is a high priority at the University of Washington, and projects from around campus are highlighted at the annual Undergraduate Research Symposium. The number of undergraduate research projects in mathematics has increased substantially during the past decade, owing in part to ten years of support from the VIGRE grant. Some research projects involve working on questions in mathematical theory and applications, while others have brought students into elementary school classrooms to assist teachers in developing their students' mathematical skills. The RTG grant will maintain our already strong culture of undergraduate involvement in creative math projects.

In all these ways, the RTG grant will provide a substantial enhancement to the Department's activities for the next several years.

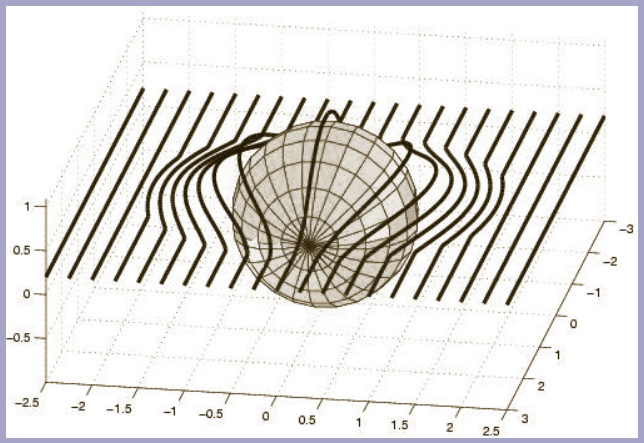
– HART SMITH

Gunther Uhlmann Elected Fellow of American Academy of Arts and Sciences



In April 2009, Walker Family Professor Gunther Uhlmann, one of the five principal investigators of the RTG grant, was elected a fellow of the American Academy of Arts and Sciences. Founded in 1780 by a group of leading citizens including John Adams and John Hancock, the Academy functions as an independent policy research center and as an honorary society that gives recognition to American leaders in the sciences, the arts and humanities, and public life.

The Academy honored Uhlmann for his work in partial differential equations and related areas. Much of his research has focused on inverse problems, as described in the story at left. In addition, he and a group of collaborators have recently made significant contributions to the mathematical theory of apparatuses that cause electromagnetic waves to detour around a body, which offer the possibility of turning "invisibility cloaks" from science-fiction dreams into real-world devices.



STUDENT HIGHLIGHTS

Mathematics Honors Luncheon

The Mathematics Honors Luncheon is held each May at the University of Washington Club to recognize outstanding undergraduate Mathematics and ACMS majors. In addition to their award stipend, each student is given a book reflecting their mathematical interests. Awardees from this year's luncheon and their books are listed below.

DEPARTMENTAL AWARDS

Outstanding Graduating Bachelor of Science Major

Ben Hayes (comprehensive) – *Symmetry and the Monster: The Story of One of the Greatest Quests of Mathematics* by Mark Ronan
Ming Li (comprehensive) – *Isaac Newton* by James Gleick
Eric Nitardy (standard) – *The Poincare Conjecture: In Search of the Shape of the Universe* by Donal O'Shea

Outstanding Graduating ACMS Major

Stephen Barr – *Expert Political Judgment: How Good Is It? How Can We Know?* by Philip Tetlock

Outstanding Graduating Bachelor of Arts Major

John Griffin (teacher prep) – *Euler's Gem: The Polyhedron Formula and the Birth of Toplogy* by David Richeson
Alisher Khussainov – *A Beautiful Mind* by Sylvia Nasar

Outstanding Student in Honors Calculus

Will Johnson (2nd year) – *Computability and Unsolvability* by Martin Davis
Keyun Tong (1st year) – *The Best of All Possible Worlds: Mathematics and Destiny* by Ivar Ekeland

Gullicksen Award for Outstanding Juniors in Mathematics

Chad Klumb – *King of Infinite Space: Donald Coxeter, the Man Who Saved Geometry* by Siobhan Roberts
Trevor McCarten – *Leonhard Euler* by Emil A. Fellmann, E. Gautschi (translator) and W. Gautschi (translator)

RECOGNITION FOR EXTERNAL AWARDS

Outstanding Putnam Team

Nate Bottman – *Naming Infinity: A True Story of Religious Mysticism and Mathematical Creativity* by Loren Graham
Will Johnson – *Computability and Unsolvability* by Martin Davis
Igor Tolkov – *What is Mathematics? An Elementary Approach to Ideas and Methods* by Richard Courant, Herbert Robbins, and Ian Stewart

Undergraduate Scholarships in Mathematics

Khanh Quoc Tran of Bainbridge Island is the recipient of the 2009-10 Thomas Bleakney Endowed Scholarship in Mathematics. Khanh is pursuing a Bachelor of Science in mathematics after transfering to UW from Seattle Central Community College where he received an AA degree. Autumn marks his second quarter here at the UW.

Traci Janea Mazzoncini of Port Angeles is the recipient of the Quoc "Mark" Hong Memorial Scholarship. This scholarship was made possible by a gift from WaveDivision Holdings. Traci is a double-major in mathematics and dance, a rare combination. Now a junior, she intends to teach high school after completing a Mathematics teaching degree.

Mimi Fung, **Amanda Geddes** and **Tam Thanh** continue to benefit from the Mathematics Undergratuate Endowed Scholarship as they make admirable progress in their studies at UW. The scholarship is made possible by an endowment established by Byron and Sheila Bishop.

Chad Klumb Awarded UW Sophomore Medal

Chad Klumb is the UW Sophomore Medalist for 2009. Now a senior, Chad is now a TA for the Department's Honors Advanced Calculus series while continuing to do undergraduate research sponsored by the RTG grant (see page 6). UW awards the Sophomore Medal to the junior having the highest scholastic standing for the first two years of his or her course. Chad was also the recipient of the Freshman Medal the previous year.

Graduate Student Robert Bradshaw Helps Find Solutions to Thousand Year Old Mathematics Problem

Graduate student **Robert Bradshaw** is part of a group of mathematicians from North America, Europe, Australia, and South America who have resolved the first one trillion cases of a thousand year old mathematics problem.

The problem, first posed by the Persian mathematician al-Karaji (c.953 – c.1029), concerns the areas of right-angled triangles. Which whole numbers can be the area of a right-angled triangle whose sides are whole numbers or fractions? The area of such a triangle is called a "congruent number" (see figure 1). The congruent numbers between one and twenty are 5, 6, 7, 13, 14, 15, and 20.

The incredible task of finding the congruent numbers between one and one *trillion* was made possible by a clever technique for multiplying large numbers—numbers so enormous that if their digits were written out by hand they would stretch to the moon and back. As the numbers would not fit into the main memory of the available computers, the group made use of the computers' hard drives. Each calculation was done twice on different computers using different algorithms by two independent teams. Bradshaw's team used 128 gigabytes of accessible memory and 3 terabytes of storage space on UW's *Sage* computers. They wrote their code at a workshop on L-functions in summer 2009.

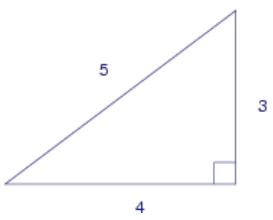


Figure 1:
A 3-4-5 right triangle has area 1/2 x 3 x 4 = 6, so 6 is a congruent number.

One value of such problems is the new research developed by those looking for new ways to solve them, and the group's efforts moved far beyond what others have done. As Bradshaw's advisor William Stein told University Week, "Understanding this problem could be exactly what's needed to understand many other interesting and important questions in mathematics."

For more detail, see the American Institute of Mathematics press release at www.aimath.org/news/congruentnumbers.

GRADUATE PROGRAM

The Graduate Program

The graduate program forms a core part of the Mathematics Department's mission. Our graduate students' research supplements the research programs of our faculty and contributes to an atmosphere of discovery and exploration within our department. Their service as Teaching Assistants helps thousands of undergraduates in our entry-level classes each year, and they are very effective instructors of intermediate-level service courses. When they graduate and leave the University of Washington for either academic or industrial jobs, they become part of the mathematically sophisticated workforce in education, industry, and science on which our technologically oriented society depends.

This past year, despite a very grave economic climate across the country which had a devastating effect on the availability of academic jobs, we had thirteen students graduate with PhD degrees. This is in keeping with our recent trend of a substantially increased rate of PhD graduation from our historical average of just over six students per year. Some of our students found excellent post-doctoral positions at schools such as the University of British Columbia, University of Rochester, University of Calgary and Harvey Mudd College. Others found rewarding industrial employment in research groups at the Chevron Corporation or Lincoln Research Labs at MIT.

The success of our students is built on a multi-threaded tapestry of contributions from a number of sources. First and foremost is the talent and hard work of the students themselves. In order to attract excellent students to the University of Washington, the Mathematics Department has put together a support plan that allows students to select our program on the basis of its academic merits without concern that their financial prospects here will be significantly lower than they would be elsewhere. This support plan, developed over the last ten years, has been made possible by generous contributions from the Microsoft Corporation, the ARCS Foundation, departmental endowments directed towards supporting graduate studies, and the Graduate School. The majority of these sources are temporary and vulnerable, so an important long-term goal for the Department is to stabilize the plan with permanent endowment-based funding. This will allow us to strengthen and improve the core aspects of our program as we build for continued success in the years to come.

Once our students arrive on campus, they quickly become immersed in our extensive advising and mentoring program, which has been designed to help them to succeed both in teaching and in navigating through the graduate program. All new students and teaching assistants attend an orientation and TA training program, and each of them meets individually with the Graduate Program Coordinator and with a separate faculty advisor to map out a course of study. In addition, new students are closely mentored by experienced TAs during their first quarter of teaching. The advising and mentoring of students (by multiple faculty members in numerous roles) continues throughout our program. Students who do not yet have a PhD advisor meet repeatedly with the Graduate Program Coordinator, who helps them with the often difficult first steps in making the transition from classroom learning to more direct one-on-one investigations with a faculty member.

By the third year in the program most students are working closely with a faculty member at the forefront of research in one of the diverse fields represented within the Department. The success of these endeavors is a testament not only to our students' skills, hard work, and fortitude, but also to the many hours that our faculty devote to guiding students along in their research. In the best circumstances, this relationship evolves to one that is akin to a collaboration of equals, and our faculty advisors often learn a great deal of mathematics from their students.

A department of mathematics that values both research and teaching cannot flourish without a strong graduate program. If the health of the graduate program is any indication of the health of the Department as a whole (and I would suggest that it is), then we are indeed thriving!

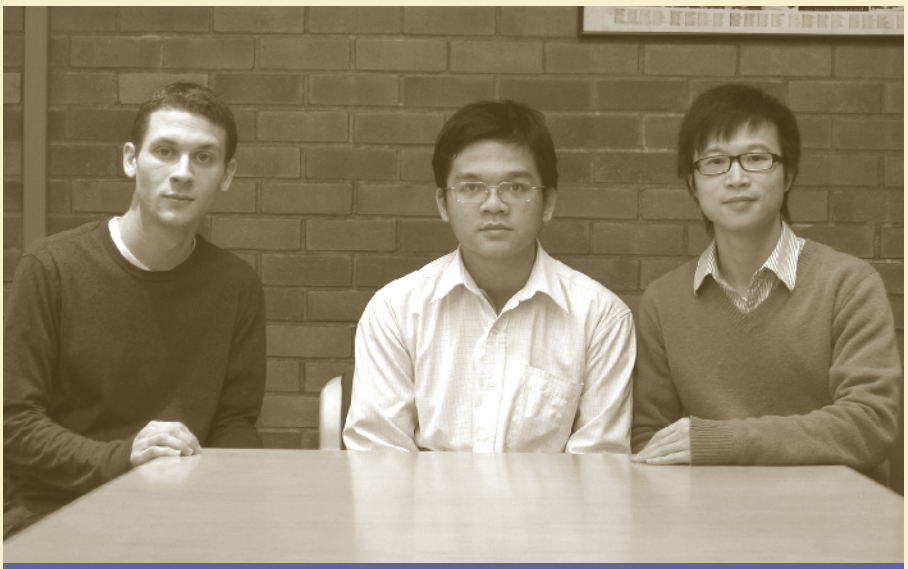
– DANIEL POLLACK

Graduate Student Awards for 2009–10

Academic Excellence Awards
Gregory Drugan
Wai Tong Fan
Huy Vo Tran

Teaching Excellence Awards
Jonathan Cross
Lee Patrolia

ARCS Foundation Fellows
Tobias Johnson
Christopher Jordan-Squire
Christopher McMurdie



Winners of this year's Academic Excellence Award (from left to right): Gregory Drugan, Huy Vo Tran, and Wai Tong Fan.

McKibben and Merner Fellows
Joel Barnes
Alberto Chiecchio
Sean Holman
David Sprehn
Dake Wang

Microsoft Scholars
Mauricio Duarte
Joao Gouveia
Zsolt Patakfalvi
James Pfeiffer
Ting Kei Pong
Xingting Wang
Guangbin Zhuang
Pal Zsamboki

RTG Fellows
Matthew Badger
Sean Holman
Mark Hubenthal
Josh Tokle
James Vargo

Tanzi-Eggerton Fellows
Ariana Dundon
Julia Eaton

Top Scholar Awards
Yajun An
Guo Chen
Rodrigo Farnham
Stephen Lewis
Cris Negron
Yang Yang

VIGRE Fellows
Mark Contois
Andrew Crites
Christopher Jordan-Squire
Jacob Lewis
Robert Miller
Cris Negron
Kiana Ross
Luke Wolcott

NSF CAREER GRANT

Ioana Dumitriu Awarded National Science Foundation CAREER Grant

Ioana Dumitriu

Ioana Dumitriu has received a CAREER grant from the National Science Foundation (NSF). The NSF awards these prestigious grants to "junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations." The following article gives a look into Ioana's contributions to the areas of random matrix theory, numerical linear algebra and numerical analysis.

Ioana Dumitriu's research career could be described as a journey through discrete and applied mathematics. During her undergraduate years at New York University, she worked on a variety of combinatorial and probabilistic problems; her PhD thesis was on random matrix theory; during her postdoctoral stay at University of California, Berkeley, she started working on numerical analysis and numerical linear algebra; and recently, as an Assistant Professor at University of Washington, her work has been focused on random structures and scientific computing.

Some of Ioana's most important research contributions are in random matrix theory, a field of mathematics with a two-fold origin in nuclear physics (with works authored by Eugene Wigner and Freeman Dyson) and statistics (started by John Wishart and L. K. Hua). Random matrix theory brings together tools from fields as varied as probability, combinatorics, special functions, linear algebra, and perturbation theory, to answer questions formulated in quantum and statistical physics, number theory, wireless communications, finance, and scientific and numerical computing. The basic problems in this field deal with analyzing eigenvalue and eigenvector statistics of (mostly large) matrices whose entries are random variables.

In classical random matrix ensembles (Gaussian, Wishart, Jacobi, Circular) the parameter β, which describes the eigenvalue distributions, has traditionally taken only three values: 1, 2, and 4, corresponding to entries distributed over the real, complex, and quaternion fields. There is, however, no intrinsic need for this restriction from the distributional viewpoint, and in fact, interpolating β-ensembles of eigenvalues have been studied since the re-discovery of the Selberg integral in the 1970s. Studying such ensembles, even in the absence of a matrix model when β is not 1, 2, or 4, has provided tremendous insight into eigenvalue statistics, as well as a way to construct a unified theory for the previously distinct cases.

Ioana's work in random matrix theory has been in the area of β-ensembles; her first major contribution, which was part of her PhD thesis, was to construct real, symmetric, tridiagonal matrix models for all β-Gaussian (β-Hermite) and β-Wishart (β-Laguerre) ensembles. These matrix models

have sparked a flurry of research in the area, as well as lead to the subsequent discovery of β-analogues for other ensembles (Jacobi, anti-symmetric Gaussian). Among the many results obtained through use of the new models are a functional central limit theorem for the eigenvalues of large random matrices and a very surprising connection between β-Hermite and β-Laguerre ensembles and stochastic Schrödinger operators (discovered by Jose Ramirez, Brian Ryder, and Balint Virag). Ioana's thesis received an Honorable Mention for the 2004 Householder Prize, a triennial award for the best PhD thesis in numerical analysis.

Another component of Ioana's work in random matrices has been the development of software for computing eigenvalue statistics of β-ensembles, both numerically and symbolically. This has been an important computational achievement in this area, both for its use in research and as an educational tool (in classes taught at MIT, Berkeley, and UC Davis). It was used to create Figure 1.

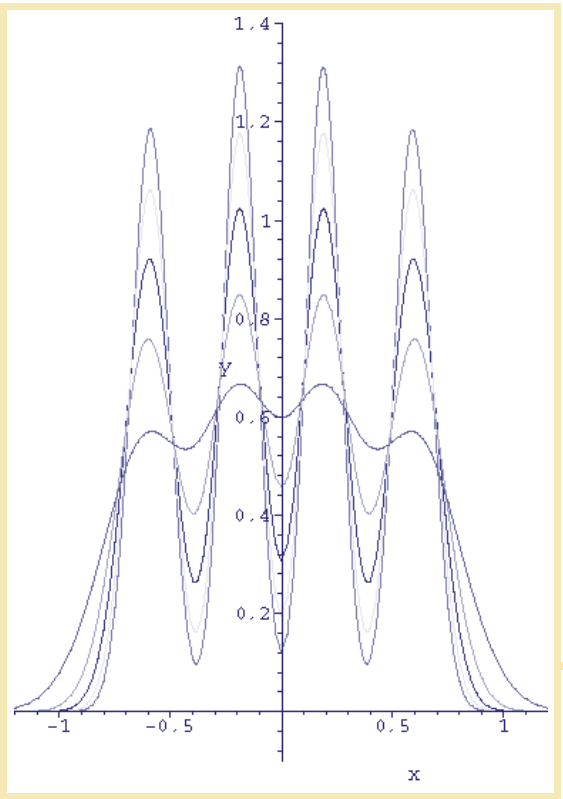


Figure 1: Distributions of a random eigenvalue from the $n = 4$ ensembles with $\beta = 2, 4, 6, 8, ++10$. The "bumps" increase with β. As β grows large, the distribution approaches the average of 4 Dirac delta distributions.

The second major area of research in which Ioana has made important contributions is numerical linear algebra and numerical analysis. During her postdoctoral studies in Berkeley, together with James Demmel and Olga Holtz, Ioana initiated a wide-scope study of accurate evaluation of multivariate polynomials; accuracy here means that the computational error is allowed to be only a (small) fraction of the true answer, as opposed to some absolute tolerance bound. This type of relative accuracy is particularly useful in evaluating the polynomials close to their zero sets, and it is thus of considerable interest in computational geometry and numerical linear algebra. In her work, Ioana has found necessary and (sometimes) sufficient conditions for the existence of accurate algorithms for generic polynomials; the resulting paper was awarded the Leslie Fox Prize for Numerical Analysis in 2007. Subsequently, Ioana has worked on the stability of fast linear algebra algorithms, showing that, using any fast matrix multiplication algorithm, one can construct a stable matrix multiplication algorithm that runs just as fast. The stable, fast algorithm can then be used to construct fast and stable algorithms for virtually all linear algebra computations.

Ioana's current research involves using randomization as a means to speed up and stabilize numerical algorithms, as well as constructing algorithms that minimize communication between the various layers of memory in computer architecture. She is also continuing to work on eigenvalue statistics of β-ensembles as well as on eigenvector statistics of adjacency matrices of random graphs.

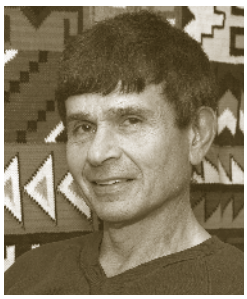
FACULTY AWARDS

New Mathematics Faculty Fellow

The Mathematics Faculty Fellowships are intended for research faculty below the rank of professor, or professors who are less than fifteen years past the PhD, and recognize the importance and impact of research support for these colleagues. This year the Department has selected Isabella Novik to be the latest recipient of this two-year award. Ioana Dumitriu and Paul Hacking, who were selected last year, continue as Faculty Fellows this year.

Isabella Novik received her PhD from the Hebrew University of Jerusalem in 1999 and joined our department in 2001 after a post-doctoral appointment at UC Berkeley. Her thesis won the Haim Nessyahu Prize for excellent PhD thesis in Mathematics in Israel. She also received the Sloan Research Fellowship in 2006. Much of her work is in algebraic and geometric combinatorics, particularly combinatorics of polytopes and simplicial complexes, but the problems she works on usually require methods from commutative algebra and algebraic topology as well as combinatorics. Novik has graduated three PhD students and is currently advising two more. She is one of the four editors-in-chief of the *Journal of Algebraic Combinatorics*.

Neal Koblitz Receives Award for Excellence in the Field of Mathematics



In April 2009, Professor Neal Koblitz was one of two recipients of the award for Excellence in the Field of Mathematics at the 2009 RSA Conference USA, an international meeting of scientific experts and industry leaders in the field of data security and cryptography. The award was given for his work in developing elliptic curve cryptography, a mathematically sophisticated technique that has become important in both academic research and commercial cryptographic systems.

Photo by Mary Levin

Graduate Alumnus Awarded SAIG/CST Prize

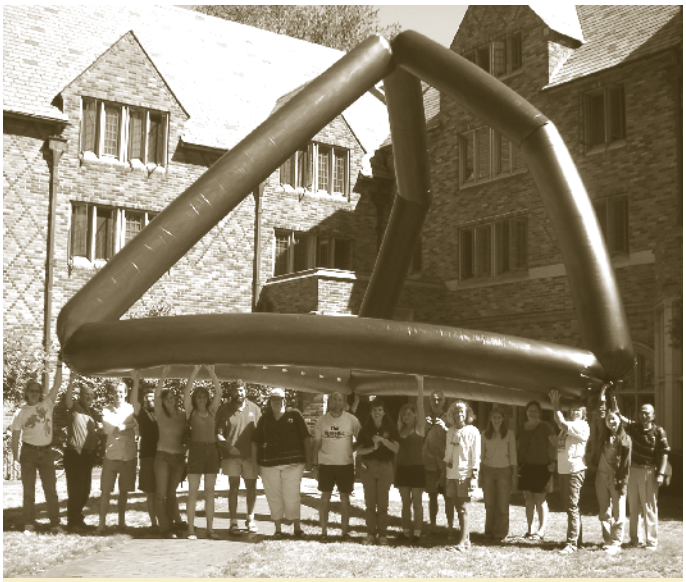
In July 2009, Rafal Goebel received the SIAG/CST Prize at the annual meeting of the Society of Industrial and Applied Mathematics for his novel and fundamental results in the study of hybrid dynamical systems. This prize is awarded every two years to a junior researcher for outstanding contributions to mathematical control or systems theory. Dr. Goebel completed his PhD in our department in 2000, advised by Professor Terry Rockafellar. Goebel returned to teach as a lecturer in 2005-07; he is now an Assistant Professor at Loyola University Chicago.

2009 Mathematics Department Outreach

As in previous years, the Department's outreach this past year had a wide range of levels, scope and visibility. As always, the most spectacular were Math Day, which brought 1200 high school students from around the state to campus on March 24 for an array of lectures and activities, and SIMUW (Summer Institute in Mathematics at the University of Washington), which brought 24 high school students to campus for a full six weeks of high intensity mathematics during the summer. You can find details about these events in some previous years at www.math.washington.edu/newsletter. Another large-scale summer event was the annual Northwest Math Interaction (see photo below), a week of multi-faceted geometry learning aimed at secondary teachers from all around the state. If you want to see a face light up, talk with any of the teachers who have been there, and if you want to see kids doing some interesting geometry projects, check out their classes.

On a smaller scale, but very enriching, are the various activities with local schools. Individual faculty members and graduate students continue to work with children at many levels, in class or after school, with single visits or in on-going math clubs. Some of these have been arranged through our connection with Explorations in Math (EIM; www.explorationsinmath.org). Up through spring quarter we were able to work with them to bring a bunch of undergraduates into one elementary school per quarter and teach children games that they were then able to teach their families at a school Math Night. If funding reappears, so will that activity. One of EIM's activities for which we continue to supply volunteers is their Math Fest (see photo above), at which hundreds of families from around Seattle come to spend several hours on math games and activities. There are phenomenal amounts of energy and noise, and it's all about mathematics!

Excited faces at Math Fest, an annual city-wide celebration of elementary school students and mathematics.



Secondary school teachers participating in the Northwest Mathematics Interaction display a giant regular tetrahedron constructed from solar tube balloons.

On a different level entirely, an outreach effort that dates back to the nineties is bearing fruit. Since 1998, the Department has supported the development of an organization bringing together faculty members from colleges and universities throughout the state who teach mathematics to future teachers. The group, called WaToToM (Washington Teachers of Teachers of Mathematics) has grown over the years in stature, cohesion and voice. As a result, when the state put together the Washington State Education Coordinating Council last year, WaToToM was given a seat on the council. So the original outreach to universities and colleges has now enabled those colleges and universities to reach out together to the state—a nice development!

– GINGER WARFIELD

SPECIAL LECTURES

Nick Trefethen to Present Milliman Lectures

The 2009–10 Milliman Lecturer is Lloyd N. (Nick) Trefethen, Professor of Numerical Analysis at Oxford University. Professor Trefethen has been a leader in the field of numerical analysis and related areas of applied mathematics for the past quarter-century. His work encompasses numerical methods in partial differential equations, linear algebra, and conformal mapping, as well as approximation theory and pseudospectra. Professor Trefethen will be visiting the department during the week of April 12–16, 2010. In a departure from tradition, his first lecture will be separate from the other two and will coincide with the spring MathAcrossCampus Colloquium.

Mathematics Colloquia: New Directions

The tradition of having regular departmental colloquia where speakers give lectures aimed at a general mathematical audience is an old one, but it has been taking a new form here for the past year. Under the direction of Professor Donald Marshall, the Mathematics Colloquium is being run on a philosophy of "less quantity, more quality." There are fewer colloquia than before—about three per quarter—but more care is being taken to ensure that the talks are interesting to a wide audience. The success of this program has been evident in the large attendance at the colloquia. In addition, the MathAcrossCampus Colloquium, initiated a year ago by Ioana Dumitriu, Christopher Hoffman and Rekha Thomas, presents one lecture per quarter to showcase applications of mathematics for a general scientifically literate audience. Last academic year it featured talks on evolutionary trees, combinatorial optimization in action, and the dynamics of voting coalitions. This year the topics will come from atmospheric science, economics, and scientific computing.

Speakers for this winter's Mathematics Colloquium talks include Alexander Holroyd of the UBC and Microsoft Research, Lionel Levine of MIT, and Carl de Boor of the University of Wisconsin and UW. The speaker for the winter MathAcrossCampus Colloquium will be Nobel-laureate economist Roger Myerson.

More information about these colloquia and other mathematics lectures can be found at www.math.washington.edu/Seminars.

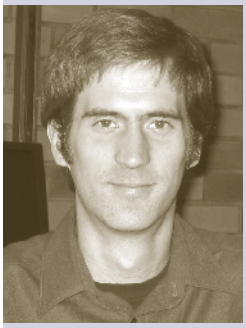
TRANSITIONS

Faculty News

Sara Billey was promoted from Associate Professor to Professor.

The Department appointed eight new faculty members (one Assistant Professor, one NSF Postdoctoral Fellow, and six Acting Assistant Professors):

Max Lieblich (Assistant Professor), PhD M.I.T., 2004. Professor Lieblich studies algebraic geometry, and was previously an Assistant Professor at Princeton.



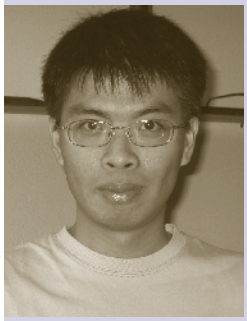
David Anderson (NSF Postdoctoral Fellow), PhD University of Michigan, 2009. Dr. Anderson studies algebraic geometry.

Salman Baig (Acting Assistant Professor), PhD University of Texas at Austin, 2009. Professor Baig studies arithmetic geometry, number theory, and computations.

Jonathan Browder (Acting Assistant Professor), PhD Washington University in St. Louis, 2009. Professor Browder studies algebraic and geometric combinatorics.

Craig Citro, (Acting Assistant Professor), PhD UCLA, 2009. Professor Citro studies number theory.

James Gill (Acting Assistant Professor), PhD Washington University in St. Louis, 2009. Professor Gill studies complex analysis.



Tu Nguyen (Acting Assistant Professor), PhD University of Chicago, 2008. Professor Nguyen studies Partial differential equations and inverse problems. He spent the previous year at the Institute for Advanced Study.

Ben Stephens (Acting Assistant Professor), PhD M.I.T., 2006. Professor Stephens studies PDEs, differential geometry, and optimization. He was a Postdoctoral Fellow at the University of Toronto before coming to UW.

TRANSITIONS

Recent Degree Recipients

The following students completed their doctorates in Mathematics during the academic year 2008-2009.

Ryan Card. His advisor was Krzysztof Burdzy, and his thesis title was "Brownian motion with boundary diffusion." Ryan is now a Lecturer at UW Tacoma.

Luke Gutzwiller. His advisor was Steve Mitchell, and his thesis title was "Birkhoff varieties in the affine grassmannian." Luke is now a Visiting Assistant Professor at Northwestern University.

Joshua Kantor. His advisor was Robin Graham, and his thesis title was "Eleven dimensional supergravity on edge manifolds." Joshua is now in a Technical Staff position at the Lincoln Laboratory at MIT.

Tak-Lun Koo. His advisor was Ralph Greenberg, and his thesis title was "Change of Selmer group under isogeny, Iwasawa invariants of lambda-adic representation, and coefficient field of newforms." Tak-Lun now holds a faculty position at Xiamen University in China.

Travis Kopp. His advisor was Sándor Kovács, and his thesis title was "Kodira-Iitaka dimension on subvarieties."

Kurt Luoto. His advisor was Sara Billey, and his thesis title was "Quasisymmetric functions and their applications." Kurt is now a Postdoctoral Fellow at the University of British Columbia.

Dustin Moody. His advisor was Neal Koblitz, and his thesis title was "The Diffie-Hellman problem and generalized Verheul theorem." Dustin is now a Postdoctoral Fellow at the University of Calgary.

David Rosoff. His advisor was John Palmieri, and his thesis title was "Mapping spaces of A-infinity categories." David remains with the Department as a Part-Time Lecturer.

Anusha Sekar. Her advisor was Ken Bube, and her thesis title was "Earthquake source inversion for tsunami runup prediction." Anusha is now a Research Geophysicist with Chevron.

Stephanie Vance. Her advisor was Henry Cohn, and her thesis title was "Lattices and sphere packings in Euclidean space." Stephanie is now a tenure-track Assistant Professor at Adams State College.

Ursula Whitcher. Her advisor was Charles Doran, and her thesis title was "Polarized families of K3 hypersurfaces." Ursula is now a Teaching & Research Postdoctoral Fellow at Harvey Mudd College.

Troy Winfree. His advisor was Ethan Devinatz, and his thesis title was "Continuous homotopy fixed point spectra: finiteness properties and computations." Troy is now a Visiting Assistant Professor at the University of Rochester.

Jun Zhang. His advisor was James Zhang, and his thesis title was "Some developments in Artin-Schelter regular algebras." Beginning this spring, Jun will be a Visiting Assistant Professor at the University of Texas at Arlington.

Below is a list of those who finished their work at the UW with a Master's degree in Mathematics, with each student's advisor listed in parenthesis:

George Bouvier (Burke)

Samuel Buelk (Billey)

Daniel Shumow (Koblitz)

Bachelor's Degrees

157 Bachelor's degrees were awarded during the 2008-2009 academic year: 108 in Mathematics and 49 in ACMS.

OUR DONORS

The following is a list of our friends who have contributed to the Department between September 1, 2007, and October 15, 2009. Should you notice an error or omission in this list, please draw it to our attention by a telephone call or e-mail message to Mike Munz (206-543-1151 or munz@math.washington.edu).

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CONTACT INFORMATION

This newsletter is published annually for alumni and friends of Mathematics at the University of Washington.

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