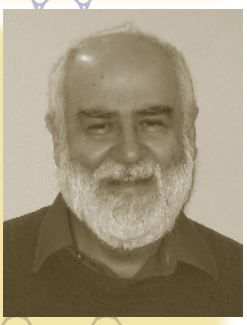
AUTUMN 2011

NEWSLETTER OF THE DEPARTMENT OF MATHEMATICS AT THE UNIVERSITY OF WASHINGTON

Mathematics NEWS



DEPARTMENT OF MATHEMATICS NEWS

MESSAGE FROM THE CHAIR

It has been another exciting year for our department. The work of the faculty has been recognized in a number of ways, including the AMS Bôcher Prize and the SIAM Kleinman Prize presented to Gunther Uhlmann, and the NSF CAREER award to Max Lieblich. As you will see on page 15, the numbers of majors in the Mathematics program and the joint ACMS (Applied and Computational Mathematical Sciences) program have continued to rise, as have the numbers of degrees awarded. In addition, these programs attract outstanding students who continue to make us proud. For example, Math majors were selected for three of the UW Medals awarded in 2011: The UW Sophomore Medal (Gracie Ingermanson), the Dean's Medal in the Natural Sciences (Will Johnson) and the President's Medal (Jacob Bobman).

Four students, including two recent graduates (Will Johnson and Tia Lerud) and two current PhD students (Cris Negron and Richard Robinson) were awarded NSF Graduate Research Fellowships. As you will read in Doug Lind's article, the graduate students make significant contributions to our teaching and research while they train to become part of the next generation of mathematicians. The program has grown to over 90 students, and is as vibrant as ever. All nine PhD students who completed their degrees this year placed into excellent jobs.

We are also pleased to have ten excellent recent PhDs in postdoctoral positions in the department, including several who hold prestigious NSF Postdoctoral Research Fellowships and NSF RTG postdocs. Their contributions enrich every aspect of our work.

Instructional software has come of age in recent years, along with wireless connectivity. Thoughtfully implemented, such software can support traditional teaching methods to enhance learning. We have been exploring the use of instructional technologies in a number of ways. David Collingwood's article on page 14 describes our (very positive) experience with the integration of grading software in calculus courses.

The positive developments reported in this newsletter stand in contrast to a backdrop of (global) financial and political uncertainty. In the fourth year of the financial crisis, the end is not yet in sight. Repeated cuts in state support, coupled with tuition increases, spell a fundamental shift in the funding of state universities. At the same time, the need to re-tool to pursue new career paths in a changing economy, the return of soldiers from overseas deployments, and the coming of age of the baby-boom echo generation bring increasing numbers of students to our campus and to our department.

Until the situation settles, new resources are generally made available to us in the form of temporary allocations instead of tenure-track faculty positions, which would require long-term financial commitments. This policy is understandable. We are able to meet the challenges it creates and advance our programs, thanks to the remarkable commitment of our faculty, staff and students, although we are concerned about maintaining the quality of our programs if the situation does not improve.

– SELIM TUNCEL

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Pictured (front cover):

Upper left: Jacob Bobman and Gracie Ingermanson (photos by Mary Levin) – See pages 4 and 5.

Upper right: Ralph Greenberg, Max Lieblich, Tatiana Toro, and Gunther Uhlmann – See pages 6–8.

Lower left: Richard Robinson, Cris Negron, and Will Johnson – See page 12.

UNDERGRADUATE MEDALS

Will Johnson: Dean's Medalist

Will Johnson graduated *summa cum laude* last June with Bachelor of Science degrees in both Computer Science and Mathematics. To those familiar with Will, such honors are unsurprising, and only the tip of the iceberg among his achievements.

Hailing from Kenmore, Will attended Inglemoor High School. His performance there earned him a Washington Scholarship, created by the State Legislature to fund in-state undergraduate education and awarded to Washington State students chosen from among the top 1% of their graduating class. It turned out to be one of many scholarships Will would earn in the next four years, including a Robert C. Byrd Scholarship and a Mary Gates Honors Scholarship.

Will is perhaps most famous for his performance in the Putnam Mathematical Competition, which occurs annually among undergraduates in the United States and Canada. He participated in the competition three times, each time earning the outstanding score out of UW students. In 2008, Will earned the sixth highest score in the entire competition. The following year Will placed in the top five, making him a Putnam Fellow, the first student from the UW to earn this distinction since the contest's inception in 1927. Will's achievement was even recognized by a Washington State Senate Resolution in April 2010.

His performance outside of the Putnam Competition is no less noteworthy. Participating in the Research Experience for Undergraduates program in summer 2010, Will wrote a highly original paper on recovering conductivities in an electrical network. He excelled at graduate-level math courses while still in his senior year. He even invented V-Braille, a program designed to allow deaf-blind cell phone users to receive information through vibration, which led to a U.S. Department of Education grant for the Computer Science Department.

Along his way to his dual degrees, Will received the UW Junior Medal and, just before graduation, the Arts and Sciences Dean's Medal in the Natural Sciences. Will is now pursuing a mathematics PhD at UC Berkeley, supported by a National Science Foundation Graduate Fellowship (see page 12). We wish Will the best in what seems certain to be an outstanding career.

Jacob Bobman: President's Medalist

Some people take math courses on their way to a professional career in the mathematical sciences, and some people take math courses as requirements for study in other disciplines. Some of those in the latter group continue to study mathematics simply because they find the subject interesting and exciting.

Jacob Bobman is one of the latter. Throughout his undergraduate studies at the UW, it was always his intention to go into medicine. He became part of a research team in behavioral neuroscience in his last two years, and he is now a medical student on a full-tuition merit scholarship at Columbia. But he graduated last June *summa cum laude* with not one but two bachelor's degrees: a B.A. in biochemistry, with minors in chemistry, music, and Jewish studies, and a B.S. in mathematics. For his achievements, Bobman was awarded one of the two President's Medals for the Class of 2011, thus joining a long, distinguished line of recent math majors who have won college-wide or university-wide honors.

Bobman took a variety of mathematics courses in fulfilling his major and was consistently one of the best students in them. He also wrote a senior honors thesis in cryptography under the direction of Professor Neal Koblitz. "Mathematics has played a crucial role in my development," he says. "I enjoy the intellectual challenge that comes from connecting ideas to synthesize a logically sound proof."

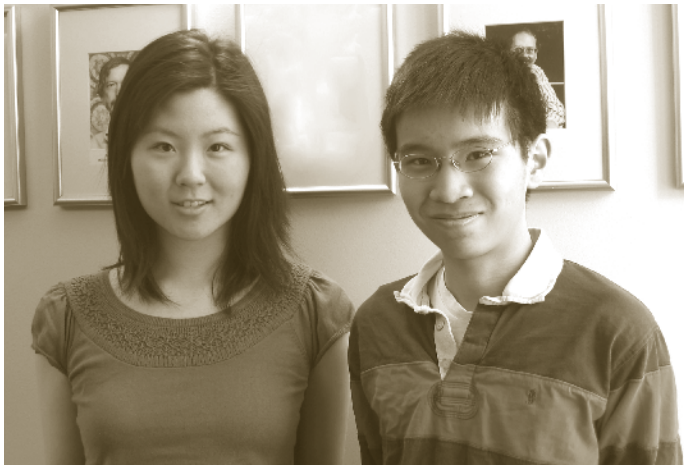
Gracie Ingermanson: Sophomore Medalist

The UW Sophomore Medal, given to the junior having the highest scholastic standing for the first two years of academic work, was awarded to Gracie Ingermanson (pictured, left). Gracie is from Battle Ground, Washington, where she attended homeschool for twelve years. She is a double major in Mathematics and Communications, and also plans to pursue a mathematics graduate degree.

Last summer, supported by a Tseng Fellowship, Gracie participated in the Research Experience for Undergraduates (REU) program. During the eight-week program, she worked on open problems in linear algebra that relate to eigenvalues and eigenvectors of symmetric matrices. Gracie describes her experience in the REU program as "a fantastic introduction to thinking abour real, open-ended math questions."

Gracie is working with Jim Morrow to understand the concept of total positivity and its relation to cluster algebras.

Mark Bun and Jane Hung: Goldwater Scholars



Last spring it was announced that Mathematics majors Mark Bun and Jane Hung were among this year's Goldwater Scholars. The scholarships, given annually by the Barry M. Goldwater Scholarship and Excellence in Education Program to foster excellence in science, mathematics, and engineering, are among the most prestigious undergraduate awards in the nation. Both Mark and Jane are double majors, pursuing degrees in Computer Science and Physics (respectively) in addition to degrees in Mathematics.

Undergraduate Scholarships in Mathematics

Brandon Saxberg has been selected as this year's recipient of the Mathematics Undergraduate Endowed Scholarship. This scholarship is renewable up to four years with satisfactory progress. Brandon is an incoming freshman who plans to pursue undergraduate degrees in both mathematics and physics. The Mathematics Undergraduate Endowed Scholarship also currently supports previous recipients Matthew Heid (2010 awardee) and Mimi Fung (2009 awardee) as they continue their studies at UW.

Daniel Dressler is the recipient of the 2011–2012 Thomas Bleakney Endowed Scholarship in Mathematics, which will help fund the cost of his education at UW. Daniel is a Math major working toward a Bachelor of Science degree. He is now in his junior year after transferring from Olympic College with an excellent mathematics GPA.

Maelonni Howard is the inaugural recipient of the John and Kathy Connors Foundation Endowed Scholarship, which is renewable up to four years with satisfactory progress. This scholarship supports entering freshman students in the Educational Opportunity Program (EOP) who wish to pursue majors in the Department of Mathematics.

Rachael Fair has been selected to receive the Martha R. Sklar Endowed Scholarship, which is awarded yearly to an EOP community college transfer student pursuing a degree in the Natural Sciences. A junior, Rachael has recently transferred from Clark and Lower Columbia College to pursue a Bachelor of Science in Mathematics.

FACULTY NEWS

Gunther Uhlmann Receives Multiple Honors

During the past year Gunther Uhlmann, the Walker Family Endowed Professor of Mathematics, has received three notable honors in recognition of his research.

The first honor came in January when Uhlmann was announced as one of two recipients of the Bôcher Memorial Prize sponsored by the American Mathematical Society (AMS). The prize, established in 1923 to honor the memory of Maxime Bôcher (1867–1918), one of the early leaders of the American mathematical community, is given every three years for work in mathematical analysis.

The AMS awarded the prize to Uhlmann for "his fundamental work on inverse problems and in particular for the solution to the Calderón problem in the papers 'The Calderón problem with partial data' (with Carlos E. Kenig and Johannes Sjöstrand, *Annals of Math.* (2) 165 (2007) no. 2, 567-591) and 'The Calderón problem with partial data in two dimensions' (with Oleg Yu. Imanuvilov and Masahiro Yamamoto, *J. Amer Math. Soc.* 23 (2010), no. 3, 655-691)." These papers establish, among other things, that it is possible to determine the electrical conductivity of a body by making voltage and current measurements on a small part of the boundary.

Additionally, the prize recognized Uhlmann's "incisive work" on boundary rigidity with L. Pestov and with P. Stefanov, and on nonuniqueness (the "cloaking" phenomenon) with A. Greenleaf, Y. Kurylev, and M. Lassas.

Then, in April, Uhlmann was awarded the Ralph E. Kleinman Prize of the Society for Industrial and Applied Mathematics, again for his contributions to the theory of inverse problems. This prize, awarded to one individual every two years, is given "for outstanding research, or other contributions, that bridge the gap between mathematics and applications."

According to Uhlmann's prize citation, "his accomplishments include groundbreaking work on uniqueness theory for inverse problems using special oscillatory solutions; the use of microlocal analysis in inverse scattering; novel connections between notions of differential geometry and problems in travel time tomography; and fundamental work on cloaking. His work is distinguished by its mathematical beauty and relevance to important inverse problems in medical imaging and seismic prospecting."

The prize was awarded to Uhlmann at the quadrennial International Congress on Industrial and Applied Mathematics (ICIAM) in Vancouver, Canada in July 2011.

In addition, Uhlmann has been selected to give the AMS Einstein Public Lecture in Mathematics in March 2012. The Einstein Lectures began in 2005 to celebrate the 100th anniversary of the year in which Albert Einstein published three papers (on special relativity, the photoelectric effect, and statistical mechanics) that changed the course of physics. They are given annually at one of the sectional meetings of the AMS but are intended to introduce the general public to some recent developments in mathematics and their impact on the wider world. Past lectures have drawn large audiences and have been delivered by speakers such as Fields Medalists Terence Tao and Sir Michael Atiyah.

The title of Uhlmann's lecture will be "Cloaking: Science Meets Science Fiction." Further details on the lecture, when available, will be found at the AMS Einstein Lecture website at www.ams.org/meetings/lectures/meet-einstein-lect.

– GERALD FOLLAND

Walker Family Endowed Professor Gunther Uhlmann, recipient of this year's Bôcher Prize and Kleinman Prize, and 2012 AMS Einstein Public Lecturer.

Max Lieblich Receives NSF CAREER Grant

Max Lieblich

Following on the heels of the Sloan Research Fellowship that he won last year, Max Lieblich has been awarded a five-year Faculty Early Career Program (CAREER) grant by the National Science Foundation. These prestigious grants are made "in support of the early career-development activities of those teacher-scholars who most effectively integrate research and education within the context of the mission of their organization."

Lieblich works in algebraic geometry, the study of the interplay between algebraic equations and geometric objects. Although this subject goes back to the introduction of the use of coordinates in geometry by Descartes and Fermat some three and a half centuries ago, its development as a discipline in its own right is more recent, and the general and abstract form in which it is practiced today is a creation of the last fifty years. Like number theory, with which it has some deep and surprising connections, it leads quickly from problems that are easily stated to techniques that require years of study to master. In particular, the concept of "stack"—a particular type of abstract geometric space—was introduced in an important paper of Deligne and Mumford in 1969, but its intricacy and abstruseness limited the extent to which it was used until quite recently. Lieblich is one of the leaders of a new generation of researchers who have mastered the technology of stacks and applied it to solve important problems in geometry and algebra.

Lieblich's work has won wide recognition for its depth, insight, and versatility. Its results bear on a variety of interesting problems whose connection with the new abstract methods was hitherto unsuspected, including some that arise from mathematical physics, and they are being incorporated into the work of a growing body of mathematicians. Some of his work has been in collaboration with our own Sándor Kovács, and their association has added to the UW's strength in algebraic geometry even beyond their notable individual talents.

In addition to his research, Lieblich has a serious interest in education and mathematical communication that has clearly manifested itself in his career at the UW. Beyond the usual teaching and mentoring duties, he has given lectures at the annual Math Day for high school students across the state, and he has been actively involved in the Summer Institute for Mathematics at the UW (SIMUW), a program for gifted high school students.

Lieblich will use his CAREER grant to support research by himself and his graduate students on the Brauer group in formal and algebraic geometry, fund a conference for new PhDs in algebraic geometry, and extend outreach efforts to find and foster mathematical talent in high schools throughout the Pacific Northwest.

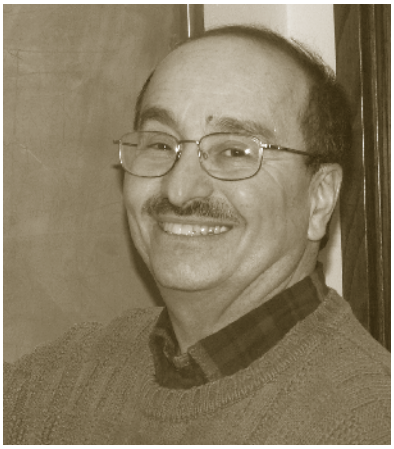
– GERALD FOLLAND

RESEARCH HIGHLIGHT

The International Congress of Mathematicians (ICM) is a gathering of several thousand mathematicians from all over the world that takes place once every four years, in a different location each time. Mathematicians attend the ICM to connect with colleagues from far-flung institutions and to hear lectures on recent progress in all branches of mathematics by the most eminent people in the field.

At the 2010 ICM in Hyderabad, India, among the invited speakers were two members of the UW mathematics faculty: Ralph Greenberg and Tatiana Toro. The following article gives a glimpse into Greenberg's work that led to him being thus honored. We plan to feature Toro's work in an article next year.

Tatiana Toro



Ralph Greenberg

The summer meeting of the American Mathematical Society in 1956 took place here at the University of Washington. One of the invited speakers was Kenkichi Iwasawa, who gave a lecture entitled *A theorem on Abelian groups and its application in algebraic number theory*. The theorem that he announced in that lecture was the beginning of the field which eventually came to be called *Iwasawa theory*.

One of the most interesting objects in algebraic number theory is the ideal class group of a number field, a measure of the extent to which unique factorization fails in the ring of algebraic integers in the field. It behaves very unpredictably as the number field varies. Iwasawa's theorem concerns certain towers of number fields and shows that there is a certain regularity in the behavior of the corresponding ideal class groups. During the next 15 years or so, Iwasawa continued to develop this theory. One of his most influential discoveries was a conjectural relationship between the behavior of those ideal class groups and certain values of the Riemann zeta function, a remarkable analytic function with many connections to number theory. It later came to be called *Iwasawa's Main Conjecture*.

Iwasawa came to Princeton in 1967. Ralph Greenberg became Iwasawa's research student in that year and started studying his papers. The whole topic was just one small corner in algebraic number theory at that time, but that began to change in the early 1970s. Barry Mazur found that some of Iwasawa's ideas could be adapted to studying elliptic curves. He formulated an analogue of Iwasawa's Main Conjecture, replacing ideal class groups by the "Selmer groups" for an elliptic curve and the Riemann zeta function by the "*L*-function" for the curve. John Tate found that

one of Iwasawa's theorems shed some light on algebraic K-theory, and John Coates and Andrew Wiles found that they could exploit an idea of Iwasawa to make an important breakthrough on the Birch and Swinnerton-Dyer Conjecture. It became more and more apparent how rich Iwasawa's original ideas were.

Virtually all of Ralph Greenberg's research over the years has been devoted to Iwasawa theory. The theory has flourished and is now one of the very active areas in number theory. One contribution that Greenberg is especially proud of was made in the period 1985–1989. Iwasawa's Main Conjecture provided an interpretation of the zeros of a certain analytic function (of a p-adic variable) in terms of the structure of a certain module (related to ideal class groups for a tower of number fields). In the early 1970s, Mazur's conjecture (mentioned above) provided an interpretation of the zeros of another analytic function, the so-called p-adic L-function for an elliptic curve. By the 1980s, a variety of p-adic L-functions had been constructed. They were associated to modular forms, and then to something called motives. But it was not clear how to interpret the zeros of those functions. Greenberg discovered that the conjectures of Iwasawa and of Mazur could be reformulated in a unified way, and this allowed him to formulate a vastly more general conjecture. In the early 1990s, Greenberg found that his conjecture could be reformulated in a way which did not involve towers of number fields, but involved families of continuously varying representations of a Galois group. This led him to a conjecture which is even far broader. It was really a precise outline of a program and has been the subject of a considerable body of work by various mathematicians over the years. Recently, Chris Skinner and Eric Urban have completed a manuscript (of more than 200 pages) which establishes a significant but still extremely special case of the conjecture.

The properties of p-adic L-functions have also been an interesting part of Iwasawa theory as it has developed over the years. In a 1986 paper, Barry Mazur, John Tate, and Jeremy Teitelbaum considered p-adic L-functions for an elliptic curve. For certain types of elliptic curves, they noticed that the corresponding p-adic L-function vanished at a certain point and decided to study its derivative experimentally. They were led to a remarkable conjectural formula for that derivative. Greenberg and Glenn Stevens succeeded in proving that conjecture in the early 1990s by a rather novel approach. It turns out that there is an analytic function of two p-adic variables which coincides with the p-adic L-function considered by Mazur, Tate, and Teitelbaum when it is restricted to a certain line, so their conjecture concerned a directional derivative for the two-variable function along that line. But Greenberg and Stevens found a way to compute the directional derivative along two other lines, and that yields the desired result. One line was relatively easy, the other far more subtle.

In recent years, John Coates and others have begun a new chapter in Iwasawa Theory, studying similar types of questions, but in a setting where they consider towers of number fields with non-commutative Galois groups. They call this non-commutative Iwasawa theory. After observing these developments over a period of years, Greenberg found a rather different point of view and developed it in a very recent (and very long) paper which appeared recently as an AMS Memoir entitled *Iwasawa Theory, Projective Modules, and Modular Representations*. The underlying theme is that certain objects that occur naturally in non-commutative Iwasawa theory can be modified so that they become projective modules over certain group rings. One can then use modular representation theory to study properties of those objects.

GRADUATE PROGRAM

The Graduate Program

Our graduate program is an essential part of the Department's mission. The research collaborations between graduate students and their faculty advisors strengthen both the students' training as well as the atmosphere of discovery and exploration in the Department. Graduate students' service as Teaching Assistants helps thousands of undergraduates learn crucial math skills in our entry-level classes, and more senior graduate students are thrilled to be able to teach their own intermediate-level courses such as differential equations. When they graduate and leave the University of Washington for either academic or industrial jobs, our graduate students become part of the mathematically sophisticated workforce in education, industry, and science on which our technologically oriented society depends.

This past year, despite the very serious economic downturn and resulting decrease in academic jobs, all nine of our graduating PhDs found excellent jobs. These ranged from traditional post-doctoral positions at Princeton and Stony Brook, to industrial positions at the Jet Propulsion Laboratory in Pasadena and the Center for Communications Research in San Diego.

The success of our students has several 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 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.

Competition for slots in our graduate program is keen, and is up sharply from previous years. Last year there were 425 applicants for our entering class of 15 students!

Once our entering students arrive on campus, they attend an orientation and TA training program, and they are closely mentored by experienced TAs during their first quarter of teaching. Each of them meets periodically with the Graduate Program Coordinator and with a separate faculty advisor to map out a course of study until the time when they begin pursuing research towards a PhD thesis. 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. This relationship often 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.

The Department sponsors numerous courses and activities designed to acquaint students with current research in mathematics, as well as with current topics related to the profession. The Department organizes regular colloquia and both formal and informal seminars and reading groups. Graduate students themselves organize the Current Problems Seminar where faculty and advanced graduate students discuss their own research. In addition to formal talks, the Department sponsors lunches with seminar and colloquium speakers. Our NSF-funded Research Training Grant provides resources to organize professional development forums for our students on a wide range of topics such as finding support for attending conferences and essential skills for finding a good job.

We are proud of the successes of our graduate program and our students. Despite the recent economic uncertainties we confidently expect not only to continue operating at the high level we have achieved, but to build further upon it.

– DOUGLAS LIND

Graduate Student Awards for 2011–2012

Academic Excellence Awards:
Sayan Banerjee
Shirshendu Ganguly
Simon Spicer

Teaching Excellence Awards:
Matthew Junge
Luke Wolcott

ARCS Foundation Fellows:
Peter Caday
Alexander McAvoy
Christopher McMurdie
Mary Solbrig

GO-MAP Research Assistantship:
Rebecca Uhlman

Winners of this year's Academic Excellence Award (left to right): Sayan Banerjee, Simon Spicer, and Shirshendu Ganguly.

Huckabay Fellow:
Lindsay Erickson

McKibben and Merner Fellows:
Christopher Aholt
Elliott Paquette
Andrey Sarantsev
James Stark

Microsoft Scholars:
Tim Carrell
Stephen McKeown
James Pfeiffer
Lorenzo Prelli
José Alejandro Samper Casas
Pal Zsamboki

Natural Sciences Dean's Fellows:
Hao Chen
Jessica Merhej

NSF Graduate Fellows (see article, page 12):
Cris Negron
Richard Robinson

RTG Fellows:
Gregory Drugan
Stephen Lewis
Mark Hubenthal
Stephen McKeown
Lee Patrolia
Justin Tittelfitz

Tanzi-Egerton Fellow:
Alyson Deines

Top Scholar Awards:
Riley Casper
Hon Leung Lee

STUDENT AWARDS

NSF Graduate Research Fellowships

The NSF Graduate Research Fellowship program, as described by the National Science Foundation, "helps ensure the vitality of the human resource base of science and engineering in the United States and reinforces its diversity." These prestigious, three-year grants support outstanding students pursuing graduate degrees in science, technology, engineering, and mathematics disciplines.

Four students from the Department of Mathematics were named recipients of 2011 NSF Graduate Research Fellowships. Will Johnson and Tia Lerud received their undergraduate degrees from the UW and continue their studies at UC Berkeley and UC Davis, respectively. Cris Negron and Richard Robinson are both students in our PhD program. **Will Johnson** is profiled on page 4. What follows is a closer look at the other three students.


Will Johnson


Tia Lerud


Cris Negron


Richard Robinson

Tia Lerud graduated from the University of Washington last autumn with a Bachelor of Science in both ACMS and Statistics. She is now pursuing a PhD in statistics at the University of California, Davis. Tia's research interests include spatial statistics and large data sets with applications in climate and weather modeling, astrophysics, and neuroscience. She is also interested in finding ways to recruit underrepresented minorities into the math sciences. After receiving her PhD, she plans to enter a career in either academia or industry.

Cris Negron is currently in his third year of graduate study, having come to the UW after receiving his undergraduate degree from the University of Virginia. In his first year at UW, the Department named Cris one of eight VIGRE (Vertical Integration Grants for Research and Education) Fellows. Cris is now working with James Zhang in the area of noncommutative and homological algebra.

Says Cris, "Much of my initial interest had to do with the types of arguments that can be made in a homological setting. A lot of formal tools have been developed there coming from topology, group theory, geometry, and algebra. Using these tools, you can sometimes prove surprising results about rings. There is a great deal of fun to be had figuring out what the homology is telling you about tangible set theoretic operations."

Cris got a chance to learn what others are doing in noncommutative algebra at conferences he attended last summer. He also attended a UC Berkeley Mathematical Sciences Research Institute (MSRI) summer school in cluster algebras. "Cluster structures are very new and seem to be coming up everywhere. I wouldn't be surprised if I found myself working with them in the future."

Richard Robinson joined the Department's graduate program last year after completing his undergraduate work at the University of Kansas with a strong background in analysis. Though Richard has yet to choose a specific research interest, he is currently studying geometric measure theory (GMT) with Tatiana Toro. Richard says that two things led him to his study of GMT: a talk on the subject last year given by fellow graduate student Stephen Lewis, and discussions on the topic with Toro during her Real Analysis course, which he attended last year.

Richard got the opportunity to learn more about geometric measure theory at an MSRI summer school on the topic that Toro helped organize last July, which exposed him to much of the advanced work on the topic. "Unlike a research conference," says Richard, "the material was covered so that a beginning student, like myself, could keep up. It was also interesting to hear how some of the older graduate students in attendance were applying GMT to their research."

Departmental Undergraduate Awards

The following undergraduate awards were presented to students during a ceremony last June. In addition to their award stipends, the students were presented with a book reflecting their mathematical interests, indicated in italics. Some students who had received external awards were also recognized and presented with a book.

Outstanding Graduating Bachelor of Science Major
Will Johnson – *Is God a Mathematician?* by Mario Livio
Courtney Kempton – *The Black Swan: The Impact of the Highly Improbable* by Nassim Taleb
Chad Klumb – *Pioneers of Representation Theory: Frobenius, Burnside, Schur, and Brauer* by Charles W. Curtis
Andrew Ohana – *Music of the Spheres: Searching to Solve the Greatest Mystery in Mathematics* by Marcus du Sautoy

Outstanding Graduating ACMS Major
Bradley Medlock – *The Man Who Loved Only Numbers: The Story of Paul Erdos and the Search for Mathematical Truth* by Paul Hoffman

Outstanding Graduating Bachelor of Arts Major
Michelle Minato – *Journey through Genius: Great Theorems of Mathematics* by William Dunham

Outsanding Student in Honors Calculus
Shao-Chieh Cheng (1st year) – *Yearning for the Impossible: The Surprising Truths of Mathematics* by John Stillwell
Katia Nepomnyashchaya (2nd year) – *Charming Proofs: A Journey into Elegant Mathematics (Dolciani Mathematical Expositions)* by Claudi Alsina, R.B. Nelson

Gullicksen Award for Outstanding Juniors in Mathematics
Mark Bun – *The Singularity is Near: When Humans Transcend Biology* by Ray Kurzweil
Dylan Wilson – *Discoveries and Opinions of Galileo* by Galileo and Stillman Drake (translator)

Tseng Fellowship
Gracie Ingermanson – *Logicomix: An Epic Search for Truth* by Apostolos Doxiadis et al.

RECOGNITION FOR EXTERNAL AWARDS

Goldwater Scholarship
Mark Bun – *The Singularity is Near: When Humans Transcend Biology* by Ray Kurzweil
Jane Hung – *The Strangest Man: The Hidden Life of Paul Dirac, Mystic of the Atom* by Graham Farmelo

Putnam Exam, Top UW Placements
Will Johnson (Outstanding UW Score) – *Is God a Mathematician?* by Mario Livio
Chad Klumb – *Pioneers of Representation Theory: Frobenius, Burnside, Schur, and Brauer* by Charles W. Curtis
Steven Portzer – *My Best Mathematical and Logic Puzzles* by Martin Gardner
Keyun Tong – *The Shoelace Book: A Mathematical Guide to the Best (and Worst) Ways to Lace Your Shoes* by Burkhard Polster

UW Calculus Reform Revisited

Ten years ago, I wrote an article in this newsletter highlighting a major reform effort in our teaching of the first two quarters of freshman level calculus. In addition to reduction in class size, the reform effort involved four major components:

(i) The courses were framed around a highly organized course website providing access to worksheets, homework, and old archived exam materials.

(ii) An extended-time weekly worksheet session was introduced to help discover and master various key ideas in the course.

(iii) A standard textbook was adopted but supplemented with locally produced supplementary homework.

(iv) Instructional freshness and improvement was facilitated through regular instructor meetings and discussions.

Since making these changes permanent, we have observed sustained improvements in both student and instructor satisfaction in calculus.

In the spring of 2010, it was time to look back and revisit potential instructional changes we had previously rejected. Reflecting on our highlighted reform efforts, it is notable we implemented no technology (beyond website usage) into our instruction of calculus. One potential technology tool was discussed ten years ago, but quickly dropped: the use of online computer homework grading. At the time, we simply felt the technology was too new and unproven. In subsequent years, major improvements have taken place and an American Mathematical Society Task force study (2009) concluded, in part, that "such software had the potential to improve student learning in elementary mathematics courses, with a comparatively modest investment, and led to higher passing rates in these courses." Because of this changed landscape, we made the decision to test the use of a software program called Webassign. This is an online homework grading system that is integrated with the textbook homework but also allows the inclusion of our own custom created homework problems (an ingredient in the original reform effort). Additionally, the use of this software can proceed through any standard Internet web browser and requires no special computer capabilities and no local computer administrative support.

After an initial positive class test in Winter 2010, the Department adopted Webassign full scale during the 2010-11 academic year, phasing in its use in the first three calculus courses Math 124/5/6. The benefits of Webassign to the students are many-fold as reflected in our quarterly student course evaluations. For example, students frequently point to the fact that feedback is instantaneous (under our old homework grading model there was a one week delay), all problems are graded (under our old model resources only allowed grading of a select few problems), and tutorials are linked into the homework to help students in real time when they make mistakes or are stuck (a feature we've never had).

Revisiting our calculus reform has allowed us to build on our earlier improvements by implementing the use of technology. An interesting anecdote illustrates just how powerful such e-tool technology can be.

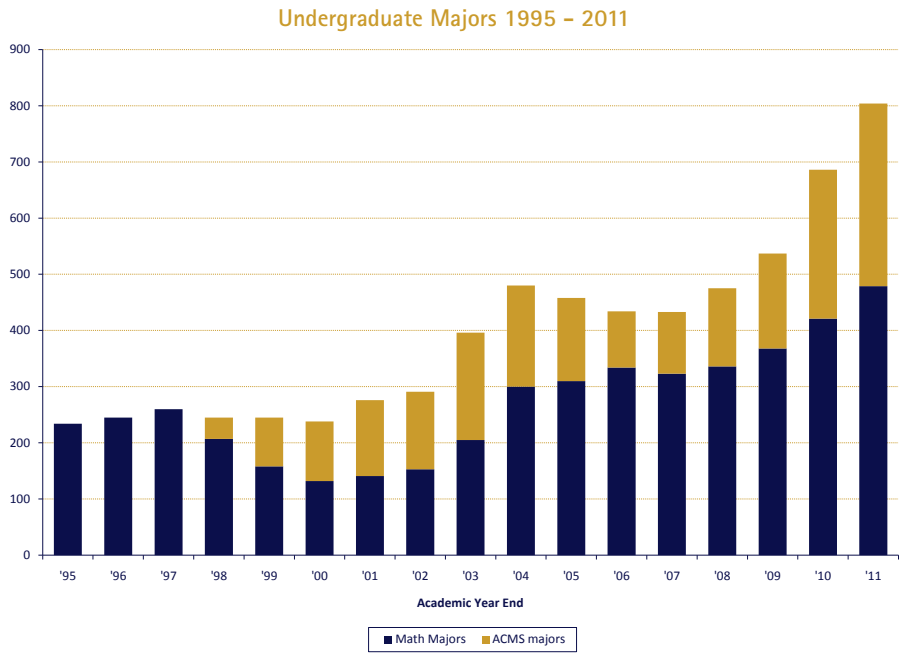
When I last taught Math 124, a student emailed me in the late afternoon (long after our morning class) and insisted that his answer submitted to a Webassign homework problem was correct, yet Webassign kept counting it wrong. As the instructor, I had the ability to go to a website, look up that student, look up all of the answers submitted on the particular problem, see his error, then email back indicating where he was mistaken. This all took place relatively quickly and prior to our next lecture class. Before that next class, I made it a point to look up this student using my UW online class resources, which provide a student photo. I walked into class, walked over to the student (whom I had never previously met) and asked if he now understood how to do the problem. Needless to say, the student was amazed at this level of personal attention.

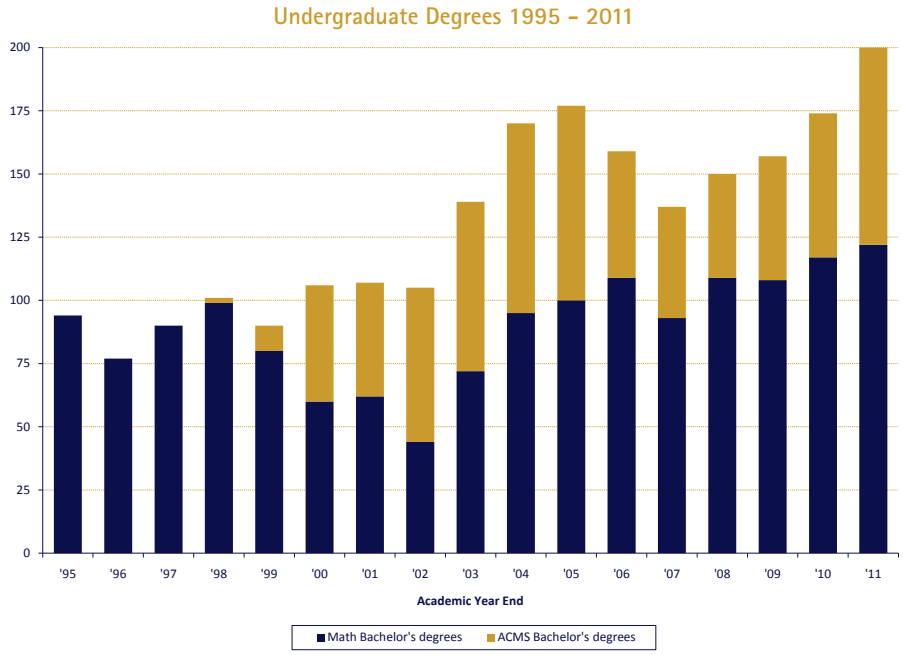
We view the implementation of Webassign as a major step forward in helping students master the material and an innovative tool that is appreciated by both students and instructors.

– DAVID COLLINGWOOD

Undergraduate Majors and Degrees

These bar graphs show the numbers of majors (top) and Bachelor's degrees awarded (bottom) in the Mathematics program and the joint Applied and Computational Mathematical Sciences (ACMS) program. As one might expect, the graph for degrees awarded follows the pattern set by the number of majors with a one- or two-year time lag.





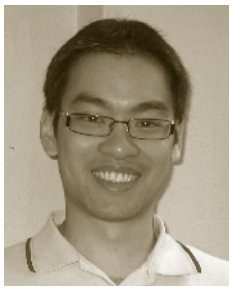
FACULTY NEWS

New Faculty

Six new faculty members and postdoctoral fellows joined the Department in 2011–2012:

Jonas Azzam (RTG Postdoctoral Fellow), PhD UCLA, 2011. Azzam studies geometric measure theory, analysis on metric spaces, and harmonic analysis.

Hariharan Narayanan (Assistant Professor), PhD University of Chicago, 2009. Narayanan, who will join us in the spring, studies randomized algorithms, machine learning, convex optimization, distributed computation and statistical physics. His appointment is joint with the Department of Statistics.



Kenneth Chan (Acting Assistant Professor), PhD University of New South Wales, 2010. Chan studies noncommutative algebra and algebraic geometry.

Linh Vinh Tran (Acting Assistant Professor), PhD Rutgers University, 2011. Tran studies probabilistic and additive combinatorics.

Benjamin Lundell (Acting Assistant Professor), PhD Cornell University, 2011. Lundell studies number theory.

Chelsea Walton (NSF Postdoctoral Fellow), PhD University of Michigan, 2011. Walton studies noncommutative algebra and representation theory.

Promotions

Three faculty were promoted this autumn:

Max Lieblich was promoted from Assistant Professor to Associate Professor with tenure.

Alexandra Nichifor was promoted from Lecturer to Senior Lecturer.

Julia Pevtsova was promoted from Assistant Professor to Associate Professor with tenure.

Mathematics Faculty Fellowships

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.

The Department has selected Soumik Pal (pictured, left) to be the 2011 recipient of this two-year award. Pal does research in probability theory and is interested in the question of how probability theory models the real world. Some of his work includes the analysis of rank-based stochastic models with applications related to the performance of economic entities such as companies, cities, or countries.

Max Lieblich and Julia Pevtsova (pictured, below), who were selected in 2010, continue as Faculty Fellows this year.

Krzysztof Burdzy: Editor of *Annals of Probability*

Krzysztof Burdzy has been selected to serve as the editor of *Annals of Probability*, one of the two leading journals in the field. This is the second time a member of the Department faculty has served as the journal's editor, the first being Ron Pyke from 1972 to 1975. In addition, *Annals of Probability* is a continuation of *Annals of Mathematical Statistics*, on which Z.W. (Bill) Birnbaum, distinguished UW professor of Mathematics and Statistics, served as editor from 1967 to 1970. (*Annals of Mathematical Statistics* split in 1972 into *Annals of Probability* and *Annals of Statistics*.)

Burdzy's term as editor, which begins in January 2012, will last three years.

2011–2012 Milliman Lectures: Wendelin Werner

This year's Milliman Lectures will be given on May 22–24, 2012, by Professor Wendelin Werner of the *Université Paris-Sud* (Orsay, France). Werner works in probability theory and its applications to mathematical physics, especially statistical mechanics. In 2006 he won a Fields Medal, one of the highest honors in mathematics, for his work on Schramm-Loewner evolution, the geometry of two-dimensional Brownian motion, and conformal field theory.

RECENT DEGREES

Recent Degree Recipients

The following students completed their doctorates in Mathematics during the academic year 2010–2011.

Matthew Badger. His advisor was Tatiana Toro, and his thesis title was "Harmonic Polynomials and Free Boundary Regularity for Harmonic Measure from Two Sides." Matthew is now a James H. Simons Instructor at SUNY, Stony Brook.

Jeremy Berquist. His advisor was Sándor Kovács, and his thesis title was "Singularities on Nonnormal Varieties." Jeremy is now a visiting assistant professor at SUNY Oswego.

Andrew Crites. His advisor was Sara Billey, and his thesis title was "Pattern Avoidance and Affine Permutations." Andrew is now a researcher at the Center for Communications Research in La Jolla, CA.

João Gouveia. His advisor was Rekha Thomas, and his thesis title was "Geometry of Sums of Squares Relaxations." João now holds a tenure-track position at the University of Coimbra, Portugal.

Zsolt Patakfalvi. His advisor was Sándor Kovács, and his thesis title was "Moduli Spaces of Higher Dimensional Varieties." Zsolt is now an instructor at Princeton University.

Ting Kei Pong. His advisor was Rekha Thomas, and his thesis title was "Convex Optimization in Sensor Network Localization and Multi-task Learning." Ting Kei is now a postdoctoral fellow at the University of Waterloo.

Kiana Ross. Her advisor was Sándor Kovács, and her thesis title was "Characterizations of Projective Spaces and Smooth Hyperquadrics via Positivity Properties of the Tangent Bundle." Kiana is now a member of technical staff at Aerospace Corporation (FFRDC).

Travis Willse. His advisor was Robin Graham, and his thesis title was "Parallel Tractor Extension and Metrics of Split G2 Holonomy." Travis is now a postdoctoral fellow at the Australian National University in Canberra.

Ting Zhou. Her advisor was Gunther Uhlmann, and her thesis title was "Electromagnetic Inverse Problems and Cloaking." Ting is now a C.L.E. Moore Instructor at Massachusetts Institute of Technology.

Mark Hubenthal completed his graduate work at UW, earning a Master's degree under advisor Gunther Uhlmann.

Bachelor's Degrees

200 Bachelor's degrees were awarded during the 2010–2011 academic year: 122 in Mathematics and 78 in ACMS.

OUR DONORS

The following is a list of our friends who have contributed to the Department between September 1, 2009, and October 15, 2011. 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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