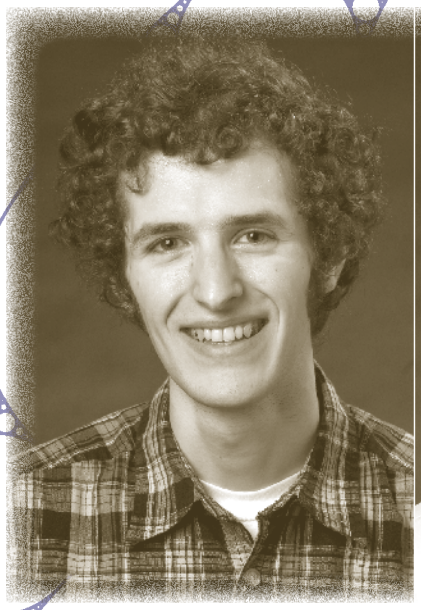
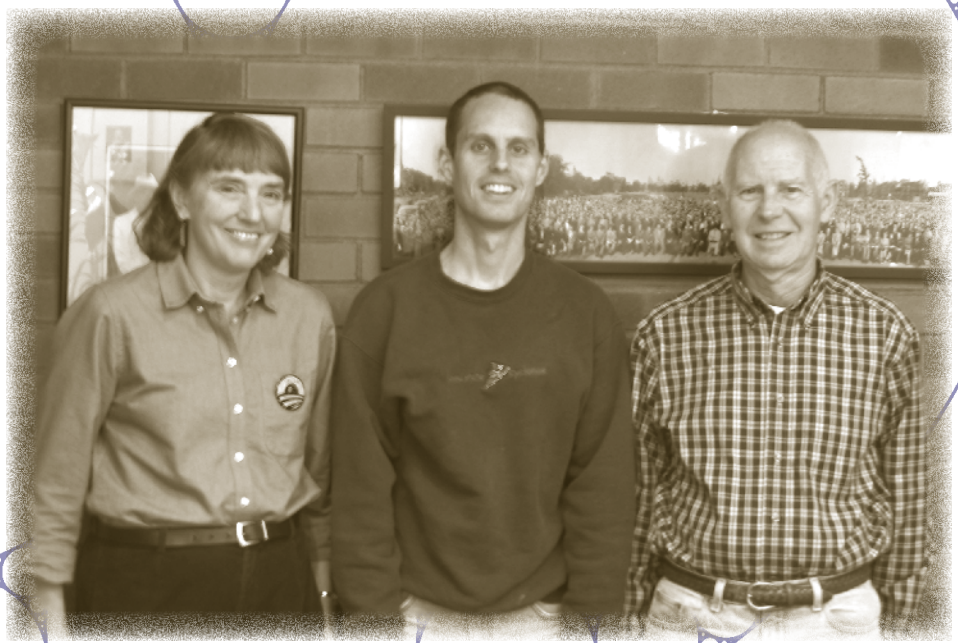
AUTUMN 2008

NEWSLETTER OF THE DEPARTMENT OF MATHEMATICS AT THE UNIVERSITY OF WASHINGTON

Mathematics NEWS





DEPARTMENT OF MATHEMATICS NEWS

MESSAGE FROM THE CHAIR

When I first came to UW twenty-six years ago, the region was struggling with an economic downturn. Our region has since turned into a hub of the software industry, while programming has become an integral part of our culture. Our department has benefited in many ways. For instance, the Theory Group and the Cryptography Group at Microsoft Research are home to a number of outstanding mathematicians who are affiliate faculty members in our department; the permanent members and postdoctoral fellows of these groups are engaged in fruitful collaborations with faculty and graduate students.

More recently, there has been a scientific explosion in the life sciences, the physical manifestations of which are apparent to anyone who drives from UW to Seattle Center along Lake Union. Researchers in the life sciences increasingly make use of mathematical, computational and statistical methods, in areas such as cancer research and genetics. We are proud of the fact that graduates of our department go on to careers in all of science and engineering as well as mathematics. For example, Jeff Eaton, Marshall Scholar and 2008 Dean's Medalist, has chosen to pursue a Ph.D. in Infectious Disease Epidemiology at Imperial College. Many of our department's alumni contribute to the technological and scientific advancements in our region.

Another development that has had a profound effect on the mathematical sciences in the region is the emergence of the Pacific Institute for the Mathematical Sciences (PIMS) as an international force. PIMS is a distributed institute based at the University of British Columbia that operates at nine universities, with UW joining eight universities in Western Canada as the only US site. PIMS activities include thematic research programs, collaborative research groups and summer schools. The Banff International Research Station, initiated by PIMS and the Mathematical Sciences Research Institute, is now an independent operation that hosts mathematical scientists from all over the world in weekly workshops and other activities. PIMS-initiated international collaborations also include the Pacific Rim Mathematical Association, whose first congress will take place in Sydney during the summer of 2009, and a scientific exchange with France's CNRS.

These activities bring mathematicians to our area; mathematicians who come to one institution visit other institutions, start collaborations with faculty, and return for future visits. They provide motivation, research experiences, support, contacts and career options to our students. Taken together, these factors have contributed significantly to our department's accomplishments during the past decade.

With this newsletter we look back on another exciting and productive year for the department. A record number of Mathematics degrees were awarded, for example. The awards won by the department's faculty and students during the past twelve months include the UW Freshman Medal (Chad Klumb), the UW Junior Medal (Ting-You Wang), a Goldwater Fellowship (Nate Bottman), a Marshall Scholarship (Jeff Eaton), a Dean's Medal (Jeff Eaton), the Haimo Award of the Mathematical Association of America (Jim Morrow), the PIMS Education Prize (Ginger Warfield), and the Centennial Fellowship of the American Mathematical Society (Chris Hoffman). Yet, as I write this we are experiencing an economic "seismic shift." It is clear that our funding will tighten, unfortunately just as the "baby boom echo" makes its way through College. It will be a tough challenge, but we are resolved to serve these students and to minimize the effects on our research and education. We hope the department will be able to look back some years from now and once again marvel at how far we have come.

– SELIM TUNCEL

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Pictured (front cover):

Upper left: Chad Klumb and Ting-You Wang – See page 10. *Photos by Kathy Sauber.*

Upper right: Nate Bottman – See page 13.

Lower right: Jeff Eaton – See page 12.

Bottom right: Mathematics faculty Ginger Warfield, Chris Hoffman, and Jim Morrow – See pages 9, 6, and 8, respectively.

SAGE – OPEN SOURCE MATH SOFTWARE

SAGE: Insight Into Open Source Technology

The open source software project SAGE, based in our Department and led by William Stein, won first prize in the scientific software category of the 2007 *Trophées du Libre*. The following article was published in *The Daily of the University of Washington* on January 18th, 2008. We thank *The Daily* and Chris Paredes for permission to include the article.

Last year, students trying to solve complex calculus problems and professors modeling galaxies had to use computer programs that cost hundreds to thousands of dollars. However, this December, UW students and a professor won first prize with SAGE, an open-source math program, in the scientific software division of *Les Trophées du Libre*, an international competition for free software.

SAGE, which stands for Software for Algebra and Geometry Experimentation, is basically a free, high-level calculator.

Like Firefox is an alternative to Internet Explorer and Wikipedia is an alternative to Encyclopedia Britannica, SAGE is an alternative to Magma, Maple, Mathematica and MATLAB, according to the SAGE Web site.

"When you purchase [commercial software], you get limited use and can't make copies," said William Stein, UW Mathematics professor and creator of SAGE.

SAGE is open source, which means users can change, copy and share it without worrying about a lawsuit. With commercialized code, mathematicians can't scrutinize the code to see how a computer-based calculation arrived at a result.

William Stein (right) and Robert Miller (left) work on a grant proposal to obtain new equipment for the development of SAGE. *Photo by Daniel Kim*

"As someone doing research, you want others to be able to verify your work and continue to build on it. From an education standpoint, it is important to be able to see how you are getting a result, instead of just the result itself," said Emily Kirkman, a senior who has been working on SAGE since spring 2006.

A core idea of open source is finding alternative ways to make programs similar to ones that are copyrighed. These new programs are more capable of addressing what people want, because the people using them can make the changes, said Robert Bradshaw, a fourth year graduate student working on the project.

"I like being able to build on what other people have done and watching other people take what I have done and make something even more exciting out of it," Bradshaw said. "I like being able to share my work freely with everyone I know and lowering the barrier of them actually using it. And finally there's the feeling that I'm simultaneously accomplishing what I need and donating something to the greater community."

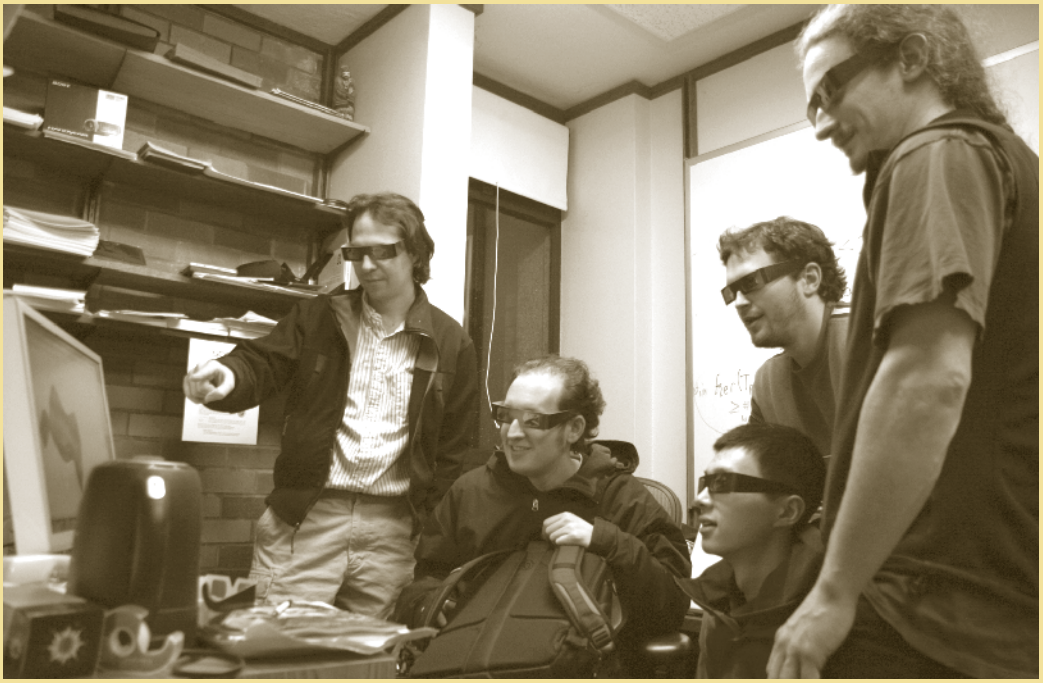
Students make up about 60 percent of the developers and about 70 percent of the users, Stein said.

"Typically SAGE gets 1,000 hits per month and our user base is 10,000; about 300 developers are on our [developer] e-mail list. Maple [a similar program] has about a million users, he added. Stein attributes low usage among professionals to the fact that some professors and engineers find it difficult to transfer their calculations to a new program. He said students appreciate the advantages SAGE provides, such as compatibility with non-open source programs and its ease of use.

Stein said students can download the programs on their computers via the Web site. Unlike Firefox, this program can't be found on the UW library computers.

"It's not on those machines, and we don't plan to [put it on]."

Stein said that a UW-restricted network for SAGE would be in the works for later.



William Stein (left), the lead developer of SAGE, and (left to right) student developers Josh Kantor, Yi Qiang, Robert Miller, and Tom Boothby view a mathematical model in 3-D. The 3-D feature was added to SAGE in January 2008.

Photo by Daniel Kim

"First we want to start with faculty," he said.

Funding for open source projects typically come from foundations, taxpayers and donations, Stein said.

"Firefox, for example, gets [funding] from Google. In some cases, [the open source version] is better. Handbrake, which allows users, among other things, to copy DVDs to iPods, is better than its commercial counterparts," he said.

Often, open source programs start out worse than the commercialized program they are an alternative to, such as with Linux but they can improve with use, Stein said.

SAGE hasn't made any money, and Stein is still trying to get funding through UW for SAGE.

"Another advantage to working in open source is that it is driven by the ambitions of users and developers rather than profits. It's a very idealist stance—it makes SAGE more of a movement of the people," Kirkman said.

SAGE has had six workshops so far, with five planned for this year. The eight UW students working on the project coordinate with students from schools such as MIT, UCLA and UCSB, Stein said. The workshops are an opportunity for students from across the nation to get together and collaborate in person.

Bradshaw said he saw only one drawback to open source software: "It's not as obvious [though still very possible] to make a living producing and selling open source code. However, I don't plan on coding for a living."

Like other programs, there is always a new edition in the works. Stein points out that there are ways to ensure that developers stay in communication, since SAGE releases a new edition each week. Work on SAGE began at an American Math and Science meeting about three years ago, but most major changes started happening about a year and a half ago, when more people got involved.

"So much was psychologized [from] a large number of failures in similar open source programs that had been attempted before," Stein said. "I thought it was absurd, but knew it needed to be done."

Stein has even allowed interested high school students to help, and at least one has shown interest.

Stein said, "To make progress...I have to genuinely trust in other people and their capabilities."

– CHRIS PAREDES, *THE DAILY*

AMS CENTENNIAL FELLOWSHIP

Named to commemorate the Centennial of the American Mathematical Society in 1988, the Centennial Fellowship is awarded annually to one or more researchers who have held the Ph.D. for between three and twelve years. The primary selection criterion for the Centennial Fellowship is excellence in research. Christopher Hoffman was the sole recipient in 2008.

Christopher Hoffman
AMS Centennial Fellow

Christopher Hoffman received his Ph.D. from Stanford University in 1996 under the supervision of Don Ornstein. After postdoctoral positions at the Hebrew University of Jerusalem and the University of Maryland, in 1999 Hoffman joined the faculty at the University of Washington, where he was promoted to full professor in 2008.

Hoffman's work has been in ergodic theory, probability and combinatorics. One theme that is common through much of his work recently is that of phase transitions, an important phenomenon in physics. The most familiar phase transition is water changing to ice when the temperature falls below 32 degrees. A different phase transition in magnets has been intensively studied by mathematical models. At room temperature the magnetic poles of most of a magnet's atoms are lined up in the same direction. If you heat up the magnet a little bit, most of the poles will remain lined up in the same direction. But near a certain temperature, called the critical temperature, the fraction of atoms whose poles line up in the same direction decreases rapidly. When the temperature of the magnet gets above the critical temperature, the magnetic poles of the atoms lie in all different directions and there is very little correlation between the directions of the magnetic poles of any two different atoms.

Many models in mathematical physics display a similar behavior to the behavior of a magnet described above. For the system there are a variety of different states indexed by the value of one parameter, such as temperature in the examples above. We say the system exhibits a phase transition if the behavior of the system is very different below the critical value than it is above the critical value. (Often the system will exhibit a third behavior at the critical value that is quite distinct from the behavior either above or below the critical value.)

Hoffman has worked on phase transitions in many different contexts. An example of his work in this area are the papers that deal with *stable matchings*. Stable matchings have been studied in a wide variety of contexts. The original motivation for their study came from the following scenario.

Imagine a high school preparing for prom where there are an equal number of males and females (and everyone is heterosexual). We consider all possible matchings of the boys and the girls so that every boy gets matched with exactly one girl (and vice versa). Any such assignment of dates is likely to make some people unhappy. In particular, we say that the matching is *unstable* if there are a boy and a girl who would both rather go to the prom with each other than with the partners they are actually paired with, and *stable* if there is no such boy-girl pair. This problem was first studied by Gale and Shapley, who asked if there always exists a stable matching no matter what the preferences of the boys and girls are. They showed that the answer is yes by devising two algorithms to find a stable matching. (The two algorithms usually don't produce the same result. One always produces the

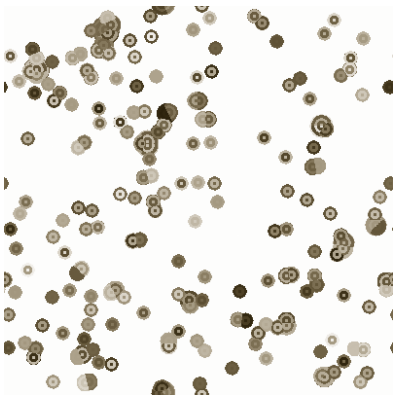


Figure 1. $a = 0.2$

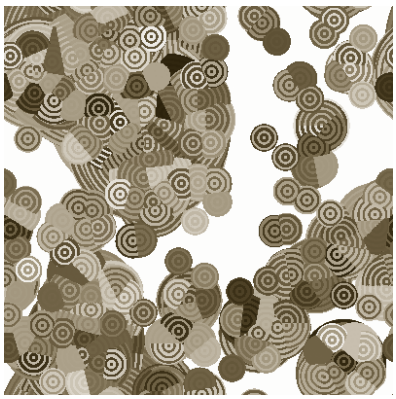


Figure 2. $a = 0.8$

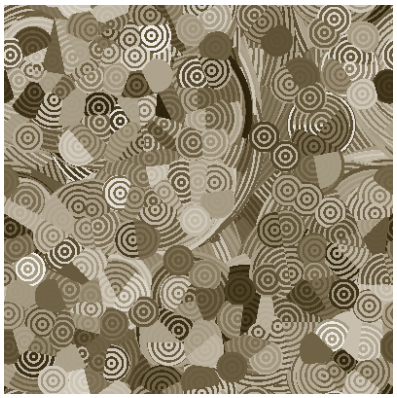


Figure 3. $a = 1$

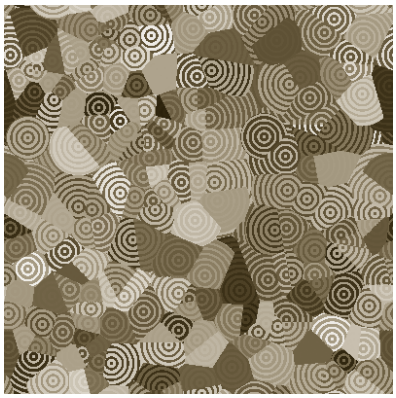


Figure 4. $a = 2$

matching that makes the boys the happiest, while the other does the same for the girls.) Such algorithms have widespread applications. For instance, the assignment of new doctors to their internships is done by one of the Gale-Shapley algorithms.

Together with Ander Holroyd and Yuval Peres, Hoffman has studied a stable matching problem between two measures in the plane. For each positive value of the parameter a, the matching problem consists of choosing a random set in the plane and assigning to each point in the set a region of area at most a in a stable manner, where points "prefer" regions that are located nearby and vice versa. To see how this system behaves we include pictures of matchings with four different values of a.

When a is less than 1 (Figures 1 and 2), the image of every point in the random set has area a, but some points (the white area) are not assigned to any point in the random set. The picture looks very different if a is greater than one (Figure 4): the image regions completely fill the plane, and some of them have area smaller than a. The critical point occurs when $a = 1$ (Figure 3). In this case the image regions fill the plane (as when $a > 1$), and they all have area a (as when $a < 1$).

Hoffman plans to use his Centennial Fellowship to continue his work on stochastic growth processes by attending the program on discrete probability at the *Institut Mittag-Leffler* in Djursholm, Sweden as well as the program on probabilistic methods in mathematical physics at the *Centre de Recherches Mathématiques* in Montreal.

MAA HAIMO AWARD

For the Love of Math: Morrow Nurtures Mathematicians, at Work and at Home

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.

James Morrow was cycling in Montana when the big news arrived: He had won the nation's most prestigious prize for higher-level math education. For those who know the UW professor, neither of these facts should come as a surprise. He has been an avid touring cyclist for decades. And his work with students, including a 2003 Distinguished Teaching Award from the UW, is tough to match.

But among the hundreds of accumulated e-mails, he almost missed a message from the Mathematical Association of America saying he'd won one of three Haimo Distinguished Teaching Awards given out this year. Morrow accepted the honor in San Diego in January.

"I knew that if you won the regional award they think of you as a candidate for the national prize. But it really surprised me that I won it," Morrow said. "It was great."

Morrow, on the UW faculty since 1969, is a well-respected lecturer. His innovations include a thesis project for a second-year honors calculus course and mentoring of students. But it's his many other activities that really put the UW's math outreach on the map.

Morrow is the driving force behind Mathday (http://www.outreach.washington.edu/k12/mathday), going strong since 1991. Some 1,200 students visit the UW campus on the Monday of spring break to learn about how math is used in the real world. Eleventh- and 12th-grade visitors do everything from visiting the planetarium to seeing mathematical card tricks to learning the secrets of Sudoku.

As far as he knows, Morrow said, Mathday is the largest math event of its kind aimed at high school students. The Kauffman-Rebassoo Professorship of Mathematics, which Morrow holds, is funded by Vaho Rebassoo, one of his first doctoral students, and George Kauffman, a fan of Mathday.

Another unique math-centered experience that owes a great deal to Morrow's influence is a 20-year-old Research Experience for Undergraduates (http://www.math.washington.edu/~reu), a national program in which a dozen top undergraduates from across the country spend eight weeks at the UW attending lectures and doing research.

Students attending one of the mathematics outreach activities Jim Morrow coordinates use toys to illustrate mathematical ideas.

Photo by Kathy Sauber

"That's when I get to take students and teach them what mathematics is about," Morrow explained. "We get to work together as colleagues." Sometimes they even co-author a paper.

Morrow doesn't consider the summer program, which comes on top of his regular teaching duties and research career, as a burden.

"I love interacting with the students," he said. "I learn a lot. Students try the craziest things, but there's always the germ of something interesting."

A few years ago, building on the success of the undergraduate program, Ron Irving and Morrow set out to create something similar for younger groups. So began the Summer Institute for Mathematics at the UW, SIMUW (http://www.math.washington.edu/~simuw/thisyear). The program draws 24 high school students from across the Northwest including Washington, Idaho, Oregon, Alaska and British Columbia. Morrow selects the teaching assistants and participants for the six-week program.

"The first thing I'm looking for is someone who doesn't give up," Morrow says of his selection process. He should know something about endurance. Morrow has completed 13 marathons and 12 RAMRODs (Ride Around Mt. Rainier in One Day), as well as cycling across the United States.

And of course there's the Mathematical Modeling Contest. In the past six years, under Morrow's coaching, the UW has scored seven wins in the grueling international competition.

While Morrow is quick to credit the teams' success to "fantastic students," the repeat wins suggest that coaching may play a role. Members of winning teams report that he

provides ample coaching and support.

"It's a serious competition, but he keeps the fun in it," said Jeffrey Eaton, a graduate student in statistics and member of a winning modeling team.

The various programs seem to build on each other. Winning modeling teams often include students, such as Eaton, who previously participated in the Research Experience for Undergraduates. Last year, one of the winning teams was made up of three students who attended SIMUW while they were in high school.

Morrow stresses that his educational outreach programs are not meant as recruiting tools, and the undergraduate research program is not intended as training for graduate work. If the students come to the UW, as many have done, he's happy to see them. But he's equally pleased to see them go to Berkeley, Harvard or elsewhere.

"All I want these students to do is to stay enthusiastic about mathematics," he said. "It's a success if they persist and keep enjoying mathematics."

Selim Tuncel, chair of the Mathematics Department, commented: "There are very few mathematicians who are as versatile as Jim. This allows him to let the students follow their interests." Tuncel added, "He is great at motivating the students, and getting them excited about mathematics."

Morrow grew up in Arkansas and Texas. Neither of his parents attended college but they both enjoyed math, he says. A high school teacher saw potential in Morrow and gave him some calculus textbooks, and he was hooked. He majored in mathematics at the California Institute of Technology and earned his doctorate at Stanford University. Morrow's brother also studied mathematics in college.

The family tradition continued. Morrow's daughter studied computer science at Stanford and now works a math-intensive job as a software engineer at Microsoft. His son studied mathematics at Harvard and worked for many years as a hedge fund manager. (No word yet on whether his two baby grandchildren are math whizzes.)

"I think there's something that runs in families, about whether you like math or not," Morrow admitted.

Morrow clearly does love math, and is able to share that joy with an academic family that counts hundreds, if not thousands, of former students. "I love solving problems. And I love seeing how math fits together to solve problems," he said. "I think math is fantastic, and I can't think of a better place to be doing it than the UW."

– HANNAH HICKEY, *UNIVERSITY WEEK*

In addition to his work as a mathematics guru, Jim Morrow is an avid cyclist who has completed 12 RAMRODs (Ride Around Mr. Rainier in One Day), as well as cycling across the United States.

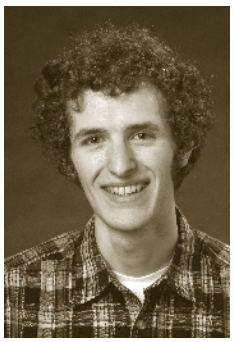
Photo by Kathy Sauber

Ginger Warfield Wins PIMS Education Prize

Ginger Warfield has done it again! Featured in last year's Newsletter as the recipient of the Louise Hay Award of the Association for Women in Mathematics, she has won the 2008 Pacific Institute for Mathematical Sciences (PIMS) Education Prize. The prize recognizes her contributions to education in the Pacific Northwest through teaching, mentoring, and outreach, as well as her contribution to mathematics education research through her collaboration with Guy Brousseau.

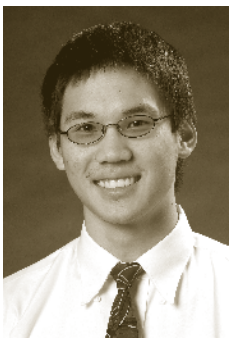
UNDERGRADUATE HONORS

UW Medalists in Mathematics



Chad Klumb, the Freshman Medalist for 2008, was a participant in the REU program in the summer of 2008. In this program he completed the solution of an outstanding problem by proving that a graph invented by a previous REU student is "3-to-1" in a certain technical sense. He is continuing his work on this subject and will give a talk on his results at the Mathfest in Portland, Oregon in August 2009. He is currently working with Jim Morrow and taking the graduate real analysis course.

Jeff Eaton was selected as an Arts and Sciences Dean's Medalist for 2008. He is currently a Marshall Scholar pursuing a Ph.D. in Infectious Disease Epidemiology at Imperial College in London (see article, page 12).



Ting-You Wang, the Junior Medalist for 2008, was previously chosen as the outstanding student in the honors calculus sequence, Math 334/5/6, for the academic year 2005-06. In the summer of 2006 he was selected to participate in our Research Experience for Undergraduates (REU) program, where he and two other students developed an algorithm to compute the solution of the discrete inverse conductivity to much higher accuracy than was previously possible. He and his teammates reported on their work at the Joint Mathematics Meetings in January 2007. Ting-You was also the winner of the Mathematics Department's Gullicksen Award in 2007. He graduated in December 2007 with degrees in Mathematics and Computer Engineering. He is currently employed by Amazon, but he is planning to attend graduate school in computer science.

Photos by Kathy Sauber.

Undergraduate Scholarships in Mathematics

Mimi Hanyee Fung has been selected as the 2008 recipient of the Mathematics Undergraduate Endowed Scholarship, which is renewable for up to four years with satisfactory progress. Mimi is an entering freshman who brings with her to UW an impressive record of study from high school, including five years' worth of mathematics courses.

Mimi joins previous winners Amanda Jane Geddes, Zachary Sanford, and Tam Thanh, all of whom are continuing their studies at UW. The scholarship is made possible by an endowment established by Byron and Sheila Bishop.

Shawn Apodaca and **Angie Zhu** have been selected to receive the 2008-09 Thomas Bleakney Endowed Scholarship in Mathematics. Shawn and Angie are beginning their junior year as Mathematics majors. In addition, Shawn is also majoring in Physics, and Angie is minoring in Statistics and Applied Mathematics. Both are outstanding students.

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, 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
Art Sadovsky – *A Beautiful Mind* by Sylvia Nasar
Jeff Eaton – *The Volterra Chronicles* by Judith Goodstein
Jill Edwards – *Hilbert* by Constance Reid

Outstanding Graduating ACMS Major
Kyotaro Hemmi – *The Great Pi/E Debate: Which is the Better Number?* (DVD)

Outstanding Graduating Bachelor of Arts Major
Ryan Bowler (standard) – *Schrödinger: Life and Thought* by Walter J. Moore
Megan Wagoner (Teacher Prep) – *Sir William Rowan Hamilton* by Thomas Hankins

Outstanding Student in Honors Calculus
Eric Nitardy (2nd Year) – *Euler, the Master of Us All* by William Dunham
Ian Zemke (1st Year) – *Counterexamples in Analysis* by Bernard Gelbaum & John Olmstead

Gullicksen Award for Outstanding Juniors in Mathematics
Nate Bottman – *Experimental Mathematics in Action* by David H. Bailey, Jonathan M. Borwein, Neil J. Calkin & Roland Girgensohn
Benjamin Hayes – *The Mathematician's Brain* by David Ruelle

UW MEDALS

UW Freshman Medal
Chad Klumb – *A Certain Ambiguity: A Mathematical Novel* by Gaurav Suri & Hartosh Singh Bal

UW Junior Medal
Ting-You Wang – *The Universal Computer: The Road from Leibniz to Turing* by Martin Davis

FEATURED GRADUATE: JEFF EATON

Jeff Eaton
2008 Arts & Sciences Dean's Medalist
2008 Marshall Scholar
2006 Goldwater Scholar
2005 Sophomore Medalist

Multiple Degrees and the Marshall Scholarship

One of the highest awards available to college graduates in the United States is the Marshall Scholarship, which gives awardees a full scholarship for graduate study in any university in the United Kingdom. Last spring, a Marshall Scholarship was awarded to Jeff Eaton.

The recipients of the Marshall Scholarship are among the best and brightest in America. Jeff is no exception, displaying both breadth and depth in his academic achievements.

Last June the Department of Mathematics presented to Jeff the award for Outstanding Graduating Bachelor of Science when he earned a Bachelor of Science in Mathematics (Summa Cum Laude). Amazingly, at the same time he also earned a Master's degree in Statistics, a Bachelor of Arts in Sociology (also Summa Cum Laude), and a Minor in Music.

This plethora of degrees is merely a single point of light in a glowing undergraduate career.

Jeff's undergraduate education began in autumn of 2003. He came to the University of Washington after his sophomore year in high school via the UW's Academy for Young Scholars. By the following summer, Jeff had declared as a Mathematics major. Encouraged by Professor Jim Morrow (see article, page 8), he would compete twice in the Mathematical Contest in Modeling (MCM), earning Honorable Mention and Meritorious Winner status with his teammates.

Jeff's participation in the MCM sparked a further interest in mathematical modeling that would guide the focus of his future studies. Says Jeff, "I became aware of what a powerful tool mathematical modeling is and how important mathematical models are to a wide variety of disciplines, and even important policy decisions."

Jeff capped his sophomore year by earning the UW's Sophomore Medal. His hard work garnered further awards the following year: The College of Arts and Sciences Undergraduate Research Award, the Washington Research Foundation's Research Fellowship for Advanced Undergraduates, and finally the Goldwater Scholarship.

The purpose of the Goldwater Scholarship, established by Congress to commemorate Barry Goldwater, is "to provide a continuing source of highly qualified scientists, mathematicians, and engineers by awarding scholarships to college students who intend to pursue careers in these fields."

Jeff won the scholarship in 2006 along with fellow MCM team member Owen Biesel. That same year Eliana Hechter, another of Jeff's MCM collaborators and former Goldwater Scholar herself, was selected to be a Rhodes Scholar. Though he couldn't know it at the time, Jeff's own success was destined to mirror Eliana's.

The following year took Jeff on a journey of research to South Africa via a Mary Gates Venture Fellowship. There, under the guidance of UW Sociology Professor Samuel J. Clark, Jeff's mathematical modeling skills were put to use in an undergraduate research project at the University of Witwatersrand's Agincourt Health and Population Unit (AHPU). The mission of the AHPU is to provide reliable longitudinal population-based health and demographic information for health workers in Africa. Studying health care and economic development in rural villages, Jeff worked on a mathematical model of potential HIV intervention scenarios.

As Clark told *University Week*, "Jeff is an exceptionally gifted scholar who has impressed me with both his talent and his gracious, engaging approach to life."

For his final undergraduate year, Jeff returned to Seattle, closing in on his three degrees while engaging in mathematical teaching as a TA for the Department's honors calculus sequence, Math 334/5/6. "He was a superb TA," says Professor Jim Morrow, under whom Jeff worked directly in the course.

Application for Marshall Scholarships began in the autumn of 2007. Jeff participated in four mock-interviews to help him prepare for the official interview with the Marshall Commission. Competition for the prestigious award was suitably steep.

"The caliber of applicants was very high," said British Ambassador to the United States Sir Nigel Sheinwald in a press release, "and those selected will undoubtedly go on to help strengthen the unique partnership between the United States and the United Kingdom."

When he learned he'd been selected as a Marshall Scholar, Jeff was also a finalist in the running for the Rhodes Scholarship. His interest in the graduate program at the Imperial College in London, which he considers to be doing the best work in infectious disease epidemiology, guided his choice between these two great honors. As the Rhodes Scholarship grants study at Oxford, he chose to decline the Rhodes interview and take the path of a Marshall Scholar.

It is an interesting side-note that Jeff's case bears similarities with that of Mathematics alumnus Eliana Hecter, his former MCM teammate and fellow Goldwater Scholar. Selected as a Rhodes Scholar in 2006, Eliana was also offered the Marshall Scholarship that year. Eliana turned it down in favor of the Rhodes—a reversal of Jeff's own decision.

Jeff now pursues his Ph.D. at the Imperial College in London where he combines knowledge from all three of his degrees in the study of the mathematical modeling of infectious disease epidemics. The Department of Mathematics is proud to wish him the best in his post-graduate career and beyond.

— MIKE MUNZ

Nate Bottman Wins Goldwater Scholarship

Mathematics and Russian Language major Nate Bottman has won a 2008 Goldwater Scholarship, the latest in a series of many awards Nate has earned that includes a Davidson Fellowship and UW Freshman Medal. Like Jeff Eaton before him (see left), Nate currently serves as a Mathematics TA while pursuing his degree.

Nate is also a winner of the Department's 2008 Gullicksen Award for Outstanding Juniors in Mathematics.

GRADUATE PROGRAM NEWS

The Graduate Program

The graduate program within the Mathematics Department is thriving. The number of doctoral degrees awarded by the Department has reached record levels over the last two years with 14 awarded in 2007 and 12 awarded in 2008. Recent graduates have accepted positions at top research universities such as Columbia, Cornell, Michigan, Princeton, Rice, Stanford and Pennsylvania; others are working at companies such as Microsoft and Samsung; and still others are teaching at local schools including Green River Community College and Seattle University. The program's success is the combined result of our graduate students' hard work and talent, the tireless dedication of the Department's faculty, and the fruition of a comprehensive recruitment and retention plan that was initiated a decade ago.

The plan begins with a multi-pronged effort to improve the quality of our entering classes by enhancing our recruitment efforts. Each application is carefully evaluated by the Graduate Admissions Committee. We use funds from the Graduate School, together with internal departmental funds, to support visits of our top candidates. During these visits, in addition to meeting with our Director of Graduate Admissions, each applicant is paired up with one of our advanced graduate students. These students are in an excellent position to both inform the applicant about the Department from the students' perspective and provide heartfelt and compelling publicity for our program.

Our recruitment strategy has been a dramatic success. The number of applicants to our program has steadily increased from a low of about 110 in 1998 to at least 250 in each of the last three years. This has allowed us to be increasingly selective in our admissions policy. We typically admit about fifteen Doctoral students as well as a few Master's students each year. Some of our Master's students have successfully transitioned into the Ph.D program; others have used the Master's degree as a springboard to jobs in a wide range of industries. Our graduate enrollment has increased to approximately 90 students, the maximum number we can fully support with our current resources.

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 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.

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 monthly colloquia which bring internationally recognized speakers to the Department as well as several seminars in specialized fields.

The graduate students organize the Current Topics Seminar, where faculty and advanced graduate students make their own research accessible to beginning graduate students. In addition to formal talks, the Department sponsors graduate student lunches with the colloquium speakers and "brown-bag lunches" to discuss issues related to the teaching and learning of mathematics.

Developing a comprehensive support package to guarantee adequate financial support to our students has been crucial to our recruitment strategy. Most of our top applicants receive offers from leading universities that include financial incentives beyond their base TA salary, which in turn is often significantly greater than ours. In recent years we have been able to promise an attractive 11-month salary for a minimum of five years, subject to making satisfactory progress toward the Ph.D. To fund this plan we have to call upon all sources of funding available to us: resources coming from the Graduate School at UW and outside sources such as the National Science Foundation, the ARCS Foundation, and the Microsoft Corporation, as well as internal departmental funds. 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.

— DANIEL POLLACK

Graduate Student Awards for 2008–09

Academic Excellence Awards
Daeshik Choi
Christopher Jordan-Squire
Guangbin Zhuang

Teaching Excellence Awards
Camil Aponte
Luke Gutzwiller

ARCS Foundation Fellows
Tobias Johnson
Christopher Jordan-Squire

McFarlan Fellows
Zsolt Patakfalvi
Ting-Kei Pong

McKibben and Merner Fellows
Alberto Chiecchio
Sean Holman
Matthew Korson
Dake Wang
Wenhan Wang

GO-MAP Research Assistantship
Lindsay Erikson

Microsoft Scholars
Mauricio Duarte
Joao Gouveia
Zsolt Patakfalvi
Ting Kei Pong
Dake Wang
Xingting Wang
Carto Wong
Amanda Young

Tanzi-Egerton Fellow
Kiana Ross

Top Scholar Awards
Joel Barnes
Wai Tong Fan
Shuwen Lou
Elliot Paquette
Brendan Pawlowski
Sourav Sen Gupta
Erik Slivken

VIGRE Fellows
Alexsandr Aravkin
Gregory Drugan
Sean Holman
Tobias Johnson
Joshua Kantor
Antonio Kirson
Steven Klee
Travis Kopp
Qiuying Lin
Kurt Luoto
Robert Miller
Kiana Ross
Troy Winfree
Amanda Young

ROBERT & ELAINE PHELPS PROFESSORSHIP

Rekha Thomas: Robert & Elaine Phelps Professor

Robert R. Phelps received his B.A. in Mathematics from the University of California at Los Angeles in 1954 and his Ph.D. from the University of Washington in 1958. After two years at the Institute for Advanced Study in Princeton, and two years on the faculty at the University of California at Berkeley, he joined the UW Mathematics Department in 1962. Phelps was a Visiting Professor at the University of Paris in 1969-70 and at University College London in 1977-78. He served as Chair of our department from 1978 to 1981. He retired in 1996 and was named Professor Emeritus.

Elaine F. Phelps received her B.A. in Slavic Languages and Literature from the University of California at Berkeley and her Ph.D. in Linguistics from the University of Washington. Her non-linguistic efforts were devoted to liberal political activism supporting secular humanism in general and abortion rights in particular.

Together they initiated the Robert R. and Elaine F. Phelps Endowed Fund in 1999. More recently, they supplemented the fund with an additional contribution in 2007, bringing it to the level of an endowed professorship. Rekha Thomas has been selected as the first Robert and Elaine Phelps Endowed Professor of Mathematics for a four-year term.

Rekha Thomas

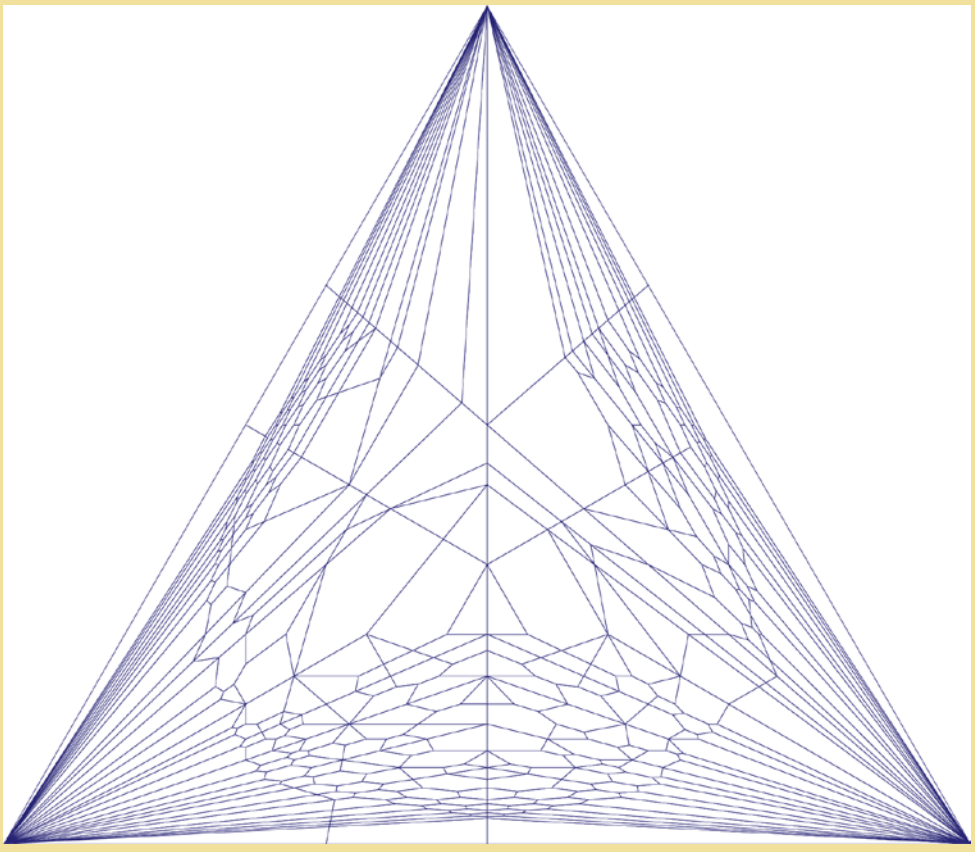
Rekha Thomas began her research career as a Ph.D. student in the School of Operations Research at Cornell University. Operations Research is a branch of applied mathematics that emerged as a discipline around the 1940s, motivated by the optimization and scheduling requirements of the Second World War. The fathers of the field include some of the great minds of the time such as John von Neumann, Alan Tucker, George Dantzig, and John Nash, all of whom worked in many areas of mathematics. The main subjects of the field are optimization, probability, and statistics, and operations research methods have applications in many areas such as computer science, engineering, economics, biology, finance, manufacturing systems and health care. Thomas specialized in discrete optimization and wrote a thesis on algebraic methods in integer programming which was on the mathematical end of the optimization spectrum. She received her Ph.D. in 1994, got her first job in a math department, and has remained in mathematics ever since. She came to the University of Washington in 2000 after spending the first five years of her career at Texas A&M University.

Thomas's main research contributions are in discrete optimization and computational algebra. Until 2000 her main focus was on using algebraic methods to gain insight into the structure of integer programs, which are optimization problems where one needs to find non-negative integer solutions to linear systems of equations. We are very far from a complete understanding of integer programs even though very large ones are solved routinely in applications such as airline scheduling and portfolio management. The general integer program was studied intensely in the 1960s and 1970s using methods from linear algebra, number theory and linear programming, but then was deemed too hard without specialization to specific instances. However, theoretical results continued to surface pioneered by researchers in economics, computer science and mathematics such as Herb Scarf, Laci Lovász, Hendrik Lenstra, and Alexander Barvinok. Thomas's thesis work made a connection between integer programming and methods from computational commutative algebra and algebraic geometry via the notion of a *Gröbner basis*. This connection has led to several structural results for the general integer program.

Gröbner bases drive many of the algorithms in commutative algebra and algebraic geometry today. These are special generating sets for a polynomial ideal that are to a polynomial equation system what a row echelon form is to a linear equation system. In particular, they solve polynomial systems. The idea of a Gröbner basis can be seen in Paul Gordan's proof of Hilbert's basis theorem in 1900 but was

formalized only in the 1960s by Bruno Buchberger, working under Wolfgang Gröbner. Gröbner bases carry important invariants of the ideals they come from while facilitating a transformation of the ideal to a simpler (combinatorial) ideal where many of these invariants can be computed more easily. An ideal has only finitely many distinct Gröbner bases, and in many instances it is important to calculate one, several or all Gröbner bases of an ideal. As part of his Ph.D. work at the University of Aarhus done under Thomas's supervision, Anders Jensen developed a software package called Gfan that can compute all Gröbner bases of an ideal (among other things). This is a major computational development in this area and one that was considered impossible ten years ago. Thomas's contributions in computational algebra all stem from the theory of Gröbner bases in different guises.

Thomas is currently interested in problems that come from real algebraic geometry and semidefinite programming. The former is the study of real solutions to polynomial inequality systems, while the latter is a branch of optimization theory in the space of symmetric matrices. There is an intriguing connection between these two disparate fields via the fact that polynomial optimization can be approximated by semidefinite programs. Thomas is currently part of an NSF Focused Research Group to work in this area along with Bill Helton and Jiawang Nie at UC San Diego, Bernd Sturmfels at UC Berkeley, and Pablo Parrilo at MIT.



A Gfan drawing of the Gröbner fan of the ideal generated by $f := x^5 + y^3 + z^2 - 1$, $g := x^2 + y^2 + z - 1$ and $h := x^6 + y^5 + z^3 - 1$. The lexicographic Gröbner bases that could solve the system $f = g = h = 0$ (analogs of row-echelon forms for linear systems) correspond to cells hugging the sides of the triangle. They are usually very difficult or impossible to calculate directly. However, if any one cell is known, then a simple homotopy through the fan from that cell to the lex cells can be implemented fast. Gfan performs such tasks.

MATHEMATICS FACULTY FELLOWS

The Mathematics Faculty Fellowships are intended for research faculty below the rank of professor, or professors who are less than 15 years past the Ph.D., and recognize the importance and impact of research support for these colleagues. The Department has selected both Ioana Dumitriu and Paul Hacking to be the latest recipients of this two-year award.

Ioana Dumitriu

Ioana Dumitriu received her Ph.D. from MIT in 2003 and joined our department in 2006 after holding a Miller Research Fellowship at Berkeley. Her thesis received an Honorable Mention for the 2005 Householder Prize for the best dissertation in numerical analysis in the past three years, and she won the 2007 Leslie Fox Prize for the best paper in numerical analysis by a young researcher in the past two years. Much of her work is at the confluence of numerical analysis and random matrix theory. On the one hand, she uses methods from numerical linear algebra to study random matrix models arising in physics and statistics, and on the other, she applies results about random matrices to find faster algorithms to solve problems in numerical linear algebra.

Paul Hacking

Paul Hacking received his Ph.D. from the University of Cambridge in 2001. He subsequently held assistant professorships at Michigan and Yale before joining our department in 2006. Hacking's research is in the field of algebraic geometry, that is, the study of geometric spaces that can be defined by polynomial equations. Hacking studies the geometry of the space that parametrizes all possible types of algebraic surfaces, particularly the interesting limiting phenomena as the parameters become very large, using techniques from algebra, differential geometry, and topology.

Sara Billey and John Palmieri, who were selected last year, continue as Faculty Fellows this year.

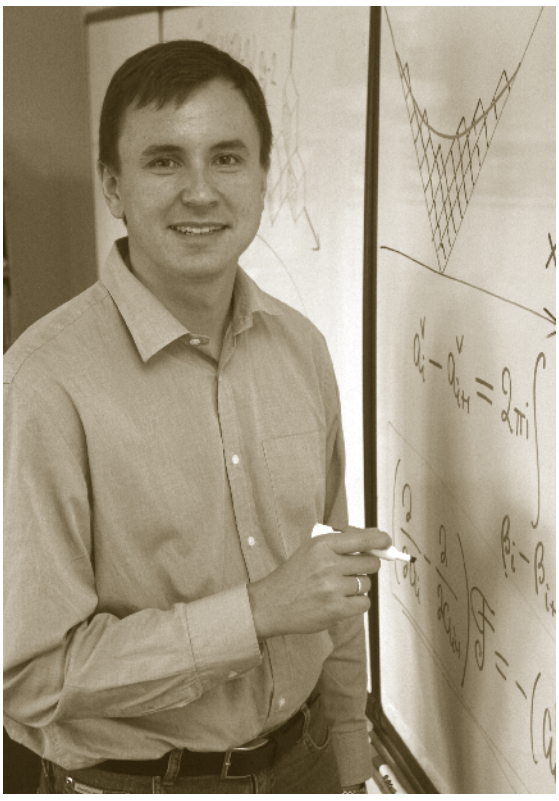
SPECIAL LECTURES

MathAcrossCampus Colloquium

This year a new series of colloquia is being organized by two professors and a graduate student from our department: Rekha Thomas, Ioana Dumitriu, and Nathaniel Blair-Stahn. Called MathAcrossCampus, the series is designed to showcase applications of mathematics, with a special emphasis on the growing role of discrete methods. The goal of this quarterly colloquium is to expose theoreticians to applied work, to create a community of mathematicians and users of mathematics at UW, and to serve as a guide to students and researchers looking for projects and jobs in math-related areas in the Seattle area. The first lecture, by Professor Joseph Felsenstein of the Department of Genome Sciences, was on "Evolutionary trees, coalescents, and gene trees: can mathematicians find the woods?"

For information about further events in the MathAcrossCampus series, see www.math.washington.edu/mac.

A Buddhabrot rendering of the Mandelbrot set.
Image courtesy of Paul Bourke.



Andrei Okounkov to Give Milliman Lectures

The 2008-09 Milliman Lecturer will be Professor Andrei Okounkov of Princeton University, who will be visiting the UW for the week of May 18-22, 2009. Professor Okounkov was one of the recipients of the 2006 Fields Medal, the highest honor in mathematics, "for his contributions bridging probability, representation theory, and algebraic geometry." This citation by the Fields Medal committee only hints at the remarkable scope of Okounkov's work, which also involves combinatorics and mathematical physics and often reveals deep new connections between different fields of mathematics. Okounkov has not yet announced the topics of his lectures, but they are sure to be interesting.

For more information about the Milliman Lecture series, see www.math.washington.edu/Seminars/milliman_0809.php.

OUTREACH

UW Mathematics Outreach

Two programs vie for top billing on the outreach front: Math Day and SIMUW. We'll start with Math Day, which has been around much longer.

Math Day occurs on the Monday of the University's spring break, when some 1,200 high school students from as near as Seattle and as far away as Moscow, Idaho come to campus for a day full of mathematics both in its own right and as it turns up in various sciences. The day always starts with a lecture by someone known for the sparkle as well as the content of their presentations. This year's, for instance, was by a biometrician, Noble Hendrix, and bore the splendid title of "One Fish, Two Fish, False Fish, True Fish." For the rest of the day, students have choices of many smaller sessions, including lectures ranging from "The Curvature of Surfaces" to "Why Dogs have Wet Noses and Other Mathematical Insights," as well as activities from visiting a laboratory to making boomerangs. Meanwhile, their teachers, besides attending sessions, have a luncheon together, where they have lively conversations with each other and with UW faculty and students and even get to play some mathematics games of their own. All of this is managed annually by Professor Jim Morrow who maintains (somewhat implausibly!) that it is easy to do.

For SIMUW, otherwise known as the Summer Institute for Mathematics at the University of Washington, the age range of participants is similar, and the total student-days is not far different, but in this case we have not 1,200 students for one day but rather 24 students for six weeks. A further difference: while the underlying motivation for Math Day is to entice students who may not have thought about it into exploring mathematics and considering UW for college, the SIMUW students are most definitely already interested in mathematics. They are chosen by their solutions to a problem set posted on the department's web site—problems that do not involve calculus, but do require some heavy-duty thinking. The program, which exists thanks to a very generous anonymous donor, allows these students live in a dormitory, take six different two-week half-day courses on topics ranging from the probabilistic method and the art of the non-constructive proof to the mathematics of internet security, and take part in a wide-ranging collection of special events and lectures—all the while surrounded by peers who not only do not consider their taste for mathematics weird, but share it. It's a pretty exciting event all round, and not just for the students!

Other outreach efforts are less visible, but nonetheless significant. One that has exciting possibilities is a revival of the Math Fairs that we enjoyed for a number or years, thanks in part to a VIGRE fellowship awarded to graduate student Troy Winfree for the purpose. As before, the new Math Fairs—now transformed into Family Math Nights—take a bunch of undergraduates into high-needs elementary schools to play some mathematical games with the students and prepare them to teach and challenge their parents at an upcoming evening event. One change that greatly enhances our chances of making this a sustainable activity is that we have now joined forces with Explorations in Math, a non-profit organization that you can read about at www.explorationsinmath.org. They take care of logistical arrangements that used to fall to UW organizers—a vast improvement!

Less formal, and not even possible to tally, are the relationships that many faculty members, graduate students, and undergraduates have built with different schools around the area by tutoring, running math clubs, and helping to prepare for events such as Math Olympiads. Not something to put in a list, but a nice collection of reassurances that the mathematics department counts among its members many who are indeed willing to reach out!

— GINGER WARFIELD

TRANSITIONS

Faculty News

This year the Department made three new appointments:

Soumik Pal (Assistant Professor), Ph.D. Columbia University, 2006. Professor Pal studies applied and theoretical probability.

Julia Pevtsova (Assistant Professor), Ph.D. Northwestern University, 2002. Professor Pevtsova studies representation theory; she was an Acting Assistant Professor in the Department last year.

Susan Sierra (NSF Postdoctoral Fellow), Ph.D. University of Michigan, 2008. Dr. Sierra studies noncommutative algebraic geometry, noncommutative algebra, and algebraic geometry.

Matthew Conroy was promoted from Lecturer to Senior Lecturer.

Chris Hoffman was promoted from Associate Professor to Professor.

Rekha Thomas was promoted from Associate Professor to Professor.

Ginger Warfield was promoted from Senior Lecturer to Principal Lecturer.

Edward Curtis and **K. Bruce Erickson** retired; they joined the Department in 1970 and 1973, respectively.

Visiting Faculty

The following is a list of this year's supported long-term visitors, their affiliations, and areas of research:

Sergey Bezuglyi (Autumn), Institute for Low Temperature Physics. *Ergodic theory, topological dynamics, and Borel dynamics.*

Nurlan Dairbekov (Winter), Kazakh-British Technical University. *Function theory, partial differential equations, differential geometry, and integral geometry.*

Robert Easton (Autumn), University of Utah. *Algebraic geometry.*

Kyeong-Hun Kim (Autumn), Korea University. *Partial differential equations, stochastic partial differential equations, and stochastic processes.*

TRANSITIONS

Recent Degree Recipients

The following students completed their doctorates in Mathematics during the academic year 2007-2008.

Matthew Ballard. His advisor was Chuck Doran, and his thesis title was "Derived categories of sheaves of quasi-projective schemes." Matthew is now a Math/Physics Research Group RTG Postdoctoral Fellow at the University of Pennsylvania.

Andrew Frohmader. His advisor was Isabella Novik, and his thesis title was "Face vectors of flag complexes." Andrew is now an H.C. Wang Assistant Professor at Cornell University.

Christopher Kunkel. His advisor was Jack Lee, and his thesis title was "Quaternionic contact pseudohermitian normal coordinates." Christopher is now an Adjunct Professor at Seattle University.

Ian Langmore. His advisor was Gunther Uhlmann, and his thesis title was "Inverse transport with angularly averaged measurements." Ian is now a Postdoctoral Researcher at Columbia University.

Micah Warren (see also below). His advisor was Yu Yuan, and his thesis title was "Special Lagrangian equations." Micah is now an Instructor at Princeton University.

Catherine Williams. Her advisor was Dan Pollack, and her thesis title was "Asymptotic behavior of marginally trapped tubes in spherically symmetric black hole spacetimes." Catherine is now an RTG/Samuelson Postdoctoral Fellow at Stanford University.

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 parentheses:

Walker Carlisle (Toro)

Laura Celis (Hoffman)

Michael Decker (Thomas)

Adam Estrup (Marshall)

Michael Gaul (Yuan)

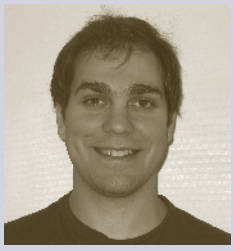
Sarah Gilles (Thomas)

Eina Ooka (H. Smith)

Andrey Pestov (Uhlmann)

Bachelor's Degrees

148 Bachelor's degrees were awarded during the 2007-2008 academic year: 109 in Mathematics and 39 in ACMS.



National Science Foundation (NSF) postdoctoral fellowships are among the most prestigious for mathematicians. **Micah Warren** *(pictured, left)*, who received his Ph.D. in Spring 2008, was offered an NSF postdoctoral fellowship at Stanford University, but has turned it down in favor of his current position as an Instructor at Princeton University. Micah chose this position over others offered at the Institute for Advanced Study, the University of Texas at Austin, and the University of British Columbia. He was also the recipient of a Clay Mathematics Institute Liftoff Fellowship in Summer 2008.

OUR DONORS

The following is a list of our friends who have contributed to the Department between September 1, 2006, and October 17, 2008. 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).

INDIVIDUALS

Mr. and Mrs. Roy K. Abe
Mr. and Mrs. Tom Adams
Mr. E. Aksay & Ms. D . Furutani-Aksay
Mr. and Mrs. Roberto E. Altschul
Corin R. Anderson, Ph.D.
June Lucile Anderson
Mr. and Mrs. Andrew Anschell
Prof. Judith M. Arms & Mr. Stan Sorscher
Dr. and Mrs. Charles W. Austin
Mr. Hazen Porter Babcock
Mr. and Mrs. Gary L. Baker
Mr. Kim R. Bankson
Mr. and Mrs. Joseph A. Baranoski
Ms. Kathryn Barnett & Mr. Jeffrey Price
Mr. and Ms. Jeffrey Barr
Ms. Daisy J. Beach
Prof. A. Beebe & Ms. S. Giudice
Ms. Tamara K. Bennett
Dr. and Mrs. John L. Berggren
Dr. Joel David Berman
Orlando M. Biazzi
Prof. Sara Billey & Mr. Paul Viola
Ms. Bonnie C. Birch
Mr. T.P. Bleakney & Ms. M.T. Stanley
Mr. Hans Boehm & Ms. Soroor Ebnesajjad
Mr. Phil R. Bombino
Mr. and Ms. Michael R. Borden
Mr. and Mrs. John M. Bossert
Mr. Jeffrey D. Bravo
Dr. Kathryn Renouard & Mr. Michael Brown
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Mr. Andy K.K. Chan
Dr. Laura M. Chihara
Mr. Eddie Chin
Mr. and Mrs. Gordon P. Chin
Mr. Shinn-Te Chou
Mr. Gregory M. Clark
Mr. Robert D. Clark
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Mr. and Mrs. Douglas E. Compton
Mr. and Mrs. John G. Connors
Ms. Dona M. Costello
Mr. and Mrs. Robert E. Coyle
Mr. Benjamin Logan Crockett
Dr. and Mrs. Charles N. Curtis
Mr. Lan Q. Dam
Ms. Irene S. David
Ms. Yosha R. Delong-O'Connell
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Mr. Steven Diklich and Ms. Joann Blalock
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Mr. and Ms. Gary Goldwater
Mr.Graham Gordon & Ms. Elizabeth Smith
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Mr. and Mrs. George A. Graf
Ms. Lisa A. Granat
Mr. David Casey & Ms. Linda S. Green
Mr. Owen R. Green
Mr. and Mrs. Gary G. Grimes
Mr. and Mrs. Gerlad W. Griswold
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Mr. Earl G. Hansen
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Mr. and Mrs. Gustav N. Harras
Ms. Henri J. Hartman
Mr. and Mrs. Thomas L. Henderson
Mr. and Mrs. Randal Henzler
Mr. Terence James Hiatt
Dr. and Mrs. Jack E. Houston
Mr. Hsin-Haw Hsu
Mr. and Mrs. Wendell P. Hurlbut III
Prof. Ronald S. & Ms. Gail L. Irving
Mr. and Mrs. Joseph C. Jaeger
Mr. Naqi Jaffery
Mr. Peter James
Dr. R. James & Ms. Cynthia Morgan
Robert E. Jamison, II, Ph.D.
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Mr. and Ms. William D. Joyner
Mr. and Ms. Brian I. Kanekuni
Dr. Palaniappan Kannappan
Mr. and Mrs. Joseph Karpen
Dr. and Mrs. Theodore Katsanis
Mr. and Mrs. George B. Kauffman
Mr. and Mrs. Matt S. Kaun
Kiran S. Kedlaya
Ms. Leslie C. Kelly
Ms. Bora Kim
Mr. Minbok Kim
Prof. and Mrs. James R. King
Ret. Lcdr. and Mrs. Ronald E. Kline
Dr. John E. Koehler
Prof. Sándor Kovács & Ms. Tímea Tihanyi
Ms. Cathy Kriloff & Mr. Ray Lappan
Mr. John V. Russell & Ms. Ann L. Kuder
Robert P. Kurshan, Ph.D.
Mr. Victor J. La Forest
Robert W. & Jian Ping Larse
Mr. David K. Lau
Mr. Phong Le & Ms. Thuy Dao
Mr. and Mrs. Michael J. Lebens
Mr. and Mrs. Vernon G. Leck
Prof. John M. Lee & Ms. Pm Weizenbaum
Prof. and Mrs. Victor K. Lee
Ms. Ling K. Leung
Mr. Randal J. Lewis
Ms. Deanna Jean Li
Mr. and Mrs. Charles K. Lin
Prof. Douglas A. Lind
Mr. and Mrs. John R. LLoyd
Mr. and Mrs. Eric P. Loken
Mr. and Mrs. Douglas Lowther
Mr. Hilary M. Lyons
Mr. and Mrs. Gerald E. Magner
Mr. and Mrs. Michael D. Mallory
Mr. Stephen L. Mar
Mr. Asa C. Martin
Mr. Glenn McCauley & Ms. Ellin Huttel
Mr. James Kelly McClimans
Ms. Clara M. McGee
Mr. Craig McKibben & Ms. Sarah Merner
Mr. John H. McKinley, Jr.
Mr. and Mrs. Peter M. McLellan
Dr. and Mrs. George D. McRae
Mr. and Mrs. Christopher R. Merrill
Prof. and Mrs. Ralph W. Metcalfe
Prof. Ernest A. & Dr. Erika B. Michael
Mr. Norman D. Miller
Mr. Raymond S. Miller
Mr. and Mrs. Mark V. Milodragovich
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Ms. Polly Moore
Mr. and Mrs. Nicholas D. Murphy
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Mr. and Mrs. Gerald A. Oberg
Mr. and Mrs. Douglas L. Oliver
Mr. Donald K. Olson II
M. Scott Osborne, Ph.D.
Dr. and Mrs. Krzysztof Ostaszewski
Mr. Clifford W. Otis
Mr. and Mrs. Ian A. Paige
Prof. J. Palmieri & Ms. D. Bacharach
Ms. Carroll M. Pearson
Mr. Erik J. Pearson
Mr. and Mrs. Scott R. Persing
Ms. Barbara B. Peterson
Ms. Barbara S. Peterson
Prof. Richard B. Peterson
Mr. and Mrs. Thomas A. Pfeiffer
Prof. Robert R. & Dr. Elaine F. Phelps
Mr. and Mrs. Mark L. Pierson
Mr. L. Plummer & Ms. G. Fennema
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