For ALUMNI and FRIENDS

Proof Reader

From the School of Mathematics, College of Sciences @ Georgia Tech®

Georgia Tech

Notes from the Chair

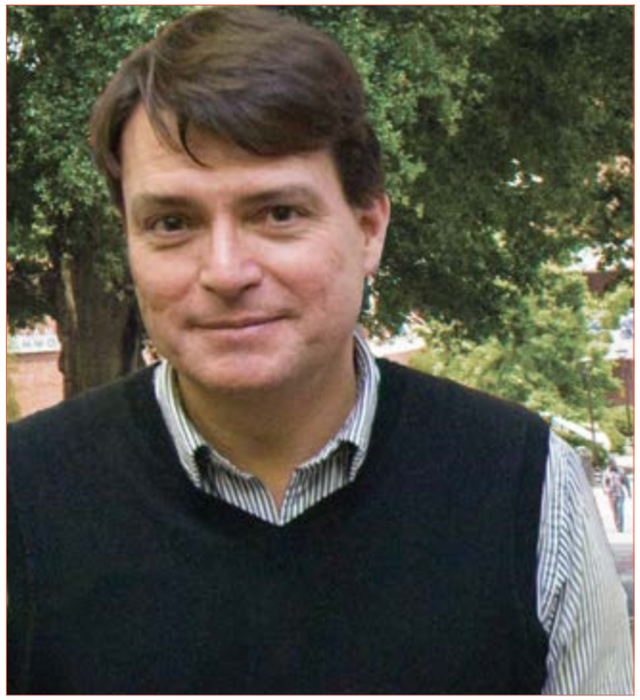
In my notes last year I mentioned that we have been taking a hard look at our lower-division curriculum—the foundational calculus and linear algebra courses that form the backbone of most majors at Tech. That process is now well along, and we plan to roll out new 1000-level courses in Fall 2015. The catalyst for this review is the fact that incoming Tech students are better prepared than ever—fully 80 percent of them have had significant exposure to calculus in high school, and 20 percent of them arrive having completed AP calculus or similar courses, with high exam scores to confirm their mastery. This has led us to divide the material in a new way that will be better aligned with students' preparation and make their course selections more straightforward. We also expect the revamp to improve the success rates of incoming students whose math backgrounds are not as strong, especially those who arrive with no previous exposure to calculus.

We've also been thinking about how we teach our courses, as well as what we teach. Several faculty members formed a pedagogy study group to look at the latest developments involving active learning, adaptive computer techniques, and "flipped" classrooms. The common thread in all these ideas is that one learns mathematics by doing it, not by watching someone else do it. After surveying current thinking and discussing what would be appropriate for Tech-caliber students, we have designed some controlled experiments to collect data and see what really works here. Anyone who has been in education for long realizes that there are no silver bullets and that the road to the mastery of difficult mathematics inevitably involves lots of hard work, but we do think there may be ways to improve the success of our students, and we are actively seeking them out. Stay tuned for more news on these efforts.

A long-standing and ongoing part of our effort to deliver quality instruction is the school's Director of Teaching Effectiveness (DOTE). The DOTE helps junior faculty improve their teaching and helps the school and the college document and evaluate teaching for the purposes of tenure and promotion. It's an important job you can read more about on page 10.

The research activities of the school continue at the highest international level. This issue of *ProofReader* includes a faculty profile of new Assistant Professor Martin Short who does mathematics with an applied flavor. I think you will find his approach to modeling and predicting crime interesting. In fact, several police agencies have found it useful enough that it has changed the way they operate. See page 8 for more. We also include a research feature on the (hundreds of years old) Dürer problem on unfolding polygons and exciting recent progress by Professor Mohammad Ghomi.

In earlier *ProofReaders* I've written about our ambitions to have a large program of postdoctoral fellows and our progress toward that goal. Another major step was realized this year with the funding of the IMPACT project. A team led by Associate Professors Christine Heitsch and Brett Wick wrote a proposal to the National Science Foundation for a grant in the Mentoring through Critical Transition Points program. The transition from graduate student to tenure-track faculty member is a big jump that often involves two or three years in a postdoctoral position. Our new project will bring cohorts of postdocs to campus and engage them in a highly structured mentoring and research program centered on interactions between mathematics and other areas of science and engineering. The goal is for them to leave Tech ready for tenure-track positions at the top research universities. See page 17 for more on this very exciting project.



I've also mentioned many times what a treasure we have in the School's staff. Unfortunately, other units on campus also recognize that and have recruited away our finance team. Christy Dalton has moved to the School of Civil Engineering, and Inetta Worthy has moved to the Office of Development. In light of these departments and the increased administrative pressure coming from a very active and ambitious faculty group, we are rethinking our entire staff structure and expect to make changes that will lead to a higher level of service. Recruitment of new people is underway, and we should be able to announce the new structure soon.

In closing, let me take the opportunity to introduce the new Director of Development for the College of Sciences, Art Wasserman (see photo on page 46). Art has extensive experience in development in academic, research, and humanitarian settings, and he has global experience and perspective. We look forward to working with Art to further develop relationships with our base of alumni and friends.

Best wishes,
Doug Ulmer
Professor and Chair

About the Cover:

Our history article this year pays tribute to that mechanical computer called a slide rule. SoM author and photographer Professor Tom Morley contributed the article and the photographs. He offered the following comment on the cover: "No batteries. A mechanical calculator on a mechanical transportation device. Mechanical computer by K&E." Our graphic designer, Janet Ziebell, nicely adapted his photograph.

SoM Statistics Spring 2014

Faculty	56	(tenured or tenure track)
Emeritus Faculty	14	
Academic Professionals	5	
Visitors	11	
Postdocs	14	
Staff	12	
Graduate Students	95	
Undergraduate Students		
Math	145	
Discrete Math	23	

Slides Ruled

by Tom Morley

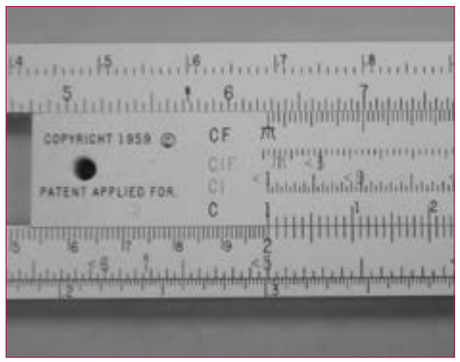
"Grabbing a pencil and a slide rule, Tom was soon covering sheet after sheet of paper with diagrams and computations." From Tom Swift, "Jr." Number 20, written by Victor Appleton, II 1962

From time immemorial, mathematicians, scientists, and engineers have computed. When computers were a job description and not a physical device you could carry around, students and professionals had other devices to help them compute. Before laptops and smartphones, before HP-35 and the TI SR-10 calculators, the tool of choice for professionals and students was the slide rule. Back in those days, most students arrived at Tech already carrying around a slide rule in its special holder, attached to their belt.

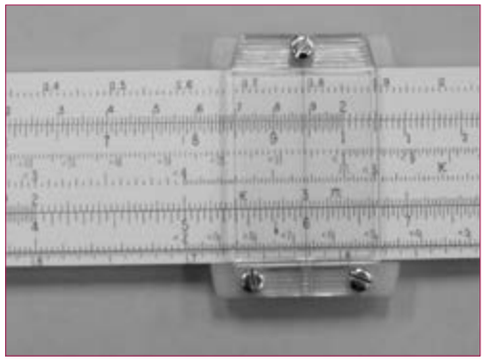
Slide rules came in many forms—straight, circular, and even built into wristwatches—but most students owned a slide rule about 12 inches long, which had scales that allowed them to multiply and to compute logs and trig functions.

The slide rule consists of three parts: a fixed part with several scales; the middle piece, which slides back and forth; and a movable cursor, which is transparent with a vertical line. The most used scales on the slide rule were the C and D scales, which were used to multiply. So get yourself a slide rule and follow along.

Find the C scale. This is located on the middle-sliding piece. Find the 1 on the left of this scale. Move it over



so that the 1 is right above a 2 on the D scale. The D scale is right below the C scale but on the fixed piece of the slide rule.



Now move the cursor so that the vertical line is right over the 3 on the C scale. Now look right below, on the D scale, and you'll see the number 6. Congratulations! You have just multiplied 2 times 3, which is (I believe) 6.

To multiply 2×10^5 times 3×10^4, you would add 5 and 4 (perhaps using your fingers) and then set the slide rule in the same way—and conclude that 2×10^5 times 3×10^4 is 6 times 10^9. Correct!

One of the reasons that mathematics teachers liked slide rules is that the slide rule multiplied only the significant digits. The order of magnitude of the answer—the 10^9 part—had to be estimated or computed by heads or hands. Therefore, the students always had to have a good idea of the relative size of the answer, thus improving their power to estimate answers.

The C and D scales that are used in multiplication are logarithmic scales. Multiplication on the slide rule works because log(a b) = log(a) + log(b). Other scales such as A, B, S, T, etc. on the slide rule are used to compute square roots, cube roots, and various trig functions, but I have mostly forgotten how to use them. However, there's lots of information on the web about how to use a slide rule.

Now go to an online auction site and buy a slide rule, or get out your old slide rule and find the product of 1.8×10^2 and 5.8×10^{-4}. Next time: How to use the Texas Instruments SR-10.

Tom Morley

AFFINE UNFOLDINGS OF CONVEX POLYHEDRA: PROGRESS ON DÜRER'S PROBLEM

by Mohammad Ghomi

Convex polyhedra are among the oldest mathematical objects. Indeed, the five platonic solids, which constitute the climax of Euclid's books, were already known to the ancient people of Scotland some 4,000 years ago (1). During the Renaissance, polyhedra were once again objects of fascination while painters were discovering the rules of perspective and laying the foundations of projective geometry. This remarkable confluence of art and mathematics was personified by a number of highly creative individuals, including the German painter Albrecht Dürer, who was based in Nüremberg at the dawn of the 16th century and is credited with ushering in the Renaissance in Northern Europe. During extended trips over the Alps, Dürer learned the rules of perspective from his Italian contemporaries and subsequently described them in his influential book *The Painter's Manual* (4). Aside from being the first geometry text published in German, this work is remarkable for containing the first recorded examples of unfoldings of polyhedra.

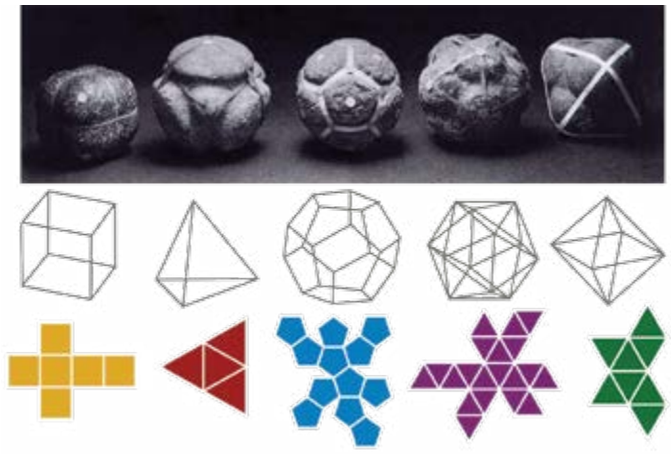


Figure 1. First row: Neolithic carved stones from 2000 BC discovered in Scotland.
Second row: The familiar representations of platonic solids studied in Euclid's *Elements*.
Third row: Examples of unfoldings of the platonic solids.

An (edge) unfolding of a polyhedron is the process of cutting it along a collection of its edges, without disconnecting it, so that the resulting surface may be developed isometrically into the plane. Many schoolchildren are familiar with the process of cutting out a template from a craft book and then folding the paper along dotted lines to form simple polyhedra such as a tetrahedron or a cube; an unfolding is the reverse process. Note that the cuts are made along a connected subset of edges of P that contains each vertex of P and no closed paths. In other words, the cut set forms a *spanning tree* of the edge graph of P, and thus a convex polyhedron admits many different unfoldings depending on the choice of this tree. Furthermore, it is not the case that every unfolding of every polyhedron is simple or nonoverlapping. For instance, there are even some (non regular) tetrahedra that admit some unfoldings which overlap themselves. On the other hand, all the examples of unfoldings that Dürer constructed were simple, and in the intervening five centuries no one has yet discovered a convex polyhedron that does not admit some simple unfolding.

Figure 2. A self-portrait of Dürer completed in the year 1500 at the age of 28, together with some illustrations from his book *The Painter's Manual*.

The problem of the existence of simple unfoldings for convex polyhedra was explicitly posed in the 1970s by Shephard (6), and the assertion that a solution can always be found or that every convex polyhedron is unfoldable (in one-to-one fashion) has been dubbed *Dürer's conjecture*. There is substantial empirical evidence both for and against this supposition. On the one hand, computers have found simple unfoldings for countless convex polyhedra through an exhaustive search of their spanning edge trees. On the other hand, there is still no algorithm for finding the right tree, and computer experiments suggest that the probability that a random edge unfolding of a generic polyhedron overlaps itself approaches *one* as the number of vertices grow (3). To date, the problem remains wide open, and it is not even known whether simple classes of polyhedra such as prismatoids (polyhedra generated by the convex hull of a pair of convex polygons in parallel planes) are unfoldable.

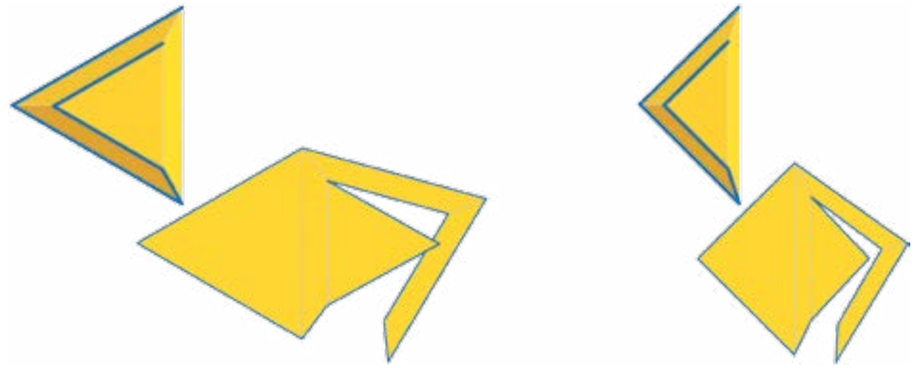


Figure 3. The left side shows a truncated tetrahedron (viewed from "above") together with an overlapping unfolding of it generated by a monotone edge tree. As we see on the right side, however, the same edge tree generates a simple unfolding once the polyhedron has been stretched.

Recently, the author has been able to make some progress in this area by solving a weaker form of Dürer's problem posed by Croft, Falconer, and Guy (2, B21): Is every convex polyhedron combinatorially equivalent to an unfoldable one? It turns out that the answer is yes, and therefore there exists no combinatorial obstruction to a positive resolution of Dürer's problem. What the author shows is that every convex polyhedron becomes unfoldable after an affine (or linear) transformation. More explicitly, suppose that a convex polyhedron P is in general position in R^3, i.e., no two of its vertices are at the same height. Then it is easy to construct a spanning tree T of P that is *monotone*, i.e., if T is rooted at the lowest vertex r of P, then each of the branches of T which connects its leaves to r have strictly decreasing heights or z-coordinates. Now stretch P via a rescaling along the z-axis. Then the corresponding unfolding eventually becomes simple, as illustrated in Figure 3. The proof that this stretching procedure works is by induction on the number of leaves (or branches of T that connect each leaf to the root r). The first step, i.e., when T consists of only one branch is relatively simple to prove and follows from a topological characterization for embeddings among immersed disks in the plane. The inductive step is more technical. See the author's paper (5) for further details and references.

Mohammad Ghomi

References

(1) M. Atiyah and P. Sutcliffe. Polyhedra in physics, chemistry and geometry. *Milan J. Math.*, 71:33-58, 2003.

(2) H.T. Croft, K.J. Falconer, and R.K. Guy. *Unsolved problems in geometry*. Problem Books in Mathematics. Springer-Verlag, New York, 1991. Unsolved Problems in Intuitive Mathematics, II.

(3) E.D. Demaine and J.O'Rourke. *Geometric folding algorithms*. Cambridge University Press, Cambridge, 2007. Linkages, origami, polyhedra.

(4) A. Dürer. *The painters's manual: A manual of measurements of lines, areas, and solids by means of compass and ruler assembled by Albrecht Dürer for the use of all lovers of art with appropriate illustrations arranged to be printed in the year MDXXV*. Abaris Books, New York, N.Y., 1977 (1525).

(5) M. Ghomi. Affine unfoldings of convex polyhedra. *arXiv:1305.3231*. To appear in *Geom.Topol.*

(6) G.C. Shephard. Convex polytopes with convex nets. *Math. Proc. Cambridge Philos. Soc.*, 78(3):389-403, 1975.

URL: www.math.gatech.edu/~ghomi

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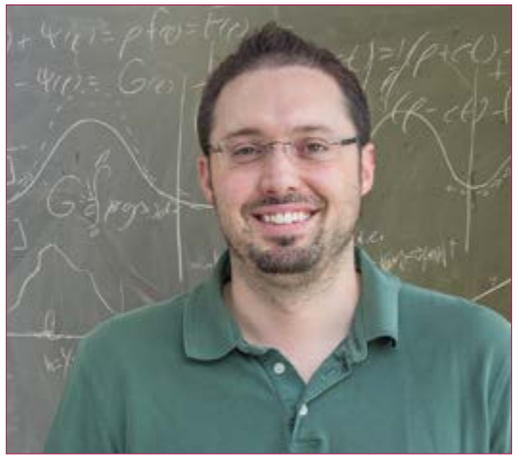
Faculty Profile

Martin Short

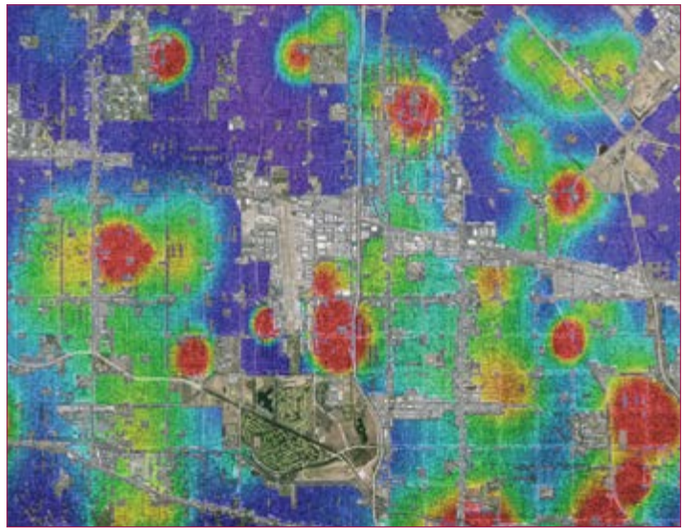
by Sung Ha Kang



Professor Martin Short (PhD, Physics, University of Arizona, 2006) joined the School of Mathematics in the fall of 2013 after holding a computational and applied mathematics assistant professor position in the Department of Mathematics at UCLA, 2007–2013. Professor Short's interests lie in mathematical modeling, analysis, and simulation of physical, biological, and, most recently, social systems. In fact, much of his recent research has been on understanding spatiotemporal patterns in criminal activity and has led to an application called "Predictive Policing."

It is known that crime rates exhibit hot-spot patterns, whereby criminal events tend to concentrate in relatively localized regions of time and space. This is largely due to the fact that crime is "self-exciting"—a successful crime at space-time location (x,t) causes the rate of events near x to increase in the near future of t, since criminals tend to repeatedly return to areas where they experience success. This phenomenon can be modeled through a coupled set of PDEs that are in the form of reaction-diffusion equations.

These equations allow for steady-state solutions that are constant in space and time. However, these states are unstable to small perturbations—when the model parameters satisfy a certain inequality, crime hot spots will nucleate and form a distinct pattern. The figure shows how a typical crime pattern can develop; red regions are the prime hot spots, blue regions indicate the safer areas, and yellow and green areas represent the different degrees of the predicted crime level.



Professor Short has employed stochastic equations in which the current crime rate is influenced by previous crimes through mathematical kernels. Based on this work, Short and his colleagues founded PredPol Inc., a company that develops crime-prediction software for police departments. Atlanta PD is one of its current customers.

Professor Short also holds a current grant through the Army Research Office to study "Scalable, Stochastic, and Spatiotemporal Game Theory." He is considering the task of determining the optimal way for law enforcement officers to patrol a metro system, such as the MARTA system in Atlanta, in order to alleviate crime.

Problems of this type are often approached through the framework of Stackelberg games. This framework is typically used to defend against highly strategic adversaries who will take the time to plan out a large attack in detail and not deviate from that plan once it is made. However, typical everyday crimes are not planned attacks, and criminals can easily adjust their strategies on the fly in response to current police activity nearby.

To address these issues, Short and his colleagues model the game between a police defender and a criminal as a Markov process, in which the states of the system are a combination of the current location of the officer and the station at which the criminal is attempting to commit crimes. This nonlinear optimization problem is quite difficult to solve for large metro systems or for cases of multiple patrol units, but Short and his colleagues have developed approximate methods to solve the problem that take only a fraction of the time.

In addition to his dedication to research, Professor Short says he enjoys cooking, exploring Atlanta restaurants, wasting money on the latest technological "gewgaws." and spending time with his family. He has one daughter, Clementine, with whom he currently spends an inordinate amount of time playing Minecraft, and a wife, Kimberly, who is pursuing her PhD in physics at Georgia Tech.

More information on Professor Short's work can be found on his SoM web page, which is located at http://people.math.gatech.edu/~mshort9.

So...What Is a DOTE?

by Xingxing Yu

Beginning in the academic year 2001–02, Georgia Tech's College of Sciences initiated a program to help promote and document evidence of teaching effectiveness. Each unit in the College appointed a Director of Teaching Effectiveness (DOTE), and since 2012 that person in the School of Mathematics (SoM) has been Professor Xingxing Yu.

Yu is the sixth faculty member in the SoM to serve as the DOTE. Professor Don Estep was the first, followed by Professors Wing Li, Carl Spruill, Luca Dieci, and Chris Heil.

What does the DOTE do?

The College of Sciences requires that sample lectures of all nontenured assistant professors be reviewed at least once a year via videotaped lectures or reports from classroom visits. In the School of Mathematics, each nontenured assistant professor chooses a senior colleague to be his or her faculty adviser. The faculty adviser, after reviewing course preparation and organization, evaluates lecture content and delivery, student-teacher interactions, and other aspects of their advisee's teaching.

The DOTE then analyzes the classroom visit reports as well as student evaluation scores and submits the findings to the Department Chair and relevant committees. In addition to supporting effective teaching, the material gathered—for example, peer-reviews and student evaluations—is analyzed in tenure and promotion packages.

Other tasks

- DOTE analysis is part of the post-tenure review process for senior faculty.

- To ensure that junior colleagues will have taught a variety of courses at various levels before they go up for tenure, the DOTE is a member of the scheduling committee.

- The DOTE serves as a teaching resource to all instructors in the School of Mathematics and participates in the teaching panels during job candidate interviews.

What words of advice do experienced DOTEs have for us? Professor Heil offered this: "Patience. Try to remember what it was like when you were a student—it wasn't easy! Your students are having just as hard a time as you had (or worse). Take the time to try to reach them in class, to listen to them in your office, and to be patient with their email messages. Often the teaching issues that I saw as the DOTE came down to poor communication—and, in the end, effective communication is one of our main jobs as teachers!"

Making a Difference in the Classroom: What Works?

by Sung Ha Kang

Among the many charges of the Center for the Enhancement of Teaching and Learning (CETL) is that of faculty development, which it accomplishes through various workshops throughout the year. The February workshop was based on student feedback from the fall 2013 "Thank a Teacher" program. Sending a thank-you note though the CETL program is a way for students to express their appreciation to their teachers, and the comments provided material for the following workshop topics: What kind of teachers do students value? How do students respond to good, purposeful teaching?

One of the panel members talking about what works well for him was SoM Professor Greg Blekherman. Greg shared his techniques on connecting with and motivating students: "Making individual connections is hard in these large calculus classes of 170–200 students, so I use some humor to show that I am human too. On the other hand, I also push the students by saying, 'I know this is hard; a learning process is supposed to be hard, and I am not going to make things easier for you.' Surprisingly, not making things easy seems to work well with students.

Sung Ha Kang

One of four student notes Blekherman received said, "Thank you for showing me that I'm capable of handling college calculus. It's always reassuring to have a teacher who gets you to do things that you didn't think you could. It means a lot to me that you coax 'magic' out of us and make us enjoy (it when you're) doing so." This workshop also encouraged discussions among the participating faculty members by prompting them to consider the various teaching skills reflected in the student comments.

Greg Blekherman

Where in the World Are Evans, Shui-Nee, and Wilfred?

Given that Africa Atlanta 2014, a citywide yearlong series of events designed as a cross-cultural interdisciplinary collaboration among multiple stakeholders across the city of Atlanta, has been successfully launched here at Georgia Tech, we thought it might be interesting to take a look at some of the African connections we have in the School of Mathematics. In fact, two SoM faculty members came to us from Africa, and several others also have research connections to that continent. *– Editors*

West Africa

by Wilfred Gangbo

Some of the School of Mathematics' closest ties are with West Africa, where Professors Wilfrid Gangbo, Evans Harrell, and Shui-Nee Chow have had longtime professional relationships with the Institute for Mathematical and Physical Science (IMPS) in Dangbo, Benin, and with two universities in Senegal: University Cheikh Anta Diop (UCAD) in Dakar and Gaston Berger University in Saint-Louis. Over the past twenty years, Professors Gangbo, Harrell, and Chow have given lectures or taught several summer courses in the countries of Benin, Senegal, and Mali.

A recent visitor from the UCAD math department in Dakar, Professor Souleye Kane spent a few weeks at Georgia Tech, and his stay was partially supported by our School. During that visit, he began a collaborative research project with our colleague Professor Ronghua Pan.

Professor Harrell introduced another visitor, Professor Diaraf Seck of UCAD, to Georgia Tech. Professor Seck spent a semester at Georgia Tech, and his stay was also partially supported by the School. Since then he has had several years of active interactions with other GT faculty members, including Professor Chow. Other scientific exchange visitors from West Africa in the past few years include Professors Joel Tossa and Aboubacar Marcos, both of whom are mathematicians.

One of the visitors from Senegal who spent a few weeks at Georgia Tech while he was on the faculty at the Gaston Berger University is Mary-Teuw Niane.

Professor Niane later became Rector of that university and is now the Minister of Higher Education. He has been very supportive of developing a high-level research infrastructure in Senegal, including the establishment in 2012 of a branch of the African Institute of Mathematical Sciences (AIMS) in Mbour, which is not far from Dakar. AIMS Senegal hosts international research meetings and has a graduate program.

Recently, Benin's IMPS Center of Excellence in Mathematics was awarded funds by the World Bank. Mali and Niger were also core recipients of this grant. In fact, initiatives led by some Georgia Tech faculty created fruitful contacts among the mathematical communities of Benin, Mali, Burkina, and Niger, and may have been a contributing factor to winning the grant. The grant will result in a network that organizes joint activities with eminent mathematicians from Africa, the USA, and Europe.

Tech has also been home to several graduate students from West Africa. So far, we have had 100 percent success with the graduate students accepted from Benin based on recommendations from local mathematicians with whom we have created good relationships. The most recent case is Romeo Awi, who has passed the comprehensive exam and is continuing in our PhD program. Awi won a Chateaubriand Fellowship from the French Embassy in Washington, DC, which supported his 2014 spring semester stay in Nancy, France, where he collaborated with Professor Antoine Henrot, a previous Tech visitor in 2009.

Wilfred Gangbo

Georgia Tech's School of Mathematics expects to continue benefiting from our unique connections with West Africa by continuing to train and host PhD students and faculty members from that region.

The new buildings of the Institute for Mathematical and Physical Science (IMPS), which is now located in Dangbo, a village located a few miles from the capital, Porto-Novo, where the old building used to be.

Graduate Awards
July 2013–June 2014

Fourth-year PhD student **Romeo Awi** won the highly prestigious and merit-based Chateaubriand Fellowship from the French Embassy in Washington, DC, that supported his spring semester 2014 stay in Nancy, France.

Awi collaborated with Professor Antoine Henrot, who is at the Institut Élie Cartan Nancy, a research institute in the mathematics department at the University of Lorraine (Université de Lorraine). They worked on questions complementary to Awi's thesis on "Minimization Problems Involving Polyconvex Integrand." He had previously spent the fall 2013 semester at the Mathematical Sciences Research Institute (MSRI) in Berkeley California, as a Program Associate in the Optimal Transport: Geometry and Dynamics Program.

School of Mathematics graduate student **JD Walsh**, a second-year student in our PhD program, has been awarded an NSF Graduate Research Fellowship. According to the NSF: "The program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based master's and doctoral degrees at accredited US institutions." The fellowship offers three years of support. The NSF received 14,000 applications for the 2014 competition.

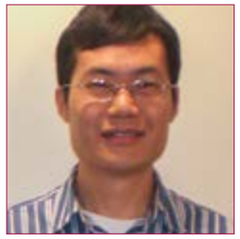
The CETL/BP Teaching Assistant Awards are the only institute wide awards for teaching assistants at GT. Being nominated for this award is a very big honor! Congratulations to **Jamie Conway**, SoM nominee for the award given to an outstanding graduate student instructor who taught his own class, and to **Justin Boone**, SoM nominee for the outstanding graduate teaching assistant award.

The Society for Industrial and Applied Mathematics (SIAM) Student Chapter Certificate of Recognition according to chapter adviser Professor Luca Dieci, is given to the student who has been instrumental in fostering the activities of the local SIAM chapter. After a few years hiatus of awarding the certificate, this year's recipient is PhD student **Fabio di Fonzo**, The award recognized his efforts toward revamping the program, maintaining a steady flow of SIAM chapter seminars, and securing SIAM funds for the same.

The School of Mathematics Graduate Awards: Spring 2014

SoM Top graduate student: **Spencer Backman** Awarded for evidence of superior academics and achievement.

SoM Outstanding Teaching Assistant: **Tobias Hurth**.



SoM Best PhD Thesis: **Ke Yin**.

SoM Best Scholarship in Science, Technology, Engineering, and Mathematics

(S-STEM) Fellows: **Robert Rahm** and **JD Walsh** Awarded to students exhibiting superior academic skills and who are contributing significantly to the STEM program and the SoM.

Festa Fellowship: **Rebecca Winarski** Award includes a cash stipend to the student who shows superior academic and leadership skills.

Bob Price Summer Travel Awards: **Chun-Hung Liu**, **Robert Rahm**, **Yanxi Hou** Enables students to travel to conferences or universities to enhance their research programs. These students will go to Boston, Finland, and Paris!

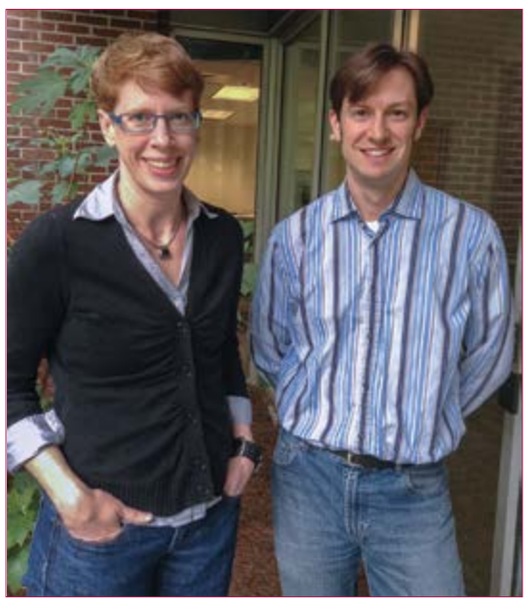
In the March 2014 U.S. News & World Report rankings, the graduate programs of the School of Mathematics continued to climb, reaching a ranking of No. 28 this year, up from No. 36 in 2009. Discrete math had an extremely strong showing, moving from No. 8 last year to No. 4 this year. Special congratulations and thanks to Professor Robin Thomas for his leadership of the ACO program.

Faculty Awards
July 2013–June 2014

Dan Margalit and **Klara Grodzinsky** both won the Class of 1940 Course Survey Teaching Effectiveness Award from the Center for the Enhancement of Teaching and Learning. Selection for the award was based on high CIOS scores with high response rates in courses taught during the academic year 2012–13; the award comes with a $1,000 bonus.

Professor **Greg Blekherman** has been awarded an NSF CAREER grant. According to the NSF website, "The Faculty Early Career Development (CAREER) Program is a Foundation-wide activity that offers the National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research."

Professor **Martin Short** is one of the inaugural recipients of the LexisNexis Dean's Award. The company states: "The purpose of this award is to recognize outstanding educators from among the untenured junior faculty at the assistant professor level. Award recipients are selected for extraordinary effectiveness in classroom teaching, educational innovations, inspiration transmitted to students, direct impact and involvement with students, and impact on the postgraduate success of students." There were three winners, one each from the Colleges of Computing, Engineering, and Sciences.



Professors **Christine Heitsch** and **Brett Wick** have been awarded the College of Sciences (CoS) Faculty Mentoring Award for their work mentoring postdocs. The award, sponsored by the College and the Institute's ADVANCE project, was presented at the CoS Advisory Board meeting and included a monetary bonus.

IMPACT Project

Professors **Christine Heitsch**, **Doug Ulmer**, **Brett Wick**, and **Hao Min Zhou** have received a large NSF Mentoring Through Critical Transition Points grant to support postdocs in the School of Mathematics. This five-year, $1.3M project is called IMPACT (Interdisciplinary Mathematics Preparation and Career Training). It will bring three cohorts of postdocs to Georgia Tech for three-year appointments, providing them with a variety of research, training, and mentoring opportunities centered on interactions between mathematics and other disciplines ("Math+X"). The first three Math+X cohort themes are:

2014–2017: Applied and Computational Mathematics plus Computational Science and Engineering

2015–2018: Discrete Mathematics plus Molecular Biology

2016–2019: Analysis plus Electrical & Computer Engineering

The EAGER Awards—Effective Collaboration

SoM Professor **Prasad Tetali**, while serving as the Director of Georgia Tech's Algorithms & Randomness Center (ARC), led a team of 10 principal investigators (PIs) that included SoM Professor Vladimir Koltchinskii in securing three NSF Early-concept Grants for Exploratory Research (EAGER). The awards, each for $300K, started March 1, 2014, and will last for two years.

This collaborative effort involved faculty from the College of Computing, the Schools of Computer Science and Interactive Computing, the College of Engineering, the Schools of Electrical and Computer Engineering, and Industrial and Systems Engineering, and the College of Sciences, and the School of Mathematics. In addition, two more PIs are from Carnegie Mellon's School of Machine Learning and School of Computer Science. The team has expertise in algorithmic theory, discrete and convex optimization, machine learning, robotics, signal processing, and statistics.

We hope to report on the highlights of the research activities stemming from these awards in a future issue. The grants will fund the following studies:

Convex Optimization Algorithms for 21st Century Challenges
PI: Santosh Vempala (co-PIs: Vladimir Koltchinskii, Arkadi Nemirovski, Justin Romberg, Prasad Tetali)

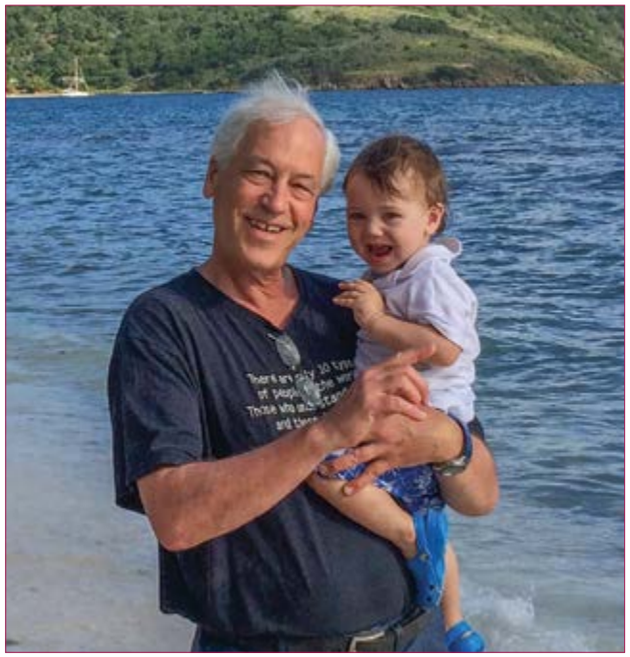
Physical Flow and Other Industrial Challenges
PI: Prasad Tetali (co-PIs: Henrik Christensen, Sebastian Pokutta, George Nemhauser)

Discrete Optimization Algorithms for 21st Century Algorithms
PI: George Nemhauser (co-PIs: Nina Balcan, Avrim Blum, Santanu Dey, Santosh Vempala)

The Multitalented Evans Harrell

by Michael Loss and Drake Lee-Patterson

There are usually three ways a faculty member can contribute to the intellectual life at a university: by advancing science, by passing on this knowledge to others, and by putting in place administrative tools to facilitate this process. Faculty members may be good at one or two of these options; Evans Harrell is one of the rare people who has excelled in all three areas.



Evans with grandson Samuel Scott Harrell

Evans came to the SoM about 30 years ago. He graduated from Stanford with a BS in physics and continued on to Princeton for a PhD, also in physics. After a few stopovers at Haverford College, the University of Vienna, MIT, and Johns Hopkins University, he came to the SoM. Lucky for us, he stayed and was instrumental in attracting Jack Hale and Shui-Nee Chow to Georgia Tech, thereby setting the SoM on its path to success. Evans also introduced Georgia Tech to mathematical physics.

Mathematical physics is precisely what the name says: practicing theoretical physics with mathematical rigor. The successful mathematical physicist is one who serves mathematical interests with an eye toward physical relevance. Evans is among the few who has mastered this balancing act. He has made seminal contributions to the understanding of resonances in atomic physics, the splitting of eigenvalues, and the estimation of tunneling phenomena. In these endeavors, he developed a mathematical toolbox that allowed him to contribute to what is now called shape optimization—the field aimed at understanding how eigenvalues of boundary value problems depend on the shape of the underlying domain. It was then a natural step for Evans to turn to the study of spectral problems related to differential geometry. This field was a perfect fit for his sense of aesthetics, and his passion for it has inspired many of us to contribute to it.

For Evans, being an expert in a field has never meant pursuing narrow research interests. To the contrary. He has worked in many fields: Schrödinger operators, geometry, partial differential equations, chemistry, laser physics, semiconductors, and to top it all off, he fixed the maritime boundary between Libya and Tunisia. Tunisia, of course, has a special meaning for people like Evans who work on shape optimization, as it was Queen Dido's discovery of the isoperimetric inequality that led to the founding of Carthage. It was therefore fitting for Evans to help organize a conference about this topic in Carthage in 2010.

And then there is Walter Thirring. If it weren't for Evans, the English-speaking world would have been deprived of a fundamental text in mathematical physics. In the mid-seventies Walter Thirring, a prominent Viennese physicist, published a four-volume course in mathematical physics that he wrote in German. Evans took on the challenging task of translating this work into English—a great service to the scientific community. More locally at the SoM, Evans served as associate chair and graduate coordinator from 2002 until 2005, and then was appointed associate dean in the College of Sciences. He has received many awards, including the Georgia Tech Outstanding Service Award in 1996, and the Eichholtz Teaching Award in 2006. In 2006 he was elected a fellow of the American Association for the Advancement of Science.

Evans advised about a dozen master's and PhD students and numerous postdoctoral fellows. And as the following quotes attest, he did a superb job: "Evans is my collaborator, my unofficial mentor, and, most important of all, a great friend," says Lillian Wong, who had the same PhD adviser as Evans. "(He) is a dependable collaborator who embraces new ideas with an open mind, a dedicated mentor who cares about the next generation, and an enthusiastic mathematician who works hard to build the future for the scientific community." Selma Yildrim Yolcu, a former PhD student, said, "Evans is brilliant, extraordinary, inspiring, and the most supportive adviser I could have asked for. He was always there for me whenever I needed advice. I feel very happy and blessed to have benefited from his personal wisdom and expertise."

Evans is not easily intimidated. As a serious hiker, he is not afraid to pitch his tent within the reach of a bear camp or to walk the flooded slot canyons of remote southern Utah while finding himself up to his hips in water. He and his wife lived for some time in the Navajo Nation, and he "survived" a visiting professorship in Austria and several in France. And he surely won't be intimidated by the retirement he is beginning. While being able to spend more time with his family, all the signs that he will continue to be quite productive are there. His research

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is ongoing and so is his role in the Atlanta Science Festival. He will also continue his work promoting scientific exchanges between the US and sub-Saharan Africa. And, of course, because he is free of his administrative duties, we ideally can look forward to seeing more of him at the SoM, continuing to share his mathematical and other insights with us.

Faculty Transition

Richard Millman

by Sung Ha Kang and Doug Ulmer

This spring, Professor Richard Millman stepped down as the director of CEISMC (the Center for Education Integrating Science, Mathematics, and Computing). He will remain at Tech for the calendar year 2014 as Professor of the Practice of Mathematics and then take a well-earned retirement.

Professor Millman is a mathematician who has had a multifaceted career. He received a BS from the MIT and a PhD from Cornell University in mathematics. He then rose through the faculty ranks at Southern Illinois University at Carbondale, eventually becoming full professor, with research in various aspects of geometry, including connections on fiber bundles, the spectrum of the Laplace operator on compact Riemannian manifolds, and spaces of Riemannian metrics. He also published expository articles on the geometry of connections and Kleinian transformation geometry, as well as textbooks on differential geometry and non-Euclidean geometry.

Professor Millman went on to serve in a number of administrative positions. These included two terms as a program officer at the NSF; service as chair, dean, and provost at several institutions, and two years as president of Knox College.

In 2008, Professor Millman came to Georgia Tech as the director of CEISMC, where he had tremendous success obtaining federal funding for outreach projects. In particular, he was the principal investigator on a multimillion dollar "Race to the Top" grant as well as other STEM education research grants that were focused on K-12 students and teacher professional development in Georgia.

On March 6, 2014, a number of CEISMC colleagues and professionals, including Dr. Lynne Weisenbach, vice chancellor of USG for Educational Access and Success, spoke at a reception honoring Professor Millman's work. Among them was Paul Houston, former Dean of the College of Sciences at Tech, who noted, "Many of us talk and worry and wring our hands about STEM education in the K-12 sector. Richard and his colleagues do something about it!"

As a dedicated educator and teacher, Millman says "It is the students, faculty, and staff at GT who made my time here so enjoyable. The students at Tech are first-rate, and it has been a pleasure for me to teach them both geometry and calculus." In April, Millman was excited to give a colloquium lecture on "Completeness in the Space of Riemannian Metrics" at Bryn Mawr and Haverford Colleges. He said, "To have my wonderful granddaughter, a math major, present in the audience was incredible. Besides, she is the only person who actually laughs at my math jokes."

New Faculty 2013

Joe Rabinoff
Assistant Professor

Joe earned a PhD from Stanford University in 2009 for work done with Brian Conrad and Ravi Vakil. After that, he spent three years at Harvard as a Benjamin Pierce lecturer. Joe's research interests lie in arithmetic and algebraic and tropical geometry. He won several teaching prizes at Stanford and Harvard. In his spare time, Joe is an avid Lindy Hop dancer.

Martin Short
Assistant Professor

Martin received a PhD in physics from the University of Arizona in 2006. He spent several years at UCLA in computational and applied mathematics, where, among other things, he was involved in projects modeling the geographic and temporal distribution of crime. Research from the lab he was in at UCLA is currently being put to practical use by law enforcement agencies in southern California. (See page 8.)

Kirsten Wickelgren
Assistant Professor

Kirsten earned a PhD from Stanford University in 2009, working with Gunnar Carlsson. Based on that work, she was awarded a prestigious five-year fellowship from AIM, the American Institute of Mathematics, which she used to do research at Harvard University. Kirsten's work so far has been in algebraic topology and its connections to algebraic geometry and number theory, especially around Grothendieck's section conjecture. Kirsten has also been active in mentoring programs for young scientists and women in mathematics.

Emeritus Faculty News

SoM Professor Jim Herod (1966–98) writes:

Jim Herod? How is he doing? The best way for me to answer is in connection with my reading, writing, and running.

With respect to reading, let me say that I planted a gazillion milkweed seeds this month after reading *Flight Behavior* by Barbara Kingsolver. Now I am holding up *The Sixth Extinction* by Elizabeth Kolbert, hoping that every Alabama congressman will read it.

With respect to writing, I wrote a short story titled "Carolina Red" for Wally Lamb's workshop in Taos, New Mexico, last summer and a short story titled "A Hundred Dollar Tip" for John Dufresne's workshop at the Seaside Institute last February. I will attend a writing workshop at the Seaside Institute again in October with an as-yet-untitled story that begins this way: "Are we talking about murder?"

Running? Ah, yes. Running. I have taken the over 70 cup at two races since the New Year. This is not particularly an outstanding achievement since there was no other over 70 runner! So . . . Jim Herod is doing OK.

Staff Profile Celia Grams

by Lew Lefton

It would be easy to imagine that students and faculty no longer need textbooks in this modern world of e-books and online courses. However, the reality is that most courses in the School of Mathematics still require a good old-fashioned book full of carefully chosen descriptions, examples, theorems, proofs, and, of course, answers to the odd-numbered exercises in the back. Celia Grams was the part-time staff member in the School of Mathematics who was responsible for coordinating the many dozens of textbook editions, publishers, faculty desk copies, bookstore orders, and all other textbook-related activity. But Celia has a much richer history with the School of Mathematics and Georgia Tech that began over 35 years ago.

Celia started working at Georgia Tech in the School of Mathematics in 1978, when you could count the number of staff members on one hand and still have fingers left over. She was hired by John Neff, and she single-handedly held down the entire front office, registering students, processing grades, managing sponsored research, answering phones, and using the intercom system to communicate with others in the building. She enjoyed working with the people in SoM, and would sometimes stop by the happy hour at Grumpy's for a bit of refreshment at the end of the week. Celia ended up marrying Gerry Grams in 1988. He was a faculty member in Earth and Atmospheric Sciences.

In 1983, Celia moved to the Dean's office at the Georgia Tech College of Sciences. She worked with Dean Les Karlovitz and handled various jobs, including promotion and tenure packages and purchasing. Celia moved to Ivan Allen College in 1991, where she did budget administration, worked as an editorial assistant for several journals, and also did some IT support. Celia, in fact, enjoys working with computers, and she completed her BS in information and computer systems from Mercer University in 2002 and her MS in education from UGA in 2009. Unlike the majority of the staff members who run Microsoft Windows, she prefers her Linux desktop system. Celia also considers herself a writer at heart, and perhaps one day she'll pen a memoir of her long career at Georgia Tech.

In recent years, Celia has been focusing a lot of energy and support on her family. She is the oldest of four siblings, and her mother, who just turned 83, is living with her and her husband. No matter how stressful or challenging the situation, Celia is a stabilizer who likes to "keep everything cool." This attitude helps her in her current work, during which she faces absentminded faculty who don't turn in their book requests on time and bookstores that don't always have the books available when classes start.

Although she officially retired in 2003, she returned to work in a part-time position for the SoM until May 2014, taking her full circle to the same place she worked when she first started at Georgia Tech. The faculty and staff were glad to have her back on their team, as evidenced by the many gifts from them lining her office—ranging from a fake plastic roach (guess which professor gave her that?) to desk lamps, plush Buzz dolls, a bobblehead Einstein, and a classic collection of biographical prints of mathematicians that she displayed proudly on her wall.

And even though Celia may be headed off to a PhD program at Valdosta State University beginning this fall and Grumpy's is closed, you may still be able to talk her into visiting for a happy hour! Thank you, Celia, for your decades of service to the School of Mathematics, the College of Sciences, and the entire Institute.

Faculty News

ARC Director Baton Passed

Professor Prasad Tetali completed his third year as the director of ARC and rotated out as Advance Professor Dana Randall assumed the responsibility starting May 15, 2014. Randall said, "I am delighted to be taking over as director of the Algorithms and Randomness Center (ARC) this spring. ARC has transformed research in algorithms and randomness at Georgia Tech by building bridges across units and centers, engaging in new industrial collaborations, providing alternative perspectives on projects across the campus, and engaging students and postdoctoral researchers in novel and impactful ways. We owe much gratitude to the founding ARC directors, Santosh Vempala and Prasad Tetali, for their excellent leadership and boundless energy, as well as to the countless faculty and students who have contributed to the center's success. I look forward to working with many of them as ARC moves forward."

Another Baton—Ms. J to Dr. Mo

After 18 years, Cathy Jacobson, SoM English as a Second Language (ESL) Consultant and International Teaching Assistant (ITA) coordinator known as "Ms. J," has retired. Dr. Morag Burke, a talented ESL/ITA specialist, who came to us from the GT Language Institute, has filled the position.

Cathy began our ITA training program in the fall of 1995, and in fall 2000, along with Rena Brakebill and Klara Grodzinsky, started a training program for all new teaching assistants. She also began an intensive introductory workshop in August (preceding the fall term), for new graduate students who would be teaching as part of their fellowships. The entire program was recognized by the Georgia Board of Regents as an outstanding one and received the 2005 Regents' Teaching Excellence Award. It continues to be a model on campus.

Ms. J taught pronunciation and academic communication courses she developed for the SoM, and she was a familiar figure visiting classrooms and reviewing videotaped recitation sessions with the ITAs. Dr. Mo brings years of international experience to the position and has already made important contributions to the program and expanded services for our new postdoc participants.

Cathy says, "Thanks to all for the wonderful years with the SoM. I trust that Dr. Mo will receive the same support that made the program so successful. I will miss you all but look forward to hearing from many, and I'll keep the postcards coming!"

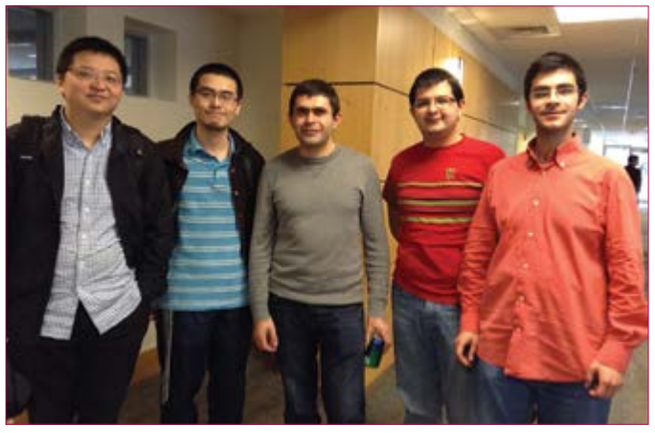
Friends of SoM BBQ

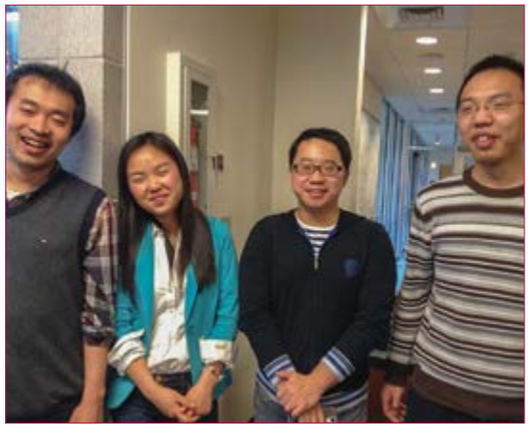








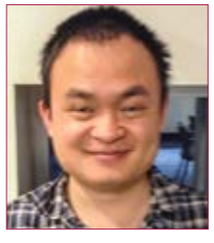


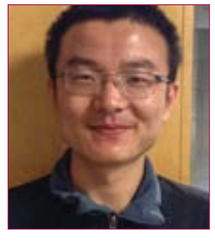













Conferences and Events July 2013–June 2014

July 8–12, 2013
Conference on Extreme Value Analysis

Organized by Professor **Liang Peng**, the eighth annual conference on extreme value analysis, probabilistic and statistical models and their applications, took place at Fudan University, Shanghai, China. The conference brought together a diverse range of researchers, practitioners, and graduate students whose work is related to the analysis of extreme values in a broad sense.

August 1–4, 2013
SIAM Conference on Applied Algebraic Geometry

Professor **Anton Leykin** was one of the organizers for the Society for Industrial and Applied Mathematics (SIAM) conference held on the Colorado State University campus in Ft. Collins, Colorado. Among the invited speakers was Professor **Greg Blekherman**. The SIAM Activity Group in Algebraic Geometry brings together researchers who use algebraic geometry in industrial and applied mathematics.

August 5–9, 2013
The Internet Analysis Seminar Conference

The Internet Analysis Seminar, organized by Professor **Brett Wick**, held its annual conference in Atlanta at Georgia Tech. The seminar included three phases involving Internet lectures, working groups, and a final conference. Its primary goal was to increase the collaborative learning and mentoring between graduate students, postdoctoral researchers, and senior faculty across the country who are researchers in the areas of complex analysis, function theory, harmonic analysis, and operator theory. Professor **Alexi Poltoratski** prepared the 2012–13 lectures on the uncertainty principle.

August 12–16, 2013
CBMS Regional Conference in the Mathematical Sciences

Professor **Brett Wick** and previous SoM postdoc, Mishko Mitkovski were members of the organizing committee for the Conference Board of Mathematical Sciences' regional conference held at Clemson University in Clemson, South Carolina. The conference was titled "Uncertainty Principle in Harmonic Analysis: Gap and Type Problems." Among the invited speakers were Professors **Michael Lacey** and **Doron Lubinsky**.

December 6–8, 2013
The Tech Topology Conference

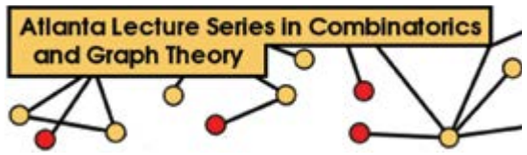
Organized by Professors **John Etnyre** and **Dan Margalit**, the third annual Tech Topology Conference was held at Georgia Tech in beautiful Atlanta. It was a gathering of established and young researchers from around the country for a weekend of mathematics, and among the featured speakers was PhD candidate **Alan Diaz**.

December 9–12, 2013
IMA Workshop: Topological Structures in Computational Biology

Professor **Christine Heitsch** was a member of the organizing committee at the Institute for Mathematics and Its Applications (IMA) annual program year workshop titled "Topological Structures in Computational Biology," held at the University of Minnesota. Heitsch also participated as a presenter on "RNA Profiling: A Combinatorial Approach to 'Denoising' Secondary Structure Prediction."

March 7–8, 2014
30th Southeastern Analysis Meeting

SEAM 30, one of the leading annual conferences on mathematical analysis, was hosted by Clemson University and organized by Mishko Mitkovski, a previous postdoc in Tech's School of Mathematics. Professor **Michael Lacey** was a plenary speaker. The research areas of the conference have focused on complex analysis, harmonic analysis, and operator theory. The main goal of these meetings is to bring together both established researchers and young people just entering the field.



April 26–27, 2014
Atlanta Lecture Series in Combinatorics and Graph Theory XII

Emory University, Georgia Tech, and Georgia State University, with support from the NSF and the National Security Agency, continued the series of mini-conferences and will host a series of nine new mini-conferences between 2014 and 2017. The 12th of these was held at Georgia Tech and hosted by Professor **Xingxing Yu**. The conferences stress a variety of areas and feature lectures by one prominent researcher, four or five outstanding researchers, and several younger researchers or graduate students. This year's featured speaker was Professor Bruce Reed, McGill University, Montreal, Quebec, Canada.

May 26–30, 2014
Constructive Functions 2014

Tech's School of Mathematics played a big part in the Constructive Functions 2014 conference held at Vanderbilt University in Nashville, Tennessee. Professor **Doron Lubinsky** and School of Mathematics alumnus Professor **Douglas Hardin** were members of the organizing and scientific committees, and Professor **Jeff Geronimo** was also on the scientific committee. The conference focus was on all aspects of constructive function theory, from asymptotics to zero distribution, and on minimum energy problems on manifolds. The conference also honored the 70th birthday of Ed Saff, reflecting Ed's seminal contributions to these areas of research as well as his career-long efforts to build connections among mathematical communities around the world.

May 26–31, 2014
High Dimensional Probability VII Conference

Professor **Christian Houdre** was a member of the organizing committee for the conference that took place at the Institut d'Etudes Scientifiques de Cargese in Cargese, Corsica. Among the invited speakers were Professors **Karim Lounici** and **Ionel Popescu**. The meeting was intended to present the state of the art in the field, point out important open problems, and set new directions for the field.

June 9–13, 2014
Topology Students Workshop

Organized by Professor **Dan Margalit**, the topology workshop is geared toward graduate students in the areas of geometry and topology. In addition to research talks by leading mathematicians in geometry and topology, there were panel discussions and hands-on training events on professional development topics. Mentors participating from Georgia Tech included Professors **John Etnyre**, **Lew Lefton**, and **Kirsten Wickelgren**.

June 23–25, 2014
Conference on Probability Theory and Statistics in High and Infinite Dimensions: Empirical Process Theory and Beyond

This conference was held at the University of Cambridge, UK, on the occasion of Evarist Giné's 70th birthday. It attempted to reflect recent developments in the many areas that Evarist has transformed and worked on in his distinguished career—from probability in Banach spaces to, empirical, chaos-, and U-process theory to mathematical and nonparametric statistics. Professor **Vladimir Koltchinskii** was one of the four organizers.

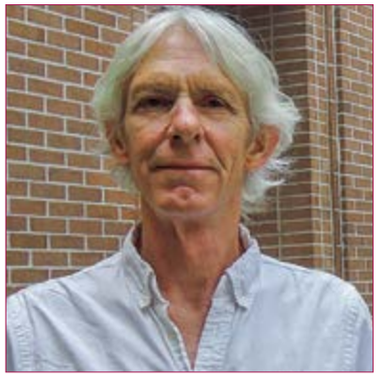
Graduate Program Is Changing and Growing

by John Etnyre, Graduate Coordinator

From personnel to the requirements for a PhD in math, the past couple of years have brought many exciting changes to the graduate program in the School of Mathematics (SoM)! These changes have resulted in a better, more efficient, and more useful experience for students and faculty members.

In the summer of 2013 we hired two new people to help with the graduate program, Kenya Payton and Dr. Martin "Marty" Engman.

Kenya had big shoes to fill as she took over for Genola Turner, who was the "go to" person for hundreds of graduate students and faculty during her 12 years as the Administrative Assistant to the graduate program. Kenya came to us from Georgia Tech's Center for Academic Success. She brings a lot of experience and enthusiasm to the job and has picked up her new responsibilities rapidly.



Dr. Engman, hired as the Director of Graduate Advising and Assessment, comes to us from the Universidad Metropolitana in San Juan, Puerto Rico, where he helped run their math department program. Marty, working with Kenya and myself, is also settling into his new job nicely. The three of us will play an important part in implementing changes and additions to the graduate program as we move forward.

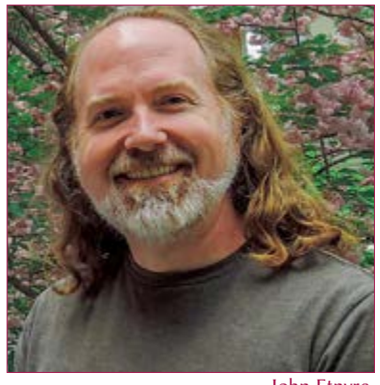
In addition to the new personnel, the graduate student population is also changing. In the past two years, we have had incoming classes of 19, then 18, new PhD students. These are some of our largest incoming classes ever, and we expect future classes to be the same size. We plan to expand our PhD program from just under 70 students in 2012 to a bit over 90 students within a few more years.

Enlarging the graduate program will have many positive effects. First, we will have a much more dynamic research environment, with more active seminars, research working groups, and advanced graduate courses. Having a critical mass of students working with a given adviser or in a specific area can have a dramatic impact on their mathematical productivity and the overall quality of the work they do. In addition, we will be able to reduce the size of recitation sections, which will lead to a better experience for undergraduates taking math courses and, at the same time, make graduate students' recitation teaching duties a bit easier. Because some advanced graduate students teach their own classes, we will also be able to run more and smaller lower and mid-level math courses.

In the past few years there have been several small changes to the math PhD program, and several larger changes are in the works. We have clarified the rules for a PhD student's Institute-required minor. In the past, a student's PhD minor requirement had to be met using coursework outside the SoM. Although this was very useful for many, some students and advisers found that this restriction hindered their development as active and independent researchers. The new rule allows students to use math classes to satisfy their minor requirement if those classes cover a subject that the graduate committee determines is sufficiently distinct from their thesis work. While students are encouraged to explore applications of math to other areas of inquiry, they now have more flexibility to make their minor really enhance their research program.

The rules for a math PhD student's oral exam have also been tweaked and clarified to bring them more in line with other PhD programs and to make the exam process a better experience for students and a more efficient use of faculty members' time.

Specifically, before students take the oral exam, they must submit a short written explanation of the exam subject matter to their examination committee. This will allow students to practice technical writing and get feedback on their written as well as their oral mathematics presentations. In addition, the examination committee members will know the specific subject matter to be covered in the oral exam, and as a result, they will be able to give more focused and meaningful advice to the student after the exam.



John Etnyre

Moving forward, there will be changes to the curricular requirements and the written comprehensive exams in mathematics, but because the approval for these changes is still winding its way through the relevant Institute committees, the changes will not be implemented for another year. Stay tuned for more details on these exciting changes, and many more, in next year's *ProofReader*!

Graduate Profile

Spencer Backman

by Alan Diaz

Spencer Backman completed his PhD in May 2014, writing a thesis at the intersection of algebraic geometry and combinatorics under the direction of Professor Matt Baker. In the summers of 2012 and 2013, he had the unique experience of teaching math to Tibetan monks, as part of the Emory-Tibet Science Initiative. (See http://tibet.emory.edu/science/. Before graduation, he met with a representative from *ProofReader* to talk about his experiences.)

Q. How did this program get started?

The Dalai Lama has always been a pretty big fan of science, and in particular he doesn't view it as being at all in conflict with Buddhism, but rather that there's great opportunity for them to inform each other. Although there have been programs for teaching science to the Tibetan monks for a while, the initiative was formalized about seven years ago. They had a vote about whether to bring science education into the monasteries. The vote passed, and it's the first substantial change they've made in the curriculum in 400 years. So it's not a small change.

Q. How did you come to be involved?

My parents studied Tibetan Buddhism, so it was a part of my life growing up. When my mother told me about the (Emory-Tibet) program, I wasn't initially interested. I thought that was my parents' thing, and I was here in Atlanta doing my own thing studying math. But in 2010, I had a chance to visit Bhutan, another Buddhist nation, and I had a really great time. I realized that I have a personal connection with Buddhism, independent of my relationship with my parents. I started emailing Emory. For a year, my emails fell through the cracks until I found the right person. We set up a meeting, had an interview, and they invited me to come to India to teach the mathematics component of their summer program and I happily accepted!

Q. How did your classroom experience compare with teaching here at Tech?

It's an infinitely different experience. For one, I'm lecturing with a translator. I'd say something mathematical in English and then have a Tibetan translator to translate on the spot, and we'd go back and forth. That took some getting used to, to get into the rhythm.

Second, we were in Dharamsala, India, in the foothills of the Himalayas. While I was collecting my thoughts for the next thing I'm going to say, I'd look out the window at the Himalayas, and that was pretty cool.

Also, I was younger than any of the monks whom I was teaching. The youngest of them was 29. He and I have become very good friends; he's now at Emory. The oldest were in their 70s. The mean age was mid-40s.

Q. As students, how would you compare the monks to undergrads at Tech?

They have no formal experience with mathematics. They can do arithmetic quite well, but they have no experience with algebra at all. Introducing mathematical formalism is tough for them, just as it is for students anywhere in the world. The idea that a letter is now representing a collection of numbers, and so on.

On the other hand, their logic skills were quite refined, because there's a huge component of Tibetan Buddhism that involves debate and Tibetan logic. So I would say that there were certain arguments that they grasped more quickly than American students—for example, distinguishing between the contrapositive and the converse.

Q. Each summer you taught five days a week for four weeks. Meanwhile the monks were also learning biology, physics, and neuroscience. What did you teach them?

The program gave me a lot of freedom as to what I wanted to teach. I tried to strike a balance between things that would be useful for their other science courses—such as linear algebra, linear functions, and basic probability—and more abstract things. I showed them some classical proofs, like the square root of 2 is irrational, and a geometric proof of the Pythagorean theorem. I spent the whole last day talking about infinity: Zeno's paradox, Cantor's theory. Infinity is an important notion in Buddhism, so that was quite fun.

Q. You've told us how math and science are benefiting Buddhism. Do you also see potential for positive influence in the other direction?

Secular ethics is an important thing that they bring to the table, and I think that could positively inform science in the future. Science is somehow independent of ethics, and when you allow it to be informed by ethics, it just enriches the subject. Take, for example, nuclear medicine versus nuclear weapons. The science itself is independent of ethics, but how you choose to apply it is up to humans, so when you have such a powerful tool, it's good for it to be guided by ethical considerations. When they're secular, it makes it more possible for people to have a genuine conversation about things.

Q. Personally, what is something important that you gained from this experience?

I learned a lot more about what Tibetan monks are like. I had never spent so much time talking with them and getting to know them before. They're just like regular people. Some monks are boisterous, some monks are shy, and some might get angry more easily than others. One older monk was telling me how in the West people think of monks either as demigods who are perfect people that have no weaknesses, while on the other end of the spectrum, people think monks are lazy and don't want to work a real job, so they go into monastic life where all they have to do is chant and hang out all day. The truth is somewhere in the middle.

Also, I got to meet the Dalai Lama in person. There was a get-together at his palace, and I took a photo shaking hands with him. It was kind of a dream come true.

Q. What's next for you? Will you continue to be involved with the Emory-Tibet program?

This summer I'll be participating in a research program in Daejeon, South Korea. Then in the fall I'll be a postdoc at Sapienza University in Rome. And yes, they've invited me to come back to the monasteries to teach in the future, so I'll definitely go back.

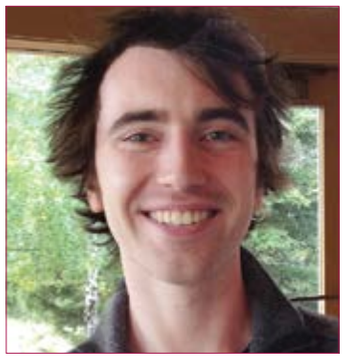
Alan Diaz

Graduate Profiles
Gagik and Peter Go to Amazon

by Alan Diaz

Gagik Amirkhanyan (top) and **Peter Whalen** (below) both earned PhDs from the School of Mathematics in May 2014, and both began work this summer for Internet retailer Amazon.com, a company with a long history of tech innovation. Whalen studied graph theory and wrote a thesis with Professor Robin Thomas. Amirkhanyan worked on additive combinatorics, and also harmonic analysis with his adviser, Professor Michael Lacey. Both talked with *ProofReader* about the role of math in their new cutting-edge tech jobs.

Q. Everyone knows Amazon. Most people have probably bought something from them. But not everyone knows why Amazon would want to hire mathematicians. Can you talk a bit about that?



PW: I'll be working on one of the logistics research teams, and they actually do a lot of math—such as operations research, optimization, and linear programming. Often they're solving the same types of questions that I solved here.

GA: I'll be working with the mobile and tablet team, doing design and logic for mobile devices. It requires not only math but also programming and algorithmic skills. But mathematical knowledge also helps you to learn that material more easily.

Q. Can you give us an example of a logistical question that's important to a company such as Amazon?

PW: Facility location is something that companies have to do; they have to decide where to place distribution centers in order to minimize shipping cost? And that's an actual question in theoretical computer science. Edges might be carriers rather than actual streets. Or edges could be trucks. You want to maximize the amount of inventory you can get from point A to point B. A lot of unexpected problems are equivalent to this one.

Q. In academia, researchers try to share their results with as many people as possible. Is there an element of secrecy in the corporate world?

PW: Yes; for example, I wasn't able to have my interview in the building that I'll be working in because I didn't have clearance. Even some of their ideas are proprietary, some of their algorithms and such. They must do some pretty cool research!

Q. What kinds of questions did they ask?

PW: There were some fun logic-type questions (as well as some probability ones,) but also simplified versions of questions they've actually faced. They'll say, "Here's what we did. How can we do it better? How would you evaluate to see whether your idea is better? What data would you collect?"

Q. What advice can you offer to students who hope to get similar types of jobs?

GA: It's important to plan beforehand. Think about what type of skills you'll need. For my job, you need an algorithmic background and programming knowledge. You should also prepare for the interviews. I interviewed with four technical people and one HR person. With the technical questions, you need to be fast!

PW: Take some algorithms classes. I think my job has zero programming responsibilities, but it was certainly helpful to have that background and be able to talk in an intelligent way.

Q. What else are you looking forward to about your job?

PW: We get 10 percent off at Amazon.com. Also, Seattle is one of three cities with Amazon's new grocery delivery service. I'll definitely be taking advantage of that!

Three Majors attend Women in Mathematics Conference

by Enid Steinbart, Undergraduate Coordinator

The School of Mathematics funded the attendance of mathematics majors **Qixuan Hou** (freshman), **Michole Washington** (sophomore), and **Amber Harris** (junior) at the Nebraska Conference for Undergraduate Women in Mathematics (NCUWM) that was hosted by the Department of Mathematics at the University of Nebraska—Lincoln, January 31–February 2, 2014. The women attending the 16th annual conference all agreed: NCUWM is a fantastic conference!

Attendees have the opportunity to meet with other undergraduate women in mathematics from across the country. Some attendees presented posters highlighting their work to others. Some met with professors in small group sessions, where they discussed topics such as how to apply to graduate school, how to find research opportunities, and how to apply for internships.

Qixuan expressed the feelings of all when she wrote, "Thank you so much for giving me the opportunity to attend this conference in Lincoln. It was really great to be with peers and learn from them. Some professors shared their research with us, the posters and presentations of other students were excellent, and the breakout sessions on research opportunities and applying for internships were informative—It was a really inspiring and useful conference for me."

Amber noted that she "had an absolutely wonderful time at NCUWM—I got to meet 260 other undergraduate women like me and network with them as well as other math graduate students, professors, and industry professionals. I would recommend this conference to any female undergraduate math major at Georgia Tech."

Michole agreed: "The community atmosphere fostered at the conference was extremely uplifting and motivational. If there were any doubts I have had while being a math major, whether it was grasping course material or what to do with my degree, attending the conference reassured me that I am not alone even on a national level—It was one of the best experiences thus far in my undergraduate career. I recommend that female math majors of all years attend this event. They will not regret it, I promise!"

Conferences are a great way to make connections and gain valuable information that is not found in the classroom. Funding these undergraduates was certainly money well spent!

Enid Steinbart

Undergraduate

Innovations: Integration Bees, Flipped Classes, and Number Theory Magic

by Doron Lubinsky, Undergraduate Coordinator

So you know all about spelling bees, but what about "integration bees?" This year, our undergraduate Club Math ran the first ever Integration Bee at Georgia Tech. To publicize the event, members prepared a YouTube Video https://www.youtube.com/watch?v=S024xKj4Pak and asked instructors of lower-level calculus courses to consider giving some extra credit to participants.

About 30 students competed in the three different rounds, attempting to evaluate successively more difficult integrals. The more challenging problems involved lesser-known techniques, such as Feynman integration, Weierstrass substitution, and contour integration. Those surviving a round received a two-by-two Rubik's cube. Nolan Hackett, a third-year applied mathematics student, won the grand prize, a dodecahedron Rubik's cube.

Peter Woolfitt, a senior and a kaiser of club math, writes, "In short, it sounded like a lot of fun. The other Club Math officers and I had heard of similar competitions taking place at other universities across the country, notably at MIT, upon whose competition we based our own. It was also a good opportunity to raise awareness for the club, and in general to remind the Tech community that mathematics can be interesting and enjoyable."

Those preparing the problems included Santosh Karnik, Elwin Martin, and Peter himself. Michael Lane, Orin Lincoln, and Riesling Mayer organized volunteers, the video, and publicity. The integration bee will hopefully become an annual event.

Not only have our students devoted hours of time to new projects, but Klara Grodzinsky and Dan Margalit, both of whom have won institutewide prizes for their teaching prowess, dove headfirst into "flipped" classes. These depart from a traditional format, with professors' lectures replaced by intensive interaction between students and instructors.

Dan notes: "Before class, students learn the new material on their own, either by reading the textbook or by watching YouTube videos and reading online notes. Then they take an online quiz designed to test very basic understanding. The last question of the quiz is always 'What did you find most confusing?' At the beginning of class, I ask the students what questions they have brought with them. The quiz is due at midnight before class, so I need to prepare this part 'just in time.' Then, during class meetings, we do three things: We work problems, we answer the student questions as they come up naturally, and we take part in concept quizzes, which I poll them on with their clickers. There is no lecture, although usually we go over the harder problems together.

"When the students are working on problems, I encourage them to work as much as possible at the board—we have whiteboards all around the room. At the very least, standing up gets the blood flowing (the Naval Academy has been using this practice for a long time).

"In recitation, students primarily work on homework. The teaching assistants treat the session like a big office hour. The goal is for the students to finish most of their homework before they leave, to make up for the fact that they are spending extra time on quizzes."

Klara's flipping of calculus I was complicated not only by the very large class, but also by the fixed seating arrangements in the Howey Physics lecture halls. When asked why she flipped, Klara responded: "I tried this approach in the summer 2013 term with precalculus and found it to be extremely rewarding for all participants. The students were always engaged in the class, and I knew the students and their abilities much better. I also felt that the flipped approach helped the weaker students by providing them with supervision during the problem-solving process. My summer class performed well, and so I wanted to try this format again in a larger classroom environment."

Klara has some advice for people who are considering this format: "Running a flipped class takes a lot of preparation time, especially the first time you try this method. I would strongly recommend using a scale-up room for this type of course. Teaching with this method in a rigid lecture hall has been a challenge, as the furniture neither accommodates group work nor a facilitator who wants to circle the room."

So what is the net result of this new way of teaching? Both Klara and Dan observed that students were far more engaged, worked harder, and were enthusiastic in their feedback at the end of the course. While the actual impact on grades could not yet be definitively measured, many students benefited from the increased interaction during class meetings. There are also lessons for those following the traditional format. Recitations can be made more engaging through the use of worksheets, while clickers and the occasional group-worked problem can increase participation in lectures.

The School of Mathematics is also innovating in its outreach to high school students. Matt Baker, another multiple prizewinner for teaching, will offer them a new distance learning course in the fall of 2014, in number theory and cryptography. Matt writes: "While there are many opportunities for high school students to learn calculus, there are few existing options for more advanced courses. One of the attractive features of the proposed course is that it will require very little formal background—the material is almost completely self-contained—and yet, by the end of the course, students will have glimpsed some cutting-edge topics. The course will also be fun and quirky. For example, students will send each other secret messages, and they will learn several magic tricks that are based on number theory."

Doron Lubinsky

In summary, as you can see, there are lots of ongoing innovations in our undergraduate programs.

Undergraduate Profiles

by Doron Lubinsky

This year, ProofReader *focuses on four of our leading seniors who graduated in the spring of 2014, all of whom were double majors!*

LIANGHAO CHEN

Lianghao completed high school at Shanghai Foreign Language School, a long way from Atlanta. Georgia Tech's rigorous academic program suited his logical bent well, especially because of his interest in topics such as number theory, graph theory, and combinatorics. These were essential components of his discrete mathematics major and useful in his computer science major.

For his senior project, Lianghao worked with Professor Tom Trotter on the strong Hiraguchi inequality, which estimates the dimension of posets of given odd cardinality. Linghao notes that the project provided him essential experience in how to conduct research. He also learned a lot from mathematical modeling of objects as diverse as baseball bats, growth of leaves and trees, and global warming, as a participant in competitions at high school and university levels. During the process he won several awards.

After graduation, Lianghao will go on to graduate studies in theoretical computing and discrete mathematics or artificial intelligence. His record of an A for every math course and a GPA of 3.92 promise a bright future.

RAYMOND DECUIR

Like Lianghao, Ray is a double major in computer science and mathematics, though his flavor of the latter is applied, rather than discrete. His excellent teachers at Catholic High School in Baton Rouge encouraged his affinity for mathematics, although he was initially attracted to Georgia Tech for its computer science.

Ray has been involved in a broad array of research projects at Georgia Tech, all the while maintaining a perfect GPA of 4.0. In his junior year, he examined techniques for introducing variable precision methods to the fast multipole method, an approximation to the n-body problem (which, for example, deals with the gravitational interactions among n planets). This included mathematical tools such as Taylor polynomial approximations. In the fall of his senior year, he worked on covariance matrix estimation techniques for asynchronous and noisy time series data, and later used these to develop predictive models for time series data. In addition, for two successive summers he interned at the investment firm Citadel LLC.

His analytical skills have also served him well as director of analytics for the Georgia Tech Students Investment Committee. This purely student-run committee manages the student endowment for Georgia Tech. After graduation, Ray will be working full time for Citadel LLC, in it's Quantitative Strategies group.

GAUTAM GOEL

Gautam always knew that he wanted to be a scientist, but he decided quite late in the magnet program at Chamblee Charter High School to study mathematics: "Before I wanted to be a mathematician, I wanted to be a physicist, and before that a paleontologist (I thought paleontologists have the coolest job ever—they spend all day digging up dinosaur bones!)." Gautam exempted about two years of college coursework by taking 15 AP classes in high school. While pursuing his double major in computer science and applied mathematics, he gathered a remarkable 18 hours of graduate-level course credit.

Gautam compliments our faculty: "I was lucky to take Real Analysis I from Dr. Michael Loss, who showed that analysis was considerably more subtle than I had thought. Other great courses I've taken were Number Theory with Dr. Thang Le and Partial Differential Equations with Dr. John McCuan."

He worked on an impressive variety of undergraduate research projects: ribosomal RNA, computer simulations of Burger's equation for millions of colliding particles; analysis of human decision-making times using stochastic processes; and fluid turbulence. He enjoyed working in puzzle-solving competitions such as the Microsoft Puzzle Challenge, the Mathematical Contest in Modeling, and the Eagle Undergraduate Mathematics Competition, some of which led to team awards.

Gautam was the only student at Tech to be awarded a prestigious national Goldwater Scholarship in 2013, and also was recently recognized by the Georgia State Legislature as a University System of Georgia Outstanding Scholar. All the while, he maintained a GPA of at least 3.96. Gautam plans to go on to graduate studies in mathematics.

ROBERT GROSSE

Like the others featured here, Robert is a double major in computer science and mathematics (discrete, in his case). Like Gautam, he went to Chamblee Charter High School. He credits one of his teachers there, Dr. Hunt, for driving Chamblee's advanced mathematics program. However, his interest in math predates high school: "I've always been interested in math. If I had to pick one event, though, I think it was reading Martin Gardner's books as a kid that helped spark my interest."

Robert completed the entire calculus sequence and differential equations in high school, but he was also an independent learner: "I mostly learned about math through independent study, reading about it on Wikipedia, going to camps, etc. I'd highly recommend PROMYS (pronounced "promise"), the Program in Mathematics for Young Scientists, if you're interested in math." PROMYS is a six-week residential summer mathematics program for high school students at Boston University.

Robert notes: "Georgia Tech was always the obvious choice for me. Since I'm in-state and had the HOPE/Zell Miller scholarship, GT was very cheap, and it ranks highly too. My aunt told me that she thought the math department at Tech was actually better than at Caltech." Among his Georgia Tech mathematics courses, he especially enjoyed Professor Tom Trotter's Applied Combinatorics.

Robert has a natural flair for hacking. One of his main extracurricular activities was Grey Hat, an information security club/hacking team. He twice represented Grey Hat and Georgia Tech in national competitions. Those activities have not kept him from maintaining a perfect GPA of 4.0. After graduation, it is fitting that Robert will be off to join Google.

Undergraduate Awards
July 2013–June 2014

Shown with other graduating seniors, second from the right, **Ryan W. Keane** was nominated by the SoM for the College of Sciences Cynthia Bossart and James Efron Scholarship and was selected by a faculty panel to receive this award in recognition of his accomplishments at Tech. Ryan will graduate in the spring of 2015, when he will receive a Bachelor of Science (BS) in computer science and a BS in discrete mathematics.

Ryan's undergraduate research included work with Professor Dana Randall in computer science focusing primarily on Markov Chain analysis and study. During the spring of 2014 Ryan also participated in the Budapest Semester in Mathematics and worked with Dr. Alex Kuronya of the Budapest University of Technology and Economics, studying algebraic geometry.

Thomas F. Kieffer, a senior majoring in applied mathematics and physics, recently received the prestigious Goldwater Scholarship. Kieffer's work focuses on computational astrophysics, and he has worked with Professor Tamara Bogdanovic, a theoretical astrophysicist in the School of Physics at Georgia Tech. Named for US Senator Barry Goldwater, the Goldwater Scholarship is awarded to students in science, mathematics, and engineering who intend to pursue research careers in their fields, with the intent of providing a continuing source of highly qualified scholars in these areas.

School of Mathematics Undergraduate Prizes: Spring 2014

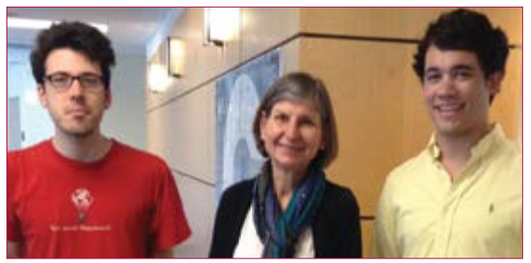
The (SoM) Undergraduate Committee annually awards prizes at the end of the spring semester to the best junior and senior mathematics majors, and to excellent undergraduate teaching assistants (UTAs).

The SoM Outstanding Undergraduate TAs were **Colleen Crouch** and **Rachel Wiseley**. This award, which comes with a stipend, goes to graduating seniors who have excellent evaluations from students and faculty and have been good departmental citizens.

Those undergraduate TAs judged by their recitation classes to be effective teachers through student survey responses received certificates honoring them as having Outstanding Student Evaluations:

Michael Baldwin, **Albert Bush**, **Wesley Gillis**, **Andrew Grice**, **Ryan Kerns**, **Timothy Kierzkowski**, **Alex Lind**, **Chris Pryby**, and **Conrad Rybka**.

Ryan Kerns was also the SoM nominee for the 2014 CETL-BP award for Outstanding Undergraduate Teaching Assistant.



The SoM Senior Prize is awarded to graduating seniors for outstanding academic achievement. **Robert Grosse** and **Raymond Decuir** are also both double majors in math and computer science, and have perfect 4.0 GPAs, and plenty of other feathers in their caps.

The 2014 Junior Prize was awarded to undergraduate math majors **Bhanu Kumar** and **Gautam Goel** for their outstanding academic achievement. In fact, both awardees are double majors who have taken graduate courses as undergraduates while keeping a GPA of at least 3.96, and both are involved in many other aspects of Tech life.

A Toast to Double Majors

by Doron Lubinsky

Undertaking a double major,
is quite a risky wager;
will the volume of work
drive you berserk?
It's definitely a danger.

How do rings and modules fit
with least squares, no, not a bit;
woes NP completeness go
along with a viscous flow?

So doubles, congratulations,
you survived our machinations
to triple the load of projects
to extend the number of subjects.

To Google or grad school you
wend, may they not drive you
round the bend;
but if Tech couldn't succeed,
what place can do this deed?

Alumni News

B. K. Richard, BS Applied Mathematics, 1969

The journey from Tech to retirement was completed in 2002. After a math PhD from Caltech and 30 years in the aerospace industry (TRW Inc.) in California, I've settled in a smaller city (San Luis Obispo) and been able to immerse myself in nonprofit work (a land trust), some interaction with the local university, and lots of healthy outdoor activity and travel. I live with wife, Emily Rosten.

Three things really stand out for me from my experience at Tech: the mentorship of Professor Marvin Sledd (who inspired me to switch to math); the trust by the department to allow me to teach as a senior (and earn the money I needed to get married and move to California); and the Tech/USSR exchange trip for a first, stunning immersion into the wider world.

P.S. Even with the distance in time and space, I still enjoy tracking the research progress at Tech—and the exploits of the sports teams.

Almut Burchard, PhD Mathematics, 1994

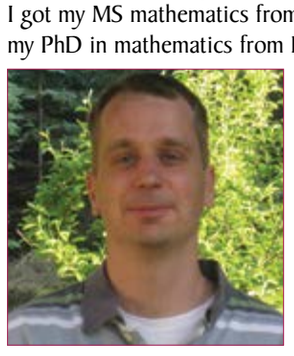
When I first came to Georgia Tech as a graduate student in 1989, Fred Andrew picked me up at the airport, a yellow Springer text in his hand, and Jim Herod let me stay with his family for two weeks. (Clearly, I was not in Germany anymore.)

The School of Mathematics was in a period of rapid growth and change, and so nobody cared to check if I had taken the GRE, TOEFL, or any classes that required homework. After drifting for a couple of years, I came to work with Michael Loss. Being Michael's first student was the best thing that could have happened to me. Looking back, now that I advise students myself, I find it remarkable that he offered me three well-defined problems to work on, each of which would have made a fine thesis and would have led to a different path in research. (I eventually solved one of them and graduated in 1994.) After trying for years to broaden my interests, I am now returning to the topics I studied in my thesis: symmetrization and geometric inequalities.

I have many good memories of Atlanta. My husband, Jorg, and I met at Georgia Tech (He got his PhD in the newly founded College of Computing). As a postdoc, I spent four years at Princeton and then joined him at the University of Virginia; in 2005, we moved to the University of Toronto, where we have been since. Toronto is a vibrant, multinational city of comparable size to Atlanta, yet we can bike to the university and grow tomatoes in the backyard. In some ways the department reminds me of Georgia Tech—the urban location, the diverse student body, the size of the department—but I still miss the breezy layout and collegial atmosphere of Skiles.

Klay Kruczek, BS Mathematics, 1996

After graduating from Georgia Tech in 1996, I got my MS mathematics from Virginia Tech and my PhD in mathematics from Rutgers University in 2004. My PhD thesis, under the advisement of Jozsef Beck in the area of positional game theory, was titled "Tic-Tac-Toe and Tumbleweeds."



I spent seven years as a faculty member at Western Oregon University, where I served as chair of the department during my final two years. I left that position to come back home to Connecticut, where I am now an associate professor of mathematics at Southern Connecticut State University. I was a coeditor of the MAA Notes volume on Resources for Preparing Middle School Mathematics Teachers. On a personal note, I married Jessica Kruczek (CE '97) and we have a daughter, Marlee.

John Weathers, BS Applied Mathematics, 1998

I've been a professional software engineer for the past 16 years. I'm living in Atlanta and happily married to Melinda Pierce, a fellow Georgia Tech alumni (BME, '99), who majored in mechanical engineering but, like me, found herself becoming a programmer instead. I've spent the past four years working with some great people on what became Oracle's Social Platform, where businesses can engage their customers on Facebook, Twitter, and other social networks. This March, I'm leaving the software giant for a small start-up where I will be leading and growing a development team to build out a platform for business-to-business partnerships.

Both my wife and I were among those applicants chosen to take part in Georgia Tech's first semester of its new online masters program in computer science. The first semester was very tough in terms of time management with the rest of life, but we struggled through and we both came out with A's in machine learning. We're currently enjoying a course in computer networking. I plan to focus on artificial intelligence in hopes of one day applying it to some of the fascinating challenges involved in finding and exploring underlying patterns in big data.

Shuli Fu, MS Mathematics, 1999

After a couple of job changes, I landed at Citi eight years ago. Citi does not have consumer-banking branches locally, but there is a Retail Services Cards group headquartered here in the Vinings area. Our function is to manage retail stores' credit cards. I worked in Decision Management for a few years and am now in Risk Management. It's exciting to go to work every day knowing there are things I can contribute to improve the business.

On the personal side, I've been a runner since my GT days; I ran my seventh marathon in November and totaled 1,800 miles in 2013. I do ballroom dancing occasionally. And most of all, I sail, sometimes on Lake Lanier or in the BVIs.

Marion Weedermann, Mathematics, 2000

Marion is a professor and department chair at Dominican University, which is located just outside Chicago. She teaches courses across the entire undergraduate spectrum and works with undergraduate students on research that is usually quite removed from her own work, which is on topics in differential equations and mathematical modeling. She writes, "I really enjoyed returning to GT last March and was amazed by how much campus has changed."

Christel Hohenegger, Mathematics, 2006

After a three-year postdoc at Courant, I moved to Salt Lake City, where I am an assistant professor in the mathematics department at the University of Utah. I work at the intersection of math biology and computational fluid dynamics. My winter months are pretty busy between teaching, research projects, and, of course, skiing at Snowbird. I am looking forward to spending this coming summer in the West and exploring more of the national parks. Michael (Burkhart) and I got married on July 27, 2013, in Sion (Valais, Switzerland), where I grew up. It was a beautiful, very hot Saturday in the Alps, and we were fortunate to have many of our friends and family from the USA (including a good group of our friends from GT) and Europe join us. Before the big day, we had three days of fun activities in Switzerland, including a tour of the Cailler chocolate factory; a fondue in Gruyere; a hike in the Alps, during which we saw the famous cows from Valais; a wine tasting of local wines, including Fendant and Amigne; and a real raclette dinner. Photo: Gracie Blue Photography at www.grblue.com

David Krumm, MS Mathematics, 2008

I'm currently a visiting assistant professor at Claremont McKenna College. Having lived in Georgia for the past seven years, it's taken me some time to get used to such a different

Alumni News

place, but I'm very much enjoying both the academic environment and the way of life in Southern California. In particular, I've become quite good at doing math on the beach!

Michelle Delcourt, BS Discrete Mathematics, 2011

Michelle is currently the associate manager of the Illinois Geometry Lab at the University of Illinois at Champaign-Urbana where she is a mathematics PhD student. She has designed a number of mathematical outreach lessons for elementary, middle, and high school students in the Champaign-Urbana area. She will be spending the next six months researching combinatorics in Hungary with her adviser, Jo'zsef Balogh.

Maria Carmen Reguera, Mathematics, 2011

Maria completed a one-year postdoc at Lund University, Sweden, in 2011. Then she was the recipient of a Juan de la Cierva Fellowship and worked at the Universitat Autonoma de Barcelona, Spain, in 2012. She left that position in September 2013 to become a permanent member of the School of Mathematics at the University of Birmingham, UK, after receiving a Birmingham fellowship.

Maria writes: "My postdoc years have been very intense (in terms of my) career and personally. In terms of my research I have had the opportunity to branch out and study other problems in operator theory, complex analysis, and geometric measure theory. Personally, I have made several moves across countries that were very enriching but at the same time were tiring. So far, I really like my new position in Birmingham. The analysis group in the math department is great, and I have no serious teaching duties yet. I must confess I am not so happy with the weather in England, but I hope I can get used to it."

Marc Sedjro, PhD Mathematics, 2012

I am in my second postdoc year in the RWTH Aachen University, a research university of technology located in Aachen, North Rhine-Westphalia, Germany. I am part of the research group of Professor Michael Westdickenberg, a former Georgia Tech professor. My current research focuses on constructing solutions to the pressureless Euler equations using optimal mass transport techniques, which were significant tools in my work as a PhD student at Georgia Tech. Besides research, I am slowly learning the German language and enjoying the culture. I have good memories of my time in the SoM at Georgia Tech and regularly check news, upcoming events, and talks on its website.

Huy Huynh, PhD Mathematics, 2012

I graduated from Georgia Tech in the summer of 2012 and have been a faculty member at the Department of Applied and Computational Mathematics and Statistics at the University of Notre Dame ever since. My current research interest is quantitative finance and investment, particularly in stock options pricing theories and trading strategies.

At Notre Dame, I teach both undergraduate and graduate courses, mainly in applied math and statistics. Also, I take part in developing course curriculums, mentoring graduate student teaching, and directing undergraduate student research.

My life has been working out great. I married my beautiful wife, Trina, and we now live in South Bend, Indiana. In the fall of 2013, I was nominated for and won the Kennesaw State University (where I went for my undergraduate studies) Distinguished Alumni Award for 2013. I am proud to be a Tech alumnus and a student of the School of Mathematics. The education, preparation, and support I have received from the school have led me to where I am today. Thank you, and Go Jackets!

Alumni Awards: Adam Marcus

Adam Marcus (adviser Prasad Tetali) received the 2014 George Polya Prize at the SIAM annual meeting in Chicago in July. He shares the prize with his coauthors Daniel Spielman and Nikhil Srivastava for their proof of the Kadison-Singer conjecture.

Adam Marcus, PhD in Algorithms, Combinatorics and Optimization (ACO), 2008

The George Polya Prize, established in 1969, is given every two years, alternately in two categories: (1) for a notable application of combinatorial theory; (2) for a notable contribution in another area of interest to George Polya, such as approximation theory, complex analysis, number theory, orthogonal polynomials, probability theory, or mathematical discovery and learning.

Adam spoke at the next International Congress of Mathematicians, which was held in Seoul, Korea, August 13-21, 2014. Being invited to speak is a significant honor indicating that the speaker's recent work is highly regarded by the mathematical community. The Congress takes place every four years, with over 4,000 mathematicians from all continents in attendance. The program consists of about 20 plenary one-hour lectures; about 160 invited 45-minute lectures held in 19 sections; and prize ceremonies, including the award of the Fields medal.

Adam's talk was classified jointly in Section 8: Analysis and Its Applications and Section 13: Combinatorics, and is a collaboration with his coauthors Daniel A. Spielman and Nikhil Srivastava. This International Congress, was the fourth and the third in a row, at which at least one of the invited speakers was affiliated with the Algorithms, Combinatorics, and Optimization Program.

Marcus, Spielman, and Srivastava recently solved the Kadison-Singer problem, which has been open since 1959. A short (three-page) purely expository paper that states Kadison-Singer (but is really about "frames," not K-S) can be downloaded from a recent AMS Notices.

Retirees: Happy 84th Birthday to Jackie Smythe!

A group of SoM retirees that meets regularly gathered on March 21, 2014, at Royal China to help Mrs. Smythe celebrate her birthday. Jackie was the mover and shaker of the SoM from 1989 to 2000, and she wore many hats while serving as the Academic Assistant to the Associate Chairs. Her bustling energy and smile were legendary, as she efficiently tackled each new task.

Jackie enjoyed the outing; however, perhaps her best present that day was the birth of her first great grandchild!

Front (left to right) Sara Osborn, Ai-Chuan Tong, Rosalind Ho, Jackie Smythe, Marion Nadel, Fred Andrew

Back (left to right) Jim Osborn, Yung Tong, Antoinette Earley, Bill Green, Tom Morley, David Ho, Rena Brakebill, Steve Demko, Roger Johnson, Jean Johnson, Cathy Jacobson

High School Math Competition

by Chris Pryby

On February 15, 2014, the School of Mathematics hosted its annual High School Mathematics Competition (HSMC), capturing the spirit of Valentine's Day with heart-themed problems and hot-pink T-shirts. This year, 310 students from 46 schools competed in exams testing their skills in algebra, geometry, trigonometry, combinatorics, calculus, and mathematical reasoning. Each school fielded up to five teams of five students each.

The students took a 90-minute, 30-question multiple-choice test and then competed in a 10-question ciphering round in which they had only three minutes to solve each problem. The 70 top-scoring contestants advanced to the final round, in which they had two hours to solve six challenging proof-based questions. The remaining contestants competed in a group test for gift bags containing a Rubik's dodecahedron and a book of mathematical puzzles by Martin Gardner.

Each team's overall score was determined by adding together the four best multiple-choice scores and four best ciphering scores on each team. The top five teams this year came from Northview High School (first and fourth place); the Gwinnett School of Math, Science, and Technology (second place); Walton High School (third place); and Brookwood High School (fifth place).

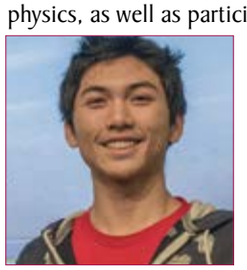
Northview, Walton, & Campbell High School Students Win

In this year's *ProofReader*, we are proud to spotlight our top three scorers in the individual competition, as determined by the proof-based round. **David Xing**, our third-place finisher last year, was our overall first-place winner in 2014. David aspires to be a researcher in applied mathematics or engineering and has already written a paper, "Layer Sequencing and Flat-Foldability of Uniformly Gridded Polygons." The topic of this paper overlaps with another of David's passions, origami. David founded and serves as president of the origami club at Northview High School. He leads the club in community outreach, providing origami workshops to seniors at assisted-living centers and organizing origami Valentine's Day cards for young cancer patients. For his first-place finish in the HSMC, David will receive a $1,500 scholarship to attend Georgia Tech.

Edward Park, who received a $1,000 scholarship to Georgia Tech for winning second place, is a senior at Walton High School in Marietta, Georgia. He plans to pursue degrees in engineering and computer science.

Edward captains his school's Math, Science Olympiad, and Academic Bowl Teams, and he has conducted independent research in mathematics and statistics and has authored two papers: "Classification of Graph-like and Polyhedra-like Continua and An Examination of the Random Walk Hypothesis: Statistical Analysis of the Financial Stock Market." Edward is also very involved in giving back to his community—he founded and runs "Hand in Hand with People with Special Needs," a nonprofit organization helping children with disabilities.

Rounding out the top three this year was **Benjamin Chen**, a junior at Campbell High School. Besides math (his primary interest), Benjamin enjoys programming, linguistics, and physics, as well as participating in FIRST robotics, where he can put his coding abilities into practice. He also enjoys playing Frisbee in his free time. In the future, he hopes to study math and computer science in college. Benjamin will receive a $750 scholarship to attend Georgia Tech for winning third place at the HSMC.



Notes from the ProofWriters

Dear Reader,

We hope you've enjoyed our latest edition of *ProofReader*. As always, this has been a joint effort. Many people have contributed to its content, and although we can't list you all individually, our heartfelt thanks go out to you all. Special thanks go to Chris Heil, who collected much of the included material; to Janet Ziebell for the dazzling design of the *ProofReader*'s distinctive look; and to Douglas Ulmer, our chair, for his strong overall support and contributions.

In addition to all the good news that we were able to report about the SoM, we are sorry to inform you that Cathy Jacobson is retiring from Georgia Tech after many years of invaluable service.

As many of you know, Cathy is one of the founders of the *ProofReader*. She was the editor-in-chief for its past six editions and single-handedly managed this latest one. Cathy's contributions to the `Proofreader' cannot be overstated. Without her involvement, the 'ProofReader' would at best be a nondescript newsletter, if it had come into existence at all.

She edited every one of the submitted articles, and since we are not necessarily born writers, there was much to be done. Cathy straightened up our grammar and turned a contribution into an engaging article. Her excellent writing and editing skills improved our manuscripts and saved many from the shredder. This was a huge amount of work—but that wasn't all she did: Cathy also was the one who pulled all the material together and kept track of all the contributions, and if need be, needled faculty until they delivered a promised contribution.

What I greatly admire about Cathy—and what I believe lies at the heart of her success with the *Proofreader*—is her keen understanding of its readership. For example, not only did she transform our math-speak into enjoyable prose, but she also suggested that we display all our international collaborations on a world map. So we did, and the resulting product resonated strongly with our readers. I think that this representation not only showed to our readers that the activities of the SoM span the whole world, but also communicated in one image that the universal language of mathematics brings together people from many different cultures.

Our students who fill our lectures halls hopefully come to appreciate this fact as they sit next to international classmates and are taught by faculty and teaching assistants who were born and raised in countries all over the world. This aspect of mathematics is not obvious, and, in pre-Cathy times, more often than not may have been lost on our students because they had to struggle to understand their teachers' English. Not anymore, thanks to Cathy! Since 1995, she has prepared our foreign teaching assistants and visiting scholars for the classroom, coached them in the necessary language skills, and helped them navigate the intricacies of the American way of life.

So this is the last of our joint ventures! In future editions of the *ProofReader*, we will have to make do without Cathy. Hers will be a tough act to follow. As a small token of our appreciation, we dedicate this 7th edition of the 'Proofreader' to Cathy, with all our best wishes for her retirement.

As always, we love to hear from you, about you, and any stories related to the SoM. Just write to editors@math.gatech.edu.
– Michael Loss, for the Editorial Team

Why Make a Gift?

The short answer is this: Your gift can have a large impact on the education and research efforts of the School of Mathematics. Below are some of the many ways this can happen.

The High School Mathematics Competition is an inspiring event in which students gather with others interested in mathematics and compete for scholarships. It is run entirely by undergraduate and graduate student volunteers, with scholarships supported by corporate and private donations as well as a federal grant. Contributions toward prize money or operating expenses would help to continue this event and inspire the next generation.

(See http://www.math.gatech.edu/outreach/hsmc/georgia-tech-high-school-mathematics-competition.)

Everyone knows that college affordability is a serious issue for many families. Funds for undergraduate scholarships would help support deserving students as they work toward a very valuable degree.

Teaching is a central part of the mission of the School of Mathematics, and we have a very talented and dedicated teaching staff. Recognizing the best of them through prizes for excellent teaching and mentoring would underscore the importance of these efforts and encourage even more excellence. A named prize would be a great way to remember an alumnus or former faculty member who had a big impact on your life.

Our graduate students are integral to all the efforts of the School—from teaching to research to outreach. They are also the future of the discipline. Supporting them with scholarships, thesis prizes, travel and professional expense funds, or other small gifts would have a large impact on the School and the discipline.

Finally, a long-standing goal of the School is to have a program of named postdoctoral fellows. These positions are the route to a permanent appointment at a top department (such as at Georgia Tech). We've made a good start toward such a program, but there is more to do. Securing sufficient funds to sponsor a permanent program of postdocs will be a long-term project requiring significant effort, but it promises to contribute greatly to the School's progress into the top ranks worldwide.

We're very grateful for the help of our friends in all its forms, both large and small. If you would like to contribute to any of the efforts mentioned above or discuss other possibilities, please get in touch.

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Alumni Class Notes

Information Needed

Share your story with *ProofReaders* please let us hear from you! What's going on in your professional or personal life?

Name:

Degree and Class:

Email Address:

Snail Mail Address (new?)

Your Story:

Your High-Resolution Photo:

Go to **www.math.gatech.edu/shareyourstory** and submit your updated contact information and your story. You can also upload a recent high-resolution photo of yourself at this site. Please be sure to check the box giving us permission to use the material in the next *ProofReader*.

Or email the same to editors@math.gatech.edu and attach your photo.

If your submission is accepted, we reserve the right to edit it for length and style. We hope to hear from you soon!

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