For ALUMNI and FRIENDS

Proof Reader

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

Georgia
Tech

Notes from the Chair

There has been a lot of discussion in the news recently about what sorts of learning are and aren't happening on college campuses and about the value of a college education. In this context, it is worth asking the question "Why study mathematics?"

Of course there are many answers to this question. On a very practical level, an undergraduate degree in mathematics opens doors to opportunities in fields as diverse as computing, finance, insurance, logistics and operations research, telecommunications, cryptography, public policy, medical and biological research, and education. Potential employers include large and small companies, national laboratories, federal and state agencies, as well as public and private schools.

It is also true that those with mathematical training often succeed in ostensibly non-technical careers. For example, students with an undergraduate degree in mathematics are very competitive for admission to the top law schools.

More advanced training opens doors to more technically sophisticated careers. A doctorate in mathematics is the portal to the very rewarding career of professional mathematician—those lucky people who spend their days creating, applying and communicating mathematics, thereby extending and propagating one of the most glorious and powerful creations of our culture.

I think it is important to emphasize the deeper reasons underlying the diverse utility of studying mathematics. Students who grapple with advanced mathematics digest difficult and subtle concepts; they learn to apply them in new contexts, they analyze complex scenarios and competing alternatives, and they learn to communicate their ideas in crisp, clear prose. It is clear that these "meta-skills" are the foundations for success in any number of pursuits.

We in the School of Mathematics at Georgia Tech are proud to be advancing the frontiers of knowledge in mathematics, preparing the next generation of leaders in the field and providing foundational training to a wide spectrum of students on campus. Carrying out this complex mission requires a first-rate faculty supported by top-notch graduate students and a dedicated and efficient staff. It also requires the support of the taxpayers as well as our friends and alumni.

We're fortunate to have all of these ingredients and more at Tech. This issue of ProofReader profiles some of our people and activities.

Late last year, **Robin Thomas** was appointed Regents' Professor, the highest academic rank in the University System of Georgia. This promotion recognizes his long career of ground breaking research, excellent mentoring, and academic leadership. See pages 6 and 7 for an extended profile of Professor Thomas.

We were delighted to recruit two exciting new members to the faculty this year. **Rafael de la Llave** moved from the University of Texas at Austin to Tech this Fall and began a position as tenured full professor. Dr. de la Llave is an internationally recognized expert in differential equations and dynamical systems (traditional strengths at Tech) as well as mathematical physics. **Greg Blekherman** has joined us as assistant professor. Dr. Blekherman is a pioneer in a dynamic new area at the intersection of

convex geometry and algebraic geometry. He also has interests in mathematical biology. See page 14 for profiles of Drs. de la Llave and Blekherman.

Our staff continues to amaze me—they are efficient, pro-active and always a pleasure to work with. See page 13 for a profile of Annette Rohrs, the woman behind our web site and a crucial player in our efforts to obtain outside funding for our research and training activities.

Tried and true technologies such as chalk and slate are still very much in use in Skiles, but we are also exploring more recent innovations such as personal response systems ("clickers") and on-line homework systems. These and other technologies are being tested and adapted to our context. See pages 8 and 9 for more on some of these efforts.

We are very fortunate to attract some of the most talented students from around the world. See pages 12, 26-29 for profiles and news about our undergraduate majors and pages 11, 15-17, 24-25 for news about our graduate students.

In January, we were happy to move into our new space on the ground floor of Skiles; it includes two spacious new seminar rooms, a pleasant and sunny common area for tea, and several new faculty offices. Come by and visit us soon.

Funding provided by external grants and contracts is an important resource for the School of Mathematics and our faculty continue to be extremely competitive in obtaining such awards. During the academic year 2010-2011, there were 68 active grants and awards reflecting a total multi-year commitment of $13.3M*. During each of the past three years, external agencies funded an average of $3.3M to sponsor School of Mathematics research, conferences, collaborations, travel, and students. We received funds from federal agencies such as the National Science Foundation, the National Institutes of Health, and the National Security Agency, as well as awards from private foundations such as the Alfred P. Sloan Foundation and the Simons Foundation. These awards are a testament to the

quality and originality of the work of our faculty and students and we are proud of the accomplishments they represent.

Last but not least, we are very grateful for the support of our alumni and friends. This past academic year, we formed a group of "Friends of the School of Mathematics" (FoSoM) to help provide a point of contact and focus for our alumni. There were two events for this group during the year—a poster session featuring undergraduate research in October and a panel discussion followed by a Q&A session on the topic of non-academic careers for students with advanced mathematical training. See pages 36 and 37 for photos and descriptions of the events. We look forward to more activities that engage our alumni and improve opportunities for our students.

As you can see, the School of Mathematics at Georgia Tech is an exciting place to work and study. We hope you enjoy reading about our work and we'd be delighted to have you get involved. In particular, your suggestions for future Friends of the School events are most welcome. I look forward to hearing from you.

Best wishes,
Doug Ulmer
Professor and Chair

SoM Statistics Spring 2011

Faculty	56	(Tenured or tenure track)
Emeritus Faculty	15	
Academic Professionals	3	
Instructors	3	
Visitors and Postdocs		
Visitors	11	(for semester or more)
Postdocs	5	
Staff	10	full-time
	1	part-time
Graduate Students	95	
Undergraduate Students		
Math	141	
Discrete Math	25	

* These fund were awarded in various years with award periods that include the current year.

Who Was This Skiles Guy, Anyway?

By Richard Duke

William Vernon Skiles was born in Troy Grove, Illinois in 1879 and received a diploma from the Illinois State Normal School in 1901. After a couple years of public school teaching he went to the University of Chicago, and upon receiving his BS degree there, joined the mathematics department at Georgia Tech in 1906. Later he obtained an A.M. (Masters) degree at Harvard in 1911 and a Sc.D. (Doctor of Science) at the University of Georgia in 1926. Skiles' career was very similar to that of Floyd Field, the third chairman of the department and first dean of students. Both came in 1906, both became deans in the 1920s, and both remained in those positions until the mid-1940s.

Skiles became the school's second academic dean in 1925. He later described the duties of that position as being in charge of everything the president didn't want to handle. William Lloyd Williams, Jr., writing in an alumni publication, recalled that in the 1940s Skiles was the "unofficial chairman of the Fulton County Draft Board" since "if you had a deferment, and he felt your grades were unsatisfactory, one phone call and you were on your way to the armed forces." Robert Wallace, in his book *Dress Her in White and Gold,* quotes Fred Ajax as follows: "When Dean Skiles became angry at a person, he refused to speak to him under any circumstances. He and Dean Field went two years without speaking in the early forties, and I received a great deal of experience as a go-between." Ajax related another incident where he served as a go-between that reveals both the range of Skiles' duties, as well as something of his temperament. There was a Naval Officers' Training Program on campus, and Skiles himself was responsible for all decisions concerning transfer credit for those entering that program and for making out their schedules. He often refused to grant credit for work done elsewhere as not being up to Georgia Tech standards. But a friendly young officer with the program would rewrite the schedules, placing the trainees in more advanced courses. Ajax recalled that, "Dean Skiles told me that he was ready to throw the Navy off campus unless the practice was stopped, and the young officer removed from campus." When Ajax finally persuaded the program's commanding

officer to agree to all of the dean's demands, Skiles simply said, "Have him send me a letter to that effect, and I'll think about it." The offending officer was gone in twenty-four hours.

Although clearly not a man to trifle with, Skiles was apparently well liked by the students. He is said to have attended almost every social event on campus and to have made almost all of the trips to away games with the football team. (He had taught Coach William Alexander when Alexander was a student.) The Blueprint yearbook was dedicated to Skiles in 1927 and again in 1935. The 1935 dedication said of him that, "by reason of his unfailing courtesy, his sympathetic understanding, and his ever present sense of right and fair play, he has won the confidence of the students, and made them his admirers and friends."

Skiles was still teaching calculus in the forties, wearing a hearing aid because of his increasing deafness. When a student of that era complained that he wasn't using the same symbol for the logarithm as the text, Skiles' response was, "I've been teaching for thirty-six years, and that's the way we're going to do it."

When Skiles finally did retire in 1945, Lauren Norwell, writing in the *Atlanta Constitution,* hailed him as "Tech's Mr. Chips." Skiles died in 1947, and in 1964 the Bauhaus-inspired Classroom Building, first occupied in 1959, was named in his honor.

RICHARD DUKE

Professor Richard Duke, past Interim Chair of the School of Mathematics (1998-2002) retired in 2006 and has recently completed *History of Mathematics at Georgia Tech, the First One Hundred Years.* A digital copy can be found by looking under History at **www.math.gatech.edu/about-us.** Dr. Duke generated our quiz from that material for your enjoyment. The answers are in two blocks: page 35 and the back cover.
YOU MAY BEGIN!
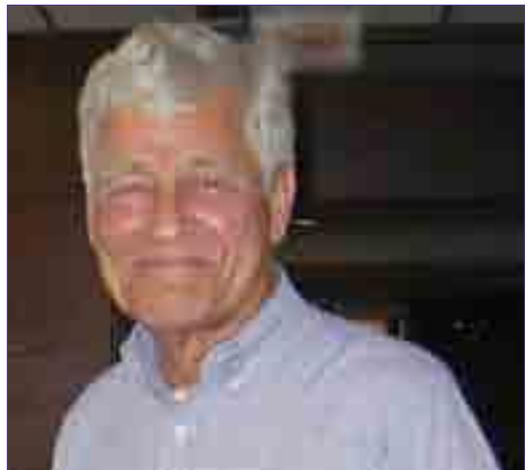
1. Which eight campus buildings are named for former members of the School of Mathematics?

# Faculty Profile: Robin Thomas

By Xingxing Yu and Michael Loss

Tremendous advances have been made in graph theory in the last twenty years, and some of the most exciting ones are due to Regents' Professor Robin Thomas, together with his collaborators. They found a new and much more transparent proof of the Four-Color Theorem. The resulting new techniques led to many advances in other areas of graph theory. Likewise, due to their efforts, the 'Strong Perfect Graph Conjecture' is now a theorem.

In layman's terms, the Four-Color Theorem states that every map can be colored with four colors so that no two states with contiguous boundaries have the same color. This problem was posed in 1852, and the first printed reference was by Cayley in 1878. Since then, many "proofs" have been discovered.

The first proof was by Kempe in 1879, however, eleven years later Heawood discovered a flaw; Tait published another failed proof in 1880, but again, Petersen found a gap eleven years later. In 1976, based on the ideas of Heesch, Appel and Haken published their proof of the Four-Color Theorem with the extensive use of a computer. However, one part of the proof, which is done by 'hand' and not by computer, is almost impossible to check in practice.

Thomas, jointly with Robertson, Sanders and Seymour, gave a new proof of the Four Color Theorem that is much simpler and practically checkable. It clears away many difficult discussions in Appel and Haken's proof. Their techniques have since been used successfully to solve numerous problems in graph theory. For more details see: http://en.wikipedia.org /wiki/Four_color_theorem

The long standing 'Strong Perfect Graph Conjecture' is of importance in combinatorial optimization and information theory. Perfect graphs are ubiquitous. They appear naturally in integer programming. A clear definition of a Perfect Graph and a precise description of the Strong Perfect Graph Conjecture would take us too far but please refer to: http://en.wikipedia.org/wiki/Perfect_graph and http://users.encs.concordia.ca/~chvatal/perfect/spgt.html
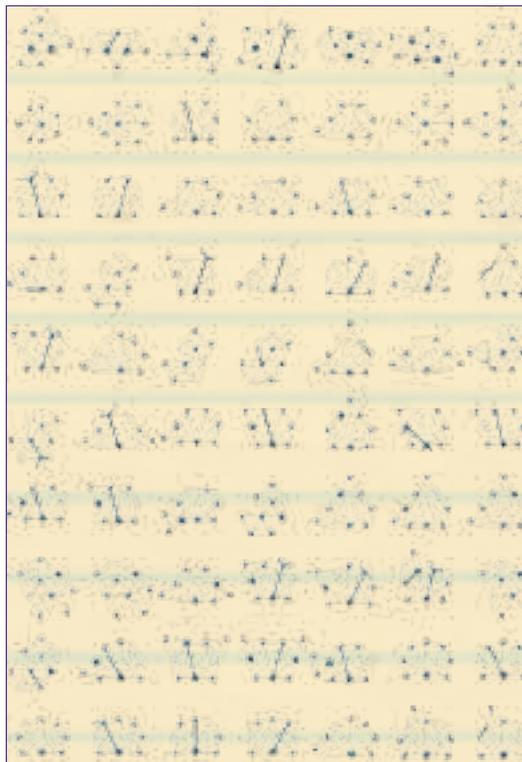
2. Name three former members of the school who are in the Georgia Tech Athletics Hall of Fame.

In 2002 Thomas, jointly with Chudnovsky, Robertson and Seymour, found a proof of the 'Strong Perfect Graph Conjecture' that was published in 2006 in the *Annals of Mathematics.* Their proof is a tour de force and takes nearly 180 pages. Moreover, the technique they invented has opened up new research areas in several fields, including structure theories on induced sub graphs and imperfection ratio of graphs with applications to radio channel assignments.
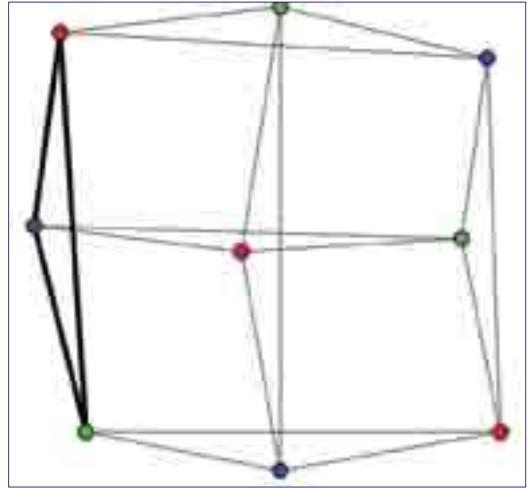
For this achievement the authors received the 2009 Delbert Ray Fulkerson Prize that is sponsored jointly by the American Mathematical Society and the Mathematical Programming Society, and awarded every three years at a meeting of the MPS.

These are not the only honors that Robin has received. Thomas, jointly with Robertson and Seymour, received the 1994 Delbert Ray Fulkerson Prize for proving Hadwiger's conjecture for K6 free graphs. With close to one hundred papers published, much more could be said about Robin's career, but we dwelt a little bit on the above-mentioned achievements because they are of a truly outstanding nature.

Robin got his PhD from Charles University in Prague, one of the centers for graph theory. He came to Georgia Tech in 1989 and began teaching and building up the research group in combinatorics. Besides his success in research, Robin has excelled as a PhD advisor. Twelve students have received their PhD under his guidance and, without exception, they have gone on to excellent careers in academics and industry.

Besides advising PhD and Masters students and teaching undergraduate courses as well, Robin contributes much through his service to the SoM and to the Mathematics community at large. He has been the Managing Editor of the *Journal of Graph Theory*, one of the premier journals in the field, and he is an editor for the journal *Graphs and Combinatorics.* In addition he is the director of the ACO PhD program (Algorithms, Combinatorics and Optimization) at Georgia Tech. This interdepartmental program is co-sponsored by the College of Computing, the H. Milton Stewart School of Industrial and Systems Engineering, and the School of Mathematics. It has been an unqualified success in attracting the very best students in these fields. For more information go to: http://www.aco.gatech.edu/

Robin is married to Sigrun Andradottir who is a professor of systems engineering here at Georgia Tech. Sigrun works on engineering applications, such as decision-making using probability and stochastic theory. They have three children; Misha who is 12 years old, Klara, 9 years old, and Martin, 5 years old. Besides cracking hard theorems in graph theory, Robin enjoys games like table hockey. He is also very fond of traveling, and likes sports such as soccer, tennis and skiing.

3. Lyman Hall was the first chairman of the department. Who was the second?

On-line Learning Comes to Mathematics

For some of us, the word "homework" conjures up images of handwritten solutions to a list of problems assigned in class. In recent years, it has often meant printing out a set of problems posted on a course website. However, there is a "greener" future: homework completed online. This allows different numbers for different students, several attempts at each problem, online hints, and a plus for instructors: automatic grading. Two of the School's faculty, Jeff Geronimo and Klara Grodzinsky, have tried out very different systems over the past few years.

Jeff has used an online e-learning platform called MUMIE in the linear algebra part of Calculus II. It was developed by Ruedi Seiler and his team at the Technical University of Berlin, and is also being used in Zurich and Delft. Klara has used two packages associated with the textbook publishers, Pearson and Wiley. Since 2009, Klara has employed Pearson's MyMathLab for homework assignments in Finite Mathematics, and, in the Spring of 2010, she piloted WileyPlus   in Calculus II.

The MUMIE platform has an online pre-lecture component and a homework component. Pre-lecture modules introduce students to concepts that will be further developed during subsequent lectures and, as their name suggests, are to be completed before each lecture. Homework modules provide students with additional practice and have to be completed by the end of a week. Both modules have three parts: demo, training and problem. The demo part shows how a problem is to be solved. The training part presents the students with problems that they solve and then check for accuracy. Students can retry the same problem or ask for another similar training problem. After the training part, students receive another set of problems that they need to submit for grading. The program is algorithmic so that students receive individual problems (i.e., involving different numbers).

Pearson's homework package, MyMathLab, contains selected homework problems taken directly from the textbook and uses algorithms to provide each student with a slightly different assignment. Students can attempt the problem any number of times until the due date, gaining immediate feedback as to how they performed on the problem. If the answer is still incorrect after three attempts, then the numbers change to a different algorithm. Instructors can also limit the number of trials if desired. While working the homework problems, students have a variety of help at their fingertips: "Help Me Solve This" walks them through the steps, "Show Me an Example" provides a similar problem with solutions, "Video" gives a video presentation on the topic, and "Textbook" will take the student to the proper section in the electronic version of the textbook. WileyPlus is similar to MyMathLab, but has some different features. Both platforms provide the students with drill problems, a math pallet, and   immediate feedback.

The key questions are how online learning has influenced understanding and grades. Although it has received a lot of attention in mathematics education literature, online learning effectiveness has been hard to determine as experimental data is rarely obtained. Jeff notes, "I wanted to do an experiment to see if online learning benefits the students at Georgia Tech. My goal was to teach two Calculus II courses back to back, one using the

4. Who was the first member of the department who had a master's degree in mathematics?

MUMIE platform and one in the regular format for at least three semesters. I asked Tris Utschig in the Center for the Enhancement of Teaching and Learning (CETL) and Ute Fischer, an experimental psychologist, to help me design and run the experiment.

The first semester I conducted this experiment was in the fall of 2008. I taught two sections of Calculus II, each with about 70 students. Statistical analysis indicated that students using the MUMIE platform had significantly higher linear algebra test scores than students in the regular classroom. Moreover, data suggested that MUMIE helped the middle 30% of the students in particular. The experiment was repeated during the fall of 2009, again involving two sections of Calculus II, each with 160 students. Spring 2011 is the third time I am using the MUMIE platform. A full report will be forthcoming soon."

Klara is enthusiastic: "Homework grades for my Math 1711 class have skyrocketed using MyMathLab. Last fall, the class homework average was a 95%. Students want to receive an "A" on the homework, and thus, they repeat the problems until they get the correct answer, spending much more time on their math homework than they would have otherwise done. Students come to office hours more prepared, knowing exactly which problems need to be addressed. The TAs use the on-line homework system to better prepare for recitation sessions, as they can see which problems are most difficult for the students prior to class meeting times."

The School is grateful for Klara and Jeff's leadership in exploring new technology to enhance mathematics teaching and learning in the twenty-first century!

5. Who was the first member of the department who had a doctorate in mathematics?

Awards July 2010–June 2011

September 2010

Justin Filoseta was awarded an honorable mention in the Chancellor's Customer Service Excellence Award, individual category. This is a USG system wide award and comes on top of the Institute award for Outstanding Staff Performance Justin won in April 2010.

January 2011

Professor Jeff Geronimo received one of the highly competitive Catedras de Excelencia (Chairs of Excellence) from Carlos III University of Madrid. The award aims to encourage researchers in all disciplines at the University to develop synergies and build partnerships. Geronimo will begin his research stay in Madrid in the Spring 2012.

February 2011

Awarded annually since 1955, the very competitive Sloan Research Fellowships are given to young scientists "in recognition of distinguished performance and a unique potential to make substantial contributions to their field." This year, 118 researchers from across the country received a Sloan Research Fellowship, but only three faculty members from the state of Georgia were selected by the Alfred P. Sloan Foundation, and they were all from Georgia Tech. One of them was Silas Alben who studies how fluids flow and exert forces on flexible solid bodies. His research is designed to enhance understanding of how fish swim in an effort to guide the design of swimming robots. He also investigates how thin solid plates can deform to create novel three-dimensional structures.

Klara Grodzinsky was chosen for the 2011 CETL Undergraduate Educator Award. This is an Institute-wide award which recognizes Klara's "creative approach to teaching," her work with teaching assistants, and "the impact she has on students and the curriculum at Georgia Tech."

Jean Bellissard was honored on the occasion of his 65th birthday with a conference February 28—March 2 on "Challenges in Aperiodic Media" held in Lyon, France (See page 21)

March 2011

Prasad Tetali was named as the next director of the Algorithms and Randomness Center (ARC) (http://www.arc.gatech.edu/). The center is a joint effort of the College of Computing, the School of Industrial and Systems Engineering, and the School of Mathematics.

April 2011

There are two winners of the College of Science Faculty Mentor award: Professor Prasad Tetali of the School of Mathematics and Professor Roger Wartell of the School of Biology. This award recognizes the time and effort that faculty members spend in mentoring and expresses Georgia Tech's appreciation for the mentors' services to the community.

Joanne Cook was recognized at the College of Sciences Awards luncheon as having served Georgia Tech for twenty-five years. She currently serves the School of Mathematics as the staff person in charge of all faculty personnel information and records.

Graduate Students Awards

September 2010

Huy Huynh, PhD student and the SoM graduate student representative, received the 2010 Clendenin Fellowship. These endowed Fellowships are awarded from Kennesaw State University to its alumni who are pursuing graduate studies.

March 2011

PhD student **Jie Ma**, advised by X.Yu, was a recipient of the Student Paper Competition at the 33rd SIAM South-Eastern Atlantic Section Conference held at the University of South Carolina. See http://www.math.sc.edu/~siamseas/

April 2011

PhD student **Sarah Fletcher** won an NSF Graduate Research Fellowship. Supervised by X.Yu, Sarah is a second year student in the ACO program. The NSF award commended Sarah's outstanding abilities and accomplishments, as well as her "potential to contribute to strengthening the vitality of the US science and engineering enterprise."

PhD student **Peter Whalen** received an NSF Graduate Research Fellowship Honorable Mention. Peter is a second year student in the ACO program and is being supervised by R. Thomas.

School of Mathematics 2011 Graduate Student Awards:
- *Best Graduate Teaching Assistant:* **Marc Sedjro**
- *Best PhD thesis (4/2010-3/2011):* **Ulfar Stefansson**
- *Top Graduate Students:* **Ricardo Restrepo** *and* **Ben Webb**
- *Festa Fellowship:* **Jie Ma** *(a sponsored award to student who exhibits superior academic and leadership skills.)*

Marc Sdejro

May 2011

Math PhD student Alan Diaz received a Goizueta Foundation Fellowship to pursue doctoral studies at Georgia Tech. The Goizueta Foundation provides the Georgia Institute of Technology with an endowment to establish programs designed to advance students of Hispanic/Latino origin in higher education.

Ben, Dr. Dieci and Ricardo

Undergraduate Students   Awards July 2010—June 2011

July 2010

Stefen Froehlich, mentored by P. Cvitanovic, received a Fall 2010 President's Undergraduate Research Award.

March 2011

The College of Sciences selected **Michelle Delcourt** as one of this year's Outstanding Undergraduate Researchers in the college. Her advisor is X. Yu. Award selections were based on high quality research work and demonstration of project leadership.

April 2011

School of Mathematics 2011 Undergraduate Awards

- *Outstanding Undergraduate Teaching Assistant*:
  Erik Gustafson and **Rachel Lunde**
- *Best Course Instructor Opinion Survey Scores received by Undergraduate Teaching Assistants:*
  Melissa Hopkins and **Russell Krenek**

Erik Gustafson

In recognition of the following students' outstanding academic accomplishments and excellence:

- *Senior Prize:* **Melanie Stam**
- *Undergraduate (Freshman–Junior) Prize:* **Mark Mclain Bolding**
- *Research and Service Prize:* **Michelle Delcourt**

It is notable that our newest school alumni garnered three NSF Graduate Research Fellowships and an Honorable Mention. They are:

- **Carola Conces**, BS 2010, now in graduate school at Berkeley, Public Policy
- **Michelle Delcourt**, BS 2011.
- **Melanie Stam**, BS 2011.
- **David Lowery**, BS 2011, Honorable Mention.

Mark Mclain Bolding

May 2011

Sheridan Ackiss, an Applied Mathematics Major with a minor in Earth and Atmospheric Science, interned this spring at NASA Goddard Space Flight Center in Greenbelt, Md., through the Undergraduate Student Research Program (USRP).

6. Who served the most years in the department?

Staff Profile: Annette Rohrs

by Michael Loss

If you want to have your math checked, go to see Annette Rohrs! I admit that this is an exaggeration, but only a slight one. It was what faculty said in the old days when they were writing their papers by hand and then had them typed by Annette. Once in a while she would find that some of the equations did not look right and ask the author to check once more.

Annette's connection to Tech goes back a long way. She started in 1972 as a technical typist in Mechanical Engineering, working for a professor who was trying to create solar panels! After stints at the Georgia Tech Research Institute and at the School of Earth and Atmospheric Sciences, she came to the School of Mathematics in 1982. Annette's work was centered around technical typing, mostly research papers and lecture notes. She did all of this while raising two children.

The release of the typesetting program TeX slowly changed all of this. The faculty began typesetting their papers themselves. However, this did not speed up the process because nobody competes with Annette in speed and accuracy.

Next, publishers also realized that the authors could do the typesetting job. Annette, knowing all the intricacies of the TeX typesetting program, was of invaluable help to the math faculty. She was the one who, through clever formatting, brought the manuscripts into publishable form. As a result, Annette's job description changed; or rather, one should say that Annette has changed her job description to meet the needs of the School.

Submitting grants for faculty members is a full time job and, when deadlines are approaching, Annette's days seem longer than twenty-four hours. There are always last minute changes and faculty who come running with their proposals literally an hour before a deadline expires. The submission process is complex. There are many rules and the requirements are strict. One little technical mistake and the proposal will not be accepted, resulting in a lost funding opportunity.

Fortunately, Annette has taken on this big responsibility and keeps up with rules and regulations of the various funding agencies. She also reminds the faculty when their reports are due. Besides being responsible for getting grant proposals submitted, Annette helps with organizing conferences, is strongly involved in supporting the yearly High School Math Competition and last, but not least, is the Webmaster for the SoM. (Just one example: Annette does all the weekly listings of seminars or the news about the SoM.) I had always assumed that the SoM pushed the Webmaster responsibilities on her; but I was wrong. Annette volunteered for the job and she is now an "expert-in-training" in matters www.

Annette is a true professional. She works as hard and as long as necessary to get the job done. Furthermore, she is our 'institutional memory' and knows the ins and outs of institutional processes. We are very grateful to have Annette on our staff.

I also found out why Annette can size up some of the math of our faculty. She took five mathematics courses at Clayton College! When I asked her what she likes about Georgia Tech she immediately replied that there is so much to learn—and that's the point about this place, is it not?

7. Which member of the department owned the original "Ramblin' Wreck"?

New Faculty

Greg Blekherman
Assistant Professor
Fall 2011

Professor Blekherman received his PhD in Mathematics from the University of Michigan in 2005. Since then he has held several postdoctoral positions, including Postdoctoral Researcher at Microsoft, Cancer Researcher at the Virginia Bioinformatics Institute, Postdoctoral Researcher and Lecturer at the University of California at San Diego and Postdoctoral Participant at the Institute for Pure and Applied Mathematics at UCLA. His research interests include algebraic geometry, convex geometry and mathematical biology.

Rafael de la Llave
Professor
Fall 2011

Professor De la Llave earned his PhD from Princeton in 1983 and comes to us from the University of Texas Austin, where he has been a faculty member since 1989. Prior to joining the UT faculty, he held postdoctoral positions at the University of Minnesota (IMA) and the Institut des Hautes Etudes Scientifique, and an Assistant Professorship at Princeton University. He has supervised nine graduate students in Mathematics and four in Physics, and written more than a hundred publications. He is widely recognized as a leader in research in differential equations, dynamical systems, and mathematical physics.

Promotions to Associate Professor with Tenure

Left to Right: **Zhiwu Lin**
Christine Heitsch
Maria Westdickenberg
Sung Ha Kang

Promotions to Full Professor

Left to Right: **Ronghua Pan**
Guillermo Goldsztein
Matt Baker

Featured Graduate Students–Maria, Nan and Amit

What do Spain, China and Israel all have in common? Outstanding graduate students who have just completed their PhD studies at Georgia Tech's School of Mathematics! While here, they have contributed to research advances and served as talented teaching assistants and instructors. Here is a peek at graduate student life from three international students' points of view…

Already in graduate school, Spain's **Maria Carmen Reguera Rodriguez** transferred into our School from the Fields Institute. As her advisor, Professor Michael Lacey, remembers it, after meeting her, he encouraged Maria to switch studies to Georgia Tech and was so glad that she did.

"Her thesis topic has come to dominate my research, with core techniques in her thesis becoming a critical new technique, employed by an array of international researchers," Dr. Lacey said. "Her growth as a scientist, coupled with her precise insights, has certainly helped me. There are more than a few of us remorseful that she was here in Atlanta for only three years. And, I am thrilled to have her as part of the mathematics research community."

Her interest in analysis resulted in a dissertation titled *Sharp Weighted Estimates for Singular Integral Operators* and has led to a postdoc at Lund University, in Lund, Sweden beginning in fall 2011.

"There are many things about this School of Math that makes it special, and one of the most important ones is that people in the School get along very well," Maria said. "When I transferred, I was afraid people would be too competitive as I am certainly not the competitive type. The department exceeded my expectations. Students, faculty and staff were all very approachable. When you walk down the halls you see students discussing problems in their offices, sharing ideas, sharing notes; not at all competitive, but a very encouraging, enthusiastic environment for a future mathematician."

"Getting to work with my advisor has been one of the most rewarding, wonderful experiences of my life. Now I understand why many people talk about the math genealogy tree and their mathematical parents…it is true that, like a parent, Michael introduced me to the profession. He guided me through my research, took me to conferences and research programs and introduced me to other mathematicians. I know I wouldn't have gone this far without him and I will always be grateful. But he also showed me different aspects of the city; the symphony, the art strolls, the good food…My three years in Atlanta have made me grow enormously, not only as a mathematician, but also as a human being, and I owe much of that to my advisor, Professor Lacey."

Featured Graduate Students–Maria, Nan and Amit

China's **Nan Lu** was initially encouraged to study in the US by Professor Chongchun Zeng, who was at the University of Virginia at the time. When Zeng came to Georgia Tech, he brought Lu with him. "I first met and interviewed Nan during a trip to China and was very impressed by him," Professor Zeng recalled. "In the past few years, he has mastered a great amount of material including the invariant manifold theory, the perturbation theory of homoclinics, and singular perturbations of the normally elliptic type. On this last topic, very little had previously been achieved in this context due to its highly delicate nature." Nan's research problem, begun in 2007, ultimately resulted in his thesis about some singular perturbation problems titled *Normally Elliptic Singular Perturbation Problems: Local Invariant Manifolds and Applications.*

Lu says, "Initially my advisor, Dr. Zeng, didn't ask me to start my research immediately. Instead he asked me to take classes to enhance my background and see what really interested me in mathematics. Our School invited many speakers each week to speak on various aspects of mathematics so that I was able to greatly broaden my knowledge and interest. I also attended many conferences and workshops with the School's support. I enjoyed every day that I spent in the School of Math and I have learned much mathematics, especially from my advisor."

A gifted teacher, Nan received the 2010 SoM Top Teaching Assistant Award. "I was so amazed to be selected as an outstanding TA last year, because I didn't have any teaching experience before I came to the US." Nan feels that without the help of the SoM TA training program and administrative support he would not have become the teacher that he is.

Dr. Zeng noted that Lu was his first PhD student and that he was very happy to have started his advising career with him. "Always enthusiastic about mathematics, Nan worked very hard. We worked together very closely and I enjoyed discussing mathematics with him very much. He has accomplished a great deal both in research and in his teaching assistant (TA) duties, as evidenced by his journal publication and TA award," Dr. Zeng said. "Moreover, Nan is a very pleasant person with a warm heart. On numerous occasions, he gave a lot of help to me as well as to many other people. With his hard working and cheerful personality, I am sure he has a very bright future ahead of him."

Lu graduated this past summer 2011 and then joined the University of Massachusetts at Amherst as a Visiting Assistant Professor for three years. His future mentor will be Professor Andrea Nahmod whose background is in harmonic analysis and who is currently interested in nonlinear wave equations and dynamical systems.

8. Which member of the department was the historian of the Atlanta Society of Magicians?

ProofReader

Featured Graduate Students–Maria, Nan and Amit

At the age of sixteen, Israeli **Amit Einav** decided that he wanted to learn Physics and Mathematics and so began his college education at the Technion (Israel Institute of Technology) in a joint program of both subjects. He next completed an MS at the Technion in Functional Analysis. He said, "I knew that it was only the beginning as I still thirsted for more knowledge! I thought that a Doctoral degree abroad would help me widen my horizons both in my field of study and as a person, so I applied to Schools of Mathematics across the US that had people working in the field of Mathematical Physics. I never dreamt I'd be lucky enough to get into Georgia Tech."

Academically speaking, Georgia Tech was all that he had hoped for and more. "The level of teaching is fantastic," Einav declared. "The School is filled with brilliant people who are passionate about what they do. I am also fortunate enough to have had Professor Michael Loss as my advisor. His teaching, attitude, friendship and mentorship have made me the mathematician I am today."

The School of Mathematics was much more than just an academic environment for Amit—it was home away from home. He concluded, "The people I met here, the friends I made—they will stay with me for a lifetime. Coming here was one of the best decisions I have ever made." A successful teacher as well, Amit has encouraged his undergraduate students by his clear explanations and math lab tutorial support.

Einav and his advisor, Dr. Loss, have been working on analytical problems related to mathematical physics for the past two years. Loss recalls, "As Amit's first problem, he proved a conjecture by Villani from 2003 concerning an entropy production estimate for the Kac Model. My initial reaction, when I discussed Villani's Conjecture with my longtime collaborator Eric Carlen who suggested it as a topic for a thesis, was 'You should not give a conjecture of a mathematician who will probably get the Fields Medal as a PhD topic.' Amit proved me wrong; his paper is a real tour de force, a very complex calculation. He was quick to sort out what was doable and what was not doable. He then came up with a plan and, with his great powers of concentration, pushed it all the way to the end." In fact they now also have a joint preprint on a problem in the calculus of variations where they establish what is known as sharp trace inequalities.

Having successfully defended his thesis titled *Two Problems in Mathematical Physics: Villani's Conjecture and Trace Inequality for the Fractional Laplacian,* Amit is now applying for 2012 positions. He says, "Whatever may come in the future, the School of Mathematics at Georgia Tech will always be a wonderful memory."

Campus Central Returns to Skiles Neighborhood

Thanks to SoM Professor Fred Andrew who followed the evolution of Campus Central with his trusty camera and faithfully recorded the CULC construction to completion. We share a few of his photos with you here, but to view the whole project, go to:

http://picasaweb.google.com/fred.andrew/CULCFromBungerHenry#

January 2009

December 2009

"During my years at Georgia Tech, I have often wished I had taken regular pictures looking north from Skiles 236, documenting the changing skyline. The center of campus had moved north due to steady construction and I felt the Clough Undergraduate Learning Center (CULC) would bring us back to the center of campus, and increase our interactions with our students, many of whom we teach in remote buildings. Since I walked to one of these remote buildings, Howey Physics, regularly to teach calculus, I started taking photographs in the early afternoon on my way to or from class in January 2009. I always stood in the same location at the edge of the Bunger Henry building. I've been fascinated by the project and will conclude my SoM career teaching Calculus I in the CULC, Fall 2011."

Professor Fred Andrew

August 2010

February 2011

April 2011

July 2011

Mathematics Conferences and Events June 2010 through May 2011

October 10–5, 2010

Workshop: "New Perspectives in Univariate and Multivariate Orthogonal Polynomials"

The focus of the workshop at the Banff International Research Station, Banff, Canada was univariate and multivariate orthogonal polynomials, especially their spectral theory, and asymptotic behavior. The aim was to bring together experts who have different approaches to these questions. Georgia Tech mathematics Professors J. Geronimo, P. Iliev, and D. Lubinsky were among the co-organizers of five-day workshop.

November 22, 2010

Stelson Lecture

Professor James Glimm, Chair of the Department of Applied Mathematics and Statistics at University of Stony Brook, New York, delivered two talks: *The Role of Mathematics Across Science and Beyond* and *The Moving Interface Problem for Fluid Flow*. Glimm has made outstanding contributions to shock wave theory and has been a leading theorist in operator algebras, partial differential equations, mathematical physics, applied mathematics and quantum statistical mechanics. Visit www.math.gatech.edu/news/2010-stelson-lecture-james-glimm to view his lecture.

December 13, 2010

Southeast Geometry Seminar:
"From Black Holes and the Big Bang to Dark Energy and Dark Matter: Successes of Einstein's Theory of Relativity."

The Southeast Geometry Seminar is a series of semiannual one-day events focusing on geometric analysis. Georgia Tech, Emory, University of Alabama at Birmingham and University of Tennessee at Knoxville host these events in rotation. This year's seminar was held at the University of Tennessee.

9. Which member of the department was a rear admiral in the U. S. Navy?

February 28–March 2, 2011

Conference: "Challenges in Aperiodic Media"

A conference honoring the 65th Birthday of SoM Professor **Jean Bellissard** was held at the Institut Camille Jordan, University of Lyon, Lyon, France, a town to which Jean has strong links. The conference united experts from different communities to present the state of the art and exchange ideas about aperiodic media. Many countries and multiple generations of mathematicians were represented; speakers included J.E. Avron, A. Connes, and SoM Professor **M. Loss** among others.

March 17–19, 2011

27th Southeastern Analysis Meeting and John Conway Day

SEAM 27 was held in conjunction with John Conway Day on the occasion of Conway's upcoming retirement and in recognition of his influence on function theoretic operator theory, his many students and collaborators, and his contributions to SEAM. The combined meeting took place on the University of Florida campus. Organizers and speakers included **W.S. Li, B. Wick and M. L. Wong**, all of Georgia Tech's SoM. The meeting promotes interaction between researchers and encourages research and education in the field of analysis.
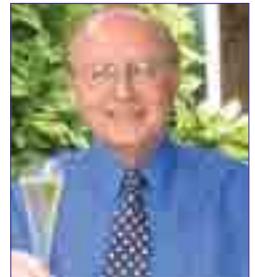
John Conway

March 20–25, 2011

Spring School in Geometry and Quantum Topology, Les Diablerets, Switzerland

The Spring School brings together senior and junior researchers as well as graduate students who are interested in quantum knot theory, hyperbolic geometry, three-dimensional topology and quantum field theory (i.e., Chern-Simons field theory in 3-dimensions). It is part of the University of Geneva bi-annual meeting at Les Diablerets. Among the organizers was SoM Professor **S. Garoufalidis**, and the speakers included SoM Professor **T. Le**.

Mathematics Conferences and Events June 2010 through May 2011

April 10, 2011

Southeast Geometry Seminar

The Southeast Geometry Seminar is a series of semiannual one-day events focusing on geometric analysis. Georgia Tech, Emory, University of Alabama at Birmingham and University of Tennessee at Knoxville host these events in rotation. Presentations were made on topics that included geometric analysis and related fields, such as partial differential equations, general relativity and geometric topology. This year's seminar was held at Emory.

April 16–17, 2011

Atlanta Lecture Series in Combinatorics and Graph Theory, Number 3

Emory University, the Georgia Institute of Technology and Georgia State University have alternated hosting a series of nine mini-conferences on combinatorics and graph theory. The series began in November 2010 and will end in April 2013. The conferences stress a variety of areas and feature one prominent researcher and four outstanding southern researchers. This year the featured speaker was M. Chudnovsky, Columbia University, and the conference was held at Georgia Tech.

April 29–May 1, 2011

Graduate Student Probability Conference 2011

The Georgia Tech School of Mathematics hosted the 5th Annual Graduate Student Probability Conference (GSPC) this spring. The conference was open to all graduate students and post-doctoral fellows interested in probability. The Georgia Tech graduate student organizers were **R. Gong, A. Hoffmeyer, H. Huynh, J. Ma, R. Wang and L. Xin.**

A Special Thank You

Alan Diaz, a recent Goizueta Foundation Fellowship recipient (see page 11), is a PhD student in the School of Mathematics. He has previously studied literature and physics, and worked as a print journalist. We appreciate his articles on the SoM Graduate and Undergraduate student worlds!

10. What did the Georgia Tech Athletic Association present to D. M. Smith upon his retirement?

May 23–27, 2011

Swiss Knots 2011: Knot Theory and Algebra

The Swiss Knots conferences are organized on a biennial basis with the location rotating among participating Swiss universities. This year the organizers included SoM Professor **T. Le.** The aim of the conference is to bring together researchers in knot theory and low dimensional topology, from Switzerland and abroad, in order to provide a forum for the exchange of new ideas and as a way of keeping abreast of the most recent developments.

May 24–18, 2011

The 15th International Conference on Random Structures and Algorithms

The conference, co-organized by Emory University, the Georgia Institute of Technology and Adam Mickiewicz University, has met biennially since 1983 and brings together probabilists, discrete mathematicians and theoretical computer scientists working in probabilistic methods, random structures and randomized algorithms. Georgia Tech participants were SoM Professor **P. Tetali** who served on the organizing committee and College of Computing Professor Eric Vigoda who was an invited speaker.

Graduate World

<div align="right">by Alan Diaz</div>

A doctoral student's most important goal is to write a thesis, and the most influential person on this endeavor is his or her advisor. Nonetheless, there's a lot to be gained by sharing ideas with other professors, and even fellow students. In recent years the School of Math's graduate students have enthusiastically pursued these opportunities by traveling to conferences and forming student organizations back home.

One new and thriving organization is the School's Women's Group (approved as a chapter of the Association for Women in

Mathematics in May) led by PhD students third-year Becca Winarski and second-year Ranjini Vaidyanathan who founded it in 2010. A main goal of the group is to support the participation and achievement of women in mathematics. To this end, the group brings women of all ranks together for roundtable discussions on academic, social and career issues.

Associate Professor Maria Westdickenberg, one of three female faculty members who earned tenure this year, said a supportive community can be a key factor in encouraging students to stick with academia instead of leaving for other pursuits.

"One of the best defenses against over-isolation comes from student groups that build bridges between undergraduate and graduate students, first-year and advanced students, students and professors," Westdickenberg said. "The SoM Women's Group at GT has already built bridges at every level—and my sense is that this is just the beginning."

Winarski said the Women's Group has an additional mission of serving the entire math community by bringing light to important but seldom-discussed issues in academic life. The group has tackled topics like the job search, authority in the classroom and academic etiquette. "Etiquette is a great example," she said. "Appropriate dress, what to say to people. It affects everyone. We want to be the ones who think to ask about those things."

Math graduate students are also supporting each other in more strictly academic endeavors, as evidenced by Tech's student chapter of the Society of Industrial and Applied Mathematics (SIAM). Founded in 2009 by Shannon Bishop (PhD '10), the club maintains a weekly seminar in which the speakers and audience members are exclusively students—no professors allowed.

"Since there are no professors, students feel free to ask more questions," said Treasurer Maria Reguera Rodriguez (PhD '11). "It's a very relaxed atmosphere." This provides the perfect forum for students to hone the art of giving research talks, she added. SIAM membership includes other benefits for students, including support for travel to SIAM conferences. Tech's group even hosted its own student conference in March 2010.

Third year PhD student Meredith Casey reports that her studies will have taken her to three countries—Vietnam, France and

Germany—by the end of 2011. In addition to broadening one's personal horizons, such trips underscore the universality of mathematics.

The Vietnam trip, for a workshop on braid theory in January, was especially meaningful for Casey because it was set in the homeland of her colleagues Anh Tran and Thao Vuong. "The culture there is so different," she said. "I got to see where they live, what it's like. I think we're more likely to work together now."

Sergio Angel Almada, who graduated in May and will start in August as a postdoc at the University of North Carolina feels that travel was essential in securing a good placement "I felt like a business executive at times," he said. Almada spent a good portion of his final year going to conferences and talking about his work.

"It's really important to put a face to your name. My advisor [Prof. Yuri Bakhtin] was extremely helpful and generous in supporting my travel."

Since his specialty, stochastic analysis, is also prized in the finance world, Almada entertained various corporate suitors before deciding to stick with academia. He called the corporate interview process grueling.

"It was intense, many rounds of interviews and tough questions." He found it gratifying, however, because he witnessed the respect that Tech commands in that industry. "Several times, while interviewing at the big financial firms, I encountered among the managers people who had studied in this very building."

Professor Luca Dieci, now in his sixth year as Graduate Coordinator, pointed out that in response to the realization that graduate student travel is an important component of graduate education, the graduate program has doubled the amount of travel funding from the SoM during the last three years.

"Moreover, we've also used funds received from alumni to sponsor travel awards, and the alumni support is very much appreciated and vital to the success of our program," he said.

Professor Dieci would ideally like to give the world more Tech-trained mathematicians. "We could easily have 100 PhD students (a 40% increase of the present number) working on ground breaking research problems," he said.

Dieci admits, however, that only a more moderate growth is likely in the current economic environment. He noted that the program at its current size, as measured by research, teaching performance, graduation rate and placement, is doing extremely well. "I am very proud of all our graduate students," he said. "You couldn't find a nicer bunch of people."

Featured Undergraduate: Michelle Delcourt by Doron Lubinsky

Walk around the School of Mathematics (SoM), and you will bump into Michelle Delcourt, doing something great in the service of mathematics. During her years at Tech, Michelle has been involved in absolutely everything mathematical—research, outreach to high school students, teaching and, of course, learning a lot of mathematics too.

Michelle has had a remarkable research career as an undergraduate, with one paper already appearing in the *Proceedings of the American Mathematical Society*, and three other papers submitted. She was selected by the College of Sciences as one of 2011's Outstanding Undergraduate Researchers, another recognition of her achievements. Much of Michelle's research has been undertaken within the Research Experience for Undergraduates (REU) program. (See page 29 for more information on this very successful summer semester research program.)

Michelle's first REU was at Clemson University in 2008, where she worked with Neil Calkin on Bernoulli convolutions, and it was this research that led to the paper that will appear in *Proceedings of the American Mathematical Society*. In 2009, Michelle worked under Neal Stoltzfus of Louisiana State University, Baton Rouge, on problems arising from knot theory. Yes, you read that correctly—knot theory as in tying knots. In summer of 2010, Michelle worked with the SoM's own Xingxing Yu, on graph theory. Every single one of her projects has resulted in a paper—a tribute to Michelle's persistence and her ability to cover diverse topics. Her presentations at conferences have reaped praise too— her 2010 poster at the annual Mathematics Association of America meeting in San Francisco was a prize winner.

Michelle's calling to math came early: "When I was ten years old, the original works of M.C. Escher came to the United States, and my father took me to see them at the Knoxville Museum of Art. I was captivated by the originality and cleverness of Escher's artwork. Viewing his renderings of 'impossible' geometric figures left me

II. Which member of the department was the first female member of the Georgia Tech faculty?

with the desire to create my own works of art. One of my uncles, a computer scientist and physicist, sent me books and letters on topics including an article on the mathematics behind Escher's prints by Martin Gardner. I eagerly read them and quickly found myself enthralled by the level of mental stimulation posed by open problems and the euphoria accompanying moments of insight that math can provide. I found my artistic medium—math.

Applied Combinatorics, my first higher-level class in discrete mathematics, was particularly influential. From the day when Dr. William T. Trotter mentioned that his favorite colors were one, two, null set and banana, I knew the class would be an interesting one. The material from his experimental manuscript was exciting, and he encouraged us to work on difficult open problems in the field of combinatorics in addition to our homework sets. His anecdotes and interesting questions encouraged me to read papers outside of class, enhanced my introduction to combinatorics, and reaffirmed discrete math as my vocation."

Immersion in research has not stinted her service either. Michelle has helped with the SoM's High School Mathematics Competition. She was president of the Pi Mu Epsilon Mathematical Honor Society, and Vice President of Club Math. Michelle represented the SoM on the College of Sciences Student Advisory Board, and was secretary of Harris Hall. All of this has not come at the expense of an excellent GPA and consequent membership on the Dean's List.

What does the future hold? It's a PhD in mathematics, specializing in the discrete side of things. The graduate school that attracts her will be lucky indeed.

Examples of Michelle's work.

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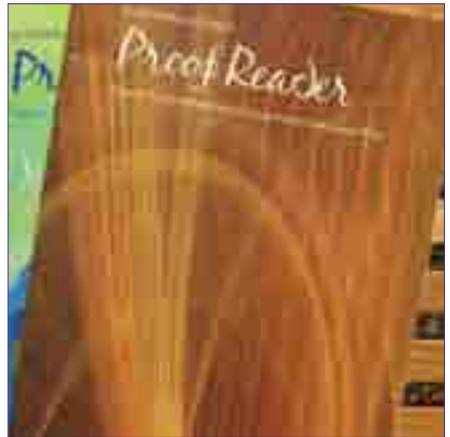
Undergraduate World

by: Alan Diaz and Professor Igor Belegradek

Left to Right: Amena Warrayat, John Cummings, Stephanie Cook, Sarah Leggett, David Hollis, Michelle Delcourt, Nicolas Villanueva, Stefan Froehlich, Antonio Blanca-Pimentel, Melanie Stam, Paige Hoffman, Melissa Hopkins, and Doug Ulmer, seated is Enid Steinbart.

You might think Georgia Tech math majors have their hands full with challenging courses like real analysis and abstract algebra, but many of these energetic students are finding ways to interact with math—and each other—outside the classroom.

One example is Club Math, whose members meet weekly to solve puzzles, play games and talk about some of the many mathematical ideas that don't typically come up in class. The club, which is open to all students at Tech, was founded in 2006 and has recently begun to coordinate larger scale events. For the second year in a row, Club Math teamed up with the honor society Pi Mu Epsilon in April to host an exciting general interest lecture.

The speaker this year was Dr. Robert Lang, one of the world's leading origami artists and

experts in the mathematical theory behind origami. After treating students to a personal folding lesson, Lang dazzled a packed auditorium with modern examples and applications of the ancient Japanese art.

When they aren't helping to organize great talks like Dr. Lang's, Club Math members entertain each other by giving talks themselves. Speakers generally choose topics based on personal interest and often end up learning as much as the audience, said second year Applied Math major **Martin Copenhaver**, who serves as the Club's "Puzzlemeister." Martin gave several talks this year that dealt with one of his favorite areas, mathematical biology.

"Giving talks to Club Math gave me a platform where I can present to an audience who will raise thoughtful questions which in turn increases my own understanding of the subject," he said.

The Undergraduate Seminar, a course that is run by Dr. Enid Steinbart, Undergraduate Adviser for the School of Mathematics, provides another opportunity for a wider exploration of topics. The class listens to presentations by faculty members designed to open student eyes to the different areas of math and the possibility of undergraduate research. Some of the most inspiring talks are by fellow undergraduates; alumni of the Research Experience for Undergraduates (REU) program who come back to tell the younger students about their experience.

"You can see that really motivates the seminar participants," said Steinbart. "There's a sense that, if they did it, I can do it too!"

The REU program is funded by National Science Foundation grants. This on-going eight-week summer program (currently being run by Professor Igor Belegradek) involves research supervision of individual students by professors. For many students, this first glimpse of mathematics research is immensely helpful in deciding whether to continue on to graduate school.

Meet some of the thirteen Georgia Tech students who participated in the summer 2010 program: Jonathan Paprocki, an Applied Math-Physics double major, worked with Professor Bellissard on the physics of aperiodic tilings. (See page 38.) Melanie Dunn, a Discrete Math major, worked on plotting tropical curves under the direction of Professor Baker. David Hollis, a Discrete Math major/ Computer Science minor, and David Lowry, an Applied Math-International Affairs and Modern Languages double major (BSAM-IAML II)—and now headed to Brown University's Mathematics PhD program—worked with Professor Croot on Polymath4, a collaborative web-project on efficient ways to find prime numbers.

Club Math President Josh Anderson, a Discrete Math-Computer Science double major (BSDM-CS II), reports that his 2010 REU with Professor Heitsch helped cement his plans to pursue graduate study in bioinformatics. "I had an idea that I wanted to do bioinformatics," said Anderson, who used his programming skills to help study protein folding, "but it was great to get some actual experience with research."

In some cases research experience can help students find the means, along with the will, to pursue further study. Applied Math major Melanie Stam (BSAM II) used her 2010 REU work with Professor Belegradek, studying families of curves on the hyperbolic plane, as the basis for her successful application for a National Science Foundation Graduate Research Fellowship. Stam, who will use the fellowship as she begins doctoral studies in Math at Cornell University this fall, said one of the most important skills she gained from the REU experience was to maintain patience in the face of uncertainty.

"It took some time to adjust to the idea that I would spend more than a month thinking about it every day and maybe not have an answer even then," she said. "I think it was very important for me to have an experience with the mindset that must go with mathematics research."

Besides its educational value, REU's yield original research, which in many cases gets published in professional journals, like the 2010 paper by Brian Benson, Applied Math major (BSAM 08) on "Parking Functions and Orientations of Graphs" (directed by Professor Tetali).

All the students and the mentors thoroughly enjoyed the experience and the summers of 2011 and 2012 promise to be just as hectic.

Undergraduate Alumni News

Alex Hill, BSAM 2003, was a co-op student with the Georgia Tech Research Institute (GTRI) as an undergraduate and a Research Scientist at GTRI from 2003-2007. Since 2007 he has been employed at Kforce Government Solutions (KGS) and is now lead engineer for development of MATT, a multiple amputation trainer, used to train US Army medics and civilian paramedics.

After graduation, **Jeffrey Landgren**, BSAM 2009, hiked the 2,178-mile Appalachian Trail, and is now a student in the University of Iowa's doctoral program in Applied Mathematics.

Daniel Connelly, BSAM 2009, worked at MIT's Lincoln Labs for a year, and then returned to Georgia Tech to pursue Master's degrees in Computer Science and Mathematics. Through an assistantship with Tech's Center for Education Integrating Science, Mathematics, and Computation (CEISMC), he taught number theory in a Gwinnett County charter school, and was an intern with Google summer 2011.

Andrew Brown, BSAM 2006, first worked in the IT department of Porsche's North American headquarters, and in 2008 enrolled in the University of Georgia (UGA) PhD program in Statistics. He earned the MS in Statistics in 2010, and his doctoral research involves "constructing improved Bayesian models for identifying sparse signals in spatial data" and applying them to comparisons of MRI brain images. He won an Outstanding Teaching Assistant award, and subsequently was the instructor of record in UGA's introductory statistics course, STAT 2000.

Miles Stoudenmire, BSAM 2005, received his PhD in Physics from the University of California at Santa Barbara in 2010, and is now a Postdoctoral Fellow in Physics at the University of California at Irvine, where he is working on "low dimensional electron systems using the Density Matrix Renormalization Group Technique."

Jon Ong, BSDM 2008, has operated a Mathnasium Learning Center in Marietta since 2008, and is now preparing to become an actuary.

12. When was the freshman year first entirely devoted to the calculus?

Undergraduate Alumni News

Jason Mather, BSAM 2004, now lives in Manhattan, and after completing a two-year hybrid program at Citi, has moved into a full time sales and trading role. In the hybrid program he spent one year in research "modeling and forecasting the performance of pooled commercial mortgages and the second year in quantitative trading." He writes "I've found my studies at Tech to be incredibly useful in the real world...the various problem solving approaches and ways of breaking complex problems into workable pieces...have served me every day since I graduated."

Carola Conces, BSAM 2010 with a GPA of 4.0, is studying economics at Berkeley and was just awarded a National Science Foundation Graduate Fellowship. She writes "My first year at Berkeley has been challenging and memorable. I can't believe how much I've learned on one year!" She says her courses use a lot of real analysis and her "GT preparation was really useful." She also uses convex analysis, linear programming, stochastic optimization, linear algebra and numerical analysis. She writes that despite classes keeping her

busier than she could have imagined, she's gone backpacking in Yosemite with her running club and seen the San Francisco Ballet. She also has two part-time jobs helping revise economics text books.

Kelly Westbrooks, BSAM 2001, worked first as a software engineer in Atlanta, and then earned MS and PhD degrees in Computer Science at Georgia State University. His dissertation dealt with "solving a certain type of DNA assembly problem using the machinery of network flows." After completing the PhD in 2009, he worked at Life Technologies, a biotech company producing DNA sequencing equipment, until March of this year, when, as he writes "Google made me an offer I couldn't refuse." He is now working for Google in San Francisco.

Anthony Ritz, BSAM 2004, also earned a BS in Physics from Georgia Tech in 2004, and a JD from Georgetown University in 2007. He was a Judicial Extern with Judge Paul J. Kelly in Santa Fe, New Mexico and Judge Richard D. Cudahy in Chicago, and clerked with the Electronic Privacy Information Center in Washington, DC. He has worked as an LSAT prep instructor, taught GMAT courses in the United States, Canada and as far away as Hong Kong, and worked as a private tutor.

Graduate Alumni News

Diana Thomas, PhD 1996, has been at Montclair State University in New Jersey since 2000. She and her husband, Anand Hariharan, have three children—Ajay (11), Anjali (5) and Aishwarya (4). She says teaching graduate PDE's recently brought back fond memories of the course she took here from Professor Loss. She is currently working on mathematical modeling related to obesity research with funding from the NIH, and in addition to her position as associate professor at Montclair State University, she is a research associate at the New York Obesity Research Center at Saint Luke's Roosevelt Hospital and adjunct professor at the Pennington Biomedical Research Center.

Michael Keeve has been on the Mathematics Faculty of Norfolk State University since he received his PhD from Georgia Tech in 1997. He was an MAA Project NExT Fellow during the 1998-99 academic year and served as department chair from 2002-2008. His recent professional activities include the Governor's Conference for STEM Education in Roanoke (2009) and the Quality Education for Minorities Network program *Integration of Mathematics into Lower Division Science Courses* in Memphis (2010). "Outside the world of mathematics," he writes, "I was the leader of the band at Calvary Revival Church in Norfolk, Virginia from 2002 to 2010," and "played the keyboards for all singing groups of the church."

Demetrio Labate, PhD 2000, is currently associate professor of Mathematics at the University of Houston. He writes "I spent some very exciting formative years first at Washington University in St. Louis, as a post doc, and then at North Carolina State, as an assistant professor, where I broadened my research interests to include wavelets, multiscale analysis, and their application to signal and imaging processing." He is currently directing two doctoral students and two postdoctoral fellows. He received an NSF Career Award in 2008, and has been funded by the National Science Foundation, the Army Research Office and the Norman Hackerman Advanced Research Program.

Jorge Rebaza, PhD 2002, now an associate professor, has been a mathematics faculty member at Missouri State University since 2002, and writes that since June 2002, he has "been very happily married to Mariandine Huertas"...They "travel very often to their homeland Peru to visit family and friends," and they "both agree that their time in Atlanta, and especially at Ga Tech, has been by far one of the most exciting times of their lives, in particular, because of the very welcoming environment provided by faculty and staff at the School of Mathematics." They both feel "they were very lucky to be surrounded by the nicest and friendliest group of graduate students, making Skiles really feel like home." Jorge has been active in research, teaching, and textbook writing, and was Co-PI of an NSF-REU grant from 2007 to 2009. Our current doctoral student Sarah Fletcher was one of his REU participants. Jorge is also co-organizer of the IX Americas Conference in Differential Equations and Nonlinear Analysis which will be held in Trujillo, Peru, in January 2012.

13. In what year did the school first offer bachelor's and master's degrees?

Qing Hui, MS Applied Mathematics 2005, earned a PhD in Aerospace Engineering from Georgia Tech in 2008 and is currently an assistant professor in Mechanical Engineering at Texas Tech University. His research is in various aspects of control theory and his teaching includes control theory courses jointly listed in mathematics and mechanical engineering.

Nimesh Bhakta, BS Applied Mathematics 2002, MS Applied Mathematics 2006, also earned a BS in Physics from Georgia Tech in 2008, and is currently a faculty member at Georgia Perimeter College. We fondly remember him as one of four top students who came to their Math 4318 final exam dressed in robes as "Math Monks," of the Rigorian Order of course.

Brent Griffin, MS Applied Mathematics 1989, is an associate professor in the Division of Mathematics at Georgia Highlands College, where he joined the faculty in 1996. He served as Interim Chair of the Division of Mathematics at GHC in 2006-08 and as director of the college's Marietta Instructional Site in 2008-09. He recently completed his fourth year as the mathematics representative to the Council on General Education for the University System of Georgia. The Council oversees and maintains the integrity of the core curriculum for the University system and its thirty-five member institutions.

Ulfar Stefansson, PhD 2010, reports that his second child, Stefan, was born in September 2010, and that he is still working for the Resolution Committee of the failed Icelandic bank, Kaupthing, which is "winding up [to be] the fifth largest bankruptcy in history."

Selma Yildirim Yolcu, PhD '09, is currently a postdoc of Rodrigo Banuelos at Purdue University in West Lafayette, IN and she is working on problems at the intersection of spectral theory and probability while enjoying teaching as well.

Turkay Yolcu, PhD '09, is a visiting assistant professor at Purdue University who is currently working on applications of variational methods in mathematical finance.

14. When did the school award its first doctorates?

High School Mathematics Competition (HSMC) 2010

HSMC Arrival

HSMC Guru

HSMC Anticipation

HSMC Ciphering

HSMC Volunteers

HSMC Lunch

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 where 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 tuition and fees are increasing dramatically at a time when the HOPE scholarship has become less generous. Funds for undergraduate scholarships would support talented and needy 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 underline 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 of 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 post-doctoral fellows. These positions are the route to a permanent appointment at a top department (such as Georgia Tech) and they are the one major element lacking in our current program. Establishing a post-doc program is a long-term effort requiring significant funds, but also promising the opportunity to continue the School's progress into the top ranks worldwide.

We're very grateful for the help of our friends in all of it 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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ANSWERS TO THE HISTORY QUIZ   by Richard Duke

1. The Lyman Hall, D. M. Smith, and Skiles Buildings, the Field, Fulmer, and Hefner dormitories, Alexander Memorial Coliseum, and the Lawrence Wood ("Chip") Robert, Jr. Alumni/Faculty House. Alexander and Robert were instructors in mathematics after graduating from Georgia Tech. (One might add the plaza in front of the Ferst Center, named for Dean George Griffin who also served as an instructor in mathematics.)

2. Chip Robert, Coach Alexander, and Roy Mundorff, math professor and head basketball coach.

3. Otto Theodore Geckler, who later served many years as the chairman at the Carnegie Technical Schools, begun in 1905 and now known as Carnegie Mellon University (CMU).

4. Alan Benton ("Froggy") Morton, who came to Georgia Tech with a master's degree from Brown in 1899. (The first master's degree at Georgia Tech was awarded in 1925.)

Undergraduate Poster Session during the Alumni Homecoming Reception October 2010

15. Which member of the department secured the first advanced computer for Georgia Tech?

Friends of the School of Mathematics (FoSoM) Panel April 2011

The School of Mathematics has alumni that show great interest in all SoM matters and with the organized FoSoM we now have an excellent forum for learning from alumni experience and exchanging ideas with them. One particularly successful event was held on April 14, 2011 in our new conference room.

What are the professional opportunities for a mathematics major besides academia? This is certainly one of the questions that is very much on our students' minds, especially these days. The question was addressed in a panel discussion on *Non-Academic Careers: Opportunities and Challenges for Students.* On the panel were Tim Norris (MATH 1977, MS ICS 1982), Bob Price (MS MATH 1958), Gary Robinson (MATH 1967) and Tim Waller (MATH 1970). The event was well attended; interestingly, there were more graduate students than undergraduates.

The expertise of the panel ranged from financial, health care and insurance to computing. The panel gave advice on a number of issues but one topic stood out: 'Communication'. The panel members pointed out that it is crucial to have skills in writing as well as in public speaking. The ability to communicate effectively is indispensable if one wants to move beyond a technical job.

Today mathematicians can work in a number of industries such as banks and investment firms, insurance companies and

in actuarial science. If one has a predilection for probability theory, one can work in the gambling industry or in risk management, the hottest field these days.

Not only were the alumni on the panel generous with their time but they also gave our students their phone numbers and encouraged contact in case the students had any questions. We look forward to continued mentoring from our SoM Friends!

Gary Robinson, Bill Wise, Tim Waller and Bud Pass

Doug Ulmer and Tim Norris

Jack Line   Obituary

March 2, 1929 - January 5, 2011

John Paul (Jack) Line of Stone Mountain, Georgia passed away on January 5, 2011. He is survived by his wife of fifty-three years, Frances (Fran) Winn Line, and three sons Paul, Carl, and John and wife Melissa, grandchildren and several nieces and nephews. He was born March 2, 1929 in Pontiac, Michigan to Paul B. and Dortha T. Line. His parents, son Mark and brother Robert predeceased him. He graduated from the University of Michigan and was a math professor at Georgia Tech for thirty-nine years. Jack was an active member of Memorial Drive Presbyterian Church for forty-one years serving as Deacon and Elder.


Jim Osborn recalls; "Jack and I met as undergraduate mathematics majors at the University of Michigan and were close friends ever since. We also did our graduate work together at the University of Michigan. Jack, who had been a student of Ruel Churchill, then held short term positions at Oberlin College and the University of Rochester before joining the faculty of Tech's School of Mathematics in 1956. After graduate school I took a position at Ohio State University, but when Jack told me how much he liked Georgia Tech, and that there was a vacancy on the faculty, I applied and joined him here the next year.

Jack was always physically active. As undergraduates we used to bicycle about forty miles from Ann Arbor to his home in Pontiac, Michigan. He and his wife Frances were dedicated square dancers and served for thirty years on the board of the Georgia State Association of Square Dancers. Along with George and Marilyn Cain, George and Henny Caldwell, Roger Johnson, Juanita Pitts, Bill Smythe and others, Jack competed in the Yellow Jacket Bowling League, and naturally, his team was called the Line Integrals! Several of their trophies are still on display, albeit a bit dusty, in the Skiles 236 faculty lounge.

Jack retired in 1995 after thirty-nine years on our faculty. His teaching reflected his interests in applied mathematics, and over the years he taught calculus, linear algebra, differential equations, boundary value problems and related courses to thousands of students, who surely remember him as does Margaret Moore, a student in the 1970's—'a tough, but fair professor.' We all miss him."

About the Cover
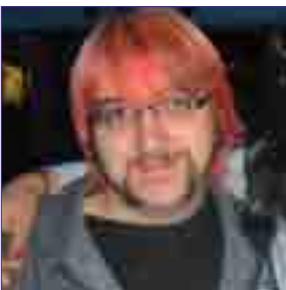
Undergraduate **Jon Paprocki,** a math/physics double major, studied octagonal tiling at a 2010 summer REU with SoM Professor Bellissard while in Bielefeld, Germany. The octagional tiling discovered by R. Ammann and F. Beenker and illustrated on the *Tiling Encyclopedia* web site developed by E. Harriss and D. Frettloh can be seen at http://tilings.math.uni-bielefeld.de/. Some of Jon's work on the Ammann-Beenker tiling that can be seen on the next page, top right, was the impetus for Janet Ziebell's interpretive cover design.

16. Which member of the department has been called "the father of sparse matrix theory"?
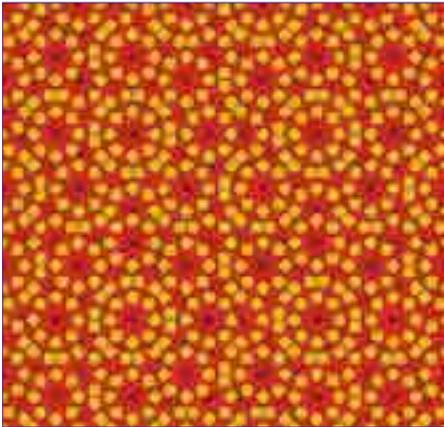
Samples of Jon's
Octagonal Tiling
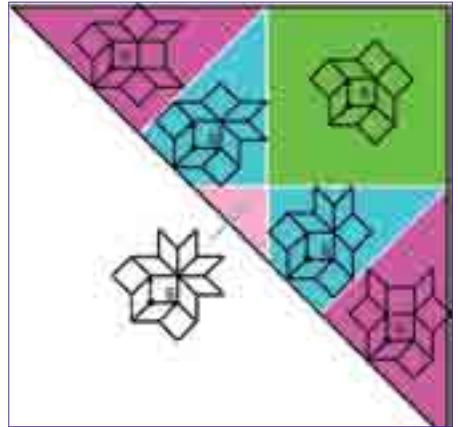
Notes from the ProofWriters

Another year, another *ProofReader*! You have come to the penultimate page of Volume 4 of our little journal and we hope that you have enjoyed it. In fact, our journal is not so little anymore. As you can see it has grown to forty pages.

We also would like to think that reading our journal gave you a reprieve from the bad news you have been hearing for the past year. Some of it is of particular concern to us at the SoM since the news is about numbers. For example, we were informed that our national debt is close to 100% of the Gross Domestic Product. This statement, however, does not make any sense as the two numbers carry different units.

Mathematical training is needed to avoid such pitfalls; training that we strive to give to our students by employing various, often new, methods. And, as you may have gathered from this issue, we are doing quite well in this endeavor; many of our students are very successful and move on to exciting new careers. We expect that they will not make the mistake of comparing numbers that carry different units!

The new Clough Undergraduate Learning Commons (CULC) is a further testimony to Georgia Tech's emphasis on undergraduate teaching and learning. We are particularly happy that our Skiles classroom building has 'returned' to the center of campus. With the Library and CULC next to us, we form both the physical and educational core of learning here at Tech. As an added bonus, there is a coffee house in the CULC. Since mathematicians are machines that turn coffee into mathematics, we are quite optimistic that the mathematical output at Georgia Tech will increase.

It has been our goal to entertain the readers of the *ProofReader* on more than one level. We hope that you enjoyed the superb layout and graphics from Janet Ziebell and that you found the reports and stories informative that were prepared by a host of contributors as well as by the editorial team members Fred Andrew, Doron Lubinsky and Michael Loss. For the enjoyment that comes from reading good prose, you have to thank Cathy Jacobson, our chief stylistic editor.

As always, if you would like to give us feedback or any story related to the SoM, please let us know about it at editor@math.gatech.edu. We love hearing from you.

For the *ProofReader* editorial team—Michael Loss

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MORE ANSWERS TO THE HISTORY QUIZ

by Richard Duke

5. Elmer Clifford Colpitts, who came to Georgia Tech with a PhD from Cornell in 1906, but left after one year, eventually teaching at Washington State. D. M. Smith, who came in 1913, was the first person with a PhD in mathematics to make his career at Georgia Tech (Skiles also came in 1906, and Morton even earlier, but they didn't obtain their doctorates until the 1920s. The average number of doctorates in mathematics being awarded per year during the 1920-1925 time period in the U. S. and Canada was 26.)

6. Dan Robinson, who at 42 years beat D. M. Smith by one year.

7. Floyd Field, the third chairman of the department and first dean of men.

8. Ralph Hefner, mathematics professor and dean of the General College.

9. Francis McKee Adams, who was advanced to that rank when he was added to the retired list in 1945. He joined the department in January of 1946 along with many other veterans hired to deal with the crush created by the G. I. Bill.

10. An automobile—a 1954 two-toned sedan—and a check for $1,500.

11. Mary Katherine (Kay) Cabell, was hired by the school director Marvin Sledd in 1960. Kay and her husband, Randy, came to Atlanta in 1960 with his employer, IBM, but were transferred at the end of that year, so Kay was only on the faculty for one year. (She and Randy, a Georgia Tech graduate, had met at the University of Virginia where she was working on her doctorate and he was in business school.)

12. 1966-1967. Calculus was first taught in the third and fourth years, and by 1902 it was completed in the third. A few years later it was a second year subject, and remained there for 50 years. By 1960 calculus was taught beginning in the Freshman year,

13. 1952. In that year the "service" department of mathematics was established as the degree granting "School of Mathematics."

14. 1965, to George Cain and Wilbur Stiles.

15. E. I. Perlin, who secured a 24-bit ERA 1101 computer in 1954. It was produced by Energy Research Associates, which had begun building machines to break codes for the Navy during W. W. II. (Some claimed that Perlin had talked Douglas MacArthur into giving the machine to Georgia Tech.) Perlin later became the director of the Rich Electronic Computer Center and joined the School of Information and Computer Science when that unit was established. (Most of Perlin's group who were working in computing and numerical analysis were gone from Georgia Tech by the early 1960s.)

16. Ralph Arthur Willoughby, who was a member of the department in the early 1950s and went on to a long career at IBM.