

The Quaternion

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The Newsletter of the Department of Mathematics and Statistics



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The Quaternion is an annual publication of the USF Department of Mathematics and Statistics, which can be visited on the web at <http://www.math.usf.edu/>. Our our snail-mail address is Department of Mathematics and Statistics, University of South Florida, 4202 E. Fowler Ave., CMC342, Tampa, FL 33620. Our phone number is (813) 974-2643, and our fax number is (813) 974-2700.

Computer Guided Coursework: the SMART Lab



Doing homework and tests on a computer? What hath the Digital Age wrought? At Virginia Tech the answer is the *Math Emporium*; at the University of Alabama it is the *Math Technology Learning Center*; and at USF it is the *SMART Lab*.

A major redesign of introductory USF math courses began last Fall with the opening of the Science, Math and Research Technology (or SMART) Lab. The Lab, located on the second floor of the Library, is equipped with more than 300 computer workstations arranged in hexagonal pods. On a typical day during the semester, the Lab is filled with students busy with their on-line homework. Tutors, graduate teaching assistants, and instructors monitor students, who request help by clicking an icon on their desktop; a low overseer-to-student ratio (about fifteen-to-one) means that overseers are readily available. At other times the Lab goes into “test” mode and shuts down while students take tests, which can be delivered in either multiple choice or free response formats.

Virginia Tech launched their Math Emporium in response to a directive from the

National Center for Academic Transformation (NCAT) to rethink the teaching of introductory math courses, particularly those with large enrollment. This directive, issued in the late 90’s, sought to exploit then recent advances in technology. In the Math Emporium, students spent less time in lectures and more time practicing at their own pace on a computer. The experiment was successful: the overall pass rate in Virginia Tech’s introductory linear algebra course jumped from 80.5% to 87.25% and the cost of delivering the course *decreased*. The savings were due to a reduction in the number of classrooms, which eventually offset the initial funding for the computer lab.

Since Virginia Tech’s early success, many other schools have adopted the “Math Emporium” model and have seen similar improvements in student performance. At USF, redesigning College Algebra (MAC 1105) began in Spring 2011, when Dr. Fran Hopf taught a section of 190 students. She met with them for 75 minutes once a week in an auditorium, when she would give an overview of the topics to be covered that week; active learning during this lecture was encouraged by using clickers (see the 2009 Quaternion). Students then spent three hours a week working in a computer lab. During the lab times, Dr. Hopf or a TA would be present to monitor student activity and provide assistance. Homework, quizzes, and tests were all taken on the computer. At the end of the semester, Dr. Hopf’s students took the same paper-and-pencil multiple choice final exam given to all students enrolled in College Algebra that semester. Other sections followed the “traditional” format: instructors met their

students twice a week for 75-minute auditorium lectures and TAs met the students twice a week for 50-minute help sessions.



Dr. Fran Hopf is an instructor at USF. She started teaching here in 2001.

The results of Dr. Hopf's Spring 2011 pilot were immediately encouraging. The failure rate on the common final exam was 13% less for the redesigned course than it was for the sections taught in the traditional format.

Further, the failure rate for the redesigned course was 9% less. Based on this success, in Fall 2011 and Spring 2012, Dr. Jogindar Ratti joined Dr. Hopf, each teaching a section of College Algebra following the "emporium" model. Results from these sections further confirmed the model's validity. Armed with the data from these pilot courses, Drs. Hopf and Ratti, along with the Math/Stat chair Dr. Marcus McWaters and the associate chair Dr. Leslaw Skrzypek, successfully lobbied the administration to fund a large computer lab that would serve as the hub of lab-based work for USF's introductory math courses. The SMART Lab opened in Fall 2012.

The goals of the SMART Lab are to improve both student understanding and student performance. The nation-wide pass rates for such courses as Intermediate Algebra (MAT 1033 at USF), College Algebra (MAC 1105), Precalculus (MAC 1147), and Finite Math (MGF 1106) typically range from 50 %

to 65%. Schools that have implemented an emporium model have increased these rates to 65-80%. With the introduction of the SMART Lab, USF anticipates replicating, and even improving, these results.

The central philosophy of the Lab is to get students to *do* mathematics, rather than passively watch their professor (or graduate TA) demonstrate mathematics. Dr. Hopf is fond of invoking the Native American saying: *Tell me and I forget; Show me and I remember; Involve me and I understand.*

Consequently, lecture time in the SMART Lab courses is reduced to about half of what it was in a traditional course format. Lecture time is replaced by a weekly Lab time requirement of 2-3 hours, which the students are able to schedule for times that best fit their availability. The accrued Lab time is monitored by software installed on the Lab workstations.

The on-line homework requires the students to actively engage in problem-solving and puts them in control of their own learning. Further, they receive instant feedback on their performance, rather than wait for graded papers to be returned. Additionally, the hexagonal design of the computer pods promotes collaboration among students enrolled in the same course. The tutors in the Lab are able to provide one-on-one assistance to those students who need more individualized instruction. A useful feature of the computer software is the *Help Me Solve This* option, which provides guided step-by-step solutions to problems. The software also provides a *Study Plan*, which can be used as a diagnostic tool to pinpoint weaknesses in the student's mastery of the subject. At USF we try to further promote mastery by not allowing a student to take a section quiz until they have scored at least 70% on the homework for that section.

There are two primary challenges facing instructors who teach SMART Lab courses.

The first is learning how to present the course material in half the time that was previously allocated. The recommended solutions include providing an overview of the week's material rather than a detailed lecture. Examples should combine multiple skills and concepts. Also, common errors should be pointed out and study strategies should be suggested. The main goal is to alert students to difficulties they may encounter with the material. Instructors who are reluctant to give up lecture time need to remind themselves that students learn math by *doing* math. Their role shifts from pedagogue of math content to facilitator of student learning.

The second challenge is convincing students of the necessity of the weekly required lab time. A frequently asked question is: "If I can do the homework and quizzes on my computer at home, why do I have to come to the SMART Lab?" Rationales such as *studies show student performance improves when students do at least some of their homework in a structured and supportive environment, or the SMART Lab hours are only replacing time that would have otherwise been spent listening to lectures, or the Lab hours give the tutors, TAs, and instructors a chance to observe students as they solve problems and offer study tips or clarify concepts as needed* are not wholly satisfactory to all students. Of course, the bottom line is that most students will do better if lab time is required.

Nonetheless, institutions with similar Labs have responded by allowing students who achieve grades of B or better on the tests to be exempt from Lab hours; other schools have required that quizzes be done in the Lab, but allow homework to be done at home. Both of these options are being considered at USF.

USF has invested \$3.3 million in the SMART Lab, so the Math/Stat department has a major stake in its success. The department has assigned a team of course coordinators to

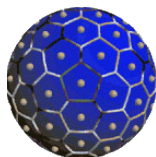
monitor and improve the student success rates of their respective courses, educate instructors who are new to the SMART Lab about its underlying philosophy, and insure that all instructors teaching the course are following this philosophy and staying on pace. These are not easy goals! To achieve them, the coordinators work closely with Dr. Ana Torres Ayala, the Assistant Director of Tutoring and Learning Services and manager of the SMART Lab. The coordinators are Dr. Hopf for MAC 1105, Dr. Ratti for MAC 1147, Ms. Amber Bieske for MGF 1106, and Dr. Ruthmae Sears from Math Education for MAT 1033.

The results to date have been good. There is far more consistency (in terms of content, coverage, assessment, and pedagogy) between sections of the redesigned courses than existed in the past. Further, each of these four courses appears likely to routinely achieve success rates for its students of between 70 and 80 percent. Is 100 percent achievable? Those who think so should keep in mind the Robert Browning quote: "Ah, but a man's reach should exceed his grasp. Or what's a heaven for?" A more down-to-earth objective would be to track the success of students in a course for which they took a SMART Lab course as a prerequisite. (Improving success in a prerequisite course, a primary goal of the SMART Lab, is of lesser value if it does not translate into improved chances of success in a follow-on course.) Discussions are ongoing of how best to track the SMART Lab "graduates" and gather the necessary data to validate the assumption that the Lab is improving not only student success, but also student understanding.

What does the future hold for the SMART Lab? USF has made a long term commitment, so it will continue to be an integral part of the courses that already rely on it. There has been some discussion of migrating other math courses to the SMART Lab model; Business

Calculus (MAC 2233) has made some moves in this direction. Clearly we have come a long way from the days when a piece of chalk was

the essential teaching tool - the times they are a-changin'!



Faculty News

This year, two USF instructors were promoted to assistant professor, and we welcomed a new assistant professor to the department.

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Arthur Danielyan joined the Department in 2003 as an instructor. A native of Armenia, he was an undergraduate and a graduate student at Yerevan State University in Yerevan (the largest university in Armenia), but he received his Ph.D. from the Institute of Mathematics of

the Academy of Sciences of Armenia in 1987 – when Armenia was still a republic of the USSR. He simultaneously served as a lecturer at Yerevan State University and as a researcher at the Institute of Mathematics for the Academy until 1994, when he joined the Moscow Aviation Institute as a senior scientific researcher (while simultaneously visiting Moscow State University and later the University of Oldenburg, in Germany). In 1998 he came to the United States, visiting the University of South Florida and then the University of Central Florida, until 2003. He works in complex analysis and approximation theory, and is best known for solving some longstanding problems. Recently promoted to Instructor, Level II, this spring he was hired as a tenure-track assistant professor in a search conducted by our department.

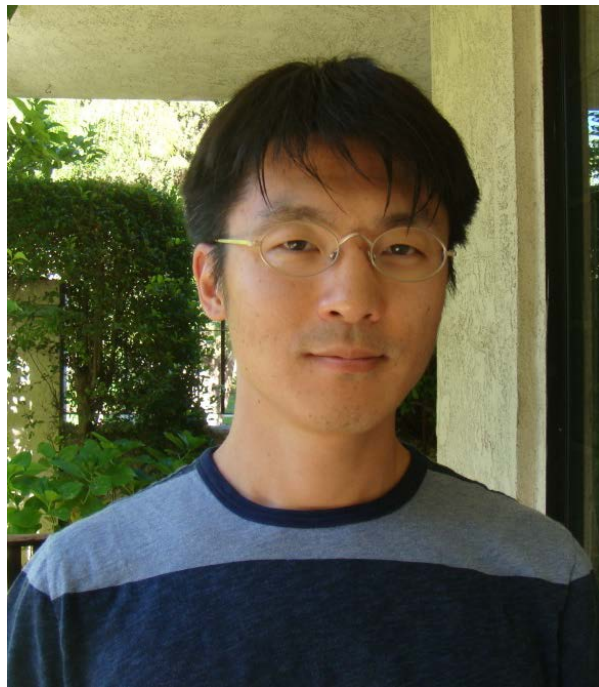
Milé Krajčevski joined the Department in 1995 as an Instructor. A native of Macedonia, he received his B.S. from St. Cyril and Methodius University in Skopje (the largest university in Macedonia) in 1979, and then his Ph.D. in mathematics from SUNY Binghamton in 1994. While continuing his

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research in combinatorial group theory, geometric group theory, small cancellation theory, and hyperbolic groups, he became very active in undergraduate education at USF. He supervised the teaching assistants and coordinated their Teaching Seminar, served as course coordinator for College Algebra, Precalculus Algebra and Trigonometry, and Trigonometry, and was a co-sponsor of the USF Student Math Clubs – the MAA Chapter and the Pi Mu Epsilon Chapter. He became active in mathematics education research, and was the co-PI for four grants for mathematics education at USF, including a \$ 1.2 million NSF Robert Noyce grant for STEM education. He was recently promoted to Instructor, Level II, and this spring he was hired as a tenure-track assistant professor in a search conducted by the School of Natural Sciences and Mathematics in Science & Mathematics Education, for our department.

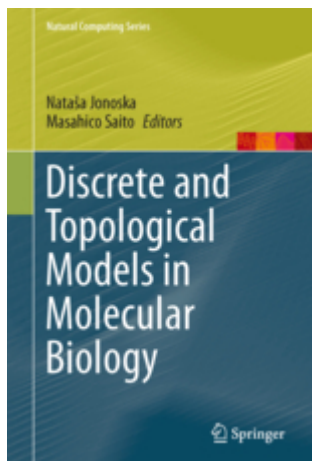
Seung Yeop Lee, a native of South Korea, received his B.S. and his M.S. from Seoul National University and his Ph.D. in physics



from the University of Chicago in 2007. Since then he was a CRM-ISM postdoctoral fellow for the Centre de recherches mathématiques at the Université de Montréal and then a Sherman Fairchild research fellow at the California Institute of Technology. He works on random matrix theory and related topics in physics and mathematics. He was hired as a tenure-track assistant professor in a search conducted by the School of Natural Sciences and Mathematics in Computational Modeling, for our department.

And in other news...

Catherine Bénéteau, together with Zdenka Guadarrama of Rockhurst University, Jill Guerra of the University of Arkansas – Fort Smith, Lauri Lenz of Marymount University, and Andrei Straumanis of the POGIL Project, have produced a text, *Calculus I – A Guided Inquiry*, published by Wiley and POGIL Press. POGIL stands for Process Oriented Guided Inquiry Learning, a classroom technique that started in chemistry and has since spread to other fields, including mathematics.



Nataša Jonoska and **Masahico Saito** edited an anthology on *Discrete and Topological Models in Molecular Biology*, published by Springer. Articles in this book include expository chapters on discrete mathematical modeling of biological phenomena – from algebra, combinatorics, and topology – from leading scientists of the field. And with Laura Landweber in Princeton, they were awarded a National Institutes of Health grant for \$ 1,999,995, the first NIH grant awarded to the department.

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The *Second International Workshop on Nonlinear and Modern Mathematical Physics* met on USF Tampa in March had 49 invited speakers and attracted 71 participants from twelve nations. The local organizing committee included **Sherwin Kouckekian**, **Wenxiu Ma**, and **Razvan Teodorescu** as well as Roy Choudhury, David J. Kaup, and Constance Schober from the University of Central Florida. This workshop brings mathematicians and physicists together to work

on integrable system methods and soliton theory. Among the plenary speakers were **Dmitry Khavinson** of USF and David J. Kaup of UCF. This workshop was supported by the National Science Foundation, the USF Office of Research and Innovation, and the Department. The presentations will be published by the American Institute of Physics.

Manoug Manougian has made the Silver Screen. In the 2011 Quaternion, Professor Manougian wrote a Personal Reflection on his tenure at Haigazian University (in Lebanon) during the early and mid-sixties, when he advised a student organization, the Haigazian College Rocket Society. They built a sequence of rockets, the last being a nineteen-foot two-stage rocket with a range of ninety miles.

And now, Professor Manougian got top billing in a documentary, *The Lebanese Rocket Society: The Strange Tale of the Lebanese Space Race*. Produced in France and Lebanon, and directed by Khalil Joreige and Joana Hadjithomas (perhaps best known for *Je veux voir - I want to see*), it was shown at the *2012 Toronto International Film Festival*. The *Hollywood Reporter* described it as "...a blast for the viewer with an interest in strange historical facts about the Middle East. A funky, easy-access doc with socio-political-asides ..."



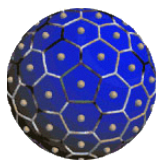
In an interview with Claire Vassé,

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Hadjithomas said that the Lebanese Rocket Society was composed of “dreamers”, and continued, “... maybe we don’t allow ourselves these kinds of dreams anymore... This is why such an adventure seems nearly inconceivable today, impossible even to imagine.” That, added Joreige, is why they did the film: “There isn’t a lot of science fiction in the Arab World, and more specifically not very much anticipation, projecting ourselves in the future ...” and he continued: “We wanted to establish that dimension of projection into the

future in the film through the animation created by Ghassan Halwani, whose work we have long admired. The animated section closes the film and imagines Lebanon in the year 2025, what it might have looked like if this space program had continued.”

Manougian received the Haigazian University Distinguished Scholar Award and the film received the Best Feature Documentary at the Doha Tribeca Film Festival in 2012. There are trailers on YouTube: search under “Lebanese Rocket Society.”



STEM Education Center

The STEM Education Center went national this year. The Center conducted the 34th summer program for gifted high school students. The four-week program was from July 8 through August 2. For the first time in its history, the program was residential. Students came from Florida and states that included Connecticut, Georgia, Maine, Massachusetts, New York, and Pennsylvania. Twenty-one students participated both in classwork and research.

The daily program started at 9:00 am and went through 4:00 pm. The courses covered included the following:

1. **Genetics**: Principles, processes, and research methodologies in Mendelian and molecular genetics. Taught by Dr. Johnny El-Rady and Valerie Carson.

2. **Bioinformatics**: A project-based course that develops skills in analyzing and interpreting biological data. Taught by Dr. Jing Wang.

3. **3D-Visualization**: Creating visualizations to reveal patterns and correlations to gain insight into various research projects. Taught by Dr. Lori Collins, Howard Kaplan, and Travis Doering.

4. **Linear Algebra**: Methodology and applications of linear algebra. Taught by Dr. Thomas Bieske.

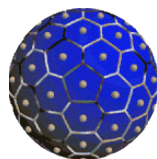
5. **Interdisciplinary Science**: Cross-cutting concepts in various fields of science. Taught by Dr. Donald Haynie.

In addition to the courses offered, students visited the Morsani College of Medicine, the Nanotechnology Research and Education Center, and the Kennedy Space Center. A trip to Clearwater Beach, the campus recreation facilities and a chess tournament were also provided.

During the commencement ceremonies students gave a brief description of the research projects they were involved in.

The program received support from the College of Arts and Sciences, the Department of Mathematics and Statistics, University College, Academy of Applied Science/Army Research Office, the Jacarlene Foundation, The Jagged Peak, and Brooks/Cole Publishing.

Manoug Manougian is the Director of the STEM Education Center, and Richard Warner is the Assistant Director.



Student News

We were proud during commencements in August 2012, December 2012, and May 2013 to send eighty students on their way.

54 students received baccalaureate degrees: Jenna Aman; Saurabh Arora, *with honors*; Caleb Beachy; Kyle Beard; Kitoxtansoma Bradley; Jason Burgess; Harold Chick; Brittany Cobb, *with honors*; Lennon Conson; Sarah Croome, *Cum laude*; Daniel Cruz, *Magna cum laude with honors*; William Deering; Jeremy Dreyer; Aaron Driscoll, *Cum laude with honors*; Zachary Forrest, *Summa cum laude*; Robert Glorioso; Robert Gougelet; Sandali Handagama, *Cum laude with honors*; James Harnage; Kimberly Hess; Derek Hoge, *Cum laude*; Daniel Inness; Cody Johnson; Ryan Kempey; Peter Kirby; John Kurkowski; Daviel Leyva; Arielle Lindemeyer, *Magna cum laude*; Jennifer Lovell, *with honors*; Paul Mayers; Gabriel Mayor; Ketner Merise; Christine Morgan; Katelin Newcomb; Jessica Norris; Travis Orcutt; Eduardo Ortiz; Eduardo Perez; Victoria Perkins; James Pham; Wyatt Radabaugh; Andrew Reilly; Jamie Sprecher, *Summa cum laude with honors*; Phyllis Taylor; Steven Valente, *with honors*; Jason Valle; Magdalena Viera-Bugari; Gurnos Watson; Brendan Weger, *Cum laude*; Donald Willard; Nathaniel Wolford; Tavier Wright; Timothy Yeatman; and Aaron Zemetres.

Thirteen students were awarded Masters' degrees: Hongyi Chen, Gaojie Gong, Yin He, Courtney Howard-Kirby, Seang-Hwane Joo, Arbin Rai, Pulahinge Hansapani Rodrigo, Eric Thompson, Ryan Thurman, Ching-Chi Yang, Tadesse Zerihun, Mengshu Zhang, and Dan Zhao.

And thirteen received Doctoral degrees: Alrazi Abdeljabbar, *Wronskian, Grammian and Pfaffian Solutions to Nonlinear Partial Differential Equations*, under Wen-Xiu Ma; Teffera Asfaw, *Topological Degree and Variational Inequality Theories for Pseudomonotone Perturbations of Maximal Monotone Operators*, under Athanassios Kartsatos; Jill Dizona, *On Algorithmic Fractional Packings of Hypergraphs*, under Brendan Nagle; Egor Dolzhenko, *Modeling State Transitions with Automata*, under Nataša Jonoska; Waththage Fernando, *A Study of Permutation Polynomials Over Finite Fields*, under Xiang-Dong Hou; Zahra Kottabi, *Statistical Modeling and Analysis of Breast and Pancreatic Cancers*, under Christos Tsokos; Jinghan Meng, *Bi-integrable and Tri-integrable Couplings and Their Hamiltonian Structures*, under Wen-Xiu Ma; Tilahun Muche, *Hamiltonian Set of Polygonal Paths in 4-valent Spatial Graphs*, under Nataša Jonoska; Arnut Paothong, *Dynamic Processes in Network Goods: Modeling, Analysis and Applications*, under Gangaram Ladde; Jean-Claude Pedjeu, *Multi-time Scales Stochastic Dynamic Processes: Modeling, Methods, Algorithms, Analysis, and Applications*, under Gangaram Ladde; Daniel Siu, *Stochastic Hybrid Dynamic Systems: Modeling, Estimation and Simulation*, under Gangaram Ladde; Joseph Van Name, *Boolean Partition Algebras*, under Vilmos Totik; and Divine Wanduku, *Stochastic Modeling of Network-Centric Epidemiological Processes*, under Gangaram Ladde.

Math Club News

Mathematical Association of America

The USF Student Chapter of the Mathematical Association of America was led this year by USF math majors Maja Milosevic (President), David Kotschessa (Vice-President), and Jamie Sprecher (Treasurer). Faculty advisors are Drs. Fernando Burgos and Mile Krajcevski. Club activities this year included:

An enthusiastic group of ten math club members attended the 2012 MAA Suncoast Regional Meeting at Florida State College in Bradenton on December 7th.

On February 22-23 a group of fifteen math club members attended the 2013 Meeting of the Florida Section of the MAA at the University of Tampa in Tampa, Florida. Jamie Sprecher, USF math club treasurer, made the presentation "Hamiltonian Polygonal Paths in Assembly Graphs".

In the fall semester, a group of five math undergraduate students - Sarah Croome, David Kotschessa, Crystal D'Orville, Alfredo Peguero, and Brandon Sweeting - participated in a USF math club project to review a chapter of a new calculus book by MacMillan/Freeman Publishers. The math club earned \$ 400.00 for their efforts.

During the spring semester, the USF math club was again invited by MacMillan/Freeman to write a chapter review of a new math book. This time the club received \$500.00 for a job well done. The student reviewers were Andres Botello, Mark Diba, David Kotschessa, Daviel Leyva, Peng Fei Liu, and Ayrton White.

Biweekly math presentations directed mainly to undergraduate students interested in mathematics were held every other Friday during the academic year. Highlights included

presentations on *Dedekind's Group Determinant* by Sarah Croome, *What is Game Theory?* by Dr. Andrei Barbosa of the USF Economics Department, and a session of *Newsworthy Mathematics* that included short presentations by club members on *Math Ability Requires Crosstalk in the Brain* by Rachael Daugherty, *Toward an Artificial Pancreas: Math Modeling and Diabetes Control* by Ayrton White, *Popular Physics Theory Running Out of Hiding Places* by Ethan Torres, and *Mathematicians Develop New Method for Describing Extremely Complicated Shapes* by Brandon Sweeting.

The "Math Problem of the Month" is a monthly student contest consisting of a math problem suitable for math undergraduates, which is posted in the math building hallways on the first day of each month during the academic year. It continued its popular run, but did not have an overall winner this year, as no individual student proved to be head and shoulders above the rest of the competition. Dr. Krajcevski is the contest maintainer.

Incoming USF Math Club leaders were elected in May. For 2013-2014 new officers will be David Kotschessa (President), Brandon Sweeting (Vice-President), Andres Botello (Treasurer), and Ayrton White (Web Master).

Pi Mu Epsilon

Our Florida Epsilon Chapter of PME, the national math honor society, had its 47th Banquet and Induction Ceremony on Friday, April 26th. The keynote speaker was Dr. Alexander R.A. Anderson, of Moffitt Cancer Center, with the presentation "Integrated Mathematical Oncology".



New PME inductees.



PME Outstanding Scholar Award recipients Jamie Sprecher (left) and Sarah Croome (right)

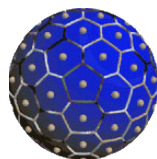
Newly inducted PME members who received membership certificates at the induction ceremony were: Wael Al-Sawai, Nana Osei Bonsu, Sandali Handagama, Toni Jung, Ram C. Kafle, Doo Young Kim, David Kotschessa, Denys Kukushkin, Shanna Lindemeyer, Elizabeth Loyer, Venkateswara Rao Mudunuru, Joel Negron, Janmarie Pena, Muditha Devamita Perera, Hoang-Chi Phan Do, Keshav Pokhrel, Darian Rivera, Jared Sango, Taysseer Sharaf, Brandon Sweeting, Juliana Teodorescu, Bhikhari Thari, and Nicholas Valdes.

The PME Outstanding Scholar Award, awarded every year to graduating USF math students that exemplify academic excellence and dedication to mathematics, this year went

to math majors Sarah Croome, and Jamie Sprecher. They each won \$250.00 Nagle Memorial Scholarship awards, and commemorative plaques.

The president and vice-president of the Florida Epsilon Chapter of PME during the academic year 2012-2013 were math majors Timothy Yeatman and Sarah Croome. The faculty advisor is Dr. Fernando Burgos, and the chapter's permanent correspondent is Dr. Milé Krajčevski.

PME members and math majors Ryan Arredondo and Tim Yeatman attended the PME national meeting in August of 2013 that took place during the MAA MathFest in Madison, Wisconsin. Ryan's presentation was *Nesting Index for Assembly Words* and Tim's was *A Pictorial Introduction to Knot Theory*.



We'd Like to Hear from YOU!

The Department of Mathematics & Statistics would like to hear from alumni, friends, collaborators, members of the community, and fellow explorers of and guides to the world of mathematics and statistics. Contact us at: 974-2643, or fax 974-2700. We have a web-page at <http://www.math.usf.edu/>. Snail-mail address is Department of Mathematics & Statistics, University of South Florida, 4202 E. Fowler Ave., CMC342, Tampa, FL 33620.

Appeal for funds

We are a growing department, and we strive to develop new programs to meet the needs and provide opportunities for our students and our community to fulfill their aspirations. With all due respect to Benjamin Franklin, many of the best things in education and scholarship cost money. We would appreciate any assistance we can get from alumni and the community. Feel free to contact our chair, Marcus McWaters, at the above address for details.