FSUmath
THE FLORIDA STATE UNIVERSITY COLLEGE OF ARTS AND SCIENCES
FALL 2010

The Making of Searchable Math

Professor Mika Seppälä and the 20-year building of MathML and OpenMath

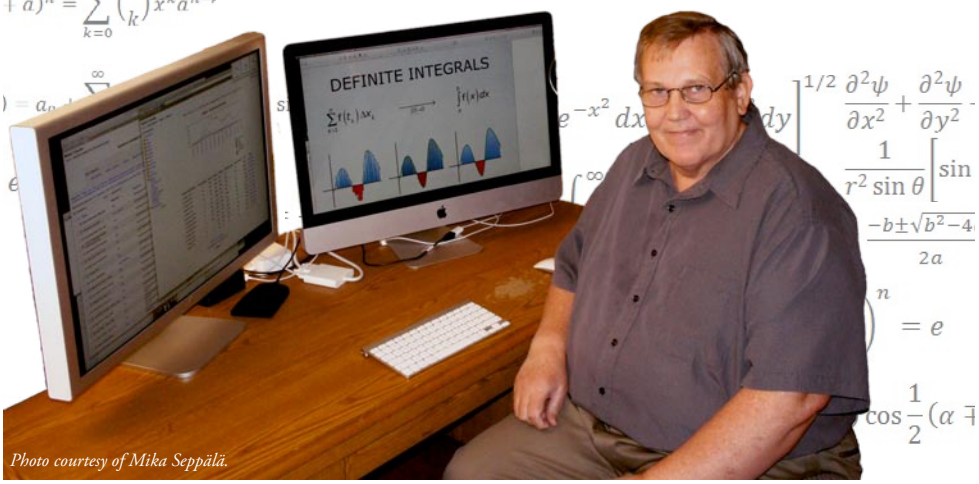

Photo courtesy of Mika Seppälä.

When FSU math students sit down to take an online quiz or type an equation into a Microsoft Word document, the process looks simple on screen. The symbols, markings, and even the concepts of math are embedded cleanly into a wide array of applications in today's computer-dominated academic culture. Those students are unlikely to be aware, however, of the complex architecture of code that enables computers to comprehend mathematical formulae and display their various forms. What they may be even less aware of is that much of the work that makes all of it possible was done by one of FSU's own.

Professor Mika Seppälä, who joined the FSU math faculty in 1995, first got involved with the push to encode mathematics for computers when he was a young assistant at the University of Helsinki in Finland. The year was 1985, and he got the opportunity to represent Finland at meetings of the then two-year-old Euromath Project. Euromath was perhaps the first attempt by mathematicians to create an encyclopedic database of mathematical facts that could be consulted by computers. Donald Knuth's recent introduction of the TEX typesetting language had solved a number of problems related to printing mathematical formulas on modern photographic typesetting technology, but Euromath wanted something more.

"Even at that time," Seppälä explains, "it was possible to generate something that, when printed, looks alright, but you would like to go a step further, you would like to be able to search a database using a mathematical formula as a keyword." The biggest obstacle to this was finding a way to avoid the confusion caused to computers by the ambiguous nature of characters in a mathe-

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In This Issue

Letter from the chair

by Philip L. Bowers

Welcome to the Fall 2010 issue of FSUMath. I think you will find this issue particularly interesting as you read about Mika Seppala's endeavor in helping to create the tools used to encode mathematics on the web. It is a fascinating look into the recent development of the mathematics markup language now in use to render mathematics on web browsers and has led directly to Mika's involvement in a large European effort to bring Calculus to the web. Also in this issue you are introduced to our newest Assistant Professor, Kathleen Petersen, or Kate as she is known around the department, and our newest Full Professor, Kyle Gallivan, who recently moved laterally from Computer Science to Mathematics.

The university continues to negotiate a very challenging budgetary environment. Last year's readers know of the 25% reduction in the state's support for the public universities in Florida since 2007 and the havoc that caused FSU. The department has navigated these waters rather unscathed over the past three years, except in hiring, and as retirements come up we may have to adjust to a department with fewer graduate faculty. Budgetary challenges are sure to remain in the near future with talk of further cuts to the universities in the 2011 budget. The department has had to pare down its overall support for graduate students by limiting to 5.5 years of support for doctoral candidates, but our hope is to weather the next few years without further cuts in support.

Even with these challenges, the department continues to improve and excel in research and graduate education, our primary missions, and in the undergraduate preparation of majors in mathematics, applied mathematics, biomathematics, actuarial science, and FSU-Teach, the new program for training secondary mathematics teachers. This has been a very successful year. We have graduated ten new PhDs with all four student specialization areas in the department represented and we continue to support a steady pipeline of PhD students with another dozen graduations expected in the next year or so. Steve Paris, coordinator of our actuarial science program, was awarded a University Teaching Award last spring and we welcomed two new promotions, Amod Agashe to Associate Professor with tenure and Mark Sussman to Full Professor. We congratulate Richard Bertram for the award of a $2.6 million NIH grant, the first NIH grant awarded to a department member. You may read of the recent trends in our undergraduate studies in an article by Steve Bellenot and in our graduate studies in one by Bettye Anne Case. I think all in all you may get a good snapshot of the health of the department from top to bottom by perusing this issue.

Introducing The Marion Bradley Brennan Professorship in Mathematics

A generous gift from Ms. M. Carol Brennan has been used to endow a named professorship in mathematics in honor of Carol's mother, Marion Bradley Brennan. The Marion Bradley Brennan Professorship in Mathematics shall be used to "support an internationally known scholar in the field of mathematics, with a proven track record in research, teaching and especially mentoring undergraduates and graduate students." A committee appointed by the Dean will be charged with selecting a holder of the award among nominations from mathematics faculty for a three year period. The department expresses here its heartfelt thanks to Carol Brennan for her generous gift and will endeavor to so honor her mother's memory by recognizing quality individuals with this named professorship.

FSUmath
The newsletter of the Department of Mathematics at Florida State University.

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Exciting Trends in Undergraduate Studies

by Steve Bellenot

What would a mathematics alum most notice about today's undergraduate mathematics? First, if you check the list of courses being offered (registration for spring semester 2011 is going on as I write) you might be surprised at the names and numbers of special topics courses. Most of them carry the number 4934, (MAA4934, MAD4934, MAP4934, MAS4934, MTG4934) and are ways for our many well-prepared undergraduates to take graduate-level courses without the course looking like a DIS on the transcript. The numbers are also used for topic courses like Advance Calculus III offered by Professor Bowers last year. (It included topics like the contraction mapping principle, the inverse function theorem and the implicit function theorem.)

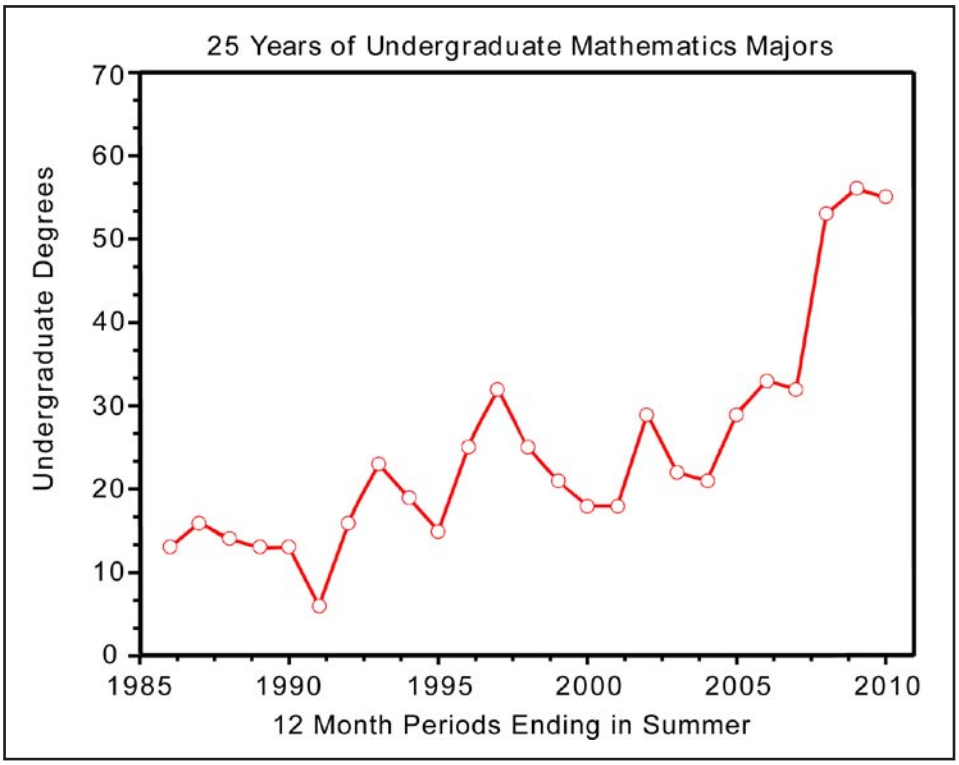
My favorite brief course title is ``Fun and Modeling',' short for Functions and Modeling, which is being developed as part of the new Mathematics major for FSU-Teach. Fun and Modeling is offered with a topics number and will be offered for the third time this spring. Its preliminary course description: "Collaborative problem-solving and lab activities focused on deepening understanding of secondary mathematics. Use of data, simple modeling; connections between secondary and college mathematics; effective use of technology; proper use of the language of mathematics."

Mathematics FSU-Teach is now the fifth undergraduate major in the mathematics department. The others are the standard (pure) Mathematics, Applied and Computational Mathematics, Actuarial Science and Biomathematics. FSU-Teach is expecting its first three graduates in Spring 2011. This fall they already make up 20% of all the undergraduate mathematical majors.

The second item you would notice looking at the list courses is the increased number of both major courses and service courses like Calculus. Calculus I for example went from 597 students in Fall 2006 to over 742 students this Fall 2010 - a 24% increase in just four years. In Fall 2005 there was one section of MAS3015 Linear Algebra, and there are three sections in Fall 2010. Many of the major courses are being offered more frequently, for example MGF3301 Introduction to Advanced Mathematics is now offered every fall, spring, and summer.

Using the registrars' database I collected some information on the number of mathematics bachelor's degrees awarded over the years which I will share with you. I've averaged the number of graduates in 5 year blocks to smooth the variation.

The first two five-year periods (Fall 1985 to Summer 1990 and Fall 1990 to Summer 1995) had an average of nearly 15 undergraduate degrees a year. This old data didn't break out the applied majors from the pure majors. Overall these are a small



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A Career in Curiosity

Assistant Professor Kate Petersen

When FSU Assistant Professor of Mathematics Kate Petersen was growing up in Philadelphia, she had no idea that a career in mathematics was in her future. Her parents, an engineer and a nurse, couldn't have predicted it either. Even when she went away to Oberlin College in Ohio for her undergraduate education, math wasn't really on her radar.

"I went to college as an undecided major," she says, "and I guess at some point I was thinking about majoring in science of some sort and I just kept taking math classes out of curiosity and I was informed that this wasn't normal behavior." That curiosity continued to grow the more Petersen immersed herself in math courses, and it wasn't long before her college friends started to notice and decided to clue her in to what was obvious to everyone else. "They did an intervention," she recalls. "[They said,] 'We hate to break it to you, but you might be a math major.'"

That diagnosis turned out to be accurate, but even after Petersen finished at Oberlin she was unsure how to proceed. She took a year off from school after graduation while she gave the possibility

of graduate school some serious thought. While that year didn't exactly illuminate her life's path right away, it did convince her that further study in math was worth a try. "I figured, you know, why not? I was curious about it. I wasn't convinced that I wanted to go the academic route, but I didn't really feel like having a proper day job."

She made her way to the University of Texas, and in doing so had to transition from the small, close-knit academic community of Oberlin to one of the largest campuses in the United States. "The math faculty [at Oberlin] was around ten people, maybe even less. Everybody knew everyone else; there were no grad students. The faculty knew every major's name. I played tennis with my faculty advisor every week." The contrast when she arrived in Austin couldn't have been starker. "I believe the freshman dorm has its own zip code," she says. "There were hundreds and hundreds of grad students, so that was a bit of a culture shock." That shock may have been an intimidating factor at first, but it taught her a few things about navigating a different kind of department. In time, she found that seeking out likeminded students within her sub-discipline was helpful, not only in providing a sense of community but in focusing her own interests.

Her arrival at Texas also spurred her on toward a new seriousness about her studies, supplanting the cavalier curiosity that brought her to grad school in the first place. The complexities of three-dimensional shapes grabbed her interest, and she found herself fascinated with topology and number theory. "In two dimensions," she explains, "you can think of a sphere, the surface of a ball, the surface of a donut, the surface of a two-hole donut – but it really doesn't get that much racier than taking a donut with lots of holes and looking at the surface… In three dimensions, it's much more complicated, and it turns out that there's a way to decompose something that's three dimensional into little pieces… and it turns out that most of these pieces are hyperbolic." That discovery led her to focus on hyperbolic geometry, an field of study that she continues to work in even today.

After Petersen finished her Ph.D. she moved to Queens University in Ontario, Canada, for a postdoctoral fellowship to continue her work on topology. The switch to the Canadian education system as well as the unfamiliar world of the postdoc were initially sources of concern

Photo courtesy of Kate Petersen.

for her, but Queens actually turned out to be more of a return to familiarity than she could have guessed. "Most of the Canadian schools are relatively smaller, you know. There are less people in Canada." The shift back to a smaller department was a positive change, and her experience with the welcoming, friendly atmosphere at Queens was a full rebuttal of her fears about the postdoc.

Her work at Queens led to a one-semester fellowship at the Fields Institute in Toronto, and then, in January 2009, Petersen was headed south once again. This time, she was on her way to her first faculty appointment as Assistant Professor of Mathematics at Florida State.

Since her arrival at FSU, Petersen has continued the work she began years ago as a graduate student at Texas. "Recently, I've been looking at these things called character varieties." That study allows her the opportunity to combine topology to her other chief interest, number theory, by trying to represent complex hyberbolic shapes with equations. The work provides her with a chance to make new discoveries about those shapes, as well as a serious challenge. "The hope is that those equations can tell you things about the original thing you started off with. The problem is that this process of going from a picture to the equations is actually hard." The payoff, fortunately, is as big as the work is difficult. When complex shapes can be broken down into x's and y's, those hard-to-conceptualize shapes begin to make more sense.

Petersen has found, in FSU's math department, a friendly and supportive community of scholars, as well as the chance to work with young students in the same position she was in back in her days at Oberlin. She can often spot students whose probing interest in math may lead them down the same path. "There are some people that are really just curious about what's going on… They don't need to understand [the subject matter] this deeply to get the right answer." That same curiosity was what led Petersen into a lifelong academic pursuit and, coincidentally, to Florida State. With her own interests well stabilized, she just hopes now that she can finally find some consistency in her climate.

"I moved from Texas to Canada, and then I moved from Canada to Florida, and I grew up in the northeast… I have a closet full of sweaters that I never use." •

New Directions in Graduate Studies

by Bettye Anne Case

If you're in a position to help our new grads get jobs, or if you know potential graduate students to suggest for our program, please let us know!

We offer a flexible and strong program in a comfortable learning environment - see www.math.fsu.edu/graduate with links.

As the Associate Chair for Graduate Studies, I can see how much of the recent improvement of our graduate program is built on the efforts of my predecessors Sam Huckaba and Eric Klassen. They brought in a large group of strong PhD students and gave attention to infrastructure; one highly visible effect of their efforts is a dramatic four-fold surge in annual earned doctorates awarded beginning '05-'06. We maintain a pipeline of advanced students to sustain the resulting research vitality. The M.S. degrees in Financial Mathematics and Biomathematics, begun during their recruiting years, continue to attract self-funded and outside fellowship students. In 2001 the PhD was added for each of those areas, joining the well regarded PhD options in Pure Mathematics and in Applied and Computational Mathematics. (For current and comparative numbers, totals and areas, and descriptions of recent innovations and advances, see www.math.fsu.edu/~bowen/numbers10.)

If you remember graduate student days before 2001, you would find many differences were you a student today! First, for the online application process, you would choose one of four study "areas." You would then meet online with the directors of those areas as well as the grad chair for answers to your questions about the areas. We'd invite you to campus for a 2-day recruiting visit where our graduate admissions coordinator would introduce you to your hosts, and you would notice more students than you remember. You would meet students from your chosen

area, eager to tell you all about it, as you visit first-year classes and eat lunch with your hosts, then attend research seminars and meet with faculty members, area directors, and myself. A large proportion of students you would see working in their offices are already writing dissertations. Since all funded students begin with the PhD goal, they typically begin research early; this causes a welcome decrease in average time-to-degree. The Year 2 and 3 students, newly through qualifiers and candidacy exams, would give you confidence that you too can succeed. Advanced students would tell you about their early opportunities for conference attendance, posters, papers, and leadership opportunities - including the student-run Graduate Student Seminar. (This activity was described in *FSUmath*, Fall 2009, p.7.)

New activities and features include:

• A second GAANN award (U.S. Department of Education) enables the department to fund several U.S. students each year who have teaching and research career intent. As Fellows, they receive instruction about teaching and they progress in responsibility of TA assignments; teaching only one semester each year allows rapid research progress.

• M.S. degrees in Financial Mathematics and Biomathematics were designated "PSM" (Professional Science Master's) by the Council of Graduate Schools. They each have specialized seminars from the first semester, and hence students who continue for the PhD have early opportunity to match with a Major Professor.

• The Introduction to Research seminar, dormant for a number of years, was revived for Pure and ACM students. In the second semester of Year 1, they hear short research talks by professors, with invitations for further office discussion - and potentially a match.

• Nine strong Year 2 students became doctoral candidates early in Spring 2010 - five to ten months ahead of the usual pace. One student wrote of the experience, "early candidacy will ease the pressure of the crucial transition from student to researcher,... it increases your chancs of graduation within the five year time period... [and it's] fun."

The four student study areas are each a blend of modern and traditional topics. The new PhD student joins the people and culture of their chosen area and while taking basic courses - some with students from other areas - they also begin to think about background for research related to their future career intents. No one course is taken by every student, and each area has somewhat different customs for declaring doctoral candidacy.

Several faculty members direct dissertations of multiple students whose study/qualifiers were in different areas. One faculty member who directs a large number of doctoral students from two different areas runs a research seminar where all his students share ideas.

When prospective students consider us for their graduate home, we want to answer all their questions to be certain that our program is a good match for their interests and talents. We will appreciate suggestions about how we can do that better. •

Incoming and outgoing leaders of the Graduate Student Seminar. Clockwise from top left: Jonathan Bates, James Custer, Jay Stryker, Matthew Willyard, Kyle Armstrong, Candace Ohm, and Arij Daou.

A Life on the Leading Edge


Professor Kyle Gallivan

When Professor Kyle Gallivan finally landed in FSU's math department in 2008, he felt right away that he had ended up in the right place. After more than a decade at Florida State working in computer science, he had a choice to make, a luxury he's grateful for as he looks back. "I took a look and said, 'maybe the math department is the right place,' and I was very, very lucky that the department agreed. I'm very happy that that happened."

Gallivan seems to have a knack for winding up in the right place at the right time. His professional journey has taken him in a number of different directions, but in nearly every case, those turns have landed him at the leading edge of his field.

Gallivan grew up in the Chicago ar ea, not far from some of the places where the beginnings of what is now known as computer science were just starting to take shape. That geographical coincidence may have ended up having a big impact on his career, because he doesn't recall having a natural predilection toward computers as a child. Of course, in the seventies, opportunities for young people to get hooked on computers were rare. "My high school had the old teletype connection to the university I ended up going to," he recalls. "I remember doing Fortran and BASIC programming on that thing when we could… but I wasn't particularly interested in mathematics as it related to computer science."

That teletype connection was to Lewis University, a small college just outside Chicago, where Gallivan went for his undergraduate degree. Lewis was located near Argonne National Laboratory, and Gallivan found himself working there as a student research associate in the Reactor Analysis and Safety Division. That placement was arbitrary, but the work that came with it caught Gallivan's interest. "I didn't do any of the hardware," he explains, "what I did was I helped implement and then run and maintain the numerical simulation… obviously I wasn't responsible for the modeling, but it was my first exposure to this nice mix of experiment, simulation, and significant engineering analysis."

His work had to do, specifically, with running simulations to learn more about the effects of changes in coolant conditions with nuclear reactors. It was important work, but not something that was getting a great deal of attention at the time. Not long after, however, the Three Mile Island disaster occurred. Gallivan himself was still a young undergrad, and his time at Argonne happened before the disaster, but he remembers the excitement of being involved with research that ends up being of vital, practical importance. "All of a sudden, everybody was talking about loss-of-coolant accidents." Many of his coworkers, in fact, went on to work on reactors. Gallivan decided to go to grad school in computer science.

He wound up at the University of Illinois at Urbana-Champaign and found teachers that would help shape the rest of his career. "There was a magnificent group of professors at that time there, pioneers of computer science across the board – hardware, architecture, software." Among those faculty members, he found in Professor Bill Gear a mentor who taught him the importance of understanding the bigger picture. "He reinforced even further the need to do theory, to produce reliable software based on your algorithms, and use the theory and the software together to understand how things work."

After graduating with his Ph.D. in 1983 Gallivan did a short stint in the public sector, but found his way back to UIUC within a couple of years. He was drawn back by his friend Ahmed Sameh, who had been on his Ph.D. committee, to work at the Center for Supercomputing Research and Development (CSRD). Researchers there were

working on what was called the CEDAR System, an experimental supercomputer.

"It was a unique place in the history of computer science and computation. We actually did true multidisciplinary work," he recalls. It was exactly the sort of work Bill Gear had emphasized when Gallivan was a graduate student. There were people at CSRD working on all aspects of the project, from the theory and planning to the building and testing, and while people specialized in one area or another, everyone participated to some degree in every phase.

That kind of integrated cooperation is a rarity these days, when different aspects of computing research are done by independent groups, and Gallivan misses the advantages of working with people who have a broad understanding of what they're working on. "It was beautiful, absolutely beautiful. I don't think such a place has existed since then." He gives a lot of the credit to Professor Sameh, who was his supervisor at CSRD and is still a close friend, for the unique environment.

Perhaps the greatest testament to the quality of the work he was involved in at CSRD is the fact that many of the modern technological devices that have revolutionized the world can be traced back to projects developed at UIUC and other sites doing similar work 20 to 30 years ago. The advances they made ranged from large, high performance systems down to highly efficient devices for digital signal processing and communications. "Those are the precursors of cell phones," he says. "I mean, the digital revolution occurred at that time."

CSRD eventually closed as the university changed its focus, and Gallivan moved into the Department of Electrical and Computer Engineering. At that time, the earliest university computer science programs were beginning to form in scattered places around the country. One of those universities was Florida State, where Professor M. Y. Hussaini had founded the university's Computational Science and Engineering program (the precursor of today's Department of Computer Science). In 1997, Gallivan took an appointment at FSU, largely because of Hussaini's involvement.

He brought with him work he'd begun while at Illinois on model reduction. Model reduction involves finding ways to write new, smaller systems of differential equations to approximate larger ones, thus reducing the time to solve them. Over the years he managed, collaborating with Professor Paul Van Dooren and graduate students, to develop some techniques for reducing certain differential equations that are now widely used in the field.

Over 13 years at FSU, the focus of his work has shifted some, but, whatever the project, he's always found just the collaborators he's needed. Over his career as a teacher at FSU and UIUC, he's found several exceptionally bright master's and doctoral students who have been invaluable to his work. "You tend to learn more from the good students than you teach them, ultimately." Several of his students, including undergraduates, have gone on to earn doctoral degrees and start making their own contributions to the field.

By 2008, when Gallivan made his move from computer science over to the Department of Mathematics, he had already accumulated plenty of experience with the culture of FSU and found it a great place to continue his work. That move, however, turned out to be yet another good one, and he's found among his new colleagues a supportive academic community. "It's a very welcoming department. I was very happy that they said 'sure, come on.'" In exchange for that supportive community, he fills an important niche for the department, teaching courses in the foundations of computational math and other subjects as needed. Teaching is not only work, but something he finds enjoyment in.

Photo courtesty of Argonne National Laboratory.

Argonne National Laboratory in Argonne, Illinois, where Gallivan first participated in large-scale interdisciplinary work on computer systems.

Gallivan and his family – he's married and has two daughters now in their twenties – have also found in Tallahassee a pleasant place to call home, despite the downsides of being transplanted from Illinois. He was once an avid hockey player, but the Florida culture has put a damper on his athletic pursuits. "They used to have the minor league hockey team, so they would freeze the civic center. That's gone by the wayside, and I'm not going to skate on synthetic ice. That shouldn't be allowed."

Fortunately, between teaching the future minds of computational math and paving the way for new advances himself, he's got plenty to keep him occupied. •

Lead photo courtesy of Kyle Gallivan.

Actuarial Science On the Move

Faculty, students, and guests gather at last year's actuarial science picnic.
Photo courtesy of Actuarial Science program.

by Steve Paris

The actuarial science program had another successful year last year. We now have well over 100 undergraduate students majoring in actuarial science, and there were approximately 25 graduates of the program last year.

The exam preparation seminars taught by Dr. Paris for Actuarial Exams P/1, FM/2, and MLC continue to be popular. FSU students passed a total of 35 actuarial exams last year, with many students passing more than one exam. We even had one student pass all three of the above exams last year. (Wow!) Over half of the graduates of the program last year passed at least one actuarial exam before graduation. By the way, these exams are expensive for the students, with the exam fee for Exams P/1 and FM/2 now up to $200 each and the exam fee for Exam MLC being $240.

The actuarial science program is very

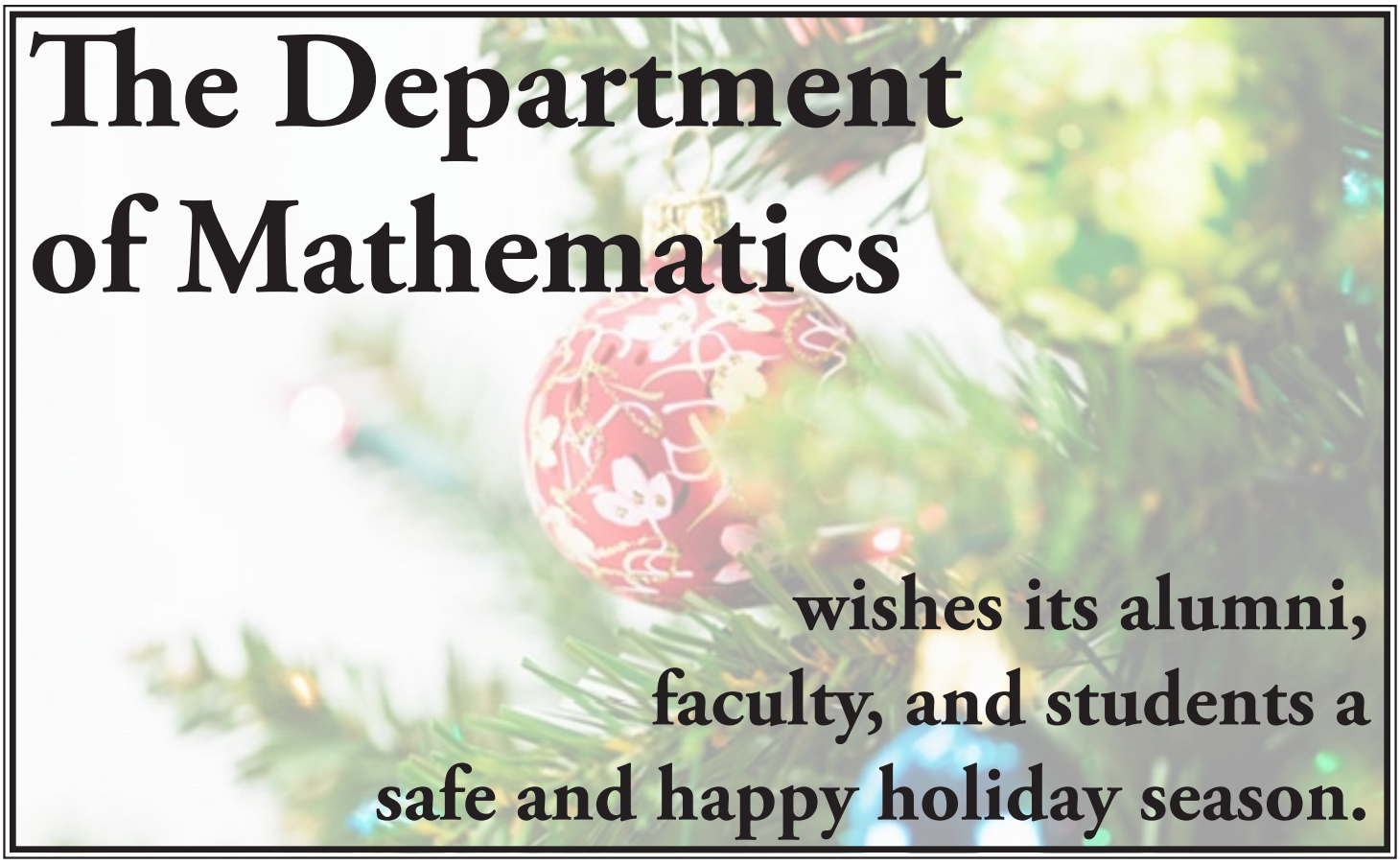
grateful for the continued alumni and corporate support during the past academic year. Many alumni donated their time and money to the program. Thank you! The Florida State Student Actuarial Society, our undergraduate actuarial science club, hosted ten actuarial companies during Fall 2009 term who came to campus to give presentations to and recruit our students. Approximately a dozen of our undergraduate students worked as summer actuarial interns, spanning all the different practice areas of actuarial science. These are great opportunities for the students, as well as a chance to make very good summer income. The majority of these internships resulted in full time job offers to the students upon graduation.

Our corporate support was not isolated to just employment opportunities for students. Towers Perrin presented us with a check for $2500 and D.W. Simpson and Company again sponsored a $1000 Actuarial Science Program Scholarship. Watson Wyatt again sponsored our annual fall tailgating party before the FSU – Georgia Tech football game. The outcome of the game was not what we wanted, but the party was a blast and it was great catching up with the alumni that were there. Also, this was parents' weekend and it was nice to meet many of the parents of current students. Now we know where our students get their good looks!

The actuarial science program is continuing to thrive, however we do need your help. Our goal is to implement an exam fee reimbursement plan whereby students who pass an exam are reimbursed 100% of their exam registration fee. Using all of the Towers Perrin and D.W. Simpson donations, together with faculty and alumni donations, we were only able to reimburse successful exam candidate 75% of exam registration fee this year. Please consider giving to this worthy cause; 100% of your donation will be used for exam fee reimbursements. If you would like to donate, please make out your check to FSU Mathematics Foundation and send to:

Dr. Steve Paris
FSU Mathematics Department
1017 Academic Way, Room 208
Tallahassee, FL 32306-4510

The actuarial science program belongs to you, the alumni. We believe we are continuing to move in the right direction to make the FSU Actuarial Science Program one of the best in the country, and we hope that the program is one that you are proud of. If you have any comments or suggestions, please do not hesitate in contacting Dr. Paris at paris@math.fsu.edu. GO NOLES!! •



Recent Ph.D. Graduates

Fall 2009 - Summer 2010

Fall 2009

Edwin N. Jimenez
Applied and Computational Mathematics
Uncertainty Quantification of Nonlinear Stochastic Phenomena
Major Professor: M.Y. Hussaini

Deborah Striegel
Biomathematics
Modelling the Folding Pattern of the Cerebral Cortex
Major Professor: Monica K. Hurdal

Juan Gutierrez
Biomathematics
Mathematical Analysis of the Use of Trojan Sex Chromosomes as means of eridaction of invasive sepcies
Major Professor: Monica K. Hurdal

Spring 2010

Yong Jung
Biomathematics
A computational study of ion conductance in the KcsA K+ channel using a Nernst–Planck model with explicit resident ions
Major Professor: Philip L. Bowers / Michael Mascagni

Giles Levy
Mathematics
Transformations of Recurrence Equations
Major Professor: Mark van Hoeij

Summer 2010

Ji (David) Shen
Applied and Computational Mathematics
No-reference Natural Image/Video Quality Assessment of Noisy, blurry, or Compressed Images/Videos Based on Hybrid Curvelet, Wavelet and Cosine Transforms
Major Professors: Gordon Erlebacher (DSC) and Steve Bellenot (Mathematics)

Xinyang Liu
Biomathematics
Shape Spaces, Metrics and Their Applications to Brain Anatomy
Major Professor: Washington Mio

Dervis Bayazit
Financial Mathematics
Malliavin calculus and its applications to finance
Major Professor: Craig Nolder

Ahmet Tatar
Mathematics
Picard 2-Stacks and length 3 complexes of abelian sheaves
Major Professor: Ettore Aldrovandi

Svetlana Simakhina
Applied & Computational Mathematics
LS and CLS on dynamic quadrilateral grid
Major Professor: Mark Sussman

Student Awards, Publications, and Presentations

Graduate student **Yaohong Wang** presented research at the Society for Industrial and Applied Mathematics (SIAM) annual meeting in July 2010 and the American Physical Society (APS) meeting in November 2009.

At the SIAM Conference On Parallel Processing For Scientific Computing in February 2010, recent Ph.D. graduate **Svetlana Simakhina** presented research titled "Interface Tracking on Dynamic Quadrilateral and Rectilinear Grids" and grad student **Austen Duffy** presented "A GPU Accelerated Block PCG Pressure Projection Solver on Dynamic Adaptive Grids."

Instructor **Deborah Striegel** and Associate Professor **Monica Hurdal** published "Chemically based mathematical model for development of cerebral cortical folding patterns" in PLoS Computational Biology, 5(9): e1000524, 2009. doi:10.1371/journal.pcbi.1000524

Deborah Striegel presented "Evolutionary Development of Cerebral Cortical Folding Patterns" at the Gordon Research Conference on Oscillations & Dynamic Instabilities in Chemical Systems, July 4-9, 2010, in Lucca, Italy

Recent graduate **Xinyang Liu**, Xiuwen Liu, Y. Shi, P. Thompson, and Professor **Washington Mio** presented "A Model of Volumetric Shape for the Analysis of Longitudinal Alzheimer's Disease Data" at the European Conference on Computer Vision (ECCV), Heraklion, Greece, 2010.

Grad student **Yu Fan**, D. Houle, and Professor **Washington Mio** presented "Learning Metrics for Shape Classification and Discrimination" at the International Conference on Pattern Recognition (ICPR), Istanbul, Turkey, 2010.

Grad student **Jonathan Bates**, **Xinyang Liu**, and **Washington Mio** presented "Scale-Space Spectral Representation of Shape" at the International Conference on Pattern Recognition (ICPR), Istanbul, Turkey, 2010.

Xinyang Liu won a travel award to attend the 2010 European Conference on Computer Vision, Heraklion, Greece.

Grad student **Celestine Woodruff** presented a poster titled "Calibrating the exchange coefficient in the coupled continuum pipe flow model for flows in karst aquifers" at the International Conference on Advances in Partial Differential Equations and Their Applications at Fudan University, Shanghai, China, May 31- June 4, 2010. Her trip was funded by the National Science Foundation.

Grad student **Yang Liu** and Professor **Alec Kercheval** coauthored the paper "Risk Forecasting with GARCH, Skewed t Distributions, and Multiple Timescales", to appear in the *Handbook of Modeling High-Frequency Data* in Finance, Wiley.

Ahmet Tatar's paper "Length 3 complexes of abelian sheaves and picard 2-stacks" was accepted by *Advances in Mathematics* for the January 2011 issue. The paper can be viewed online at: http://dx.doi.org/10.1016/j.aim.2010.06.012.

Yanyan He presented "Uncertainty Quantification in Flight Plan Horizontal Path Using Evidence Theory," co-authored with Svetlana Poroseva, Professor **Yousuff Hussaini**, and Reda Mankbadi, at the Florida Center for Advanced Aero-Propulsion annual symposium, August 9-10, 2010, Tallahassee, FL

Recent graduate **Giles Levy** and grad students **Yongjae Cha**, and **Quan Yuan**, each published a paper and gave a talk at the ISSAC'2010 conference. The title of Cha and Levy's paper was "Solving Linear Recurrence Equations." Yuan's was "Finding all Bessel Type Solutions for Linear Differential Equations with Rational Function Coefficients."

matical formula. If someone is searching for the integral ∫e^(-x^2) dx, for example, but the particular document he is searching uses instead ∫e^(-t^2) dt, the search will come up empty. This kind of problem may seem simple, but Seppälä points out that, in the computer age, such minor differences can be very significant.

"Clearly these objects have the same mathematical meaning, but they look different because here we have t, here we have x, so that kind of ambiguity renders this database useless unless one can search using as a search criteria the meaning of this expression rather than the expression as a string."

FSU calculus students use online learning tools developed by Seppälä via text messaging.
Photo courtesy of Mika Seppälä

That approach to search was unheard of at the time, when virtually every kind of computer search that existed relied exclusively on character strings. Seppälä was enthusiastic about his involvement, not only because he believed in the need for the database but because of the opportunities working with Euromath provided him. He was able to work alongside some of the world's most prominent mathematicians, including Fields Medalist Sir Michael Atiyah, who spearheaded the project.

Seppälä was only 34 at the time, and still remembers the feeling of working among the giants of his field at such a young age. Most of his collaborators at Euromath were in their sixties, with careers-worth of experience already under their belts. Nevertheless, he jumped at the opportunity, confident in his abilities, and now can look back on that time with a sense of humor. "I did not understand all the fine things they were speaking about,… after all these years, now I know that they didn't understand either!"

Despite the formidable minds working with Euromath, efforts eventually stalled. Though Seppälä recalls something like 100 different people working on the project over roughly a decade, they never managed to gain much traction. By the mid-nineties, work had pretty much ceased. Seppälä's passion for the project lived on, however, and he started searching for a way to take the work over on his own. In 1993, he went to the European Union with a proposal for a research and development project entitled "Editing and Computing." He hoped, if the EU would fund his proposal, to finally make the dream of a searchable database of mathematical facts a reality.

The odds were against him, but somehow he managed to convince the European Commission, the EU's executive body, that the work was worth the investment. "I was extremely lucky," he recalls. "I was still very young and I got several projects funded… It was very difficult to get those funds." He can only assume that it was his dedication that convinced them. "I was committed to it. I wanted to do it and I thought 'this is important,' and I put in every effort that I could in order to make that succeed."

From 1993, when work began, until 2005, Seppälä shepherded the work along as people from different disciplines and different continents were brought together to create the protocols now known as MathML and OpenMath. Seppälä brought mathematicians together with computer scientists, an arrangement that, over the last decade and a half, he has become accustomed to. When he joined the FSU faculty in 1995, he found among the computer science faculty collaborators who could help him finish the great task he'd set himself to, especially Ladislav Kohout, then a professor in FSU's Department of Computer Science.

Eventually, his persistence paid off. MathML and OpenMath are widely available today and used in all manner of computer applications, from web browsers to word processors. Thinking back to his initial pitch to the EU, Seppälä can see just how far the project was able to come. "[This was] about 17 years ago. And today, Microsoft Word supports it. So we have now achieved it. Now it's done."

Still, the completion of one project tends to lead only to the beginning of yet another, and Seppälä's work at FSU is a testament to his endless desire to keep pushing forward with new ideas. His classes are now heavily web-based. His students can access an impressive amount of information online – from quizzes and discussion boards to videos of his lectures. "Of course," he points out, "[the protocol] is somewhere in the

background, so nobody sees it, just the end result… the end user just sees the nice font." Still, the fact that all of the online tools he uses today depend on the protocol he spent 20 years developing is a source of pride for him, even as MathML and OpenMath have become hidden within the workings software applications. "I feel a very strong ownership to the whole thing. In a way, I have been in the development from the start."

Math pedagogy has become an interest for Seppälä now, and as he continues teaching undergraduates at FSU as well as at The University of Helsinki, he is learning ways to use the web to track the performance of students, pinpoint their weaknesses, and help them improve. Their performance isn't the only thing under scrutiny, however, as he is equally eager to keep an eye on his own teaching through the web. "It can be used to find students who are in danger of failing, but it can also be used to find places where the instructor is not doing a good job. If almost everybody fails a certain kind of quiz problem, then it may be the instructor's fault, and maybe the fault of the materials, and that can be improved."

Improvement is a theme that comes up again and again when Seppälä talks about his projects. He is constantly searching out ways to fix what others would rather leave alone, to fill in the gaps left by those who would just continue on with business as usual. He can envision a day in the future where his class might feasibly be completely automated. "There are some people who feel that I am working to make myself obsolete," he says, an idea that makes him chuckle but doesn't give him any hesitation about moving forward with his work. Endings tend to open new beginnings for Seppälä, so there's never the fear of having nothing more to do.

He grins when he thinks about that prospect. "When I have all the lectures recorded and all the quizzes done in a perfect state so I don't need to go to class and teach anymore, the others may ask what I will do when I have made myself obsolete, and then I will tell them, 'I start making you obsolete!'" •

'Undergraduate Trends'

continued from page 3

percentage of all university undergraduate degrees. Mathematics' overall percentage of degrees fell from 0.34% to 0.30% since the number of university degrees grew faster than mathematics degrees. The data after 1995 also includes which mathematics major the graduate completed. The Actuarial science program started producing graduates during the Fall 1995 to Summer 2000 period: 27 students or 22% of the mathematics majors. This five year period and the next running from Fall 2000 to Summer 2005, the department had an average of about 24 graduates a year. The percentage of undergraduate degrees in mathematics increased to 0.46% and then decreased back to 0.40%. Biomathematics (formally Biomedical Mathematics) had its first two graduates in 2004 and 2005. From Fall 2005 to Summer 2010, the most recent five year period, Biomathematics produced 37 undergraduate degrees, which was 16% of 229 mathematical degrees. The average number of mathematics undergraduate degrees is now 46 per year, three times the number 15 years ago. The math major percentage of all university undergraduate degrees is now at 0.68%. (The university increase was only 25% during these 15 years.) Over the last five years, 41% of the math graduates majored in Actuarial Science, 25% in the standard (pure) track, 19% in the Applied and Computational Mathematics major and 16% in the Biomathematics major. (Will Mathematics FSU-Teach increase the number of math undergraduate degrees to 1.00% of the total degrees given by the university?)

Finally I would like to point out a couple of measures that indicate that the quality of the students at Florida State University is increasing along with the quantity. Earlier, I mentioned a 24% growth in Calculus I enrollment from Fall 2006 to Fall 2010. During the same period the enrollment in MAC1105 College Algebra fell by over 10% and the enrollment in MAC1140 Precalculus held steady. This is a noticeable shift in how the new students are better prepared mathematically. Secondly, look at the number of degrees with honors in a mathematics major. There have been nine in the last fifteen years, and six of them graduated in the last five years. In the last five years, Biomathematics has the largest percentage of honors in the majors graduates with 8%, the standard (pure) math track was second with 5%. •

2010

Florida State University
Mathematics Prize Problem

Let P be a polygon. Assume that all its vertices have integer coordinates. Also assume that its perimeter is an integer. Show that the perimeter must be even. Bonus question: If we allow the vertices to have rational number coordinates, and still require the perimeter to be an integer, must the perimeter still be even?

Deadline for entries is MARCH 15, 2011. Send entries to Prof. Mark Van Hoeij, hoeij@math.fsu.edu.

Winner receives a prize of $100.

ELIGIBILITY: Entries are limited to FSU students and alumni, excluding mathematics faculty. The prize goes to the best undergraduate solution; if none, then to the best graduate solution; if none, then to the best alumni solution.

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Tallahassee, Florida 32306-2739 Questions may be directed to Dr. Bowers by phone (850.645.3338) or email (bowers@math.fsu.edu). Help us support the students who hope to follow in your footsteps.

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