

Tangents

Fall 2013

News from the Department of Mathematical Sciences
University of Massachusetts Lowell

Ken's Chronicles

From the Chair

I hadn't expected to be writing this column up until last May, but here I am serving as chair of Mathematical Sciences again after a 14 year break. I had been chair for nine years, roughly coinciding with the Clinton administration.

There are several news items to report, but first I'd like to reflect on what's changed in 14 years.



Ken Levasseur

- The last time I was chair we were housed in Olsen; now we're in Olney. With new buildings starting to pop up on campus, several departments, including us, could be moving again in the coming years.
- Since my first "retirement" as chair, we've seen the retirements of Professors Yin, Makovoz, Weinberg, Spiegel, Mueller, Winslow, Berkovits, Ruskai, and Samarov. We currently have seven tenured faculty and seven Instructors who have joined us since then.
- When I left the chair's position in the 20th century, we offered a two semester version of Calculus I, Calculus IA and Calculus IB. After trying "Preparation for Calculus" for a few years, we now have a new two semester version of Calculus I. Same name, but different catalog numbers. Everything is cyclic.
- Scholarships: Toward the end of my first run as chair, Russ and Mary Bedell's generosity had just brought us our first endowed scholarship. As you can see below, we've been fortunate to have two more endowed scholarships started since then and hope to be able to announce more in the future.
- Finally, Tangents didn't exist in 1999—the first issue was in 2002. So now I will move to the present.

One of the main reasons why I agreed to take on the chair's position is that Kiwi has agreed to help me out as associate chair. In addition, I'm getting lots of help from other members of the faculty and, of course, Cori Lee, our Administrative Assistant. I thank all of them for helping make my return reasonably smooth.

It's helped that I've been able to divest some of the things I was doing. Steve Pennell has started his "chair's retirement" by taking over as coordinator of the Industrial Math PSM program. Also, I had been editing *Tangents* since 2002 and I'm glad to announce that Jim Propp has agreed to take over as editor.

Tibor Beke has returned to us after a year on sabbatical traveling through Europe and the States in 2012-13 and Ravi Montenegro has left us for a 2013-14 sabbatical to collaborate with researchers in Japan and New Zealand.

Math majors Olivia Demers and Mary Mersereau had been working with Shelley Rasmussen in doing research on the mathematics of weaving. They recently shared their enthusiasm for the subject with some children at a local summer camp.

In the past year, Industrial Mathematics PSM Students Isaac Duodu (Putnam Investments) and Lauren Edwards (Genscape) completed internships that gave them valuable experience to further their careers. Undergraduates Gifty Bado and Tyler Gilzinger spent their summers as co-op students at Putnam Investments. After completing a co-op position at Mercury Computer, recent B.S. graduate Owen Welch accepted a full-time position at Mercury. Krithika Manohar, who graduated last May, is in her first semester of the Applied Math doctoral program at the University of Washington.

Last May, we held our annual Awards Ceremony and Alumni Reception where we presented the following awards:

- Outstanding Graduate Student: Nour Almansour
- Shapiro Scholarship: Chris Leger
- Bedell Scholarship: Tyler Gilzinger
- Zamanakos Scholarships: David Campbell, Mary Mersereau and Kevin Southwick
- Hall Prize: Kevin Cerritelli

The 2014 awards ceremony will be held at the UML Inn and Conference Center on April 25 from 5:30 to 7:30. Alumni are always welcome to attend. It's a great setting. If you haven't had a chance to check out the Inn and Conference Center since the 2010 renovations, here's your chance!

UMass Lowell Mathematical Sciences Online

Have you visited the Mathematical Sciences web page lately? Our address is <http://faculty.uml.edu/math>

Have you missed any past issues of *Tangents*? Go to <http://faculty.uml.edu/math> and click on "Alumni/*Tangents*" at the left, to see issues going as far back as 2002.

You can follow us on Twitter: <http://twitter.com/UMassLowellMath>.

Faculty Update

Tibor Beke writes:

My sabbatical year took me to distant territories, both geographically and mathematically. I spent several months in Budapest, my hometown; in Brno, in the Czech Republic; and in Berlin. (I also lived in Barcelona as a postdoc, and of course in Boston for several years. But honestly, all the alliteration is just a coincidence.)



Tibor Beke

In Brno, my host Prof. Rosicky and I discovered a new proof and extension of a beautiful old result that lies on the borderline of set theory and infinitary combinatorics. It was discovered by the set theorist Saharon Shelah who first reported it in the International Congress of Mathematicians in 1974. The margin, unfortunately, is too small to explain the nature of this result or its proof. It has to do with paradoxical decompositions of infinitely large universal algebras. We hope to have it in print fairly soon.

In Budapest, among other things, I gave a talk in the Budapest Semesters for Mathematics, an intensive, year-long mathematics program for talented undergraduates, mostly from the US. Slides of this talk, on the Brouwer Fixed Point Theorem and one of its discrete analogues, are posted on my home page <http://faculty.uml.edu/tbeke/>.

My stay in Berlin gave me a chance to visit some friends, mathematical and otherwise, and also to travel to my ex-postdoctoral sponsor, Prof. Moerdijk in Nijmegen, the Netherlands, where I gave a talk on my recent results on the Burnside semirings of various geometric categories. It was a pleasant and fruitful year—considerable parts of which I spent traveling on trains, thinking about theorems!

Under the leadership of **Dimitris Christodoulou**, the department's Applied Math Brown Bag Seminar has entered its third year. This weekly seminar is offered by the Department of Mathematical Sciences around lunch time. Participants are encouraged to bring their lunch with them. In Spring and Fall of 2012, the area of concentration was Catastrophe Theory. In Spring and Fall of 2013, the theme was Linear Second Order Ordinary Differential Equations and their Physics Applications. Active areas of study and investigation in the future will include Famous Differential



Dimitris Christodoulou

Equations of Mathematical Physics, Nonlinear ODEs of Second Order, Numerical Magnetohydrodynamics, and (once again) Catastrophe Theory. Both undergraduate and graduate students are encouraged to participate. A number of Senior Projects and Research Theses will be offshoots of the work done in this Seminar. The webpage for the seminar is http://faculty.uml.edu/Dimitris_Christodoulou/BB_Seminar/Brown_Bag_Seminar.html.

For more information, contact Dimitris Christodoulou at dimitris_christodoulou@uml.edu.

Dimitris Christodoulou and Silas Laycock from the Physics Department received a 3-year NASA grant to do a statistical study of data on pulsars in the Magellanic Clouds. More details will appear in a future issue of *Tangents*.

Prof. **Enrique González-Velasco**'s book "Journey through Mathematics: Creative Episodes in its History" was given the "outstanding title" rating in March 2012 by *Choice* magazine: "This detailed, carefully written volume is a selective history of mathematics, up to what might be considered the 'early modern period' (i.e., through roughly 1850), with emphasis on 17th- and 18th-century advances."

Professor **Lee Jones** (Mathematical Sciences), in collaboration with Professor Valeri Barsegov (Chemistry) and graduate student **Olga Kononova** (in Chemistry and Mathematical Sciences), is developing reliable statistical approaches for interpretation of force spectroscopy data. A new mathematical inverse problem approach, using new properties of order statistics to characterize protein-protein interactions in multidomain proteins, has been published by the researchers as an invited paper in the *Journal of Chemical Physics*. The title of their paper is *Order statistics inference for describing topological coupling and mechanical symmetry breaking in multidomain proteins* (*J. Chem. Phys.* **139**, 121913 (2013); <http://dx.doi.org/10.1063/1.4816104>).

Emeritus professor **Gerald Kaiser** (<http://wavelets.com>) is now Editor in Chief for the Birkhäuser Progress in Mathematical Physics Book Series, <http://www.springer.com/series/4813>.

Alexander Kheifets is a coauthor of two new papers:

- J. Ball, A. Kheifets, The inverse commutant lifting problem. II: Hellinger functional-model spaces, *Complex Analysis and Operator Theory* **7** (2013) no. 4, 873–907.
- S. Boiko, V. Dubovoy, A. Kheifets, Defect functions of holomorphic contractive operator-functions and the scattering sub-operator through the internal channels of a system. II, *Complex Analysis and Operator Theory*, DOI 10.1007/s11785-013-0330-6, Published online: 06 November 2013, 46 pp.

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The Tangents Problem

The Fall 2013 Problem #1 (submitted by James Propp):

A disk (of unspecified radius) covers two distinct points (a,b) , (c,d) where a , b , c , and d are integers such that $a+b$ and $c+d$ are even. Show that the disk must also cover a point (e,f) where e and f are integers such that $e+f$ is odd.

The Fall 2013 Problem #2 (submitted by James Propp):
See below.

Up to four correct solutions to either problem from among all that are submitted by June 1, 2014 will earn the solver a "UML Math" T-shirt. (If you win but don't receive the shirt, please contact us; we may have misplaced your address!) You may email your solution to mathematics@uml.edu or mail it to James Propp, Department of Mathematical Sciences, North Campus/Olney Hall, UMass Lowell, Lowell MA 01854. Please include your degree and year.

The Spring 2012 Problems:

1. Suppose that every 12 hours you take a 200-milligram dose of antibiotic, which has a half-life of 24 hours. Find the amount of drug in your blood after the n th dose. Describe the steady state level of the drug immediately after doses.

Correct solutions were submitted by **Robert C. Cournoyer** (M.S. Teacher Option, 1976), **Noreen Flanagan Johnson** (B.S. 2003), and **Brent Hager** (M.S. Teacher Option, 2011). Here is a composite solution:

The amount of drug in the system after n doses is the sum of $200 \times (1/2)^{(n-1)/2}$ as i goes from 1 to n . The steady-state level of the bloodstream immediately after doses are administered is found by taking the limit as n goes to infinity. This is a geometric series $a+ar+ar^2+\dots$ with $a = 200$ and $r = \sqrt{2}/2$. By the formula for the sum of an infinite geometric series the steady state level is $a/(1-r)$ or about 683 mg.

2. Consider a rectangular array of integers with 10 rows and 5 columns, like the one below, in which the entries in the top row are distinct integers between 0 and 9 inclusive, and each entry below the top row is equal to 1 more than the entry immediately above it, modulo 10. For $1 \leq i \leq 10$, let m_i be the median of the numbers in the i th row. Show that the sum of the medians m_1, \dots, m_{10} is 45.

No solutions were received, so a hint is offered, and the problem is reissued as Fall 2013 Problem #2. Here is the hint: Record the numbers in a modified table, sorting the numbers in each row, as shown below.

$i = 1$	2 9 7 5 1	\rightarrow	1 2 5 7 9
$i = 2$	3 0 8 6 2	\rightarrow	0 2 3 6 8
$i = 3$	4 1 9 7 3	\rightarrow	1 3 4 7 9
$i = 4$	5 2 0 8 4	\rightarrow	0 2 4 5 8
$i = 5$	6 3 1 9 5	\rightarrow	1 3 5 6 9
$i = 6$	7 4 2 0 6	\rightarrow	0 2 4 6 7
$i = 7$	8 5 3 1 7	\rightarrow	1 3 5 7 8
$i = 8$	9 6 4 2 8	\rightarrow	2 4 6 8 9
$i = 9$	0 7 5 3 9	\rightarrow	0 3 5 7 9
$i = 10$	1 8 6 4 0	\rightarrow	0 1 4 6 8

Show that for all k between 0 and 9, the number of occurrences of k in the 1st column equals the number of occurrences of $9-k$ in the 5th column. (In the example above, note that for the 1st column the number of occurrences of the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 is 5, 4, 1, 0, 0, 0, 0, 0, 0, 0 respectively, while for the 5th column the counts go 0, 0, 0, 0, 0, 0, 0, 1, 4, 5: the exact same numbers in reverse order!) Then show that for all k between 0 and 9, the number of occurrences of k in the 2nd column equals the number of occurrences of $9-k$ in the 4th column; and then show that for all k between 0 and 9, the number of occurrences of k in the 3rd column equals the number of occurrences of $9-k$ in the 3rd column. Once the last of these assertions has been proved, it will follow that the row-medians (which are just the entries in the 3rd column of the modified table) sum to 45.

Thanks for the Contributions!

Our thanks to all who have contributed to the Department of Mathematical Sciences over the past few years. Your generosity has allowed us to make purchases, award scholarships, and engage in activities that would otherwise have been impossible.

Many of you have responded generously to fundraising contacts. These contributions can benefit the Department of Mathematical Sciences directly if you specify that you wish to have your gift directed to Mathematics. Otherwise it will provide valuable assistance to the University at the College level.

Ken Levasseur, Chair

Writers: Ken Levasseur, Ann Marie Hurley, Dan Klain, Ravi Montenegro, Guntram Mueller (emeritus), Alex Olsen, Steve Pennell, Raj Prasad, Jim Propp, Marvin Stick.

Tangents is produced biannually by the Publications Office for the Department of Mathematical Sciences.

Your comments are welcome.

Alumni Update

Two of our students won full travel and registration scholarships to attend the Grace Hopper Celebration of Women in Computing this past fall: **Evana Gizzi** (B.S. 2013) and **Brigit Schroeder** (B.S. 2006). Both were UML math majors as undergraduates, and both are doing graduate work here. Evana is in the master's program in Mathematical Sciences, and Brigit is a doctoral student in Computer Science.



Evana Gizzi



Brigit Schroeder

Former UMass Lowell math major and current Central Catholic High School math teacher **Jarrold Brown** of Dracut (B.S. 2004) was awarded a \$2,500 "Math Hero" grant by Raytheon Co. after being nominated by current and former students. He plans to use the money toward obtaining his master's degree in mathematics.



Jarrold Brown

Michael McGovern (B.S. 1986) is now a Senior Vice President and Chief Technology Officer at Metro Credit Union in Chelsea, MA. His email address is michael.t.mcgovern@comcast.net.

Faculty Update

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Raj Prasad coauthored a paper in ergodic theory: S. Eigen, A. Hajian, Y. Ito, and V.S. Prasad, Existence and Non-existence of Finite Invariant Measures, *Tokyo Journal of Mathematics* 35 (339–358), Dec. 2012.

Professor **James Propp**, Computer Science Ph.D. student David Einstein, Mathematics M.S. student Evana Gizzi, and undergraduate students Kathy Antosca, David Campbell, James DeFilippo, Erin Graceffa, and Alvin Kow have been doing research on quasirandom processes for the past year, supported by Propp's NSF grant. Several of these students presented a paper describing the group's findings at the Mid-Hudson Mathematics Conference held at Bard College on November 2.

James Propp was one of four researchers who organized a week-long American Institute of Mathematics workshop entitled "Generalizations of chip-firing and the critical group", held July 8-12, 2013 in Palo Alto, CA. For more details, see www.aimath.org/ARCC/workshops/chipfiring.html.

In recent years, Prof. **Shelley Rasmussen** has been doing research into the mathematics of weaving. She has gotten several students involved in her work. Most recently, math majors **Olivia Demers** and **Mary Mersereau** had been working with Shelley. They recently shared their enthusiasm for the subject with some children in a local summer camp. For photos, see http://blog.uml.edu/cotangents/2013/07/mathematical_weaving.html.

Victor Shubov has written a new paper: C.I. Byrnes, D.S. Gilliam, C. Hu, and V.I. Shubov, Asymptotic regulation for distributed parameter systems via zero dynamics inverse design, *International Journal of Robust and Nonlinear Control* 23 (2013), 305–333.

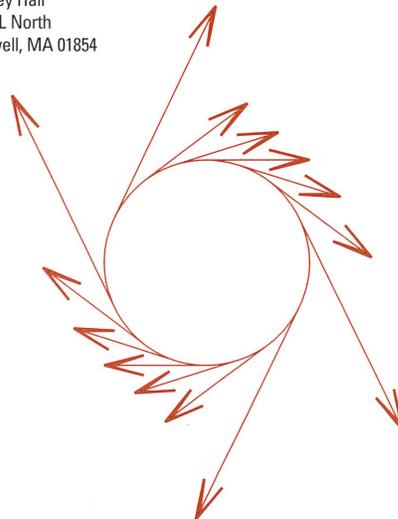
What Are You Up To?

Want to keep your classmates up to date on what you're doing and where you are? Take a few moments to tell us where you are, and whatever else you might like to share.

We can be contacted by mail at Department of Mathematical Sciences, North Campus, UMass Lowell, Lowell MA 01854. Telephone: (978) 934-2410. Email: mathematics@uml.edu

You might also wish to contact our Office of Alumni Relations, Southwick Hall 250, UML North, Lowell MA 01854-3629. Toll free telephone: (877) UML-ALUM. Email: Alumni_Office@uml.edu

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