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NEWSLETTER OF THE DEPARTMENT OF MATHEMATICS AT THE UNIVERSITY OF WASHINGTON

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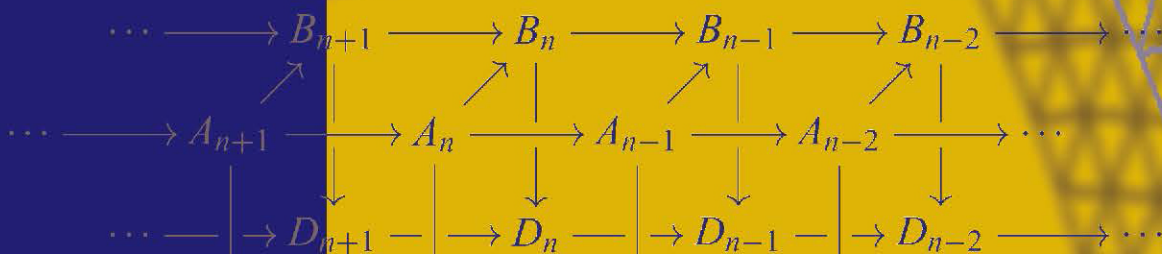
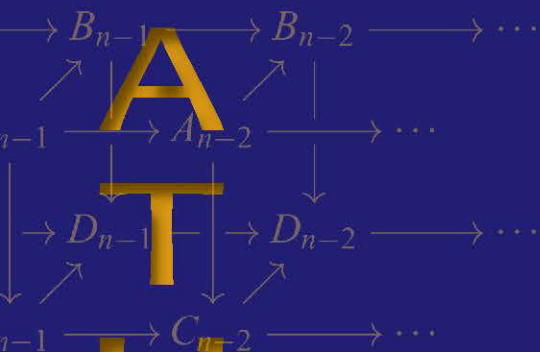
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# DEPARTMENT OF MATHEMATICS NEWS

## MESSAGE FROM THE CHAIR



It's been a year of change in the department. Yes, every year is, but this one especially so, with the retirement of three long-time faculty members and the arrival of our three newest. The end of 2013 brought the simultaneous retirements of John Sullivan, Jim King, and Doug Lind, all of whom had arrived at UW between 1973 and 1975. They were the "young" tenured faculty when I came here a few years later. Now they are suddenly gone, and their daily presence

is greatly missed, although they do come by from time to time.

Fortunately, I get to celebrate the new daily presence of Thomas Rothvoss, Dima Drusvyatskiy, and Bianca Viray, who are featured in subsequent pages. No sooner had Thomas arrived last January than he was off to Portland for the ACM-SIAM Symposium on Discrete Algorithms, at which his contribution received the best paper award. Dima, hired at the same time as Thomas, detoured to the University of Waterloo in Canada for a postdoctoral year before getting here in September. Together, they enlarge and enrich our optimization group, one of the premier such groups in the country. Bianca arrived at the start of summer. Her work at the interface of number theory and algebraic geometry promises to draw together our faculty in those fields and be a boon to our students.

Sadly, among the comings and goings, we lost two of our retired faculty just a month apart, and way too young: Lutz Bungart and Scott Osborne. Remembrances of them appear inside. You may wish to read Scott's final paper, "Hausdorffization and Such," which has just appeared in the American Mathematical Monthly's October 2014 issue.

Let me turn to happier departmental news.

A year ago I wrote about a new fellows program introduced by the Simons Foundation, which was founded by mathematician,

hedge fund manager, and philanthropist Jim Simons and is now the largest private supporter of mathematics in the US. In the program's first two years, three of our faculty became fellows: Tatiana Toro, Hart Smith, and Gunther Uhlmann. Now, a fourth has joined them, Sándor Kovács. He is using his fellowship to spend this fall as a member of the Institute for Advanced Study in Princeton. Come spring, he will visit the Instituto Nacional de Matemática Pura e Aplicada in Rio de Janeiro, where he is co-organizer of a program in algebraic geometry.

For the fifth year in a row, and the eleventh year in the past thirteen, one of our extraordinary math majors was the recipient of the Dean's Medal in the Natural Sciences. This time, it's Reid Dale whom you can learn more about in the delightful piece reprinted here from a College publication. While still an undergraduate last year, Reid took off for Berkeley to begin research with a faculty member there. Months later, an NSF graduate fellowship and Berkeley admission in hand, he has moved there full time to continue his mathematical studies.

Two of our graduate students, Toby Johnson and Austin Roberts, received prestigious NSF postdoctoral research fellowships. Toby, a student in probability and combinatorics who studied with Ioana Dumitriu and Soumik Pal, is now teaching and pursuing his research at the University of Southern California. Austin, a student of Sara Billey who also studied combinatorics, chose to assume a faculty position nearby at Highline Community College.

I hope these highlights, and the news that follows, convey how stimulating it is to have as colleagues such a dynamic group of faculty and students. With a doubling in the number of graduating math majors in the past eight years and a simultaneous diminution of our faculty ranks, the faculty are under continuing pressure to maintain high-quality educational programs while pursuing vibrant research. That they succeed is a testament to their talent and commitment. For that I am grateful, as I am for the support so many of you provide that makes such a difference in our efforts.

— RON IRVING

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Pictured (front cover):

Top: Reid Dale, Isabella Novik

Middle: Lutz Bungart, Scott Osborne

Bottom: Terry Rockafellar



# FEATURED STUDENT



## REID DALE ARTS & SCIENCES DEAN'S MEDALIST

STORY COURTESY OF  
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DIRECTOR OF PUBLICATIONS,  
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ISAIAH BROOKSHIRE  
MARKETING & COMMUNICATIONS SPECIALIST,  
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## BRILLIANT AT ANY AGE



Reid Dale is not one to shy away from a challenge. Soon after arriving at the UW as an undergraduate, he began taking graduate-level courses in mathematics and philosophy—and was regularly at the top of the class. That would be impressive for any undergraduate, but consider this: Dale came to the UW at age 15 through the UW's *Early Entrance Program*, skipping high school altogether.

"I never wanted to use my age as an excuse," Dale explains, "but I also didn't see it as something to be boastful about. It is what it is. I didn't want to sell myself short." For all his accomplishments, Dale, a mathematics major, is the 2014 *Dean's Medalist in the Natural Sciences*. Dean's Medalists are selected on the basis of academic performance and faculty recommendations.

Professor James Morrow still remembers a capstone paper Dale submitted for an honors math class early on. "His was by far the deepest and most original paper," recalls Morrow, *Barbara Hand Sando and Vaho Rebasoo Term Professor of Mathematics*. "It was a complete surprise that a sixteen-year-old student could have written such a sophisticated document." Since then, Morrow has worked with Dale on areas of common interest and readily admits that he has "benefited from having Reid teach me some things in which he is already an expert."

When Dale arrived at the UW, he was undecided on a major. A year in the Transition School at the Robinson Center for Young Scholars provided an opportunity to explore all that the UW has to offer. An essay he co-wrote for an English course during his sophomore year earned him and his writing partner the UW's *Andrew Hilen Prize for Outstanding Critical Expository Essay*, but despite the writing accolades, he gravitated to mathematics and philosophy. "I've always been attracted to abstraction," he says. "The more abstract a problem, the more it appeals to me. I found that the subject matter and the methodologies of math and philosophy aligned very well with my intuitions."

Dale explains that his philosophy coursework—mostly in the area of logic—dovetails with his math specialization in mathematical logic. "The area I'm working in is at the border of the two disciplines," he says, noting that both disciplines approach similar questions, but from a different perspective. "I got a good feel for both sides of the coin." John Manchak, associate professor

of philosophy, lauds Dale as “the best philosophy student, undergraduate or graduate, I have ever had in any class.” Bob Dumas, affiliate assistant professor of philosophy, adds that he was forced to further develop his own knowledge of model theory so that he could present material at Dale’s level of understanding.

Through summer programs at the UW, UCLA, and UC Berkeley, Dale furthered his study of logic and model theory. The Berkeley program, intended for graduate students, led to a close collaboration with Berkeley mathematics professor Thomas Scanlon, who will be Dale’s thesis adviser when he enters the PhD program at Berkeley this fall. In reality, Scanlon began advising Dale earlier this year. “Reid took the bold step of spending the last four months [of his undergraduate career] at Berkeley, working with Scanlon,” says Morrow. “I’ve never heard of an undergraduate being so bold and ambitious.”

While Dale is comfortable collaborating with faculty and advanced graduate students, he also enjoys spending time with budding mathematicians at the elementary and middle school level. He volunteered weekly through two Department of Mathematics outreach programs, *Montlake Math Challenge* and *UW Math Circle*, sharing his passion for math with younger students. He also found time to visit his own middle school in Federal Way, Washington, guest lecturing on logic and proofs at the invitation of his former middle school math teacher.

“I feel like I’ve benefited a great deal from having many mentors who have guided me, providing advice and support, and I’d like to be that for other students,” Dale explains. While he enjoys working with students who have an affinity for mathematics, he also welcomes students who are less enamored. “I try to ignite a spark in those who might not enjoy math by giving them glimpses of fascinating areas of math they might not otherwise learn about,” he says.

Dale is particularly interested in encouraging girls to consider studying mathematics, having noticed a striking gender imbalance in his graduate-level mathematics courses. He became aware of this imbalance, he says, in part due to his background in the humanities. “My contact with the humanities has made me more cognizant of the power relationships present in my day-to-day and professional interactions,” he says. “These relationships have real consequences and, in particular, affect people’s career aspirations. With this in mind, I pay close attention to how I can positively alter these structures of power in the classroom setting.”

With Dale planning a career in academia, that awareness is likely to have a profound effect on those he mentors in the future. He looks forward to encouraging others throughout his career.

“I was incredibly fortunate to have the full support of my family and peers to follow the path I wanted to follow,” he says. “To have such communal support is, unfortunately, not typical. I hope to have the good fortune to continue serving as a mentor to bright, young students who might not have realized that mathematics was an option for them - both during my time as a graduate student at UC Berkeley and beyond.”



Original article appeared in the June 2014 issue of the College of Arts & Sciences publication, *Perspectives*.  
We thank *Perspectives* and Nancy Joseph for permission to include the article.



## TERRY ROCKAFELLAR: CONVEXITY, OPTIMIZATION, RISK

EXCERPTED FROM THE JUNE 2014 ISSUE OF IMPRINTS,  
A PUBLICATION OF THE INSTITUTE FOR MATHEMATICAL SCIENCES AT THE NATIONAL UNIVERSITY OF SINGAPORE

We are pleased to present these excerpts from an interview that Y.K. Leong of the National University of Singapore had with Professor Emeritus Terry Rockafellar while Terry was visiting Singapore for a conference in January 2011. Imprints describes it as “a lively interview in which Terry traces his early years in the United States and Europe and imparts the passion of a trail blazer of a path less trodden.”

Terry Rockafellar made pioneering and significant contributions to convex analysis, variational analysis, risk theory and optimization, both deterministic and stochastic.

Rockafellar had his undergraduate education and PhD from Harvard University with a one-year Fulbright scholarship break at University of Bonn. Except for an initial short stint at University of Texas at Austin, he has taught at the University of Washington at Seattle since 1966. He became professor emeritus there in 2003 and was concurrently appointed as an adjunct research professor at the University of Florida at Gainesville.

**Imprints:** You took your PhD at Harvard University. What was the topic of your PhD thesis and who was your thesis advisor?

**Rockafellar:** The topic was in optimization, which as a subject was only about 8 years old at that time and totally unrepresented at Harvard. Before writing a thesis I had to take the standard graduate courses along with various electives and had to pass the required comprehensive exams for a PhD. Then, since there was nobody in the mathematics department who had any idea about optimization, I basically had to do my research on my own. My designated advisor was Garrett Birkhoff (1911-1996), who was a specialist in lattice theory and differential equations but knew nothing about the topics I was exploring. I anyway completed a thesis in optimization and got it approved with the help of kind words from [Albert W.] Tucker (1905-1995) at Princeton, who had heard about my interests from Talacko at Marquette.

**I:** Did you pick up the research problem yourself?

**R:** Exactly, exactly. In the year before I had gone on to graduate



studies, but had heard about optimization at Marquette, I learned that it had a phenomenon called duality. Mathematicians are generally familiar with some aspects of this, such as dual vector spaces, but this was a new and intriguingly different kind of duality. I was told it was well understood for “linear” problems of optimization but nobody knew how to extend it to “nonlinear” problems of optimization. That got me fired up and put me on my own track. I worked on it by myself even during the first two years back at Harvard, devoted to courses and exams. But later I got some help from the outside, not in research but in support from Tucker at Princeton, who was one of the founders of optimization. It was he who had arranged that I could have pursued graduate studies at Princeton instead. He was able to tell my advisor sometimes: “He’s okay. What this young man is doing is good. Don’t worry.” My advisor himself did not know how to deal with me except always to say “Work harder, work longer.” That’s how I was able to finish. And a couple of years after I got out, Tucker invited me to be a visiting professor at Princeton, which was very important to my career.

**I:** Just to pursue it a bit further, does convex optimization sort of unify different kinds of things?

**R:** I would like to put it differently. I have to explain what optimization is about. First let me say that in mathematics most people make a distinction between linear and nonlinear things, but in optimization it’s between convex and non-convex things. This means that the core entities for which the theory is nicest and computation is the easiest in optimization are those that have properties of convexity, just as in engineering and physics it’s the linear things that mostly serve for approximations and computations. But this had to be discovered. Optimization was not a known subject in those days, and its essentials had to be found out. In some way the impetus for that started with computers. Anytime there is a decision and choices have to be made, you want to make a better decision, or in other words, optimize. Once computers came in, people were able to look at problems on an entirely different scale of magnitude. In huge problems of optimization, inequalities are very important. You are not modelling with equations. You have certain ranges in which you can do things – not too much, not too little. You have a large number of these one-sided constraints, but you don’t know which ones will ultimately be active. Maybe some of them are superfluous in determining the solution, but there is no way to know that in advance of laborious computations.

Optimization draws on many different things, including a new kind of geometry, but relatively little of classical mathematics. The new geometry centers on convexity but carries over then to the treatment of functions as well.

**I:** Other than algorithmic or computational approaches, have new ideas in algebra, analysis and geometry contributed to fundamental advances in optimization?

**R:** I like this question because I can turn it completely around. I think it suggests that optimization is an area which takes existing mathematics and applies it. Actually it's quite the opposite. Optimization grew out of new demands in mathematical thinking. After all, a lot of mathematics was inspired by the challenges of astronomy, building pyramids, commerce, and the like. In physics everything is modeled by equations, but now in economics and systems management, for example, there are different needs. What I believe is that optimization theory has contributed to a new kind of mathematics, a new kind of analysis. I only wish that people in the pure mathematics departments had more access to knowing about this. A lot of mathematics tends to go on in a closed little world and in-group. You know, all areas of science and mathematics have a social component – revolving around who knows who. People just aren't aware of optimization-inspired developments. A good example of such developments is in my most recent book *Implicit Functions and Solution Mappings*, which came out in 2009, written with a colleague [Asen L. Dontchev] who is a Bulgarian-American, now in Michigan. In the mathematics of the past, the main model was solving a system of equations. Then if you wanted to know how the solution depends on parameters, you were led to the implicit function theorem. But now there are different models, such as problems of optimization or game structures in which several agents compete in optimizing from their own perspectives. How does the solution to the model depend on the model's parameters in such cases? You can't use the classical implicit function theorem. You need a new version for broader kinds of "*solution mappings*," which assign to a parameter vector the corresponding solution or set of solutions. What can be said about the derivatives of such a mapping? They have to be one-sided generalized derivatives. What does that mean? The book presents the kind of analysis that can serve in such a situation.

**I:** So it seems that optimization actually created new mathematics.

**R:** That is exactly what I believe very strongly. Nowadays there's convexity in statistics and set-based probability theory, along with many other areas. More recently I got into the theory of risk. I started out with a colleague [Stanislav Uryasev]

a dozen years ago. He's 20 years younger than I am and he's at the University of Florida.

**I:** Your work is mainly in the theoretical aspects of optimization. Has the computer come up with results or scenarios that are counter-intuitive and not mathematically proved or understood?

**R:** That's not the way computers influence optimization, because we aren't working with classical conjectures or anything that resembles that. However, there's an important aspect which, as they say, boggles the mind. It is that optimization deals with incredibly large problems in which you can have millions of variables and millions of inequality constraints. How are you going to solve them? You can only hope to do it with careful attention to structure. That may involve discretization in space or time, or stochastic representation, or a more novel kind of approximation, and we get into territory beyond what people can usually imagine. With advances in computers, what is very important is the feedback from computational methods – what can be done and what can't be done. After all, optimization was originally inspired by broader capabilities in computing. As more computational ability comes up, it's not just that you compute bigger problems. It's that you have new ways of thinking about them, requiring extensive mathematical development.

**I:** Until your retirement, you were at the University of Washington (Seattle) for 40 years. Is there any particular reason for this attachment?

**R:** We can start with why I went there in the first place. There were people on the faculty who had worked on convexity of a more geometric kind in a setting of functional analysis, for instance the study of the unit balls associated with norms. That enabled me to be invited there in the first place. Then I found a great working environment – not too many rules, the personal freedom to focus on research I liked, and the possibility of teaching courses on topics under development. Later I was able to set up a broad program of optimization-related courses in a department that supported me well, a department of mathematics where theory was welcome to thrive. I didn't want a job in a business school or an engineering school. I really felt myself to be a mathematician, so this was a wonderful thing. However, an underlying answer to your question about the 40 years is that I love the natural setting of Seattle. It has made me very much of an outdoor adventurer. I have spent many, many years climbing around in the wilderness, hiking in the mountains, fishing in high lakes with my family and friends, kayaking from one island to another, camping, catching crabs. This became an important part of me and the way I related to my family and friends, even students. After I became so tightly bound up with it, there was no substitute ever to be found in another location.

# RESEARCH HIGHLIGHT

## ISABELLA NOVIK

Isabella Novik caught the “math bug” early. She was born in St. Petersburg, Russia, a place known for its culture of Math Olympiads for middle and high school students. Novik’s mom, a math teacher, took Isabella to one when she was little. Her performance there led to an invitation to participate in a prestigious math circle, whose graduates



include many well-known mathematicians, such as Grigori Perelman and Stanislav Smirnov. The fascinating problems and the atmosphere of the math circle made it so different from regular school that Isabella made the easy decision never to leave this enchanted world, but to become a mathematician. Many of her friends, including her husband, are the people she met at the math circles or Math Olympiads.

As an undergraduate at the Hebrew University of Jerusalem, Novik was thinking of specializing in number theory or topology, but the TA in one of the classes she was taking pointed her to Gil Kalai, and that was it. Kalai supervised all three of her theses—undergraduate, Master’s, and PhD—and made her into the mathematician she is today.

Novik’s research has focused on problems that come from combinatorics, discrete and polyhedral geometry, and commutative algebra. Her work has been centered on or motivated by problems related to the face numbers of simplicial complexes and more general cell complexes. Described geometrically, a simplicial complex consists of vertices, edges, triangles, pyramids, and higher dimensional simplices “nicely” glued together. The face vector of a simplicial complex encodes the number of faces the complex has in each dimension; in other words, it measures the size of the complex.

The notion of a simplicial complex was introduced in the early days of algebraic topology as a tool for computing certain invariants of a space (its homology). Due to the discrete nature of simplicial complexes, they have also been studied by combinatorialists. Another stimulus for studying simplicial complexes came from the rapidly developing theory of convex polytopes, which are higher dimensional analogs of polygons,

such as pyramids and cubes. In the mid-1970s, pioneering work of Richard Stanley and Melvin Hochster made the study of simplicial complexes inseparable from commutative algebra. Nowadays, simplicial complexes provide the easiest way to represent topological spaces—for example, compact manifolds—on a computer, through their triangulations.

Novik’s PhD thesis contained a proof of Victor Klee’s Upper Bound Conjecture (UBC) from 1964 for a big class of manifolds. Manifolds are spaces that locally behave like spheres, but globally can have a very complicated topology. Examples of manifolds include the surface of a bagel and the Klein bottle. In the original form, conjectured by Theodore Motzkin in 1957 and proved by Peter McMullen in 1970, the UBC posited that in the class of all simplicial polytopes of a fixed dimension and with a fixed number of vertices, a certain polytope (called the cyclic polytope) has the largest face numbers. This conjecture allowed us to answer numerical questions of the following type: what is the largest number of 7-dimensional faces that a 10-dimensional polytope with 10,000,000 vertices can have? The UBC was also of special interest in optimization, since its dual version provided the largest possible number of vertices of a  $d$ -dimensional polytope defined by  $n$  linear inequality constraints.

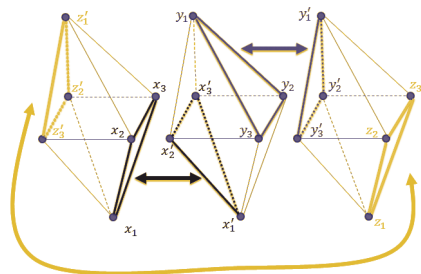
In 1964, Klee proved the UBC for polytopes with a sufficiently large number of vertices, and in fact for a much wider class of complexes—Eulerian complexes—provided that they have sufficiently many vertices, and conjectured that the UBC holds for all Eulerian complexes. Stanley (1975) settled Klee’s conjecture in the case of triangulated spheres. This was one of the first applications of commutative algebra to combinatorics and a major breakthrough on the UBC, as simplicial polytopes are but a tiny fraction of triangulated spheres. In her PhD thesis, Novik extended Stanley’s result and showed that the UBC holds for several classes of triangulated manifolds. In subsequent papers (one joint with Patricia Hersh and another with Ed Swartz), Novik established yet another extension of the UBC to a class of pseudomanifolds with mild singularities.

Another celebrated conjecture, known as the  $g$ -conjecture, posits a complete characterization of the face vectors of triangulated spheres. This conjecture is known to hold for the case of simplicial polytopes, a result due to Richard Stanley (necessity), and Louis Billera and Carl Lee (sufficiency). Both parts were proved in 1980, but the conjecture is wide open in general despite a great deal of effort that has been put into either proving or disproving it. This however did not stop Gil Kalai from suggesting in 1998 a far-reaching generalization of the  $g$ -conjecture to



all connected, triangulated manifolds. In yet another joint paper with Ed Swartz, Novik verified Kalai's  $g$ -conjecture for all triangulated manifolds whose vertex links are polytopal spheres; that is, they can be realized as the boundary complex of a polytope. In fact, Novik and Swartz showed that, surprisingly, the two conjectures are almost equivalent: namely, the strongest version of the  $g$ -conjecture for spheres would imply all numerical consequences of Kalai's  $g$ -conjecture for manifolds. This is quite an unexpected result, as it shows that despite the fact that simplicial polytopes form only a very tiny fraction of triangulated manifolds, the face vectors of triangulated manifolds are in many ways similar to those of polytopes.

While the Upper Bound Theorem for all polytopes that provides sharp upper bounds on the face numbers is a classic by now, the situation for centrally symmetric polytopes is open. What adds to the mystery is that in contrast with polytopes without symmetry, there exists a 4-dimensional centrally symmetric sphere on 12 vertices whose number of edges is strictly larger than that of any 4-dimensional centrally symmetric polytope on 12 vertices. To date no (even conjectural) sharp upper bounds on the face numbers of centrally symmetric polytopes exist, and even the largest number of edges that a 4-dimensional centrally symmetric polytope can have is unknown. Besides being of intrinsic interest, centrally symmetric polytopes with many faces appear in problems of sparse signal reconstruction (as was observed by David Donoho and his collaborators), leading to applications in such subjects as computer vision, medical imaging, and digital communications.

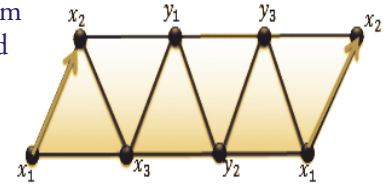


Construction of a certain balanced triangulation of the torus.

Motivated by these problems, Alexander Barvinok and Novik established certain asymptotic lower and upper bounds on the maximum possible number of  $i$ -dimensional faces that a  $d$ -dimensional centrally symmetric polytope can have. Although the gap between these bounds is huge, they are at present the only known non-trivial ones. Moreover, in a sequence of papers joint with Barvinok and Seung Jin Lee, Novik presented explicit deterministic constructions of centrally symmetric polytopes with a record number of faces. This is in contrast with previously known constructions that

were typically randomized.

Another part of Novik's research is motivated by the question, "What is the smallest number of vertices needed to triangulate a given manifold?" Starting from the seminal work of Gerhard Ringel and Ted Youngs in the late 1960s, this question has motivated a tremendous amount of research in topological combinatorics and combinatorial topology, as reflected in several books, such as Wolfgang Kühnel's and a forthcoming one by Frank Lutz. While at present we know the answer for all 2-dimensional manifolds and several 3-dimensional ones, in its general form the problem remains open even for the product of two spheres. Of particular interest are centrally symmetric triangulations of products of two spheres, a sphere of dimension  $k$ , say, and another of dimension  $m$ . It was conjectured by several people that there exists such a triangulation with only  $2k+2m+4$  vertices (for all  $k$  and  $m$ ), and the validity of this conjecture for several small values of  $k$  and  $m$  was established in the PhD theses of Eric Sparla (1997), Frank Lutz (1999), and Felix Effenberger (2010). In 2012, in joint work with Steve Klee, Novik's former PhD student, Novik proved this conjecture for all values of  $k$  and  $m$ .



Gluing together the two short sides of the parallelogram yields a centrally symmetric triangulation of the cylinder with 6 vertices.

Novik's current research, joint with Gil Kalai and Eran Nevo, is aimed at understanding the face numbers of simplicial complexes that are embeddable in a sphere of a given dimension. Another project, joint with Steve Klee, concerns face numbers of balanced complexes.

In addition to her research, Novik has served the combinatorics community for almost seven years as one of the four editors-in-chief for the Journal of Algebraic Combinatorics. This is one of the central journals in Combinatorics and the only international journal solely devoted to Algebraic Combinatorics. She co-chaired with Louis Billera the Program Committee for FPSAC 2014, an annual international conferences on Formal Power Series and Algebraic Combinatorics. In addition, Novik co-organized combinatorial conferences, among them "The mathematics of Klee and Grünbaum: 100 years in Seattle" and an Oberwolfach workshop on Topological and Geometric Combinatorics. Novik has directed five PhD theses and is currently working with two graduate students. Novik's work was recognized by the Haim Nessyahu Prize for outstanding Ph.D. thesis in Mathematics in Israel and by an Alfred P. Sloan Research Fellowship.

# IN MEMORIAM

## LUTZ BUNGART

JANUARY 29, 1938 - JUNE 5, 2014



Our colleague Lutz Bungart died in June after many years of poor health. Lutz received his PhD from Princeton in 1962 and spent several years at Berkeley before coming to UW in 1966. He did excellent work in several complex variables in his early years, but health problems intervened. After years that included careful experimentation with diet, Lutz returned to better health. What most struck me about the diet Lutz described once were two features: no eating after lunch, and lots of cherries. I liked the cherry idea. Fasting, not so much.

As director of our graduate program from 1986 to 1990, Lutz introduced many innovations, including a more comprehensive and aggressive approach to graduate student recruitment and our first foray into the construction of a student database. His efforts culminated in a successful proposal to the US Department of Education for a Graduate Assistance in Areas of National Need award. As his successor, I was the beneficiary of his creativity. In parallel, Lutz revived his research career, with a new publication, early progress toward resolution of a conjecture of Goresky and MacPherson, and the advising of a final graduate student, Whipple Neely. Alas, the onset of new health problems forced Lutz to take early retirement.

Apart from mathematics, Lutz made early keyboard instruments and ran a successful business—The Instrument Workshop—that supplied parts and plans right up to his death. He has been described as one of the pioneers of the early keyboard renaissance. The workshop was founded initially in partnership with fellow math professor Al Goldstein, who has prepared a fascinating piece about the history of their collaboration, complete with links to musical selections. I urge readers to go to

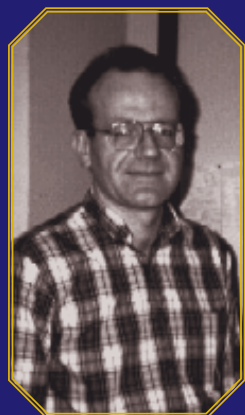
<http://faculty.washington.edu/gold/L03.html>

to learn more. Of particular interest is Al's discussion of an electro-acoustic harpsichord that they built together, along with a recording of Al's wife, Martha, playing it. Lutz also collaborated in the restoration of a historic harpsichord on loan to the School of Music from the Padelfords. Built in Pisa in 1600, it was unplayable until the restoration.

— RON IRVING

## MASON SCOTT OSBORNE

SEPTEMBER 2, 1946 - JULY 4, 2014



When I came out here in the Fall of 1966, my first non-calculus assignment was Math 427. As it happened, this was a small class with a number of very good students and the very best of these was Scott Osborne. He was then a Junior and it was very clear that he was exceptionally talented. I told him that I would be teaching a graduate course in 1967 based primarily on Helgason's great book "Differential Geometry and Symmetric Spaces." He expressed an interest in taking this course, so I suggested that over the summer break he should read Chevalley's book on Lie Groups, which he did (this in itself is an impressive feat). Needless to say, he was the lone undergraduate in the course but he more than held his own. At the end, I encouraged him to pursue mathematics (rather than physics which was technically his major) and so off he went to Yale where R. P. Langlands was in residence. He wrote a brilliant PhD thesis where, among other things, he formulated a conjecture (verified by him in some important special cases), this conjecture being later known as the "Osborne conjecture," which was finally settled in the affirmative by W. Schmid.

Moving on, Scott was eventually hired by us and this was where our collaboration began. While not the place to go into detail, suffice it to say our ultimate objective was a trace formula in the sense of Selberg. While we wrote a number of papers on the subject (and did achieve our goal in the rank-1 case), the final result has yet to be obtained (the backers of J. Arthur notwithstanding). This is a staggeringly difficult problem and as far as I can tell, nobody considers it anymore.

In summary, working with Scott was a stimulating experience. The speed with which he thought was amazing and his instantaneous grasp of difficult technical points was a wonder to behold. He certainly will be sorely missed by all.

— GARTH WARNER



# RECENT DEGREES

## 2013-2014 PHD RECIPIENTS

**Camil I. Aponte Román** (John Palmieri, advisor) – thesis entitled *Graded group schemes*.

**Sayan Banerjee** (Krzysztof Burdzy) – *On particle interaction models*. Sayan is currently a postdoc at the **University of Warwick**.

**Joel Barnes** (Steffen Rohde) – *Conformal welding of uniform random trees*.

**Alberto Chiecchio** (Sándor Kovács) – *Towards a non-Q-Gorenstein Minimal Model Program*. Alberto is currently a visiting assistant professor at the **University of Arkansas**.

**Alyson Deines** (William Stein) – *Shimura degrees for elliptic curves over number fields*. Alyson is currently a researcher at **Center for Communications Research-La Jolla**.

**Gregory Drugan** (Yu Yuan) – *Self-shrinking Solutions to Mean Curvature Flow*. Gregory is currently a Paul Olum visiting assistant professor at the **University of Oregon**.

**Lindsay Erickson** (Sándor Kovács) – *Deformation invariance of rational pairs*.

**Wai Tong (Louis) Fan** (Zhen-Qing Chen & Krzysztof Burdzy) – *Interacting Particle Systems with Annihilation through membranes*. Louis is currently a postdoctoral research associate at the **University of North Carolina**.

**Tobias Johnson** (Ioana Dumitriu & Soumik Pal) – *Eigenvalue fluctuations for random regular graphs*. Tobias is currently an NSF Postdoctoral Fellow at the **University of Southern California**.

**Stephen Lewis** (Tatiana Toro) – *Local set approximation: infinitesimal to local theorems and applications*. Stephen is currently a Dunham Jackson assistant professor at the **University of Minnesota**.

**Shuwen Lou** (Zhen-Qing Chen) – *Brownian Motion on Spaces with Varying Dimensions*. Shuwen is currently a research assistant professor at the **University of Illinois at Chicago**.

**Brendan Pawlowski** (Sara Billey) – *Permutation diagrams in symmetric function theory and Schubert calculus*. Brendan is currently an RTG postdoctoral associate at the **University of Minnesota**.

**James Pfeiffer** (Rekha Thomas) – *Problems in Probability and Optimization*. James is currently a software engineer at **Google, Inc.**

**Austin Roberts** (Sara Billey) – *Dual equivalence graphs and their applications*. Austin is currently an instructor at **Highline Community College**.

**Gautam Sisodia** (Paul Smith) – *The Grothendieck groups of module categories over coherent algebras*.

## 2013-2014 PHD RECIPIENTS (CONT.)

**Erik Slivken** (Chris Hoffman) – *Three Problems in Discrete Probability*. Erik is currently a Krenner assistant professor at the **University of California, Davis**.

**Huy Tran** (Steffen Rohde) – *The Regularity of Loewner Curves*. Huy is currently a Hedrick assistant professor at the **University of California, Los Angeles**.

**Dake Wang** (Yu Yuan) – *On special Lagrangian equations*.

**Xingting Wang** (James Zhang) – *Classification of connected Hopf algebras up to prime-cube dimension*. Xingting currently has a visiting lecturer position at the **University of California, San Diego**.

**Matthew Ward** (Max Lieblich) – *Arithmetic properties of the derived category for Calabi-Yau varieties*.

**Yang Yang** (Gunther Uhlmann) – *Three Elliptic Inverse Problems*. Yang is currently a visiting assistant professor at **Purdue University**.

## MASTER'S DEGREE RECIPIENTS

**Wenqian Gao** – under the supervision of Rekha Thomas.

**Neil Goldberg** – under the supervision of Sándor Kovács.

**Jing Hong** – under the supervision of Jim Burke.

**Anh Huynh** – under the supervision of Sara Billey.

**Jing Liu** – under the supervision of Zhen-Qing Chen.

## BACHELOR'S DEGREE RECIPIENTS

271 Bachelor's degrees were awarded during the 2013-2014 academic year: 211 in Mathematics and 60 in Applied and Computational Mathematical Sciences.

# STUDENT HONORS

## GRADUATE AWARD RECIPIENTS

### *Academic Excellence Awards*

Avi Levy, Travis Scholl, and Zihui Zhao

### *Ann Giles Fellow*

David Sprehn

### *Althea Stroum ARCS Endowment Scholar*

Sean Griffin

### *Douglas Lind Fellow*

Shirshendu Ganguly

### *Excellence in Teaching Awards*

Alan Bartlett and Harish Ramadas

### *McFarlan Fellows*

Nathan Saritzky and Amy Wiebe

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Avi Levy and Harish Ramadas

### *NSF Graduate Research Fellow*

Emily Dinan

### *Tanzi-Egerton Fellow*

Ru-Yu Lai

## UNDERGRADUATE AWARD RECIPIENTS

### *Gullicksen Award for Outstanding Junior in Mathematics*

David Jekel and Kolya Malkin

### *First Year Honors Calculus Award*

William Dana

### *Second Year Honors Calculus Award*

Daniel Vance

### *Outstanding Graduating ACMS Major*

Adam Williams

### *Outstanding Graduating Senior in Mathematics (B.S. Standard Major)*

Reid Dale

### *Outstanding Graduating Senior in Mathematics (B.S. Comprehensive Major)*

Joshua Cutler and John Zhang

### *Outstanding Graduating Senior in Mathematics (Teacher Preparation)*

Matt Heid

### *Putnam Exam Outstanding UW Score*

William Dana

## NSF POSTDOCTORAL FELLOWS



Toby Johnson

**Toby Johnson** and **Austin Roberts** were 2014 recipients of Mathematical Sciences Postdoctoral Research Fellowships from the National Science Foundation.

**Toby Johnson** works in the areas of probability and combinatorics, and was advised by Ioana Dumitriu and Soumik Pal. Toby is currently sponsored by Larry Goldstein as a postdoctoral fellow at the University of Southern California.

**Austin Roberts** works in combinatorics and completed his PhD under the supervision of Sara Billey. He currently holds a faculty position at Highline Community College in Des Moines, Washington.



Austin Roberts



# NEW FACULTY

## ASSISTANT PROFESSORS

### DIMA DRUSVYATSKIY



PhD from Cornell University, 2013.  
Research area: Nonsmooth optimization, variational analysis, and the connections of these disciplines to semi-algebraic geometry.

### BIANCA VIRAY



PhD from University of California, Berkeley, 2010.  
Research area: Number theory and algebraic geometry, particularly problems at their intersection.

## ACTING ASSISTANT PROFESSORS

### ALEXANDRU CHIRVASITU



PhD from University of California, Berkeley, 2014.  
Research area: Non-commutative geometry and quantum groups, with a focus on compact quantum groups and their representations.

### MATT MCGONAGLE



PhD from Johns Hopkins University, 2014.  
Research area: Geometric analysis and pde; in particular self-similar solutions of the mean curvature flow and geometric flows.

### CHIH-CHI CHOU



PhD from University of Illinois at Chicago, 2014.  
Research area: Singularity theories related to the minimal model program and high dimensional moduli problems.

### ANNIE RAYMOND



PhD from Technische Universität Berlin, 2014.  
Research area: Combinatorial optimization and polyhedral combinatorics.

### CARLOS R. MONTALTO CRUZ



PhD from Purdue University, 2014.  
Research area: Inverse problems, and imaging with particular interest in medical imaging applications.

## STAFF MEMBERS



**Steve Pearson** is the department's new Fiscal Specialist, having joined the department in September following the retirement of Susan Malti, who served in that position since 2009.



**Garrett Yoshitomi** has joined the department in the advising office's front desk position. He began in September as well.

# OUR DONORS

The following friends have contributed to the Department between September 2012 and October 2014. Should you notice an error or omission in this list, please draw it to our attention with a telephone call or e-mail to Rose Choi at 206-543-1151 or [rosechoi@math.washington.edu](mailto:rosechoi@math.washington.edu).

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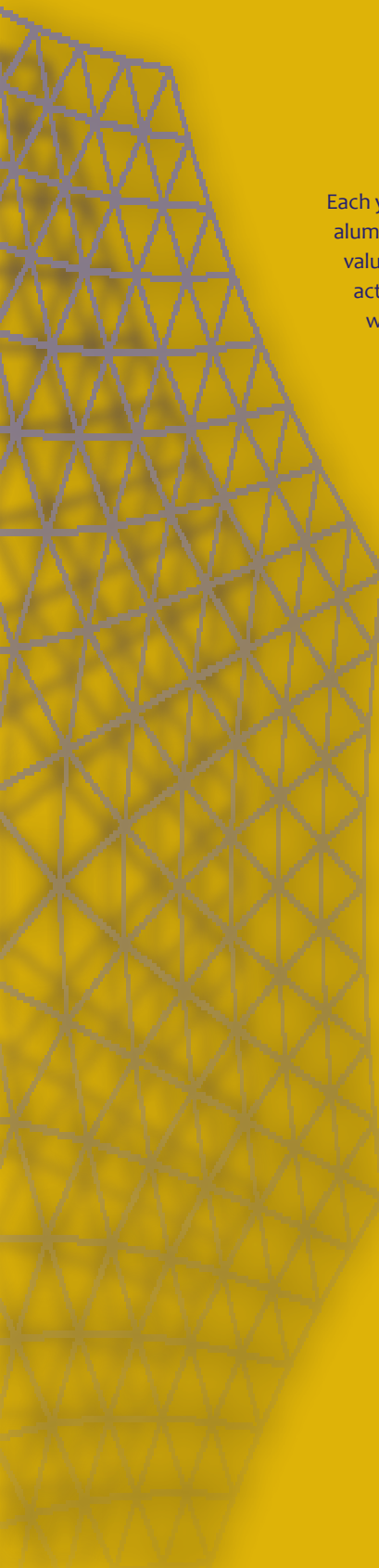
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If you are thinking of making a gift to the Department, or remembering the Department in your will, we invite you to discuss the matter with **Ron Irving**, the chair of the department (206-543-1151 or [chair@math.washington.edu](mailto:chair@math.washington.edu)), or **Alexandra Eckstein** of the Advancement Office in the College of Arts and Sciences (206-616-1989 or [alexeck3@uw.edu](mailto:alexeck3@uw.edu)). You can also visit our web site at [www.math.washington.edu](http://www.math.washington.edu) and click on "Giving to Math."

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