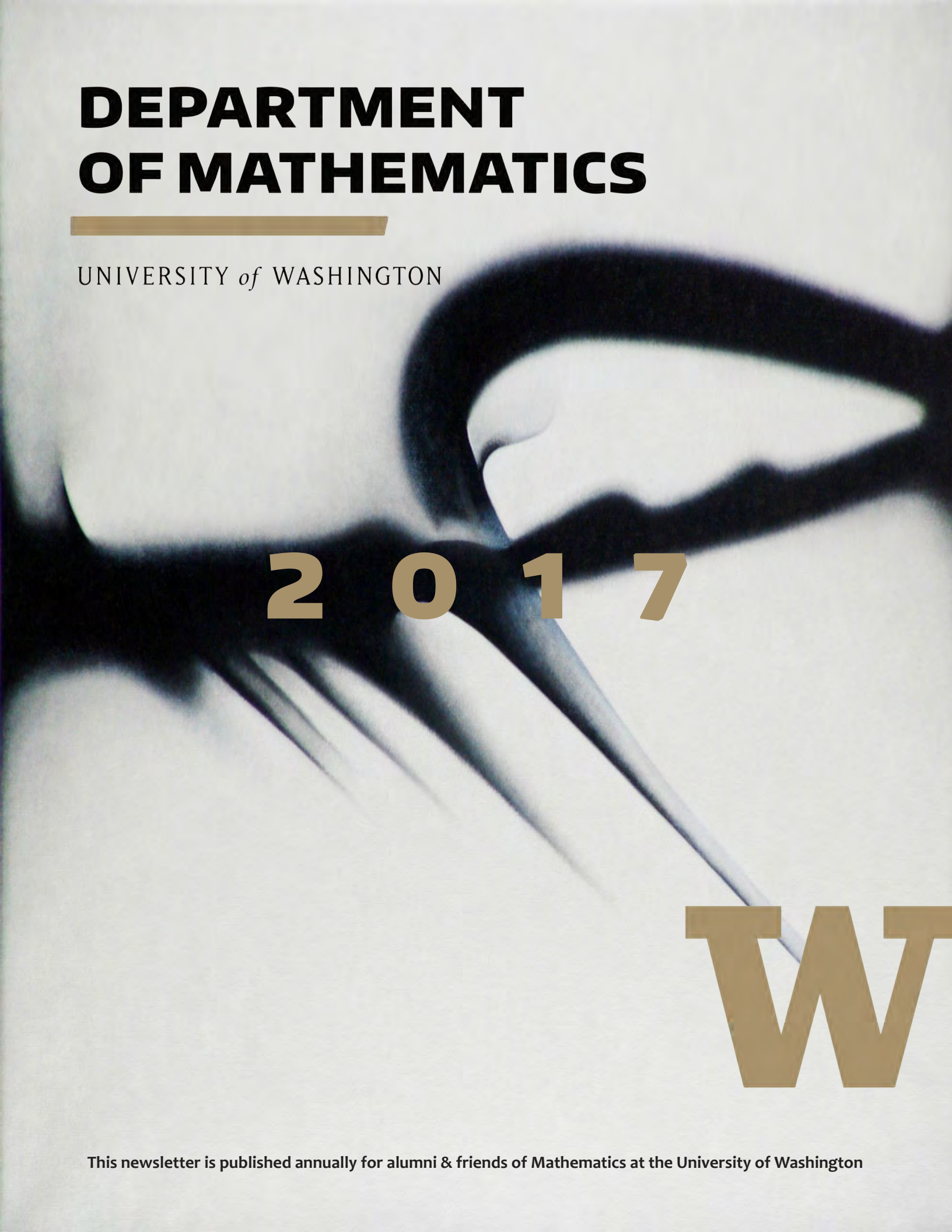
# DEPARTMENT OF MATHEMATICS

UNIVERSITY *of* WASHINGTON



2017

This newsletter is published annually for alumni & friends of Mathematics at the University of Washington

# Message from the Chair

It is a time to love and, alas, a time to hate. A time to be silent and a time to speak. But within the department, I would describe the past year as a time to weep and a time to laugh, a time to mourn and a time to dance. The pages that follow show that there is much to celebrate. Yet, we have wept and mourned as well.

Laughing and dancing first. As you will read, Ethan Devinatz and Bianca Viray were promoted to higher rank. Gunther Uhlmann received the Solomon Lefschetz Medal at the Mathematical Congress of the Americas. Isabella Novik, Julia Pevtsova, and Tatiana Toro became Fellows of the American Mathematical Society, with Max Lieblich set to join them next year. The Simons Foundation named Julia a 2017 Simons Fellow. Jim Morrow became one of the inaugural Fellows of the Association for Women in Mathematics. Thomas Rothvoss and Dima Drusvyatskiy received NSF CAREER grants. Rekha Thomas was invited to speak this coming August at the quadrennial International Congress of Mathematicians in Rio de Janeiro.

Our students provided additional cause for dancing. The undergraduate team in the annual Putnam Mathematical Competition received Honorable Mention for finishing among the second five nationally, along with schools such as Caltech and Harvey Mudd. Two of the team members, Will Dana and Jasper Hugunin, received Honorable Mention for their individual performances. And Will had the further distinction of being named the College of Arts and Sciences's Dean's Medalist in the Natural Sciences.

Let me also highlight the success of a former graduate student, Steve Klee, now a faculty member at Seattle University and affiliate faculty member in our department. In August, Steve received the Mathematical Association of America's Henry L. Alder Award for Distinguished Teaching in recognition of "seamlessly incorporating undergraduate research into his classroom curriculum and mentoring student researchers who go on to publish and present their work." As a graduate student, Steve collaborated with Julia Pevtsova on the outreach programs she runs for local K-12 students, and with me and others on our summer residential program for talented high school students. His continued involvement in these programs a decade later, along with his outstanding research and teaching, exemplifies our department's commitment to the breadth of mathematical research, teaching, and outreach. We strive to be all things to all people, so that we might by all means bring mathematics to some. This is why we laugh. This is why we dance.

But we weep and mourn too. We mourn the loss this past year of three emeritus faculty members: Frank Brownell, Caspar Curjel, and John Westwater. None had been around Padelford in recent years, but those of us above a certain age remember them fondly. And we wept on learning of the loss of our dear colleague Steve Mitchell, who died in August on his 66th birthday.

Steve was a brilliant, creative mathematician. After receiving his PhD from UW in 1981, he spent two years at MIT, followed by a year at Princeton and a year back at UW as an NSF postdoctoral fellow. He then became a permanent member of our faculty, receiving among other recognition the American Mathematical Society's Centennial Fellowship in 1990. He was also an amazing educator, who enjoyed nothing more than sharing his love of mathematics with students. Steve was adamant throughout his medical treatments that he wanted to keep teaching, to savor precious moments with students. He was an extraordinary, loving, nurturing soul and he is greatly missed.

Steve's legacy will live in perpetuity, thanks to generous family gifts that have allowed us to establish the Steve Mitchell Graduate Fellowship for the Love of Math. At a memorial service for Steve in October, the fellowship was announced, with Kristin DeVleming introduced as the inaugural Mitchell Fellow. The endowment agreement explains that the fellowship "is intended for a graduate student in pure mathematics who shows great promise as a teacher. The recipient should be a thoughtful, enthusiastic, and engaging instructor who delights in sharing the wonder and joy of math with students of all levels. A sense of humor is a plus!" Even as we weep, we remember Steve—the mathematician, the educator, the person— and laugh.

- Ron Irving

photo by Dorothée Brand



# CONTENTS




Editors: Ron Irving and John Sullivan Layout: Rose Choi

*Front and Back cover image "F142" courtesy of Walter Gorgosilits (Dextro.org)*

# Faculty Promotions,

# Honors & Awards

## Professor Ethan Devinatz


photo by Dorothée Brand

earned his PhD from MIT in 1985 and came to the University of Washington in 1991, after spending six years at the University of Chicago. He was awarded a Sloan Fellowship in 1992 and promoted to Associate Professor in 1997.

Ethan works in stable homotopy theory, a field of algebraic topology. Roughly speaking, algebraic topology may be described as the use of algebraic methods to study properties of certain objects invariant under deformations. Although geometric problems often reduce to problems in stable homotopy theory, Ethan's focus is on the intrinsic properties of the stable homotopy world. This world is very complicated: the stable homotopy groups of spheres—a fundamental building block—are mostly unknown, and it is unlikely that there will ever be a complete accessible explicit description of these groups. However, a certain sort of periodicity is ubiquitous, and this periodicity may be used to organize all of stable homotopy theory. One might hope that this organization would yield insight into "global" problems in stable homotopy theory, such as the benchmark Freyd conjecture. Ethan was one of the researchers who established the central role of this periodicity and has devoted his career to understanding it and its significance.

Apart from his research, Ethan has taught extensively at all levels and has successfully advised several PhD students.

## Associate Professor Bianca Viray

received her BS in mathematics from the University of Maryland in 2005 and completed her PhD at the University of California, Berkeley in 2010. She joined the department in 2014 after holding an NSF postdoctoral fellowship and a Tamarkin assistant professorship at Brown University.

Bianca's research lies in arithmetic geometry, which sits at the intersection of number theory and algebraic geometry. She is particularly interested in the study of rational points on varieties, or determining when a system of polynomial equations has a rational solution. This study is intertwined with the study of the Brauer group of a variety, a mysterious and slippery object that encodes a great deal of arithmetic and geometric information about the variety. Bianca's work has significantly advanced the known techniques for computing the Brauer group and revealed surprising restrictions on the Brauer group's influence on the arithmetic of the variety.

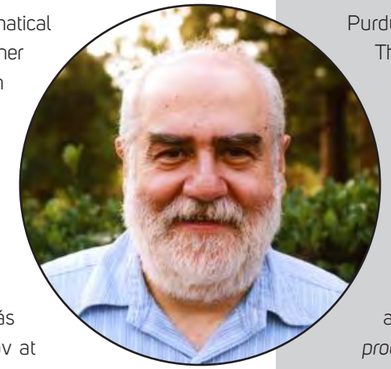
Bianca has enjoyed teaching a wide variety of classes in her four years at UW, from 100- and 300-level service courses to advanced major courses and graduate topics courses. Recently she has worked with Rekha Thomas and Patrick Perkins to standardize Math 308 (linear algebra) and find and develop materials to enhance the geometric content of the class.

Outside of UW, Bianca has been involved in a number of organizations focused on increasing diversity in mathematics. She is a member of the Women in Numbers steering committee and co-organized the recent Women in Numbers 4 workshop, focused on highlighting the research of women in number theory. Bianca is also a member of the council and diversity committee for the Western Algebraic Geometry Symposium and on the board of directors for Girls' Angle, a math club for girls.



## Gunther Uhlmann

In July, at the opening of the 2nd Mathematical Congress of the Americas in Montreal, Gunther Uhlmann was awarded the Solomon Lefschetz Medal by the Mathematical Council of the Americas. He received the medal in recognition of his excellence in research and his remarkable contributions to the development of mathematics in the Americas. As an example of Gunther's research excellence, recent work in collaboration with András Vasy at Stanford and Plamen Stefanov at



Purdue was featured last February in *Nature*. They solved the longstanding open problem of boundary rigidity in Riemannian geometry, proving for Riemannian manifolds with boundary of dimension 3 or greater (under suitable hypotheses) that knowledge of the restriction to the boundary of the manifold's distance function determines the distance function overall. The title of the Nature feature suggests potential applications: *Long-awaited mathematics proof could help scan Earth's innards.*

## Julia Pevtsova

Julia Pevtsova is a 2017 Simons Fellow. The Simons Foundation's fellowship program, which began in 2012, is designed to provide awardees with additional sabbatical funding that can "lead to increased creativity and productivity in research." Tatiana Toro was one of the inaugural fellows five years ago, followed by Hart Smith, Gunther Uhlmann, Sándor Kovács, and Chris Hoffman in subsequent years. Julia is spending the year at the Mathematical Sciences Research Institute in Berkeley, where she is co-organizer of the Spring 2018 program on Group Representation Theory and Applications.

## New AMS Fellows


Tatiana Toro (by Dorothée Brand)

Isabella Novik, Julia Pevtsova, and Tatiana Toro are among the sixty-five mathematicians from around the world who became new Fellows of the American Mathematical Society in 2017. This is the fifth year of the program, which recognizes AMS members who have made outstanding contributions to the creation, exposition, advancement, communication, and utilization of mathematics. Among the goals of the program are to create an enlarged class of mathematicians recognized by their peers as distinguished because of their contributions to the profession, and to honor excellence.

## NSF CAREER grants


Thomas Rothvoss

Dima Drusvyatskiy and Thomas Rothvoss have both been awarded CAREER grants under the National Science Foundation's Faculty Early Career Development Program. Thomas, who has a joint faculty position in Computer Science and Engineering, had previously received a Sloan Research Fellowship and a Packard Fellowship in Science and Engineering. Dima had previously received an Air Force Young Investigator Research award. Both work on aspects of optimization theory.

## Dima Drusvyatskiy

In August, Dima Drusvyatskiy and four UW colleagues were awarded one of twelve grants under the National Science Foundation's new Transdisciplinary Research in Principles of Data Science initiative, which is intended by NSF to accelerate the development of modern foundations of data science through a truly transdisciplinary collaboration between mathematicians, statisticians and theoretical computer scientists. The UW project is titled "Algorithms for Data Science: Complexity, Scalability, and Robustness."

# A STANDOUT MENTOR

In January 2018, James Morrow will be one of 32 mathematicians (and three men) honored as members of the inaugural class of Fellows of the Association for Women in Mathematics. He is traveling to San Diego to be recognized during the AWM Reception and Award Ceremony at the annual Joint Mathematical Meetings. The honor reflects his long commitment to mentorship of women in mathematics.

"I am more proud of being chosen to be in the inaugural class of Fellows of the AWM than I am of any of my other academic accomplishments," says Morrow, the Sando-Rebassoo Professor of Mathematics.

Morrow's colleagues say the honor is well deserved. "Jim is devoted to his students," says Ron Irving, chair of the UW Department of Mathematics. "He cares passionately about their learning and their lives, both while they are here and in the years that follow, advising many of them even while they are in graduate school and beyond. While many of us love teaching, he operates on an entirely different level. He is unique, a once-in-a-generation teacher."

Among other accomplishments, Morrow co-founded a National Science Foundation-funded Research Experiences for Undergraduates program at the UW that has attracted a stellar group of students through the years, including dozens of women who have gone on to do graduate work in the mathematical sciences, often at top-tier universities.

"I'm pretty sure that if it weren't for Jim, I never would have become a mathematician," says one female alum. Adds another, "Jim was the most influential professor in my undergraduate career. His devotion to his students is unparalleled."

Morrow, like any great mentor, insists his students are the ones who deserve the praise. "I am very, very lucky to have been able to meet and work with so many outstanding women," he says. "Any recognition I have received is due to their talents, accomplishments, and persistence. I thank them for putting up with me and allowing me to be part of their lives. The joy of working with these women is its own reward."

## Rekha Thomas invited to be an ICM speaker

Rekha Thomas, an expert in optimization and director of the department's undergraduate program, will be one of the invited speakers at the quadrennial International Congress of Mathematicians in Rio de Janeiro in August 2018. She joins five other mathematicians from Europe and Brazil as a speaker in the section on Control Theory and Optimization.



# Putnam Fever

**Story by Nancy Joseph // Perspectives Newsletter // December 2017**

Four years + six hours + one bout of flu. That was a winning equation for Will Dana when he competed in the prestigious William Lowell Putnam Mathematical Competition as a UW undergraduate.

photo by Nancy Joseph

In his fourth year taking the six-hour Putnam exam, flu-ridden Dana (BS, Mathematics, 2017) scored high enough to earn a coveted honorable mention in the competition. He also helped the UW team place in the top ten—the University of Washington's highest ranking ever—alongside math powerhouses like MIT, Stanford, and Caltech.

Up to 5,000 undergraduates from US and Canadian universities participate in the annual competition, which was introduced in 1938. The exam features twelve math problems so fiendishly difficult that it's rare for anyone to solve them all. In fact most students don't solve any. "Putnam has only given out four perfect scores in its entire history," says Dana. "Even if you just turn in a complete solution for one problem, you're already doing decently."

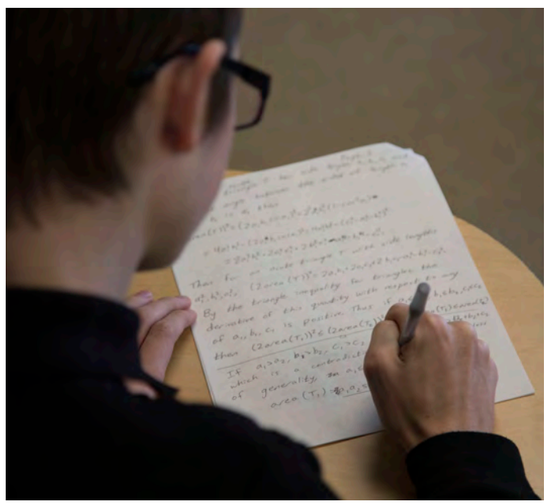


photo by Whitney Sanchez

Ioana Dumitriu, UW professor of mathematics, did more than decently when she competed as an undergraduate. In 1996, Dumitriu was the first female Putnam Fellow—an honor bestowed on the top five in the competition—and from 1995 to 1997 she was the top female participant. At the UW, she helps students prepare for the competition, coaching them in weekly prep sessions offered by the Department of Mathematics. Dumitriu shares coaching duties with Julia Pevtsova, professor of mathematics, and Jonah Ostroff, lecturer in mathematics. This year, postdoctoral fellow Noah Forman coached as well.

"We get the brightest, the most enthusiastic, the most hard-working students," says Pevtsova of the prep sessions. "Where else can one get such a concentration of brains and enthusiasm to learn? It is invigorating, and it is delightful to see them succeed."

About two dozen undergraduates attend the weekly two-hour sessions, where they hone their mathematical problem-solving skills. The Department also offers an Art of Problem Solving course that covers similar topics. "The problems that come up in the Putnam Competition belong to a very wide class of problem types," says Dumitriu. "For students to do well, they need to learn a range of problem-solving techniques."

In addition to coaching students, Dumitriu has served as a grader for the Putnam exam several times. She has seen firsthand how a score can drop from a 10—the highest

for each problem—to a 2 because of a missing or confusing argument. "It's very important to be able to communicate that you solved the problem," says Dumitriu. "You have to be able to write solutions that are clear, concise, and thorough." Because the Putnam's grading system allows only scores between 0 to 2 and 8 to 10—sort of a "go big or go home" philosophy—a minor omission can cause major damage. "The scoring is really brutal," Dumitriu admits. "I don't like it, but I understand the need for it. This way, you very clearly differentiate the people who know what they're doing from those who are dabbling. Having been a grader, I can warn students about things I've seen that can really lower a score."

But not this year. Dumitriu has had to recuse herself as a Putnam coach for the next three years while she serves on the committee that writes the exam. She says she's honored to serve in this role, and challenged by the task. "The problems must be solvable in a limited amount of time, but also new to the students," she says. "It's hard."

For students like Dana, tackling those problems is exciting. More than that, it's fun. Pevtsova says that many math majors welcome the challenge, much like athletes thrive on the pressure of a big game. "Why do students play frisbee competitively, or soccer, or any other sport?" she says. "It excites them, they express themselves through it, and sometimes they also meet like-minded people at their practices. This is the same." Adds Dana, "I always found the test super fun. If it were torture, I wouldn't do it four years in a row. Nobody was forcing me to take the Putnam."

Of course taking the exam with the flu is another story. In Dana's senior year, he had been ill for several days before the test. "I woke up the morning of the test feeling bad enough that I seriously considered not showing up," Dana recalls. But he'd been chosen as one of three UW students whose combined scores would comprise the UW team score, so he felt it was important to participate. "I decided to make an attempt, and that certainly turned out to be the right decision. In fact, as the day went on, I ended up feeling better, from which I can only conclude that math has miraculous restorative properties."

The result was Dana's best showing and the UW team's highest placement, which reflected the combined scores of Dana and teammates Austin Stromme and Jasper Hugunin. (Hugunin, like Dana, earned an individual honorable mention. Historically, the best individual performance by a Husky was in 2010, when William Johnson (BS, 2011) was named a Putnam Fellow.)

Dana is now a graduate student at the University of Michigan, but undergrads who took the 2017 exam earlier this month—solving problems developed by Dumitriu—are more than ready to fill his Putnam shoes. They won't learn their individual and team results until next April, but if one of them wins, earning Putnam Fellow status like Dumitriu and Johnson, the math world will take notice.

"People at top universities make a big deal of winning the Putnam," says Dumitriu, who was courted by top graduate schools after becoming the first female winner. "It is definitely a badge of honor."


## WILL DANA DEAN'S MEDALIST IN THE NATURAL SCIENCES

**Story by Nancy Joseph**
**Perspectives Newsletter // June 2017**

Will Dana "has won all the awards the Math Department has to offer," says James Morrow, the Sando-Rebassoo Professor of Mathematics. A major in mathematics with a minor in music, Dana has participated in research through the Research Experiences for Undergraduates (REU) program and the Washington Experimental Mathematics Lab (WXML). He also earned an honorable mention at the highly competitive Putnam Mathematical Competition, while leading the UW Putnam team to its first top-ten finish.

"Will is one of the most remarkable undergraduates I have met in my nearly 40 years at the University," says WXML faculty lead Doug Lind, professor emeritus of mathematics. "He is clearly destined for an outstanding career in research mathematics, and has the capacity and drive to make deep and significant contributions."

Morrow adds that Dana is a gifted teacher as well, serving for the past two years as a teaching assistant for a sequence of 300-level courses. "He is a wonderful TA, spending many extra hours with the students, frequently sending them documents that explain the class material in meticulous detail," says Morrow. "The students recently, as a group, told me how much they love Will and appreciate all he does for them."

In the fall, Dana will start a PhD program in mathematics at the University of Michigan, with plans to teach mathematics.



# Research Highlight

# Soumik Pal

photo by Dorothée Brand

During the last few years, a large portion of my research has focused on stochastic evolution of large graphs and networks. A graph (or a network) is a collection of objects, called "vertices," with certain pairs of vertices sharing a relation called an "edge." Graphs are everywhere in the real world. For example, consider a social network (say, Facebook) where the objects are participants and the relation is "being friends with each other." Or, consider the set of all cities in the world and the relation is "having a direct flight between the pair." Analyzing the structure of large graphs and networks is a big scientific endeavor of our time. Most graphs we encounter in the real world are large but sparse. That is, although the number of vertices in the graph is enormous, every vertex has only a relatively small number of edges. We can add a temporal effect by imagining that an observed graph changes over time due to small random changes in vertices or edges. How can one mathematically describe such an evolution?

Describing the stochastic evolution of general graphs in a comprehensible way is very, very difficult. In this article, we will reduce our scope by looking at simpler graphs such as binary trees. These graphs are best described as family trees (or evolutionary trees), where starting from one ancestor, each individual who ever existed either dies childless or gives birth to exactly two children. The lifetime of the individual can be represented as the length of the corresponding edge. Binary trees are recurring objects throughout mathematics, with many applications in statistics, population genetics, and computer science, so it is worthwhile to study them on their own. Furthermore, a random binary tree with a large number of vertices is very similar to other large random trees which need not be binary.

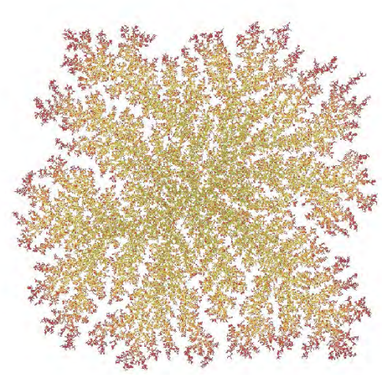


Figure 1. The Brownian continuum random tree

To understand what the last statement means, consider a simple random walk, which is a path that goes up or down by one at each time step with equal probability. If we run this path for a long time and look from afar, then it will look similar to another random path which goes up or down by a random number which may not be always one. In technical language, both paths "converge" to Brownian motion (a random continuous highly jiggly path) "in the scaling limit." Similarly, any (subject to natural conditions) large random tree, looked at from afar (in the right scale), looks very similar to a large binary tree. The limiting object to which all such random trees converge is called the *Brownian continuum random tree* and is a fundamental object that appears in many contexts involving limits of large random combinatorial objects, including non-tree graphs, maps, and quadrangulations. See Figure 1 for an image of this random tree which has infinitesimally small edge lengths, is branching everywhere, and is fractal (looks similar at various scales).

One natural evolution on the set of binary trees, suggested by David Aldous in 1999, proceeds by performing a sequence of operations as shown from left to right in Figure 2. Suppose presently we are at some given binary tree. The "leaves" of this binary tree are terminal individuals who do not give birth to any children of their own. Select a leaf from this tree at random for removal. In Figure 2, the leaf labeled 3 is selected in the first image and removed in the second. However, this creates a tree that is no longer binary due to the parent vertex of the removed leaf that has only one child. We remove this vertex as well. Then select a random edge from the remaining structure. This edge is shown by an arrow in the third image. On this edge a new vertex is created (fourth image) and the removed leaf is attached as a child of this newly created vertex (fifth image).

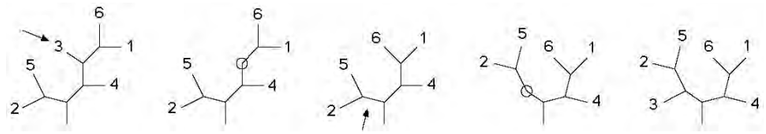



Figure 2. One step of the Aldous chain



Of course, if instead of six leaves we have six million leaves, one step of the Aldous chain does not have much effect. But after one million steps we will see a big change in the shape of the tree. An open question by Aldous is: what does this Markov chain "look like from afar" when the tree is very large and we observe it successively after a large number of steps? Intuitively this is an evolution of a fractal, highly bushy tree shape that, at any moment, is similar to the continuum random tree. Constructing this limiting process, often called *the Brownian motion on the space of trees*, is the Aldous diffusion problem.

In a series of papers with three other collaborators — Noah Forman (a current postdoc at UW), Doug Rizzolo (at Delaware, a former postdoc at UW), and Matthias Winkel (Oxford) — and working over the past several years, we have constructed the conjectured limiting process of evolving fractal trees, resolving this famous conjecture. The crux of the solution involves constructing a new probabilistic object. Pick leaf 1 from the initial tree. Imagine moving from the root to the leaf along the path connecting the two. As we move, we encounter subtrees rooted on this path. Count the leaves of each of these subtrees as we encounter them. Imagine the path as an interval of the positive line and put a sequence of positive numbers (masses), given by the counts of leaves, at the distance from the root at which the corresponding subtree is rooted. See Figure 3, where the masses are shown as symmetric tops and color-coded to match the subtrees. These masses evolve in time, some subtrees growing, others disappearing, some others being born, with leaf 1 eventually being removed. Similar stochastic processes have made appearances in other areas of mathematics, such as representation theory and machine learning. Our paper describes the limiting evolution of these masses in terms of standard stochastic objects called Lévy processes (named after Paul Lévy, an early giant in probability). This, along with the fractal nature of the continuum tree, allows us to construct the Aldous diffusion itself.

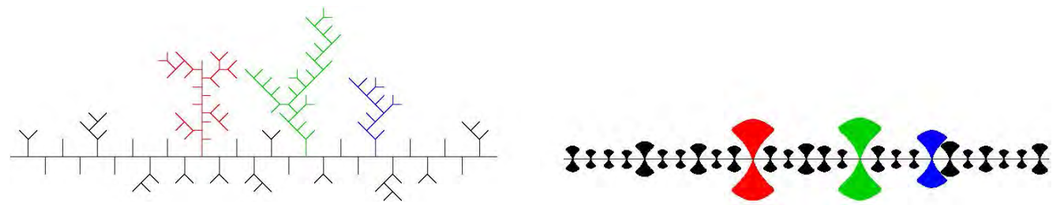
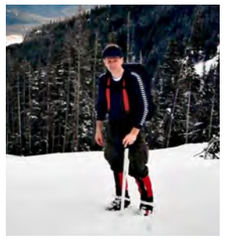


Figure 3. The atomic measure corresponding to the subtrees on a spine.

# Retirements



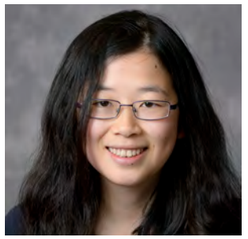
Garth Warner retired at the start of 2017 after half a century of service to the department, having come directly from the University of Michigan upon receiving his PhD in 1966. Among his many contributions are his classic two-volume text, *Harmonic Analysis on Semi-Simple Lie Groups*, still available 45 years after its publication.

Tom Duchamp, a mainstay of the department's differential geometry research and teaching program, retired this past summer and is now Professor Emeritus. Tom received his PhD from the University of Illinois in 1976 and spent three years at the University of Utah before coming to UW. He continues to teach in retirement, stepping in this fall to fill a hole in our senior-level topology course.

# New faculty & staff

## Acting Assistant Professors

Spencer Becker-Kahn received his PhD from Cambridge University in 2015, then spent two years as a postdoc at MIT. He will continue his research in geometric measure theory, collaborating with Tatiana Toro.



Heather Lee received her PhD from UC Berkeley in 2015 under the supervision of Denis Auroux, then spent a year at Purdue as a postdoc and a year as a Member at the Institute for Advanced Study in Princeton. She will continue her research in geometry, collaborating with Jayadev Athreya.

Liping Xu received her PhD from the University of Paris earlier this year under the supervision of Nicolas Fournier and Stéphane Seuret. She will continue her research in probability, collaborating with Zhenqing Chen.

Lucas Braune received his PhD from the Instituto Nacional de Matematica Pura e Aplicada in Brazil earlier this year under the supervision of Eduardo Esteves. He will continue his research in algebraic geometry, collaborating with Sándor Kovács.

Jake Levinson received his PhD from the University of Michigan last spring under the supervision of David Speyer. He will continue his research in algebraic geometry and combinatorics, collaborating with Sara Billey and Jarod Alper.

Tuhin Ghosh received his PhD from the Tata Institute of Fundamental Research in 2016, and has since been a postdoc at the Hong Kong University of Science and Technology. He will continue his collaboration with Gunther Uhlmann on inverse problems.

**In the last year, Dawn Kajimura and Alice Boytz have joined the staff of the Student Services Office.**

photo by Dorothée Brand

Dawn, a UW alumna, was previously assistant director in UW's Undergraduate Admissions office, where she worked for 16 years with prospective freshmen and transfer students. She now has the pleasure of working with students on the other side of the admissions process, as one of the department's academic counselors.

photo by Dorothée Brand

Alice came to us following many years in the financial industry. She is now a program assistant, enjoying her transition to work in higher education.



# Cédric Villani

Last May, French mathematician and 2010 Fields Medalist Cédric Villani spent a day in town on a visit arranged by the French Consulate in San Francisco. He began the day meeting with corporate and foundation leaders in the area, then arrived on campus to see the Burke Museum's collection of spiders. After that, he gave a public lecture titled *Of Triangles, Gases, Prices and Men: the surprising encounter of three fields of research, namely non-Euclidean geometry, statistical physics and mathematical economy, and a reflection on the human drivers behind mathematical research*, with a reception following. Professor Villani also devoted time to his campaign for a seat in the French National Assembly, which he would win in the June elections. He now represents a constituency south of Paris as a member of President Macron's party.

Cédric Villani answering a post-lecture question from Soumik Pal.

# 2017–18 Milliman Lecturer

## Martin Hairer

### Imperial College London



Martin Hairer is Chair in Probability and Stochastic Analysis at Imperial College London. In 2014, Hairer was awarded the Fields Medal, the world's most prestigious mathematics award, for his "outstanding contributions to the theory of stochastic partial differential equations, and in particular for the creation of a theory of regularity structures for such equations."

His other honors include the Whitehead Prize of the London Mathematical Society (2008), the Philip Leverhulme Prize (2008), the Wolfson Research Merit Award of the Royal Society (2009), the Fermat Prize (2013), and the Fröhlich Prize of the London Mathematical Society (2014). He was elected a Fellow of the Royal Society in 2014 and made an Honorary Knight Commander of the Order of the British Empire in 2017.

During a visit to the department in the fall, Hairer gave three talks, titled Bridging scales: from microscopic dynamics to macroscopic laws; An analyst's incursion into quantum field theory; and Renormalization: a BPHZ theorem for stochastic PDEs.

# Stephen Ames Mitchell

## 1951-2017

Published in *The Seattle Times* (Aug. 27, 2017)

Stephen Ames Mitchell died of cancer on August 17, 2017, his 66th birthday. Steve was a mathematician and professor, beloved by a generation of students at the University of Washington. He was a mountain lover and happiest when hiking or rock climbing, often while simultaneously thinking about math. He loved classical music, learning foreign languages, and most of all, his family.



Steve's lifelong love affair with the mountains began early, when he dropped out of Stanford as an undergraduate to hitchhike around the West, bearded and shaggy-haired, with climbing gear in tow. His propensity to "snap at the rope" of slow climbers ahead earned him the nickname "Mad Dog." His "transient phase" lasted several years; two later stints in college were likewise abandoned due to the irresistible pull of the mountains. He studied math independently, and when he applied to graduate school at the University of Washington, he was admitted to the doctoral program without an undergraduate degree.

He earned his PhD in 1981, completed post-doctoral positions at MIT and Princeton, and returned to UW to join the faculty. He mentored doctoral students who have gone on to succeed in the field, and inspired students of many backgrounds to appreciate and enjoy mathematics. In addition to skilled and devoted teaching, students will remember such classroom diversions as "Great Mathematical Moments at the Movies," the "Topological Theme Park," (as yet unconstructed, but featuring such delights as the Torsion Tube of Terror and the Hopf Rotator), and—inevitably—ongoing chronicles of his daughters and grandchildren.

He was a prominent research mathematician, publishing widely in academic journals. He spoke at conferences around the world, with a predisposition towards those located close to spectacular mountains, like the Dolomites and Bavarian Alps. He received numerous research grants from the National Science Foundation and was honored with an American Mathematical Society Centennial Fellowship. He was a passionate advocate for women in math, both as a teacher and as a colleague.

Born in New York in 1951, Steve spent most of his childhood with his parents and three siblings in Oregon and California, with a memorable year in Belgium. Steve was drawn to Seattle for the mountains, the math ... and for a certain young woman who lived in a houseboat on Lake Union. They married in 1978 and raised two daughters. Their family had many adventures: whitewater rafting, skiing, camping, and travelling to Europe for choir competitions.

Steve was diagnosed with cancer in 2014. Through three years of treatment he continued to teach, hike, and enjoy life each day. He routinely worked on math at the infusion ward at the UW Med Center, and even when he was "too exhausted to do anything" you'd find him reading 19th century literature in Italian and listening to opera. His blog to keep family and friends up-to-date was uniformly positive and upbeat. He accepted death unflinchingly and with true grace, and was profoundly grateful for a life very well lived.

He is survived by his wife of 39 years, Wendy Wagner, daughters Jessica Brown and Abigail Mitchell, sons-in-law Kevin Brown and Oliver Henderson, grandchildren Kaia and Finley Brown, mother Dorothy Mitchell, brother Kenneth Mitchell, sisters Victoria and Janet Mitchell, brother-in-law Jerry Cromwell, brothers-in-law Warren Wagner, and Wayne and Betty Wagner, and a wide circle of friends.

A topologist should always have the last word, so we'll close with this (quoted from Steve's blog, July 14, 2017): "We [humans] like to think that we are special, that we somehow deserve a better fate than a starfish, a hummingbird, or a coyote. No. We are all part of the same amazing Animal Kingdom. And why stop at the animals?

"A wildflower, a saguaro cactus, a towering redwood—they live; they die. They die because they were born.

"When I put my own life and death in this context, within the infinite beautiful cycle of life and death of all living creatures, in its turn embedded in the vast mysterious fabric of Space-Time, I can feel only awe, wonder, gratitude, and a profound peace.

"The end is my beginning."

# Michael John Westwater

## 1942–2017

John Westwater in Eastbourne, East Sussex.

Contributed by Jan Westwater

Professor Michael John Westwater passed away on May 14, 2017, at his home in Seattle. He was born in 1942 in Aylesbury, Buckinghamshire, England. After the war his family lived in Nassau, Bahamas, where his father—a meteorological officer—was stationed from 1947 to 1951. On their return to the UK, the family settled in Cheltenham. John attended Pate's Grammar School (now Cheltenham Grammar School) until he was awarded a scholarship to Trinity College Cambridge at the age of 16.

John earned a first-class degree in Mathematics in 1962 and began to work towards his PhD in the mathematics of theoretical physics. He was awarded a Jane Eliza Procter Visiting Fellowship to the graduate school of Princeton University for 1963–1964. He extended his stay by becoming an instructor for the subsequent year. During the second year, he met his future bride, Jan Justice of Lubbock, Texas, who was in graduate school at Columbia University.

The laws governing immigrant academics required John to spend at least two years away from the United States before he could seek a permanent job. He and Jan moved to Switzerland, where they both taught at the Leysin American School while John finished his doctoral thesis, On the Renormalization of Feynman Integrals. From 1966 to 1968 John held a NATO post-doctoral fellowship at the Eidgenössiche Technische Hochschule in Zürich. In the spring of 1968, John and Jan became parents to twins William and Heather.

At the end of that summer, the family moved to Princeton, where John was a member of the Institute for Advanced Study. During his two years there, he collaborated with Tullio Reggie, Giorgio Ponzano, and Gene Speer studying the monodromy rings of certain Feynman graphs.

In the fall of 1970, John accepted an assistant professorship in the Department of Mathematics at the University of Washington. In 1971, they had a third child, Elliot.

John continued at "the U" until his retirement in 2005. He described his mathematical interests as "statistical mechanics and probability theory with a special orientation which comes from quantum field theory." He was promoted to Associate Professor in 1974 and returned to the Institute for Advanced Study for a sabbatical year to continue the collaboration with Regge and Speer. Over the next few years, he was invited to speak at conferences in Kyoto, Vancouver, San Francisco, and Lausanne. In 1980, he was promoted to Professor. The following year he spent a sabbatical at Bedford College in London and at the Zentrum für interdisziplinäre Forschung in Bielefeld, Germany. He was notorious for sharing stories of famous mathematicians with his family right up to the morning of his death, evidence of his continued interest in all things math.

Besides math, John loved travel and the active outdoor life—he enjoyed swimming (especially in open water), cycling, and hiking and long-distance walking holidays. He and Jan were inveterate travellers and since his retirement they had made almost-annual trips to Europe to explore regions of France, Germany, Italy, and Spain and to visit relatives in England. He was a proud and caring grandfather of eight grandchildren and made a point of taking each grandchild, except his youngest, born just 10 weeks before he died, on a special trip to Europe to share his love of travel with them.

A celebration of his life was held at the Woodland Park Lawn Bowling Club, of which John was the board member for the croquet section—a sport which he took up quite late in life but to which he applied himself with his habitual passionate enthusiasm and no small degree of success. It was attended by all his immediate family, including Jan, his sister, Rosalind, and her husband from England, William, Heather, and Elliot and their spouses and children, and many friends and colleagues.



# Caspar Curjel

## 1931–2017

Caspar holds Aki, the daughter of Lensey and Issac, with Marianne in the middle and Lensey on the right.

Contributed by Isaac Namioka

The friendship between the Curjel family and ours began around 1960 in Ithaca, New York. Both Caspar and I were young instructors in the mathematics department at Cornell University, and we were next door neighbors on East Seneca Street. The Curjels were newly arrived from Switzerland, where Caspar was a student of Professor Beno Eckmann of ETH Zurich. Caspar's area of interest in mathematics was algebraic topology, whereas mine was linear topological spaces. I felt that at Cornell, my area was not appreciated, perhaps even regarded with utter contempt. So I started to learn algebraic topology and homotopy theory in self-defense. In 1961, Peter Hilton came to Cornell as a visiting professor, and he started a year-long lecture course on Eckmann-Hilton duality theory. Of course, Casper and I eagerly attended Hilton's lectures.

Meanwhile, at home, my wife, Lensey, became pregnant with our second child, and around the same time, Casper's wife, Marianne, also became pregnant, with their first child. Which of us would have a baby first became a small race on East Seneca Street. Marianne won with her baby boy, Ulam, born on August 16, 1961, whereas our baby girl was born on August 28, 1961.

Since there was no chance of my getting tenure at Cornell, Lensey and I decided to spend a year at the Institute for Advanced Study in Princeton. Fortunately, my application to be a visiting scholar during the 1962-1963 academic year was accepted. While at Princeton, we lived in institute housing. During that year, I visited Seattle with two purposes: to visit UW and to attend the World's Fair. At UW, I met Professor Allendoerfer and thanked him for my appointment as an associate professor with tenure. We also went to the Century 21 Exposition and looked around the city, which made a very good impression on us.

Casper and Marianne decided to spend the following year at the Institute for Advanced Study, taking over the house we had just vacated. I was appointed to be the UW Math department's colloquium chairman that year, and so I invited Caspar to give a talk at our weekly colloquium. He came and stayed with us after the talk. The next day, it was very cold and clear. Caspar, standing at a window, saw Lake Washington and the snow-covered Cascade Mountains. He was very impressed by the sight. He did not say, but perhaps it reminded him of his home country. During 1964-1965, Casper came to UW as a visiting associate professor, and became an associate professor a year later.

We bought a house in Seattle's Montlake neighborhood, since it had several advantages: it was within walking distance to the University, and it was close to the Arboretum, Interlaken Park, and the Montlake Canal. Yet housing prices were depressed in

(continued on p. 18)

(continued from p. 17)

Montlake. According to our real estate agent, houses were cheap because colored people were moving into this area. Lensey said, "But we are colored." So we were able to buy our house for a little over $20,000. The next year, the Curjels bought a large house that was only a block and a half from ours, and just a few houses away from the house of our colleague Maynard Arsove.

Caspar set up an elaborate toy train rail system in his unfinished third floor attic. His trains were very big, comparable to the toy train set at the Seattle Center during the Christmas season. I suppose Casper had those trains as toys when he was a boy in Switzerland.

Casper was involved with Montlake community matters. For instance, he was a member of Citizens Against the R.H. Thomson (CARHT), which fought against the state project of a four-lane freeway (the R.H. Thomson Expressway) east of and parallel to 1-5 that would run north-south along the Arboretum and down to I-90, removing a big chunk of the residential areas from Montlake southward. Thanks to CARHT, the City Council removed the proposed freeway from the comprehensive plan.

Casper retired from the University of Washington in 1998, two years after my retirement. After a couple of years, the Curjels returned to Switzerland. Casper visited us once on the way to see his daughter, Hania, in Oregon. Unfortunately, this was the last time we saw him.

# Frank Brownell

## 1922-2017

Published in *The Seattle Times* (Nov. 12, 2017)

Frank H. Brownell died peacefully at home with loved ones on October 21, 2017, at the age of 95 years old. Frank was born on September 20, 1922 in New York City, moving to Seattle in the mid nineteen-twenties where he enjoyed an active childhood full of newspapers, books, trips to the family home on Bainbridge Island, and boating on Puget Sound. His love of reading began as a child and books were his constant companion throughout his life. Always a scholar, photos of Frank as a child show him in a favorite reading chair, book in hand and smiling. He served as a lieutenant in the U.S. Navy in the Pacific theater during the Second World War, and in the course of operating counter-radar machines, gained his interest in mathematics that set the course for his life and career. He earned degrees and won math awards at Yale University and the School for Advanced Study at Princeton University, where he crossed paths with noted physicists Einstein and Oppenheimer. He met his wife, Gloria Collins, attending folk dances in Princeton, they married in 1950 and moved to Bainbridge Island, where they raised five daughters. Frank spent his academic career as a mathematician at the University of Washington, retiring in 1987, but remained an active researcher: his last thirty years were spent working on a new proof for the unmapped mathematics that could explain the "Lamb shift," in which sub-atomic particles jump locations unpredictably. With his second wife Catherine Noonan, Frank enjoyed travel, sailing, opera, and their mutual sense of humor. He was a devoted father and grandfather, sharing especially his love of reading-many of his family's fondest memories revolve around his regular reading aloud of stories ranging from the Wizard of Oz to Treasure Island to Winnie the Pooh.

He was preceded in death by his daughter Lissy in 1970, his son-in-law John Cameron in 1985, his second wife Catherine in 2003, his first wife Gloria in 2005. Frank is survived by his sisters Phyllis Crooks and Betty Weinstock, daughters Basilia Brownell, Susan Brownell, Nell Brownell, Jennifer Cameron and grandchildren Sarah Goldberg, Leah Goldberg, Samuel Cameron, Benjamin Cameron (Corrie Bell), and Francine Brownell, as well as stepchildren and grandchildren. The family wishes to thank Frank's wonderful caregivers for the excellent quality of life they gave him at home his last few years. Donations can be made in his memory to the Battle Point Astronomical Society or any educational scholarship fund.



# Graduating Class 2017

## DOCTORATE

Gerandy BRITO MONTES DE OCA (advisor: Ioana Dumitriu) | Spectral analysis from Ramanujan graphs to community detection. Postdoc at Georgia Tech.

William Riley CASPER (advisor: Max Lieblich) | Bispectral Operator Algebras. Postdoc at Louisiana State University.

Yuanlong CHEN (advisor: Hart Smith) | Strichartz estimates for the wave equation on Riemannian manifolds of bounded curvature. Industry.

Rebecca HOBERG (advisor: Thomas Rothvoss) | Bin packing, number balancing, and rescaling linear programs. Simons Institute for the Theory of Computing and Postdoc at University of Washington.

Avi LEVY (advisor: Christopher Hoffman) | Novel uses of the Mallows model in coloring and matching. Microsoft Research.

Abdalla NIMER (advisor: Tatiana Toro) | Geometry of non-flat n-uniform measures. Postdoc at University of Chicago.

Courtney PAQUETTE (advisor: Dmitriy Drusviatskiy) | Generic acceleration schema beyond convexity. Postdoc at Ohio State University.

Harishchandra RAMADAS (advisor: Thomas Rothvoss) | Algorithms in Discrepancy Theory and Lattices. Palantir.

Lidan WANG (advisor: Chen, Zhenqing) | Non-local operators, jump diffusions and Feynman-Kac transform. Working in China.

Hailun ZHENG (advisor: Isabella Novik) | On the $G_2$-number of various classes of spheres and manifolds. Mathematical Sciences Research Institute and Postdoc at University of Michigan.

# Student Awards

### Graduate:

| | |
|---|---|
| Academic Excellence: | Joon Yong Choi<br>David Clancy<br>Collin Litterell |
| Craig McKibben and Sarah Merner Endowed Fellowship: | Samantha Davies<br>Reed Meyerson |
| Excellence in Teaching: | Tim Mesikepp<br>Sam Roven |
| Gloria C. Hewitt Graduate Fellowship: | Yiping Hu |
| Hart F. Smith Endowed Graduate Fellowship: | Peter Lin |
| Kazanci, Mehmet Ve Fazilet Endowed Graduate Fellowship: | Travis Scholl |
| Lisa Tanzi and Charles Egerton Endowed Fellowship: | Zihui Zhao |
| McFarlan Fellowship: | Yiping Hu<br>Collin Litterell |
| Steve Mitchell Graduate Fellowship for the Love of Mathematics: | Kristin DeVleming |

### Undergraduate:

| | |
|---|---|
| Honors Calculus Award (1st year): | Jifan Zhang |
| Honors Calculus Award (2nd year): | Haim Grebnev |
| Gullicksen Award for Outstanding Juniors in Mathematics: | Everett Cheng<br>Natalie Hollenbaugh<br>Jasper Hugunin |
| Outstanding Graduating Senior in Mathematics (B.A. Teacher Preparation): | Katelyn Guard |
| Outstanding Graduating Senior in Mathematics (B.A. Standard Major): | Arianne Hermida |
| Outstanding Graduating Senior in Mathematics (B.S. Standard Major): | Peter Rudzis |
| Outstanding Graduating Senior in Mathematics (B.S. Comprehensive Major): | William Dana<br>Collin Litterell |
| Putnam Exam Outstanding UW Score: | William Dana<br>Jasper Hugunin |

## MASTER'S

Reza EGHBALI (advisor: Rekha Thomas)

Hikaru KIYO (advisor: Monty McGovern)

Ivana THNG (advisor: Isabella Novik)

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If you are thinking of making a gift to the Department, or remembering the Department through an estate gift, we invite you to discuss the matter with the chair, Ron Irving, or Alex Haslam of the Advancement Office in the College of Arts and Sciences (alexeck3@uw.edu). You can also visit our web site at www.math.washington.edu and click on "Give now."

The following friends have contributed to the Department between September 2015 and November 2017.

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