

MATH MATTERS

CORNELL UNIVERSITY DECEMBER 2017

Here's an interesting fact: Well over half of our majors earn a second major in the [College of Arts & Sciences](#). Cornell math majors may concentrate in another area by taking 3-4 upper-level courses in that subject, thereby making a double major easier. Currently, we have concentrations in Applied Mathematics, Computer Science, Economics, Mathematical Biology (conceived by [Elizabeth Rach '04](#) who wanted to pursue this area), Mathematical Physics, Operations Research, Statistics, and, of course, Mathematics. This flexibility is reflected in the wide range of activities our students pursue at Cornell and paths they follow after graduation. Here is just a small sampling of what the class of 2017 did while at Cornell and is now doing out in the world:

Jake Burchard did research in social network theory with Professor [Ben Cornwall](#) from [Sociology](#) and plans to pursue a Ph.D. in this field. Rachel Feldman applied iterated Laplace approximations in her research with [Natural Resources](#) Prof. [Patrick Sullivan](#) while Nitin Shyamkumar worked in Prof. [Jesse Goldberg's](#) computational Neuroscience lab. Noah Kwicklis joined the [Federal Reserve](#) as a research analyst and Mary Hollinger works [Bloomberg LP](#) as a software engineer. Daniel Choi is serving as a 2nd Lieutenant in the [U.S. Marine Corps](#). [Vivian Kuperberg](#), featured in the [2016 MM](#), has begun a Ph.D. program in Mathematics at [Stanford](#) on a [National Science Foundation](#) (NSF) Graduate Research Fellowship. Wenhui Feng is working as an interactive

LETTER FROM THE CHAIR

RAVI RAMAKRISHNA '88

engineer at [Snapchat](#).

We are excited to have three new faculty join the Department this year: [Daniel Halpern-Leistner](#), [Slawomir Solecki](#) and [Phillippe Sosoe](#).



Ravi Ramakrishna

They are all outstanding teachers and scholars whose research complements our current strengths very well. See page 4 for more details. We are also joined this year by Lecturer [Steven Bennoun](#). Steve will help us implement the department's piece of the [A&S Active Learning Initiative](#). Over the next three years, under the leadership of Professor [Tara Holm](#) and

Senior Lecturer [Kelly Delp](#), we will transform how we teach Calculus to A&S students.

Congratulations to [Lionel Levine](#) on his promotion to Associate Professor. Lionel works in the areas of combinatorics and probability. We are very excited to continue working with Lionel in the years to come.

[Laurent Saloff-Coste](#) and [Birgit Speh](#) were named, respectively, the Abram R. Bullis and Goldwin Smith Professors of Mathematics. Professors [John Guckenheimer](#), [Yulij Ilyashenko](#) and Senior Lecturer [Allen Back](#), whose combined service to the Department totals over 80 years, retired this year. We wish them well as they begin new chapters in their lives!

Continued on page 4

THANKS TO OUR FRIENDS

Our friends have been very generous to our students this year, both undergraduate and graduate.

Many of you will remember Retired Senior Lecturer Tom Rishel who worked for Cornell from 1974-2005. **Tom and Mary Ann Rishel** recently made a significant donation to the [Hutchinson fund](#) which provides support to outstanding graduate students.

Bung-Fung Torng, a former graduate student in the Department, has endowed the [Torng prize](#) that will be awarded each year to an outstanding graduate student TA. The prize provides summer support that will allow the student to focus on their thesis

work. The award will commence in the summer of 2018.

We have run the [Summer Program for Undergraduate Research](#) (SPUR) the last few years as a continuation our previous REU program that was funded by the NSF. **David and Jeannette ('87) Rosenblum** have generously agreed to provide funding for SPUR for the next 3 years. Though not an alum, David did summer research here at Cornell with Professor [Strichartz](#) in the early '90s and has deep family ties to the Ithaca area.

Our teaching and research are better, thanks to the gifts that we receive from our friends.

SPUR PROGRAM

BOB STRICHARTZ

This summer the Department hosted 26 undergraduates from around the world to conduct research in analysis of fractals, discrete geometry and finite group theory. The students have already begun to present their results at conferences.

The analysis on fractals group, led by Professor [Robert Strichartz](#) and grad student [Abigail Turner](#) worked on three projects.

Three students studied exotic Laplacians on the Sierpinski gasket (SG). Constructed by [J. Kigami](#), in 1989, it was the first interesting example of a fractal that possesses a Laplacian. It turns out Kigami's Laplacian is not the only one that has symmetry and self-similarity. The students this summer discovered and proved interesting properties of a whole family of Laplacians. They extended the well-known [Sturm-Liouville theory](#) of differential equations to a fractal setting. Sizhen Fang, Dylan King and Seraphina Lee '19 submitted their results to the [Journal of Fractal Geometry](#).

Another group (Yuming Chen, Harry Gu and Zirui Zhou) studied a generalization of Kigami's theory to what we are calling "hybrid fractals." These combine the structure of different pure type fractals. The first such example was given by Prof. [Patricia Alonso-Ruiz](#) of the [University of Connecticut](#) and the paper we are preparing is joint with her.

The final fractals group performed experimental studies of the Laplacian on the projective octagasket, a self-gluing of the octagasket. Yiran Mao, Levente Szabo and Hong Wong found strong experimental evidence by studying discrete approximations and are working on a paper.

The Discrete Geometry team worked on projects supervised by Professor [Florian Frick](#) and grad student [Maru Sarazola-Duarte](#).

The project "Topological Methods in Discrete Geometry" focused on the interplay of symmetries, the existence of embeddings, and intersection patterns of sets. Jai Aslam, Shuli Chen '18, Ethan



Math Majors Anna Browinsky (L) & Matt Funkhouser (R) in a 3-D SG
Photo Credit: Yuanhui Mao

Coldren, and Linus Setiabrata '20 almost entirely solved the unsettled cases of [Sarkaria's 1990 generalized Kneser conjecture](#), which concerns the intersection pattern of k -element subsets of an n -set.

Yu-hin Chan, Tristan Hull '18, Linus Setiabrata, and George Spahn worked on a curious relation between the existence of embeddings of projective spaces into Euclidean space and intersection patterns of finite sets. They found new non-embeddability results and proved higher-dimensional versions of the classification of linklessly embeddable graphs.

Yu-hin Chan, Shujian Chen, and Tristan Hull '18 proved generalizations of the [Borsuk-Ulam theorem](#), establishing the nonexistence of

maps from products of spheres or [Stiefel manifolds](#) that commute with certain symmetries. They applied their extensions to show the existence of certain equipartitions of measures in Euclidean space by hyperplanes.

Jai Aslam, Shujian Chen, Sam Saloff-Coste '18, and Linus Setiabrata showed that any rectifiable continuous curve in the plane can be split into four pieces that can be rearranged by translations into two loops of equal length. They proved generalizations of this result for curves in d -space and several loops of equal length, which also extends the seemingly unrelated fair [necklace splitting](#) result of [Noga Alon](#). Four manuscripts containing these results are currently in preparation.

Professor [Keith Dennis](#) and TA Ravi Fernando (a 2013 summer researcher here) led the research in group theory. Much of the work this summer centered around the invariant $m(G)$ of a group G . A generating set S of a group is a subset that generates the group such that no smaller set generates the group. The quantity $m(G)$ is the size of the largest generating set of a group. Ravi gave an exciting talk where he explained the computation of $m(G)$ for the group of moves of the Rubik's cube. He ended his lecture by solving a cube while juggling three!

Min Nguyen generalized a result of Whiston from symmetric groups to the alternating groups and determined $m(G)$ of many wreath products.

Tianyue Liu related towers of simple groups to $m(G)$ in many cases and thus determined $m(G)$ for a number of new cases.

Sophie Le found new methods and wrote programs to extend computations of several invariants
Continued on page 4

MATH CAREER SYMPOSIUM FOR ITHACA HIGH SCHOOL STUDENTS

MARY ANN HUNTLEY

If you...talk to your average high schooler and you ask them how they feel about math, a lot of them will respond [by] talking about how hard and tedious and painful...it is. But what about math stood out to you?.... You all talked about having a passion for math and how it's really cool and applicable...What, specifically, stands out about math – to you – as [being] a good field?

So when you're...working on a new problem, I would imagine that you wouldn't necessarily know how long it would take you to solve...how many step are required...How do you allocate your time and...work...efficiently... if there's a problem that you could work your entire life on and never make a dent in...how do you deal with that...timewise?

These are among the questions that Ithaca High School students asked math professors [Dan Barbasch](#), [Tara Holm](#), and [Operations Research & Information Engineering Professor Damek Davis](#) during the March 2017 Math Career Symposium. Dan, Tara, and Damek responded to these questions as professional mathematicians, with diverse research perspectives.

As late, mid, and early career mathematical scientists with research programs spanning from the very pure to the very applied, their responses were varied and covered a lot of ground.

A majority of the 22 students who attended the symposium were participants in the Math Seminar course. [The Ithaca High School Seminar](#) (IHS) is taught each year by three graduate students. During the first six months, each of three graduate students teaches an intensive eight-week mini course, which is roughly at the level of a junior or senior level college course. After completing the mini courses, the participants are

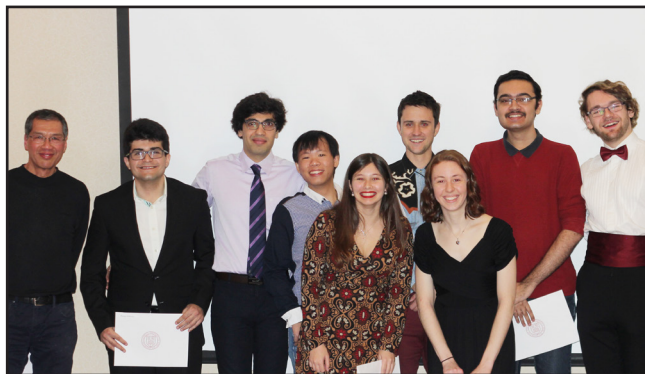
mentored by the three graduate students while working on research projects and preparing presentations on their findings. These are presented to the entire group, their families, past Math Seminar participants, and mathematics graduate students and faculty members at Cornell.

The Math Career Symposium is one enhancement made during the 2016-2017 school year to the IHS seminar, using funding from a

[Dolciani Enrichment Grant](#) from the [Mathematical Association of America](#). Additional funding for Math Seminar is provided by the [Cornell Department of Mathematics](#).



*Dan Barbasch, Tara Holm, & Damek Davis Respond to High-School Students' Questions.
Photo Credit: Mary Ann Huntley*



Congratulations Math Department 2017 Award Winners!

Left to right: [Chung-Yuen \(Herbert\) Hui](#) (MAE)-Senior Faculty Teaching Prize, [Itamar Oliveira](#)-York Award, [Hossein Lamei Ramandi](#)-Battig Award, [Swee Hong Chan](#)-Battig Award, [Maru Sarazola](#)-Torng Prize, [Benjamin Hoffman](#)-Battig Award, [Lila Greco](#)-Graduate Teaching Award & [James Barnes](#)-Graduate Teaching Award.

Not pictured: [Marcelo Aguiar](#)-Senior Faculty Teaching Prize, [Quincy Loney](#)-Junior Faculty Teaching Prize, [Matt Hin](#) (CAM)-Graduate Teaching Award, & [Max Hallgren](#)-York Award.

THREE NEW FACULTY JOIN THE MATH DEPARTMENT



Daniel Halpern-Leistner, joins us as an Assistant Professor. His area of expertise is algebraic geometry and his current research project is the “beyond geometric

Daniel Halpern-Leistner Photo credit, University Photography

invariant theory” program. He is incorporating modern methods to develop a new approach to moduli problems.

Previously, Daniel was an NSF Post Doc/Ritt Assistant Professor at [Columbia University](#) from 2013-2017 and a member in the [Institute for Advanced Study at Princeton](#) from 2014-2015. He earned his Ph.D. in Mathematics at the [University of California, Berkeley](#) in 2013.

When he is not working, he enjoys swimming, hiking, and playing table tennis.

Slawomir Solecki, is a logician who applies insights from mathematical logic to study geometric and algebraic objects and their symmetries.



Slawomir Solecki

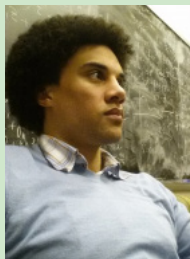
Previously, Slawek was a Professor in the Department of Mathematics at the [University of Illinois, Urbana-Champaign](#) and an Associate and Assistant Professor at [Indiana University](#). He earned his Ph.D. in Mathematics at the [California Institute of Technology](#) in 1995 and is excited to collaborate with other faculty members, teach, and supervise brilliant students. This year he is teaching graduate courses in logic.

He looks forward to visiting Cornell’s world class [Laboratory of Ornithology](#) to indulge his hobby of birdwatching.

Phillippe Sosoe, joins our probability group as an Assistant Professor. Right now Phil is working on distances in random media and dispersive equations with random data.

Before joining Cornell, he was a Postdoctoral Fellow at the [Center for Mathematical Sciences and Applications](#) at [Harvard University](#). Phil earned his Ph.D. in mathematics from [Princeton University](#) in 2014.

This semester Phil has been teaching the intro graduate course in probability. Next semester he’ll teach the undergraduate stochastic processes course.



Phillippe Sosoe

His interests include reading about physics, economics, and politics. He also likes to swim and hike. Phil finds the excellent math department with a friendly atmosphere and all of the nearby nature Ithaca has to offer, the most exciting aspects of coming to Cornell.

Read Math Matters online:

<https://www.math.cornell.edu/m/News/MathMatters>

The electronic version includes links to individuals’ webpages and research articles

LETTER FROM THE CHAIR CONTINUED

Continued from page 1

Professors [Camil Muscalu](#) and [Nicolas Templier](#) were awarded [Simons sabbatical fellowships](#). These allow them to take a full year sabbatical.

Led by mathematicians, a diverse group of Cornell faculty from across the campus have been awarded a [Research Training Grant from the NSF](#). See page 6.

As always we look forward to hearing from *you*. Please visit us in Malott when you come to campus, or drop us a line.

GIVING DAY
Giving Day 2017
Math received **36 gifts**
totalling over **\$8,500**
Thanks to our friends!

SPUR PROGRAM CONTINUED *Continued from page 2*

of finite groups to cases of larger simple, almost simple, and other finite groups.

Benjamin Hughes developed programs in [MAGMA](#) to replace the much more inefficient programs that had been developed earlier using GAP.

Ellie Thieu found new cases of solvable finite groups where $m(G) \neq \text{MaxDim}(G)$.

Wenjun Niu showed that $\text{MaxDim}(G)$ was additive on a large class of finite groups.

Hy Lam determined new cases of the replacement property for several groups of type $\text{PSL}(2, q)$.

ALUMNA SPOTLIGHT - KATHERINE McCULLOH '12

YVETTE LISA NDLOVU

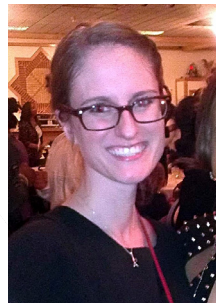
Katherine McCulloh '12 thinks math is an art. "Before attending Cornell I didn't see math as the intricate art it is," she said, "but being exposed to math at such an advanced level at Cornell helped me push myself to think, to see mathematics on a deeper level and construct more concrete arguments."

Now on the Math Team at [Success Academy Charter Schools](#), McCulloh said math has opened up many possible career options for her. After graduating with a math major, McCulloh pursued her passion for math education by teaching at [Pershing High School](#) in Detroit. She then went on to work as an operations assistant at the [National Museum of Math](#) before taking her current job.

"Being a math major and taking high level mathematics

classes made me think in a different way about the world around me," McCulloh said, "It definitely prepared me for my work after graduation at the Museum of Mathematics and my current position."

In her current position, McCulloh develops curriculum and provides resources and training to support middle school math teachers.



Founded in 2006 by [Eva Moskowitz](#), Success Academy Charter Schools is the largest free, public charter school network in New York City. Success Academy operates 46 schools serving 15,500 students in Manhattan, Brooklyn, Queens and the Bronx.

During her time at Cornell,

McCulloh participated in the math department's K-12 education and outreach activities, which are led by faculty, graduate students and undergrads in math and the Center for Applied Mathematics. She was also a math tutor at [Belle Sherman Elementary School](#), which involved both in-class tutoring and assisting with an after-school program.

Outside of the classroom, McCulloh participated in the "[Vagina Monologues](#)" productions and worked at the Cornell's [Women's Resource Center](#). She also interned at the [James Martin Center for Nonproliferation Studies/ Monterey Institute of International Studies](#).

"All my experiences at Cornell were very formative," McCulloh said. "Cornell prepared me well for my work in education."

COOK AWARDS HONOR THOSE COMMITTED TO WOMEN'S ISSUES

BILL STEELE

The [Alice H. Cook Awards](#) were presented on March 9, 2017. Cook Awards honor Cornell students, faculty and staff members for their commitment to women's issues and for improving the climate for women at Cornell.

The Cook Award Committee and the [University Diversity Council](#) select winners from nominations made by members of the Cornell community. The awards honor the late [Constance E. Cook](#), Cornell's first female vice president, and the late Professor [Emerita Alice H. Cook](#), founding member of

[Cornell's Committee on the Status of Women](#).

The 2017 recipients and highlights of their nominations: Doctoral candidates [Ayah Almousa](#),

[James Barnes](#), [Lila Greco](#), and [Smaranda Sandu](#), officers of the [Cornell student chapter](#) of the [Association for Women in Mathematics](#) (AWM), and [Tara Holm](#),

professor of mathematics and AWM faculty adviser.

The purpose of the AWM is to encourage women and girls to study and to have active careers in the mathematical sciences, and to promote equal opportunity and the equal treatment of women and girls in the mathematical sciences.



2017 Cook Awardees from the Association for Women in Mathematics (AWM) with President Hunter Rawlings and Mathematics Professor and Chair Ravi Ramakrishna (L to R) President Smaranda Sandu, Vice President Lila Greco, Treasurer James Barnes, and Professor of Mathematics & Faculty Advisor, Tara Holm (not pictured, Ayah Almousa.)
Photo Credit: University Photography

MATHEMATICIANS AIM TO IMPROVE COMMUNICATIONS

TOM FLEISCHMAN

Mathematicians often struggle with the idea of communication - to the rest of the world, and even with each other - but a recently secured grant from the [National Science Foundation](#) (NSF) will help mathematicians tackle that problem.

The NSF this spring awarded Cornell a five-year, \$2.5 million grant under its [Research Training Group](#) (RTG) program, which supports efforts to improve research training by involving people at all levels in structured research. Cornell's project is titled "[Dynamics, Probability and PDEs \(partial differential equations\) in Pure and Applied Mathematics](#)". The team, led by Principal Investigator (PI) [Steven Strogatz](#), will attempt to bridge the gaps between those mathematical disciplines through collaborative, interdisciplinary research, while including novel elements to help the next generation of mathematicians learn to communicate broadly.

The program, which started this fall includes faculty, postdoctoral associates, graduate students, undergrads, and high school students, all working together in various ways. Eleven faculty from across Cornell are involved in the project. The co-PIs are math professors [Tim Healey](#), [Laurent Saloff-Coste](#), and [Alex Vladimirovsky](#), and operations research and information engineering professor [Gennady Samorodnitsky](#).

Among the unique aspects of this RTG: a math communication seminar developed at Cornell in collaboration with the [Alan](#)

[Alda Center for Communicating Science](#). "Mathematicians are notoriously bad at [communication]," said Strogatz. We're writing on the board, with our back to the audience like they don't even need to be there as far as we're concerned," he said jokingly. "The Alda Center has this track record

intersections. Part of his motivation, he said, is that he wishes it had been taught that way to him during his graduate education at the [University of California, Berkeley](#). "It was a wonderful program," he said, "but in looking back I discovered that there was a significant deficiency: A lot of important

mathematical subjects such as probability theory, partial differential equations, dynamical systems" were taught as completely disparate subjects. It took me many years after finishing to realize the connections."

Regarding the communication component of the RTG, one of the Alda Center's proven methods helping scientists explain their work more effectively is the use of improvisational games and exercises borrowed from theater. Alda

Center instructors will participate via Skype and in person.

Communication isn't generally high on the priority list for mathematicians, especially theoreticians like Saloff-Coste. "It's clear that it's not easy to communicate mathematics; it's a fundamental difficulty," he said. "Within the [math] community, I think it's good to just talk about it, to recognize that there is a problem."

Strogatz is hopeful that this attempt at fostering better math communication will spread. "It's going to be innovative, he said. "We're going to develop this over the next five years and try to make it something valuable. If it works, we expect it to be helpful to programs elsewhere, and maybe even to the profession more broadly."



From left, [Alex Vladimirovsky](#), [Steven Strogatz](#) and [Laurent Saloff-Coste](#). The three are among the five lead professors of a research training group that has just received a five-year, \$2.5 million grant from the National Science Foundation. Their program began September first. Photo Credit: Tom Fleischman

with scientists of making people warmer and more engaging, and more understandable."

Saloff-Coste, the Abram R. Bullis Professor of Mathematics and former math department chair, was on the faculty team for Cornell's previous math RTG, "Interdisciplinary Training in the Applications of Probability," from 2003 to 2013. Building on the experience of that prior RTG, the new project brings together pure and applied mathematics, but in a broader context.

"The fields of partial differential equations, dynamics and probability all are very much intertwined, and all have pure and applied aspects," Saloff-Coste said. "They very naturally feed into one another."

Vladimirovsky agrees that the three areas have many

IN MEMORIAM

Professor Emeritus **Clifford John Earle** passed away at the age of 81, on June 12, 2017. Cliff graduated from **Swarthmore** with a B.A. in physics. He earned his Ph.D. at **Harvard** in 1962 with **Lars Ahlfors**, one of the first two **Fields Medalists**. He spent 1962-63 at Harvard as an Instructor. He was a member at the **Institute for Advanced Study** from 1963-65 and joined Cornell in the Fall of



Clifford Earle

1965. He served 39.5 years here, including a term as Chair from 1976-79. Six students earned their Ph.D. with Cliff and his 83 papers have been cited over 1000 times by almost 600 different authors. He was a **Guggenheim Fellow**, **Distinguished Orway Visitor** at the **University of Minnesota** and Honorary Professor at the **University of Warwick**. Cliff

was also a talented piano player who, with retired Director of the Math Support Center, Doug Alfors, founded the Department's annual spring recital in 1991, which continues to this day. He is survived by his wife **Lisa**, **Professor Emerita of Entomology**, daughters, Rebecca and Susan, two grandsons, Gabriel and Isaac, and a first cousin, Ed (Bobbie) Griffith.

Professor Emeritus **Roger Farrell** passed on September 28, 2017 at the age of 88. Roger's work was in the application of decision theory methods to statistical problems. He wrote two textbooks: "**Multivariate calculation - Use of the continuous groups**" in the Springer series in Statistical Sciences and "**Techniques of multivariate calculation**" in the Springer Lecture Notes in Mathematics series. Four of his 34 papers were joint with **Larry Brown**, a 1964 Cornell Ph.D. student of Professor **Jack Kiefer**.

Roger earned his Ph.D. from the **University of Illinois at Urbana-Champaign** in 1959 working with **Donald Burkholder**. His dissertation is titled "Sequentially Determined Bounded Length Confidence Intervals". He joined the Mathematics Department at Cornell as an Instructor in 1959, teaching analytic geometry and calculus in his first year here. He was promoted to Assistant Professor in 1961, Associate Professor in 1963 and Full Professor in 1967. He served as Associate Chair from 1975-77 and became Professor Emeritus in 1999. Roger was an avid photographer and bird watcher. He was a founding member of the **Cayuga Bird Club** and supporter of the **Cornell Lab of Ornithology**. He is survived by his wife LeMoyné.



Roger Farrell

FRACTALS CONFERENCE

BOB STRICHARTZ

When sunlight hits the top of a cloud, how does the energy distribute through the cloud and what part gets reflected back into space? It turns out the cloud should be modeled as a fractal, not as a pillow, and the standard methods of mathematical physics do not apply. This is the sort of question that those gathered at the **6th Cornell Conference on Analysis, Probability, and Mathematical Physics on Fractals** hope to address. The conference, held at Cornell in June, 2017, brought together mathematicians and physicists working in the area and young people interested in learning about the area. There

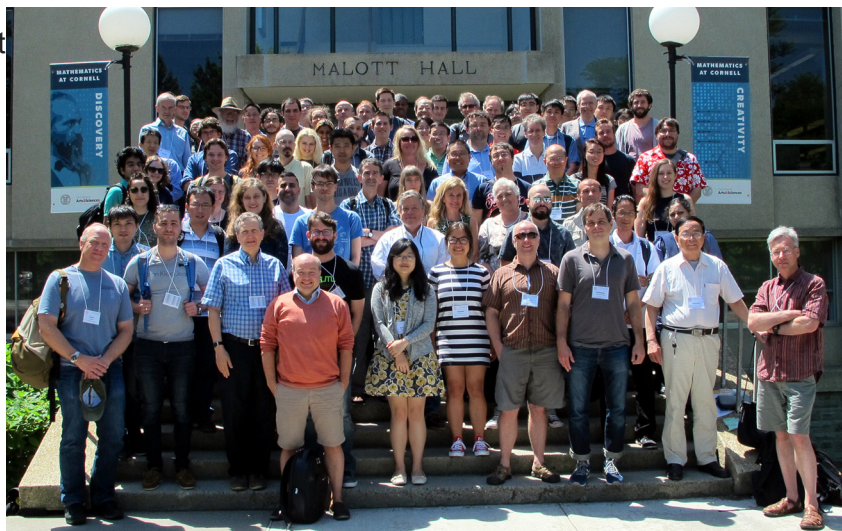
were two short courses targeted to non-experts. Also notable was the fact that some of the lectures were presented by students, both undergraduate and graduate. We have been running these conferences every three years.

For the first time we are

planning a conference proceedings volume to be published by **World Scientific Press**. The seventh conference is planned for 2020.

The conference was organized by **Robert Strichartz** (Cornell), former Cornell postdoc **Luke Rogers** (University of Connecticut) and former Cornell grad students **Joe Chen** (Colgate University) and **Alexander Teplyaev** (University of Connecticut). **The National Science Foundation** provided support.

For more information see the website: www.math.cornell.edu/~fractals.



Attendees of the 2017 Fractals Conference, Cornell University



JOHN GUCKENHEIMER PRESENTS THE CELSIUS LECTURE

In February 2017, [John Guckenheimer](#) presented the [Celsius Lecture](#) at [Uppsala University](#). The traditional Celsius-Linnaeus lectures and symposium are held in commemoration of [Anders Celsius](#) and [Carl von Linnæus](#). The selected lecturers are internationally renowned scientists, who appeal to an extensive scientific as well as public audience. Guckenheimer's talk, titled "The Remarkable Universality of Nonlinear Dynamics," explained that Dynamical systems theory uncovers universal patterns of how things change in time. Its perspective is abstract, but its ability

to unite seemingly unrelated phenomena is astounding.

Guckenheimer introduced the mathematical principles of the subject and gave examples from biomechanics, neuroscience and climate science that illustrate the power of these ideas. As an example, he asked listeners to consider human locomotion. The human body resembles an upright, unstable pendulum, but toddlers learn to walk and run without falling down before they learn to talk. We can neither explain this stability nor build legged robots with agility comparable to our own. He described

data driven mathematical strategies to understand dynamics of locomotion that avoid the complexity of our coupled nervous and musculoskeletal systems.

To illustrate how similar dynamical phenomena appear in unrelated systems, he compared dynamics in two systems from different disciplines: a neuroscience model and a reduced model for [El Nino](#), the climate phenomenon in the tropical Pacific that affects weather globally. Multiple time scales are key to explaining why the same dynamical patterns are observed in these unrelated systems.

STEVE STROGATZ NAMED WEISS FELLOW

Established in 1992, the [Weiss Presidential Fellowship](#) was conceived by the late [Stephen H. Weiss '57](#), former chairman of the board of trustees, as the University's highest recognition of faculty for teaching and mentoring of undergraduates. The awardees have sustained records of effective, inspiring and distinguished teaching and contributions to undergraduate education.

[Strogatz'](#) nomination cited his innovative teaching methods in a wide range of courses, individual attention to students and student praise for his teaching as "masterful," "infectious" and

"funny". Colleagues noted his mentorship of others seeking to improve their teaching, and his participation in Cornell's [Summer Mathematics Institute](#) for women and minority undergraduates.



*Jason Koski/University Photography
Weiss Fellow recipients. February 9 in the
Groos Family Atrium in Klarman Hall.*

Strogatz is well-known for his outreach work, helping people to understand and enjoy mathematics through public and media appearances, a [New York Times](#) column and three books: "[Sync](#)," "[The Calculus of Friendship](#)" and "[The Joy of x](#)". His research interests include mathematical biology; the small-world phenomenon ("[six degrees of separation](#)") in social networks; structural balance in social systems; and nonlinear dynamics and chaos in physics, engineering and biology. Steve joins Math Department colleagues [Richard Rand](#) and [Ravi Ramakrishna](#) as Weiss Fellows.

RIDE-SHARING STUDY FINDINGS ARE SCALABLE TO DIFFERENT CITIES

TOM FLEISCHMAN

Three years ago, [Steven Strogatz](#), the Jacob Gould Schurman Professor of Applied Mathematics, helped a group from the [Massachusetts Institute of Technology](#) identify the “shareability” of cab service in New York City.

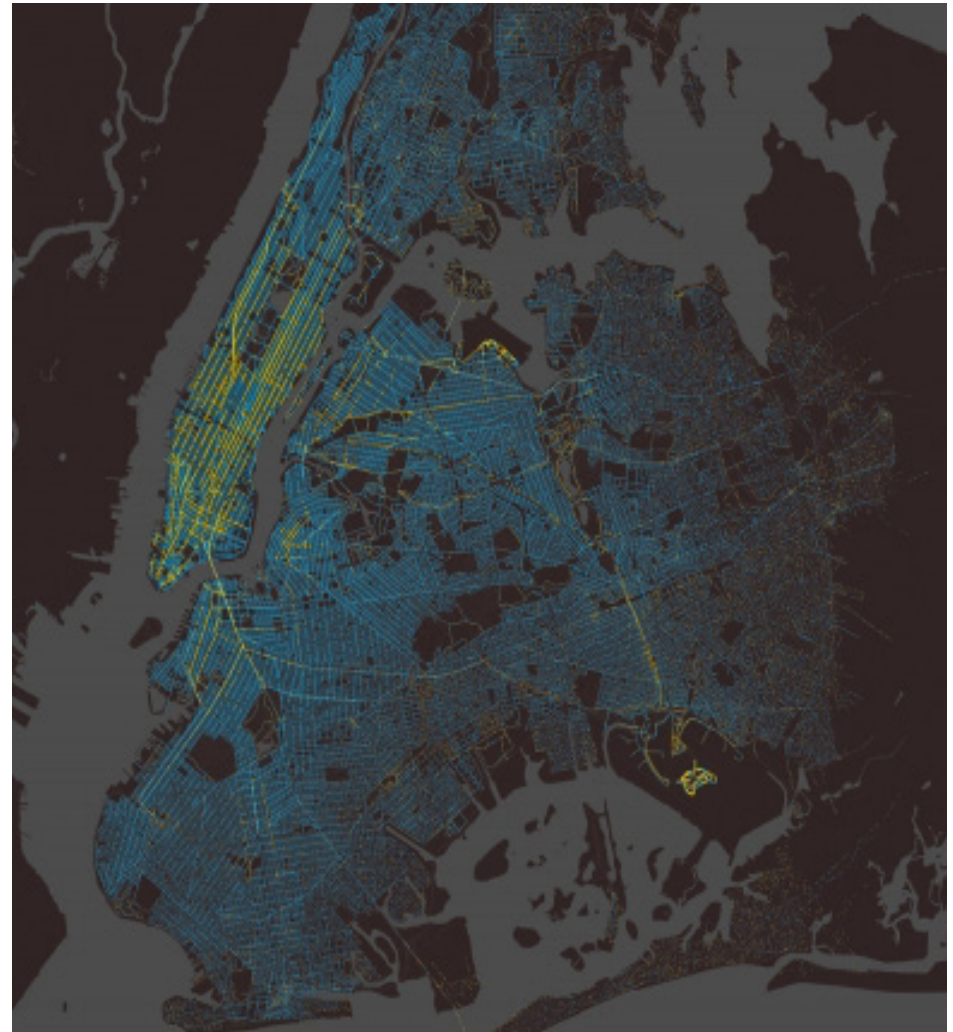
The group found that, indeed, the vast majority of the city’s 150 million taxi trips per year were shareable, and even by sharing a fraction of those rides, pollution and congestion would be significantly lessened. So the obvious follow-up question was: Will that result generalize?

In other words, could a result in a city as densely populated as New York be replicated in different kinds of cities - say, in Vienna?

Strogatz and his MIT colleagues asked that very question in their most recent study, and the results could perhaps point city planners toward a “greener” future.

“[Scaling Law of Urban Ride Sharing](#),” was published online March 6 in *Scientific Reports*. Lead author [Remi Tachet](#) and principal investigator [Carlo Ratti](#) are both at MIT’s [Senseable City Lab](#), which conducted the study. The researchers analyzed huge data sets of GPS information from four cities (New York [Manhattan only], San Francisco, Singapore and Vienna) and then plotted a “shareability curve” for each city as a function of taxi trips per hour. For all cities, the shareability rises quickly as the available trips per hour increases (this phenomenon is known as fast saturation) then levels off at a certain point. These numbers varied greatly for the cities studied, so to generate a shareability index that can apply to both more- and less-dense metropolitan areas, the group applied a natural rescaling law.

The trips-per-hour variable was replaced by the factor L , which represented the ratio between two time scales. “This is a dimensionless way of asking, how dense



A still image taken from a video available at [hubcab.com](#) showing a map of Manhattan (upper left), with the yellow lines indicating taxi trips. Intersections of lines indicate sharing opportunities. Photo Credit: Senseable City Lab

is the taxi availability?” Strogatz said. “Put it this way: You want a taxi right now, but you can’t have it right now. But how long are you willing to wait for that, compared to how long a delay are you willing to tolerate when ride sharing takes you out of your way? That ratio is what the L is measuring.”

In plotting each city’s shareability curve as a function of L , instead of its own unique trips per hour, the study reveals that all four cities (as well as a theoretical prediction) fall along basically the same line. “Key to the study,” Strogatz said, “is the fact that it includes no adjustable parameters simply determining L for each city gives the model strong predictive power. It’s a good

theory in that it totally sticks its neck out. It’s saying, ‘The world is like this, or it’s not.’ And as it turns out, the world is pretty darn close to what the theory says.”

The plots of the four cities suggest that there is a “sweet spot,” Strogatz said, where the number of available vehicles would be optimal for maximum sharing and minimal congestion. The researchers say the findings quantify the effects of ride sharing on the urban environment and offer guidance toward the design of efficient mobility systems.

This work was supported in part by grants from the [National Science Foundation](#).

DEPARTMENT BUZZ



Nicolas Templier



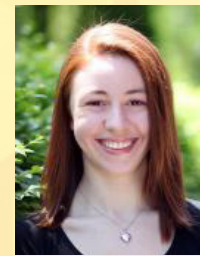
Camil Muscalu

Professors **Camil Muscalu** and **Nicolas Templier** have been named 2017 **Simons Fellows** Awardees. Muscalu and Templier will use their fellowships to visit **Université Paris-Sud** and **IHES, Bures-sur-Yvette** respectively. To see the award announcement, please visit the **Simons Award page**. Congratulations, Camil and Nicolas!

Aaron Yeiser, a high school student at Perkiomen Valley High School, was awarded a second place **Regeneron 2017 Science Talent Search scholarship** worth \$175,000. Through the PRIMES mentoring program, Aaron has been doing research with **Prof. Alex Townsend** on a novel spectral element method for anisotropic meshes.



Aaron Yeiser, Society for Science & the Public



Lila Greco



Ayah Almousa

Graduate Students **Ayah Almousa** and **Lila Greco** were awarded prestigious **NSF Graduate Research Fellowships** that will support their studies for three years. Congrats, Ayah and Lila!

Mathematics Ph.D. candidate, **Kelsey Houston-Edwards**, has been awarded the A&S **Deanne Gebell Gitner '66 and Family Annual Prize**



Kelsey Houston-Edwards

for Teaching Assistants who have demonstrated their devotion to undergraduate teaching.

Professor **Richard Rand** received the 2017 **Thomas K. Caughey Dynamics Award** from the American Society of Mechanical Engineers Applied Mechanics Division. The Award is conferred in recognition of an individual who has made significant contributions to the field of nonlinear dynamics through practice, research, teaching and/or outstanding leadership.



Richard Rand

Professor **Ed Swartz** has been named a 2018 Fellow of the **American Mathematical Society** for contributions to topological and geometric combinatorics.



Ed Swartz

John Guckenheimer, an expert in Dynamical systems and the Abram R. Bullis Professor Emeritus of Mathematics, retired on January 1, 2017. Congratulations, John!



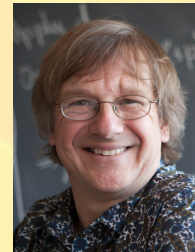
John Guckenheimer

Moon Duchin of **Tufts University** delivered the 2017 Kieval Lecture, "**Political Geometry: Mathematical Interventions in Gerrymandering**," She discussed how mathematicians can make meaningful contributions to the redistricting process.



Moon Duchin

A conference honoring **Prof. Michael Stillman** on his **60th birthday** was held in July 2017 at the University of California, Berkeley. Michael is a principal author of the commutative algebra software package **Macaulay2**, to which part of the conference was devoted.



Mike Stillman

Laurent Saloff-Coste was named the Abram R. Bullis Professor of Mathematics.



Laurent Saloff-Coste

Birgit Speh was named Goldwin Smith Professor of Mathematics.



Birgit Speh

In July 2016 Prof. **Irena Peeva** presented research at Craig Huneke's birthday conference with **Jason McCullough** (Rider University) that is reshaping the field of commutative algebra. They are currently working with collaborators on furthering their results.



Irena Peeva

Congratulations to Senior Lecturer **Allen Back** on his retirement! Allen served the department through four decades, teaching a wide variety of classes.



Allen Back

The **Oneida City School District Foundation** named Senior Lecturer Dr. **Mary Ann Huntley** a 2017 Wall of Distinction inductee for her dedication and exemplary service in her chosen career.



Mary Ann Huntley

Read Math Matters online:
<https://www.math.cornell.edu/m/News/MathMatters>

MATHEMATICS LIBRARY NEWS

STEVE ROCKEY

The [Math Library](#) continues its efforts to acquire more e-books both prospectively with new titles and retrospectively with back set purchases. In the last year with generous help of donors we made major purchases of e-book back sets from the [American Mathematical Society](#), and the [Princeton University](#) and [Cambridge University Presses](#). There are a number of large open access collections of older out of copyright books with thousands of titles. Combined with previous back set purchases and current acquisition plans with [Springer](#), the [Society for Industrial and Applied Mathematics](#), and [The European Mathematical Society](#) we are achieving good coverage of the book literature and hold about 30,000 e-book titles that are fully cataloged and available in the Library Catalog.

Early in 2016 we transferred several hundred 19th century books from the Math Library to [Rare Books & Manuscripts collection](#). This decision was driven by both security and preservation considerations. All of these books have now been digitized. There are

over 1000 new editions, reprints, and facsimile editions of 19th century and earlier math books in the stacks.

We are at the midpoint of a four-year project to relieve overcrowding in the library stacks by sending 10,000 journal volumes for which we have online access to the [Library Annex](#). At the conclusion of this Annex move we will need to shift the stack from end to end to distribute the space. We expect to have ample stack space for at least the next 20 years.

On January 1, 2018 [Dr. Henrik Spoon](#) will become the new Mathematics, Physics, & Astronomy librarian. Henrik is currently a Senior Research Associate at the [Cornell Center for Astrophysics and Planetary Science](#) and arrived at Cornell as the first [NASA Spitzer Fellow](#) in the group of Prof. [Jim Houck](#). He has a Master of Science in Astronomy from the [University of Utrecht](#) and a Ph.D. in Astrophysics from the University of [Groningen](#). He works in the field of mid-infrared spectroscopy of galaxies, has published 13 papers as first-author and 109 as co-author

and has experience applying for and managing grants, creating and handling large data sets, and organizing symposia and workshops.

STEVE ROCKEY RETIRES THIS MONTH

Steve Rockey

'70 retires this month after serving as the Math Librarian for 45 years.

Our library

is one of the best math libraries in the world, and this excellence is due in no small part to Steve. He has overseen the library's transition from emphasizing print to electronic resources, all the while bearing in mind that permanent access to old literature is absolutely crucial in Mathematics. He has been able negotiate any number of terrific deals with publishers.

We will miss him and wish him well as he pursues his passions of hiking and Big Red Hockey!



Steve Rockey

SHRUTHI SRIDHAR RECEIVES HONORABLE MENTION FOR SCHAFFER PRIZE



Shruthi Sridhar

Shruthi Sridhar '18 was selected as Honorable Mention for the [Alice T. Schaffer Prize](#) of the [Association for Women in Mathematics](#).

The Schaffer Prize is named for the former President of the AWM who made an outstanding effort over many years in support of women in mathematics.

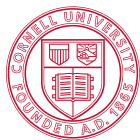
Shruthi has done research projects over three summers in combinatorics, hyperbolic knot groups and Schur functions. She began taking graduate courses as a sophomore and won an [Outstanding Presentation Award at Mathfest 2016](#) for her talk "The Geometry of Knots".

Congratulations, Shruthi!



Cornell University Photography

Tjaden Hess, Katie Borg, William Gao, Cosmo Viola and Linus Setiabrata, all '20, work on a problem in Theoretical Linear Algebra and Calculus.



Cornell University
Department of Mathematics

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MATHEMATICS DEPARTMENT ENDOWMENTS & GIFTS

We are grateful to alumni, friends, and family for their generosity in supporting our endowments or providing other gifts and donations to the department.

The [Ruth I. Michler Memorial Prize](#), established by Gerhard and Waltraud Michler of Essen, Germany, in memory of their daughter, provides funding for the Ruth I. Michler Memorial Prize of the Association for Women in Mathematics. The awardee spends a semester at Cornell focusing on research.

The [Chelluri Lecture](#) Series was established by the parents of Raju Chelluri's '99 in his memory. Funds are used to invite distinguished mathematicians to deliver an annual lecture.

The **Michael D. Morley Senior Prize in Mathematics** is presented annually to an Ithaca High School student who has excelled in mathematics and who has demonstrated originality and innovative power in mathematics.

[Teaching Awards](#) for Graduate Students and faculty were created in 2001. The endowment supports awards to graduate students.

The [Colloquium Endowment Fund](#) was instituted to invite distinguished scholars to speak at the Oliver Club seminars. (See [www.math.cornell.edu/~oliver/.](http://www.math.cornell.edu/~oliver/))

The [Eleanor Norton York Endowment](#) was established in honor of Eleanor York, a long time employee in the Astronomy Department, to recognize outstanding graduate students in both Astronomy and Mathematics.

The **Faculty Book Endowment** is dedicated to improving our world-class collection of mathematics books and publications.

The [Hutchinson Endowment](#) was created by Geneva Hutchinson to honor her husband, John Hutchinson, who taught at Cornell for 42 years. This fund provides research support for graduate students to work on their thesis problems.

The **Israel Berstein Memorial Fund** was established in honor of Israel Berstein, a professor in this department from 1962-1991. The memorial fund is intended to help young mathematicians in the field of topology.

The [Torng Prize](#), established in 2017 by former graduate student Bung-Fung Torng, this prize is awarded annually to an outstanding graduate student for their work as a teacher. It provides summer support for the student to focus on their thesis work.

The **Logic Endowment** was started with a generous gift from William Craig '40 to support promising logic students.

The [Robert John Bättig Endowment](#) was established by his parents after his untimely passing. Robert was awarded a January 1998 Ph.D. in mathematics. The fund provides an annual prize to an outstanding continuing graduate student in mathematics at Cornell.

If you would like to contribute, please make your check payable to [Cornell University](#), indicate the endowment, or that it is a gift in support of Mathematics, and send it to:

Dept. of Mathematics Endowments & Gifts

310 Malott Hall, Cornell University
Ithaca, NY 14853-4201

Gifts can also be made online at:
www.giving.cornell.edu