2019 Leroy P. Steele Prizes

The 2019 Leroy P. Steele Prizes were presented at the 125th Annual Meeting of the AMS in Baltimore, Maryland, in January 2019. The Steele Prizes were awarded to Haruzo Hida for Seminal Contribution to Research, to Philippe Flajolet and Robert Sedgewick for Mathematical Exposition, and to Jeff Cheeger for Lifetime Achievement.

Citation for Seminal Contribution to Research: Haruzo Hida

The 2019 Leroy P. Steele Prize for Seminal Contribution to Research is awarded to Haruzo Hida of the University of California, Los Angeles, for his highly original paper “Galois representations into $\text{GL}_2(\mathbb{Z}_p[[X]])$ attached to ordinary cusp forms,” published in 1986 in Inventiones Mathematicae.

In this paper, Hida made the fundamental discovery that ordinary cusp forms occur in $p$-adic analytic families. J.-P. Serre had observed this for Eisenstein series, but there the situation is completely explicit. The methods and perspectives that Hida introduced have been used in the past three decades to solve fundamental problems in the theory of $p$-adic Galois representations and $p$-adic $L$-functions, and they have led to progress on $p$-adic analogues of the conjecture of Birch and Swinnerton-Dyer. Hida families are now ubiquitous in the arithmetic theory of automorphic forms, and his research has changed the way we view the subject.

Biographical Note: Haruzo Hida

Haruzo Hida is a Distinguished Professor of mathematics at UCLA. Born in 1952 in the beach resort town of Hamadera (presently, Sakai West-ward), Japan, he received an MA (1977) and Doctor of Science (1980) from Kyoto University. He did not have a thesis advisor. He held positions at Hokkaido University (Japan) from 1977–1987 up to an associate professorship. He visited the Institute for Advanced Study for two years (1979–1981), though he did not have a doctoral degree in the first year there, and the Institut des Hautes Études Scientifiques and Université de Paris Sud from 1984–1986. Since 1987, he has held a full professorship at UCLA (and was promoted to Distinguished Professor in 1998).

Hida’s main research interests lie in arithmetic geometry, both Archimedean and Henselian, through the automorphic approach (initiated by Erich Hecke). He was an invited speaker at the ICM in Berkeley (1986), a Guggenheim fellow (1991–1992), a recipient of the Spring Prize from the Mathematical Society of Japan (1992), a senior scholar at the Clay Mathematics Institute (2010–2011), an inaugural fellow of the American Mathematical Society (2012), and a recipient of a Docteur Honoris Causa, Université de Paris XIII (2015). He is the author of seven research books and monographs on his own results.
Response from Haruzo Hida

It is a great honor (and also a big surprise) to receive the Leroy P. Steele Prize for Seminal Contribution to Research from the AMS. Why a surprise? The name of the town Hamadera appears (as “Takashi-no-Hama”) in the sixth–eighth-century Japanese “Tan-ka/Chou-ka” poem anthology “Manyou-shu” (Ten thousand leaves), and by a tradition of the town, I was familiar with the ancient poems at an early age (as they are all written in Japanese phonetic symbols, so, easy to read). Starting with the poems, I enjoyed Japanese and Chinese classics. Chinese poems by a decedent Japanese Zen monk of the fifteenth century greatly impressed me; they could be interpreted (with a question mark) to suggest the purpose of one’s life could be found only in an enjoyable pastime (or more precisely, a way to kill time), lasting until one’s demise. From that time on, I tried in earnest to find such a way to kill time. I finally found one accidentally in the mid-1970s and, after that, became totally addicted to math. Therefore, I am hardly professional nor academic in mathematical work, and I often create mathematics without tangible reference to contemporaries. It seems unfair that such a person would be chosen for a prestigious AMS prize. Nevertheless, my work has found some deep applications. This hopefully legitimizes the award.

A seventeenth-century Japanese playwright told a Confucianist that creating a play is to walk the boundary of imaginary and real (or dream and truth) without stepping out of the narrow path. When in 1975 I started to study (with Koji Doi) the relation between congruence and L-values, Doi told me that a Hecke eigenform appears to have siblings having eigenvalues (of Hecke operators) congruent modulo a (parent) prime with the eigenvalues of the initial form. While at IAS, I felt that pathwise connectedness of the Archimedean topology forces the core cuspidal spectrum of Hecke operators to be discrete; so, under a Henselian topology, totally disconnected, I imagined that the spectrum is prevalently continuous. After having returned to Japan in the fall of 1981, I started making progress in proving this guess and succeeded (partially) in getting a proof via arithmetic geometry by the end of January 1982. Since the result seemed too strong, I sought one more proof. I got another via Betti Étale cohomology of modular curves within a couple of months. Afterwards, I sent out preprints to senior number theorists I’d encountered at Princeton. The second proof is in the paper published in 1986 for the award (and now there are more than two proofs).

Since I enjoy finding results independent of my fellow mathematicians, I did not make too much effort to find applications to classical questions posed by others, but a handful of excellent number theorists became interested in later years, and found good applications for my result.

Citation for Mathematical Exposition: Philippe Flajolet and Robert Sedgewick

The 2019 Leroy P. Steele Prize for Mathematical Exposition is awarded to Philippe Flajolet (posthumously) of the Institut National de Recherche en Informatique et en Automatique (INRIA) and Robert Sedgewick of Princeton University for their book Analytic Combinatorics (Cambridge University Press, Cambridge, 2009), an authoritative and highly accessible compendium of its subject, which demonstrates the deep interface between combinatorial mathematics and classical analysis. It is a rare work, one that defines the relatively young subject in its title, mixing equal parts of complex analysis and combinatorial structure. The authors have combined their extraordinary analytical and expository skills to organize the entire subject into a well-developed and fascinating story. Its publication in 2009 was a major event, and as a result, analytic combinatorics is now a thriving subdiscipline of combinatorial and stochastic mathematics, as well as a key component of the analysis of algorithms.

Quoting Robin Pemantle’s 2010 review of Analytic Combinatorics, published in SIAM Review, “This is one of those books that marks the emergence of a subfield.” The book magically summarizes a vast amount of information. It identifies and expounds key techniques that have never been explained so well before, while consistently paying proper attention to the historical context. It features world-class graphics and typesetting and a definitive bibliography. The book is largely self-contained and a pleasure to read—any mathematician can use it as the basis for teaching a course on analytic combinatorics as an undergraduate elective in mathematics.

Biographical Note: Philippe Flajolet

Philippe Flajolet (1948–2011) was an extraordinary French mathematician and computer scientist. He graduated from École Polytechnique in Paris in 1970, obtained a PhD from Université Paris 7 with Maurice Nivat in 1973 and a Doctorate in Sciences from the University of Paris at Orsay in 1979. He spent his career at INRIA in Rocquencourt, France, where he eventually led the ALGO research group, which produced numerous outstanding young scientists and attracted visiting researchers from all over the world.

He held numerous visiting positions: at Waterloo, Stanford, Princeton, Wien, Barcelona, IBM, and Bell Laboratories. He received several prizes, including the Grand Science Prize of UAP (1986), the Computer Science Prize of the French Academy of Sciences (1994), and the Silver Medal of CNRS (2004). He was elected a Corresponding Member (Junior Fellow) of the French Academy of Sciences in 1994, a Member of the Academia Europaea in 1995, and a Member (Fellow) of the French Academy of Sciences in 2003. He was made a knight of the Légion d’Honneur in 2010.
Flajolet’s extensive and far-reaching research in mathematics and computer science spanned formal languages, computer algebra, combinatorics, number theory, and analysis, all oriented toward the study of algorithms and discrete structures. During his forty years of research, he contributed nearly 200 publications. An important proportion of these are foundational contributions or represent uncommon breadth and depth. Highlights range from pioneering work in computer algebra in the 1980s to theorems in asymptotic analysis in the 1990s that inspired decades of later research to a probabilistic algorithm that is widely used in modern cloud computing. Much of his research laid the foundation for the development, with Sedgewick, of the subfield of mathematics that is now known as analytic combinatorics, a calculus for the study of discrete structures.

These research contributions will have impact for generations. Flajolet’s approach to research, based on endless curiosity, discriminating taste, deep knowledge, relentless computational experimentation, broad interest, intellectual integrity, and genuine camaraderie, will serve as an inspiration for years to come to those who knew him.

Biographical Note: Robert Sedgewick

Robert Sedgewick is the William O. Baker Professor in the Department of Computer Science at Princeton University. Born in 1946 in Willimantic, Connecticut, he graduated from Brown University in 1968 and did his doctoral work with Donald E. Knuth at Stanford University, receiving his PhD in 1975. After ten years on the faculty at Brown, he left to be the founding chair of Princeton’s Department of Computer Science in 1985. He served for twenty-six years as a member of the board of directors of Adobe Systems and has held visiting research positions at Xerox PARC, IDA, INRIA, and Bell Laboratories.

Sedgewick is the author of twenty books. He is best known for Algorithms, which has been a best-selling textbook since the early 1980s and is now in its fourth edition. His other current textbooks include An Introduction to the Analysis of Algorithms and Analytic Combinatorics (with Philippe Flajolet) and Computer Science: An Interdisciplinary Approach (with Kevin Wayne).

Beyond his work with Flajolet on analytic combinatorics, Sedgewick’s research is characterized by a scientific approach to the study of algorithms and data structures, where careful implementations and appropriate mathematical models are validated by experimentation and then used to understand performance and develop improved versions. Many of his research results are expressed in his Algorithms books, and his implementations routinely serve as reference and are featured throughout our global computational infrastructure.

In recent years, Sedgewick has been a pioneer in developing modern approaches to disseminating knowledge, from introductory to graduate level. He has developed six massive open online courses (MOOCs) and published extensive online content on analysis of algorithms and analytic combinatorics and, with Kevin Wayne, algorithms and computer science. These materials have made it possible and convenient for millions of people around the world to teach and learn these subjects, particularly in regions where access to higher education is difficult.

Response from Robert Sedgewick

This award is thrilling and humbling for me, but also bittersweet, because Philippe is not here to share it. But all of us who were there vividly remember his excitement at our event in Paris on the occasion of his sixtieth birthday when we presented him with the first printed copy of Analytic Combinatorics. I keep the look on his face at that moment fresh in my mind and know that the same look would grace us now.

Philippe and I (and many others) were students of the work of Don Knuth in the 1970s, and inspired by the idea that it was possible to develop precise information about the performance of computer programs through classical analysis. When we first began working together in 1980, our goal was just to organize models and methods that we could use to teach our students what they needed to know. As we traveled between Paris and Princeton, producing conference papers, journal articles, and INRIA research reports, we began to understand that something more general was at work, and Analytic Combinatorics began to emerge. It is particularly gratifying to see citations of the book by researchers in physics, chemistry, genomics, and many other fields of science, not just mathematicians and computer scientists.

Analyzing algorithms is challenging—at the outset, known results were often either excessively detailed or rough, questionably useful approximations. Thus, what fun it was to consider the idea that maybe (despite the formidable barrier of the Halting Problem) one could develop a black box that could take a program as input and produce as output an asymptotic estimate of its running time. How challenging it was to develop a rigorous calculus that takes us from simple formal descriptions of combinatorial objects through properties of generating functions in the complex plane to precise information about the objects. How exciting it was to build on this work to develop theorems of sweeping generality that encompass whole families of combinatorial classes. As Philippe said, developing new theorems like these “constitutes the very essence of analytic combinatorics.”

With a vibrant community of researchers working on developing and applying such theorems, I suspect and hope that the story of analytic combinatorics is just in its infancy.

I am particularly heartened by the statement in the citation that any mathematician could use our book to teach an undergraduate course on the subject. Having the
broadest possible reach was indeed our hope when, with the support of our editor, we provided free access to the book on the web. For the past several years, I have been working hard to apply twenty-first-century tools to develop a unique resource for teaching this material. Anyone can now teach and learn Analytic Combinatorics using the studio-produced lecture videos, new problems with solutions, and other online content found at [ac.cs.princeton.edu](http://ac.cs.princeton.edu). Philippe, who always embraced technology, would be particularly pleased with the idea that it now makes analytic combinatorics accessible to large numbers of people around the world.

**Citation for Lifetime Achievement: Jeff Cheeger**

The 2019 Leroy P. Steele Prize for Lifetime Achievement is awarded to Jeff Cheeger of the Courant Institute, New York University, for his fundamental contributions to geometric analysis and their far-reaching influence on related areas of mathematics. For more than half a century, Jeff Cheeger has been a central figure in differential geometry and, more broadly, geometric analysis. His work on the profound and subtle effects of curvature on the topology and geometry of manifolds, often under very weak regularity conditions, has laid and continues to lay foundations for much of the progress in these areas ever since his 1967 dissertation.

His work, both alone and in collaboration with others, has yielded such spectacular results as the Soul and Splitting Theorems (with Detlef Gromoll) and the Compactness and Collapsing Theories (with Kenji Fukaya and Misha Gromov), which have been among the most important developments in geometry in the past three decades. These fundamental theories have had far-reaching consequences, for instance, playing an essential role in Perelman’s resolution of the Poincaré conjecture. Cheeger’s inequality bounding from below the first nonzero eigenvalue of the Laplacian in terms of a certain isoperimetric constant, known as Cheeger’s constant, has had numerous applications, as has his work on the Hodge theory and spectral geometry of singular spaces, the structure theory of spaces with bounds on Ricci curvature, his resolution of the Ray–Singer Conjecture, the theory of differential characters (with James Simons), his work on differentiability of Lipschitz functions on metric measure spaces, and many others have been the fundamental tools that enabled major advances in geometry and analysis that continue to bear fruit and shape the field.

**Biographical Note: Jeff Cheeger**

Jeff Cheeger was born in Brooklyn, New York, in 1943. He graduated from Erasmus Hall High School in 1960 and from Harvard College in 1964. He received his PhD from Princeton under Salomon Bochner and James Simons in 1967. After a year in Berkeley as an NSF Postdoctoral Fellow and a year at the University of Michigan as an assistant professor, he moved to Stony Brook, where he remained for the next twenty years, rising to the rank of Distinguished Professor. Since 1989, he has been a member of the Courant Institute, where since 2003 he has been Silver Professor of Mathematics.

Cheeger has given invited addresses at the International Congress of Mathematicians in 1974 and 1986. He was awarded the Max Planck Research Prize of the Alexander von Humboldt Society in 1996 and the Oswald Veblen Prize of the AMS in 2001. He was elected to the National Academy of Sciences in 1997, the Finnish Academy of Science and Letters in 1998, and the American Academy of Arts and Sciences in 2006. He was elected a Fellow of the AMS in 2012.

**Response from Jeff Cheeger**

It is a great honor to have been awarded the Leroy P. Steele Prize for Lifetime Achievement. It is especially gratifying to have received an award for research done over my whole career and for which the citation includes work with a number of remarkable mathematicians, the interactions with whom have enriched my life. I would particularly like to thank my collaborators Paul Baum, Detlef Gromoll, Jim Simons, S.-T. Yau, Michael Taylor, Werner Muller, Robert Schrader, Misha Gromov, Jean-Michel Bismut, Mike Anderson, Gang Tian, Xiaochun Rong, Xianzhe Dai, Kenji Fukaya, Toby Colding, Bruce Kleiner, Assaf Naor, and Aaron Naber. I would also like to acknowledge the influence of my friends Blaine Lawson, Dennis Sullivan, and Is Singer.

I was introduced to mathematics by my father, Thomas Cheeger, a structural engineer. He could not have given me a better gift. My mother, Pauline, stressed to me the benefits of hard work.

In junior high school, I made a very good friend, Mel Hochster, with whom I could share my interest in mathematics. It was exciting and fun. When I was an undergraduate at Harvard, two professors, Shlomo Sternberg and Raoul Bott, made a big impression. They introduced me to differential geometry and algebraic topology. Beyond that, they conveyed the feeling that being a mathematician was something like being a member of a special order, an order into which one could hope to one day be initiated. During my last year, I took a PDE course from Jim Simons. In graduate school at Princeton, along with my official advisor, Salomon Bochner, Jim became my teacher and then my friend. I owe him a lot.
I was very lucky to have found my way into differential geometry which, I have come to believe, was the right area for my particular turn of mind. When I started, it was a bit out of fashion, underdeveloped, not overly competitive, but poised to take off. For me, this was ideal. Later, I learned some analysis, which opened up new vistas.

As researchers, our job is to produce new mathematics. Still, looking back over a whole career, it is somewhat mind blowing to realize how little we understood when I began, as compared to what has since been discovered.

From the time I was young, I was struck by the fact that in mathematics, questions have a right or wrong answer. This has a consequence. With small exceptions, mathematicians tend to genuinely admire each other’s achievements. Another thing, as mathematicians we have quite direct access to some of the most original minds of the past and of the present. From such people, if you keep your ears open, you can really learn something. Finally, we are lucky in that we get to think about what we want and to interact with brilliant young people. I feel very fortunate to have had a life in mathematics.

About the Prizes

The Leroy P. Steele Prizes were established in 1970 in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein. Osgood was president of the AMS during 1905–1906, and Birkhoff served in that capacity during 1925–1926. The prizes are endowed under the terms of a bequest from Leroy P. Steele. Up to three prizes are awarded each year in the following categories:

1. Lifetime Achievement: for the cumulative influence of the total mathematical work of the recipient, high level of research over a period of time, particular influence on the development of a field, and influence on mathematics through PhD students;
2. Mathematical Exposition: for a book or substantial survey or expository research paper;
3. Seminal Contribution to Research: for a paper, whether recent or not, that has proved to be of fundamental or lasting importance in its field or a model of important research. The Prize for Seminal Contribution to Research is awarded on a six-year cycle of subject areas. The 2019 prize was open; the 2020 prize will be given in analysis/probability; the 2021 prize in algebra/number theory; the 2022 prize in applied mathematics; the 2023 prize in geometry/topology; and the 2024 prize in discrete mathematics/logic.

The Leroy P. Steele Prizes for Mathematical Exposition and Seminal Contribution to Research carry a cash award of US$5,000; the Prize for Lifetime Achievement, a cash award of US$10,000.

The Steele Prizes are awarded by the AMS Council acting on the recommendation of a selection committee. The members of the committee for the 2019 Steele Prizes were:

- Robert L. Bryant,
- Tobias H. Colding,
- Eric M. Friedlander,
- Mark L. Green,
- B. H. Gross (Chair),
- Carlos E. Kenig,
- Dusa McDuff,
- Victor Reiner,
- Thomas Warren Scanlon

The list of previous recipients of the Leroy P. Steele Prizes may be found on the AMS website at [https://www.ams.org/profession/prizes-awards/ams-prizes/steele-prize](https://www.ams.org/profession/prizes-awards/ams-prizes/steele-prize).

Credits

Photos of the winners were provided by each of them.
2019 Mary P. Dolciani Prize for Excellence in Research

Stephan Ramon Garcia was awarded the inaugural Mary P. Dolciani Prize for Excellence in Research of the AMS at the 125th Annual Meeting of the AMS in Baltimore, Maryland, in January 2019.

Citation

The Mary P. Dolciani Prize for Excellence in Research is awarded to Stephan Ramon Garcia, W. M. Keck Distinguished Service Professor and Professor of Mathematics at Pomona College, for his outstanding record of research in operator theory, complex analysis, matrix theory, and number theory, for high-quality scholarship with a diverse set of undergraduates, and for his service to the profession.

Garcia received his PhD in Mathematics in 2003 from the University of California at Berkeley. He is the author of eighty-nine research papers in several areas, including operator theory, linear algebra, complex analysis, mathematical physics, and number theory. His work has appeared in top research journals, as well as top expository journals, and he has been the Principal Investigator on four NSF research grants. He has co-authored four books and is currently writing two more. Garcia has also co-authored over twenty-nine articles with undergraduates, with papers appearing in the American Mathematical Monthly, the Notices of the American Mathematical Society, Proceedings of the American Mathematical Society, and the Journal of Number Theory, among others. His paper "G. H. Hardy: Mathematical Biologist," written with a student, was included in the 2016 book series The Best Writing on Mathematics, published by Princeton University Press. Garcia currently serves as an editor of the Notices of the American Mathematical Society, the American Mathematical Monthly, Proceedings of the American Mathematical Society, Annals of Functional Analysis, and the undergraduate research journal Involve. He serves on the Human Resources Board of the American Institute of Mathematics (AIM), whose goal is to foster diversity in the activities of AIM. He is also a member of the advisory board of Research Experiences for Undergraduate Faculty (REUF), an NSF-funded program for faculty who are interested in conducting research with underrepresented minority students, students with disabilities, and first-generation college students.

Garcia’s research began with complex analysis and $H^p$ spaces and now includes, among several other topics, operator theory on Hilbert spaces. One of his objectives is to develop models for various classes of operators. In a series of highly cited papers published in Transactions of the AMS and the Journal of Functional Analysis, he and his coauthors pioneered the study of complex symmetric operators. Specifically, the theory behind linear transformations $T$ that are “almost” self-adjoint by means of a conjugate-linear, isometric involution $C$; that is, $T = CT^*C$. Thus, the conjugation $C$ works to express an operator in terms of its adjoint. These almost self-adjoint operators are called complex symmetric operators. Many unexpected and highly non-normal operators have been shown to be complex symmetric, as have several classes of familiar operators. Garcia and his colleagues have developed a structure theory for this important (and large) class of operators. They are currently developing the machinery to connect truncated Toeplitz operators and complex symmetric operators. They conjecture that every complex symmetric operator on a Hilbert space can be concretely represented in terms of truncated Toeplitz operators.

Garcia has also made significant contributions to number theory. His work in number theory has been primarily...
in four areas: geometric lattice theory, exponential sums, arithmetic quotient sets, and the behavior of the Euler totient near prime arguments. Exponential sums, such as Gauss sums, Kloosterman sums, Ramanujan sums, and others, are classical objects of study in analytic number theory. Garcia’s novel approach was to view these sums from the standpoint of supercharacter theory. From this perspective, classical exponential sums can be viewed as orthogonal functions on certain abelian groups. Garcia and his co-authors (many of whom were undergraduate students) used this approach to visualize exponential sums, exhibiting some rather remarkable and visually stunning graphical features of these objects. An arithmetic quotient set is a set of fractions $a/b$, where $a$ and $b$ are elements of an infinite arithmetically defined set. Garcia and his co-authors explored the relationship between the arithmetic properties of a set and the analytic properties of its corresponding quotient set, for example its density in the positive reals or in $p$-adic completions of the field of rational numbers. Concerning the Euler totient, one striking recent result of Garcia, his student Elvis Kahoro, and Florian Luca (subject to the Bateman–Horn conjecture) is that for an overwhelming majority of twin prime pairs $(p, p + 2)$, the first prime $p$ has more primitive roots than the second, $p + 2$. Moreover, this is reversed for a small positive proportion of the twin primes.

Again, in these rich and deep subject areas, Garcia has been able to involve undergraduates in this work.

**Biographical Note**

Stephan Ramon Garcia is W. M. Keck Distinguished Service Professor and Professor of Mathematics at Pomona College. He earned his BA and PhD in mathematics from UC Berkeley and was a postdoc at UC Santa Barbara. Since 2006 he has been on the faculty of Pomona College. He was recently elected a Fellow of the AMS (2019).

He is the author of over eighty-nine research articles in operator theory, complex analysis, matrix analysis, number theory, discrete geometry, and other fields. Several dozen of these papers were co-authored with students, many of whom are from underrepresented groups in the mathematical sciences. Garcia has also written four books: *Introduction to Model Spaces and Their Operators* (with W. T. Ross and J. Mashreghi, Cambridge, 2016), *A Second Course in Linear Algebra* (with R. A. Horn, Cambridge, 2017), *Finite Blaschke Products and Their Connections* (with W. T. Ross and J. Mashreghi, Springer, 2018), and *100 Years of Math Milestones: The Pi Mu Epsilon Centennial Collection* (with S. J. Miller, AMS, forthcoming).


**Response from Stephan Ramon Garcia**

I am deeply honored to receive the inaugural Mary P. Dolciani Prize for Excellence in Research. Thanks go to the American Mathematical Society and the Mary P. Dolciani Halloran Foundation for initiating this award. Although I am the first recipient of this prize, there are many vibrant researchers at non-PhD-granting institutions who are also worthy. I look forward to celebrating the achievements of future prizewinners in the years to come.

This would not have been possible without the advice and support of my many colleagues in the profession and the members of my department. I owe a great deal of thanks to those mathematicians who mentored me during my formative years. My advisor, Donald Sarason, and my postdoctoral mentor, Mihai Putinar, are due special consideration. I also thank my innumerable co-authors, from whom I learned a great deal, and my many research students throughout the years. Finally, I wish to thank my wife, Gizem Karaali, and our children, Reyhan and Altay, for their constant support and affection.

**About the Prize**

The Mary P. Dolciani Prize for Excellence in Research is awarded by the AMS Council acting on the recommendation of a selection committee. The members of the committee to select the inaugural winner of the Mary P. Dolciani Prize were:

- Linda Chen,
- Pamela Gorkin (Chair),
- Jeremy T. Teitelbaum.

The AMS Mary P. Dolciani Prize for Excellence in Research recognizes a mathematician from a department that does not grant a PhD who has an active research program in mathematics and a distinguished record of scholarship. It is funded by a grant from the Mary P. Dolciani Halloran Foundation. Mary P. Dolciani Halloran (1923–1985) was a gifted mathematician, educator, and author. She devoted her life to developing excellence in mathematics education and was a leading author in the field of mathematical textbooks at the college and secondary school levels.

**Credits**

Photo of Stephan Ramon Garcia by Gizem Karaali.
2019 Ruth Lyttle Satter Prize in Mathematics

Maryna Viazovska was awarded the 2019 Ruth Lyttle Satter Prize in Mathematics at the 125th Annual Meeting of the AMS in Baltimore, Maryland, in January 2019.

Citation
The 2019 Ruth Lyttle Satter Prize in Mathematics is awarded to Maryna Viazovska of École Polytechnique Fédérale de Lausanne for her groundbreaking work in discrete geometry and her spectacular solution to the sphere-packing problem in dimension eight.

In his 1900 list of outstanding mathematical problems, David Hilbert asked, “How can one arrange most densely in space an infinite number of equal solids of a given form, e.g., spheres with given radii…?” Viazovska’s work is a major advance in addressing this question. Her 2017 paper in *Annals of Mathematics* shows that the $E_8$ root lattice is the densest sphere packing in eight dimensions. Shortly after this much heralded breakthrough, Dr. Viazovska, in collaboration with Henry Cohn, Abhinav Kumar, Stephen D. Miller, and Danylo Radchenko, adapted her methods to prove that the optimal sphere-packing density in dimension twenty-four is achieved by the Leech lattice. Prior to these results, the sphere-packing problem had not been solved beyond dimension three.

Maryna Viazovska’s work has been described as “simply magical,” “very beautiful,” and “extremely unexpected.” Her solution to the sphere-packing problem in dimension eight, while conceptually simple, has a deep structure based on certain functions that she explicitly constructs in terms of modular forms. It establishes a new, unanticipated connection between modular forms and discrete geometry.

Dr. Viazovska’s earlier results on spherical designs are fundamental contributions to the topic. Her 2013 *Annals of Mathematics* paper with Andriy Bondarenko and Danylo Radchenko solved a conjecture of J. Korevaar and J. L. H. Meyers by showing for $N > C_d t^d$, where $C_d$ is a positive constant depending only on $d$, that spherical $t$-designs with $N$ points exist in the unit sphere $S^d$. Spherical designs have been essential tools of practical importance in the statistical design of experiments and in both combinatorics and geometry. Most recently, spherical $t$-designs have appeared in the guise of quantum $t$-designs with applications to quantum information theory and quantum computing.

For more about the proof and background on the sphere-packing problem, see “A conceptual breakthrough in sphere packing,” by Henry Cohn, * Notices of the AMS*, 64 (2017), no. 2; 102–115.

Biographical Sketch
Maryna Viazovska was born in Ukraine and received her doctorate from the University of Bonn in 2013. She was a postdoctoral researcher at Berlin Mathematical School and Humboldt University of Berlin, as well as a Minerva Distinguished Visitor at Princeton University, before joining the faculty at Lausanne as a full professor in 2018. She has been awarded the Salem Prize (2016), a Clay Research Award (2017), the SASTRA Ramanujan Prize (2017), a European Prize in Combinatorics (2017), and a New Horizons Prize in Mathematics (2018). She was an invited speaker at the 2018 International Congress of Mathematicians in Rio de Janeiro.
About the Prize

The Ruth Lyttle Satter Prize is awarded every two years to recognize an outstanding contribution to mathematics research by a woman in the previous six years. Established in 1990 with funds donated by Joan S. Birman, the prize honors the memory of Birman’s sister, Ruth Lyttle Satter. Satter earned a bachelor’s degree in mathematics and then joined the research staff at AT&T Bell Laboratories during World War II. After raising a family, she received a PhD in botany at the age of forty-three from the University of Connecticut at Storrs, where she later became a faculty member. Her research on the biological clocks in plants earned her recognition in the United States and abroad. Birman requested that the prize be established to honor her sister’s commitment to research and to encourage women in science. The prize carries a cash award of US$5,000.

The Satter Prize is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2019 prize, the following individuals served as members of the selection committee:
• Georgia Benkart,
• Estelle Basor (Chair),
• Richard Taylor.

A list of previous recipients of the Ruth Lyttle Satter Prize in Mathematics may be found on the AMS website at https://www.ams.org/profession/prizes-awards/pabrowse?purl=satter-prize

Credits

Photo of Maryna Viazovska is courtesy of Maryna Viazovska.
2019 Levi L. Conant Prize

Alex Wright was awarded the 2019 Levi L. Conant Prize at the 125th Annual Meeting of the AMS in Baltimore, Maryland, in January 2019.

Citation

In only sixteen pages, the article gives a panoramic view of the theory of translation surfaces and of the recent breakthrough by Alex Eskin, Maryam Mirzakhani, and Amir Mohammadi on the structure of the orbit closure of a translation surface. Wright’s account combines brevity with clarity. It is a considerable feat: this active and highly technical research area comprises the work of many. The article gives nonspecialists a good entry point and a guide to further reading.

The article starts with motivation from billiards inside planar polygons. The billiard dynamical system describes the motion of a particle in a domain, subject to specular reflections off the boundary. Many mechanical systems with elastic collisions, that is, collisions in which the energy and momentum are preserved, are described as billiard systems. Little is known about billiards in general polygons (for example, we still do not know whether every obtuse triangle has a periodic billiard trajectory!); the situation is considerably better understood when the angles of the polygon are π-rational, because of their relation to translation surfaces. A translation surface is a surface that is presented as a finite collection of planar polygons, glued together along pairings of parallel edges. Reflected copies of rational polygons are special examples of translation surfaces.

Through ample figures and examples, Wright gives a simple definition of translation surfaces and their moduli space, clearly explains the relation to rational billiards, and describes an action of the general linear group GL(2, R) on the moduli space. He provides a brief survey of seminal work by Kerckhoff, Masur, Smillie, and Veech (in the 1980–1990s), including the surprising result by Veech that billiards in a regular polygon share a familiar property with billiards in a square: in countably many directions, every billiard trajectory is periodic, but in every other direction, trajectories are equidistributed.

The second half of the article is devoted to the recent breakthrough by Eskin, Mirzakhani, and Mohammadi: the closure of the GL(2, R) orbit of a translation surface is always a manifold, defined locally by linear equations in (the standard) period coordinates.

Wright outlines the proof and describes the relation of this theorem to other fundamental results, such as Ratner’s orbit closure theorem and the high and low entropy methods of Einsiedler, Lindenstrauss, and Katok in homogeneous space dynamics. Wright also describes an intimate connection between moduli of translation surfaces and Teichmüller theory.

Several applications of the theorem are presented. For example, given a polygon and two points x and y inside it, the illumination problem asks whether there exists a billiard trajectory in the polygon from x to y. Recently, Lelièvre, Monteil, and Weiss proved that if the polygon is rational, then for every x there are at most finitely many y not illuminated by x; this work relies heavily on the theorem of Eskin, Mirzakhani, and Mohammadi.

Over the years, a number of surveys of the theory of translation surfaces and related topics have appeared, from lengthy and detailed ones to short overviews of the subject. Wright’s article is based on his talk in the Current Events Bulletin at the Joint Mathematics Meetings in January of 2015. It is a tribute to the work of Maryam Mirzakhani, who passed away in 2017.
Biographical Note
Alex Wright received his BMath at the University of Waterloo in 2008 and his PhD at the University of Chicago in 2014. He was then awarded a five-year Clay Research Fellowship, which he held primarily at Stanford University. He is now at the University of Michigan. His research interests include Teichmüller theory, geometry, and dynamical systems, including special families of algebraic curves that arise in this context. In 2018 he received the Michael Brin Dynamical Systems Prize for Young Mathematicians.

Response from Alex Wright
I’m honored to receive this recognition for my expository article on the breakthrough work of Eskin, Mirzakhani, and Mohammadi. This work lies in Teichmüller dynamics, and yet it has remarkable connections to toy models in physics, other dynamical systems, ergodic theory on homogeneous spaces, and special families of algebraic curves. I am especially thankful to Alex Eskin and Maryam Mirzakhani for teaching me so much about the field. I’m also grateful to David Eisenbud for inviting me to speak on this topic at the Current Events Bulletin, and to Susan Friedlander for encouraging me to publish an article based on that talk.

About the Prize
The Levi L. Conant Prize is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2019 prize, the selection committee consisted of the following individuals:
• Thomas C. Hales (Chair),
• Izabella Joanna Laba,
• Serge L. Tabachnikov.

The Levi L. Conant Prize is awarded annually to recognize an outstanding expository paper published in either the Notices of the AMS or the Bulletin of the AMS in the preceding five years.

Established in 2001, the prize honors the memory of Levi L. Conant (1857–1916), who was a mathematician at Worcester Polytechnic Institute. The prize carries a cash award of US$1,000.

A list of previous recipients of the Levi L. Conant Prize may be found on the AMS website at https://www.ams.org/profession/prizes-awards/pabrowse?purl=conant-prize.

Credits
Photo of Alex Wright is courtesy of Alex Wright.
CIPRIAN MANOLESCU was awarded the 2019 E. H. Moore Research Article Prize at the 125th Annual Meeting of the AMS in Baltimore, Maryland, in January 2019.

Citation

This paper resolves the Triangulation Conjecture, showing that there are topological manifolds that do not admit a simplicial triangulation in each dimension greater than 4. This is achieved by introducing Pin(2)-equivariant Seiberg–Witten Floer homology to give homology cobordism invariants of oriented homology 3-spheres, including an integral lift of the Rokhlin invariant which is negated by taking the mirror image (reverse orientation). The new invariants are powerful enough to show that there does not exist a homology 3-sphere with Rokhlin invariant 1 which is homology cobordant to its mirror image. In turn, this implies the existence of non triangulable manifolds in dimensions 5 and higher by the work of D. E. Galewski and R. J. Stern and of T. Matumoto. Note that it was known before that 2- and 3-dimensional manifolds are triangulable, and there are 4-manifolds which do not admit a triangulation, thus resolving the triangulation question in all dimensions.

One expert referred to this as a “landmark article.” Moreover, the techniques from the paper are already being applied to answer other questions in low-dimensional topology, for example regarding the homology cobordism groups, and inspired a related theory of involutive Heegaard Floer homology.

Biographical Sketch
Ciprian Manolescu was born in Romania in 1978. He received his BA in 2001 and his doctorate in 2004, both from Harvard University. After appointments at Princeton University, Columbia University, and the University of Cambridge, he joined the University of California, Los Angeles, where he is now a professor. He was previously awarded the Frank and Brennie Morgan Prize, a Clay Research Fellowship, and a European Mathematical Society Prize. In 2017 he became a Fellow of the American Mathematical Society, and in 2018 he gave an invited talk at the International Congress of Mathematicians.

Response from Ciprian Manolescu
I feel very honored to receive the E. H. Moore Research Article Prize from the AMS. The main result of the paper is the existence of non triangulable manifolds in dimensions at least 5. In principle, a low-dimensional topologist like me could have no hope of proving such a result. Luckily, in the 1970s, David Galewski, Ron Stern, and Takao Matumoto managed to reduce this statement to a conjecture about the homology cobordism group in dimension 3, and this is the conjecture I proved. They deserve more than half of the credit for the final theorem. I would like to thank my mentors Peter Kronheimer, Mike Hopkins, and Lars Hesselholt. With their help, during my student years at Harvard I developed a stable homotopy version of Seiberg–Witten Floer homology. I found a few applications for this construction back then, but the theory lay more or less dormant for the next decade. In 2012 I started thinking about homology cobordism, and I then realized that by
incorporating an extra symmetry into my old construction I could get new information. The result was the article cited for this award. I am happy to see that, in the past few years, several young mathematicians have further developed the techniques from my paper to yield even more insight into homology cobordism. I would particularly like to acknowledge the contributions of Irving Dai, Kristen Hendricks, Jennifer Hom, Tye Lidman, Francesco Lin, Jianfeng Lin, Matt Stoffregen, Linh Truong, and Ian Zemke. It was a pleasure having some of them as collaborators and students. Finally, I want to thank my colleagues at UCLA for making the department a great place to do research.

About the Prize

The E.H. Moore Research Article Prize is awarded every three years for an outstanding research article that appeared in one of the primary AMS research journals: Journal of the AMS, Proceedings of the AMS, Transactions of the AMS, AMS Memoirs, Mathematics of Computation, Electronic Journal of Conformal Geometry and Dynamics, or Electronic Journal of Representation Theory. The article must have appeared during the six calendar years ending a full year before the meeting at which the prize is awarded. The prize carries a cash award of US$5,000.

The prize honors the extensive contributions of E. H. Moore (1862–1932) to the AMS. Moore founded the Chicago section of the AMS, served as the Society’s sixth president (1901–1902), delivered the Colloquium Lectures in 1906, and founded and nurtured the Transactions of the AMS.

The E.H. Moore Research Article Prize is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2019 prize, the members of the selection committee were:

- Ian Agol (Chair),
- F. Michael Christ,
- Sergio Roberto Fenley,
- Nets H. Katz,
- Claire Marie Voisin.

A list of previous recipient of the E.H. Moore Research Article Prize may be found on the AMS website at https://www.ams.org/profession/prizes-awards/pabrowse?purl=moore-prize

Credits

Photo of Ciprian Manolescu is courtesy of Reed Hutchinson.
Citation

The David P. Robbins Prize is awarded to Roger Behrend, Ilse Fischer, and Matjaž Konvalinka for the paper “Diagonally and antidiagonally symmetric alternating sign matrices of odd order,” published in 2017 in *Advances in Mathematics*.

In this work, Behrend, Fischer, and Konvalinka prove, after more than thirty years, the conjectured formula for the number of odd-order diagonally and antidiagonally symmetric alternating sign matrices, the last remaining of David Robbins’s conjectures on alternating sign matrices.

An alternating sign matrix (ASM) is a square matrix in which every entry is 0, 1, or −1, and along each row and column the nonzero entries alternate in sign and have a sum of 1. They were introduced by David Robbins and Howard Rumsey in work on a certain generalization of the determinant where these matrices surfaced naturally. Robbins, in the mid-1980s, initiated a program of counting symmetry classes of ASMs of a given size and conjectured remarkably simple product formulae for most of these symmetry classes. The quote from his 1991 survey paper reads: “These conjectures are of such compelling simplicity that it is hard to understand how any mathematician can bear the pain of living without understanding why they are true.”

All had been proven by 2006, with the exception of the conjecture for diagonally and antidiagonally symmetric ASMs, which had resisted proof until the present paper.

The Robbins conjectures have led to the development of new methods of enumeration, as well as to the discovery of deep connections to statistical physics. The first breakthrough came in 1996, with the proof by Doron Zeilberger that \(n \times n\) ASMs are equinumerous with totally symmetric, self-complementary plane partitions in a \(2n \times 2n \times 2n\) box, for which George Andrews had derived a simple product formula. In the same year, Greg Kuperberg made the connection to statistical physics by deriving the same ASM enumeration from the Izergin–Korepin determinant for a partition function for the six-vertex model on a square grid with domain wall boundary conditions. Kuperberg subsequently used this approach to enumerate three other symmetry classes of ASMs, and the enumeration by Roger Behrend, Ilse Fischer, and Matjaž Konvalinka builds on his work.

The main technical tool introduced by Kuperberg is a set of determinants and Pfaffian formulae for ASM partition functions, and it is these formulae that explain why the enumeration formulae are products of small factors. Behrend, Fischer, and Konvalinka arrive at a partition function with a compact formula by introducing vertex weights, depending on many parameters, into the model. Through computational experiments, they were able to guess the form of the partition function, which of course depends fundamentally on the choice of weights. To arrive at the compact formula, they took advantage of the observation by Soichi Okada, and by Alexander Razumov and Yuri Stroganov, that parti-
From the AMS Secretary

The David P. Robbins Prize is awarded to a novel research paper in algebra, combinatorics, or discrete mathematics with a significant experimental component. This proof of the last remaining of David Robbins’s conjectures on alternating sign matrices is a shining example. Not only is it a crowning achievement that makes use of deep methods developed by a community of researchers over more than twenty-five years, it is also a paper that makes new problems accessible.

Biographical Sketch: Roger Behrend

Roger Behrend was born in Melbourne, Australia. He studied mathematics and physics at the University of Melbourne and Imperial College London, receiving a PhD in mathematical physics from the University of Melbourne in 1997. Between 1997 and 2000, he held postdoctoral positions at the Physics Institute of the University of Bonn and the C. N. Yang Institute for Theoretical Physics at Stony Brook University. He has worked in the School of Mathematics at Cardiff University since 2001 and held a visiting position in the Faculty of Mathematics at the University of Vienna during 2017–2018. His research throughout the past decade has been in combinatorics. Much of his spare time is spent listening to classical music.

Response from Roger Behrend

I feel deeply honored to receive the David P. Robbins Prize together with my collaborators Ilse Fischer and Matjaž Konvalinka. It is fitting that in the research recognized by this award, we proved a conjecture of Robbins himself, and that this conjecture involved alternating sign matrices, which were first encountered by David Robbins and Howard Rumsey.

I believe that our construction of a proof of Robbins's conjecture for the number of odd-order diagonally and antidiagonally symmetric alternating sign matrices lies some distance from both the beginning and the end of the overall story of alternating sign matrices. Looking back, the proof depended on a significant body of earlier work, including that of Mills, Robbins, Rumsey, Izergin, Korepin, Zeilberger, Kuperberg, Okada, Razumov, and Stroganov. Looking forward, there remain many intriguing mysteries still to be resolved. As an important example, bijective proofs are currently lacking for known equalities between numbers of alternating sign matrices and numbers of certain plane partitions.

I am thankful to my wife Rachael and to my colleagues, family, and friends for their support throughout my exploration of the fascinating world of alternating sign matrices.

Biographical Sketch: Ilse Fischer

Ilse Fischer received her doctoral degree in 2000 from the University of Vienna under the direction of Christian Krattenthaler. After some years as a postdoctoral researcher at the University of Klagenfurt, she returned to a faculty position at the University of Vienna in 2004. In 2009 she was awarded the START prize of the Austrian Federal Ministry for Science, the most prestigious award for young researchers in Austria, and a 1.1 million € research grant endowment. In 2017 she was promoted to full professor. Her research is devoted to enumerative and algebraic combinatorics, and its connections to statistical physics and other fields.

Response from Ilse Fischer

The idea of working on Robbins’s last open conjecture on alternating sign matrices slowly manifested in my mind as I was writing a grant proposal about ten years ago, when I identified it as an ultimate, albeit unrealistic, goal. In the beginning I hardly dared spend much time on it, but every now and then I discussed it with other combinatorialists. Roger Behrend and Matjaž Konvalinka were obviously among them, but I also had a particularly fruitful exchange with Arvind Ayyer back in 2012, which led us to several conjectures on the enumeration of extreme diagonally and antidiagonally symmetric alternating sign matrices of odd order. About three years later, Arvind, Roger, and I were able to prove these conjectures, and to some extent also this work paved the way for the eventual proof of Robbins’s conjecture. I feel deeply honored and moved to now receive, together with Matjaž and Roger, the David P. Robbins Prize.

I would like to express my appreciation for the initiative to support mathematical research with an experimental component. Results discovered through experiment rather than intuition have the potential to be particularly surprising, and proving them can present a challenge because initially one may have no clue as to the reason why they are true. The area of enumerative combinatorics Robbins and several others originated serves as a good example: They introduced objects such as alternating sign matrices, plane partitions, and lozenge tilings, and while for most enumerations no explicit formula exists containing, say, only the basis arithmetic operations, certain enumerations of those objects are expressible by simple product formulas, which were usually discovered through computer experiments. Although all of Robbins’s conjectures have now been proven, the proofs are complicated and we still lack thorough understanding just in what situations to expect a simple enumeration formula, nor are we able to explain phenomena such as the same enumeration formula ap-
pearing in the context of two very different combinatorial objects. Much of my past and current research has been driven by these questions.

Biographical Sketch: Matjaž Konvalinka
Matjaž Konvalinka was born in Ljubljana, Slovenia. He obtained his bachelor’s and master’s degrees at the University of Ljubljana, and his PhD at the Massachusetts Institute of Technology in 2008 under Igor Pak. He held a postdoctoral position at Vanderbilt University until 2010, and has been a professor at the Faculty of Mathematics and Physics, University of Ljubljana, since then. In 2012, he received a University award for excellent teaching and research. He mostly works in enumerative and algebraic combinatorics, and particularly enjoys bijective proofs, Schur functions, and tableaux combinatorics.

Response from Matjaž Konvalinka
I am deeply honored to be one of the recipients of the AMS David P. Robbins Prize. One of the reasons I love combinatorics is that many of its problems can be explained to a child, even when they are fiendishly hard to solve, and they inspire deep new tools and theorems. Problems involving alternating sign matrices are a prime example of this. Combinatorialists will forever be grateful to David Robbins and his coauthors for introducing them to the community and for the conjectures related to their enumeration.

I owe a debt of gratitude to many people. First and foremost I have to thank Ilse and Roger, my coauthors, both amazing mathematicians and people. They are truly worthy recipients of this prize. I am also deeply grateful to Marko Petkovšek for my first combinatorics courses; to my PhD advisor Igor Pak for everything he taught me and for always knowing what problems I will like; to Richard Stanley for his wonderful lectures, papers, and books; and to Sara Billey for being the best collaborator and friend one could imagine. My colleagues and students at the University of Ljubljana are a big part of why I enjoy my job. Many thanks also go to my husband Danijel and our daughter Ana, to the rest of my family, and to my friends, not least for seeming less surprised by this prize than I am.

About the Prize
The David P. Robbins Prize was established in 2005 in memory of David P. Robbins by members of his family. Robbins, who died in 2003, received his PhD in 1970 from the Massachusetts Institute of Technology. He was a long-time member of the Institute for Defense Analysis Center for Communications Research and a prolific mathematician whose work (much of it classified) was in discrete mathematics. The prize is given for a paper published during the preceding six calendar years that (1) reports on novel research in algebra, combinatorics, or discrete mathematics, (2) has a significant experimental component, (3) is on a topic broadly accessible, and (4) provides a simple statement of the problem and clear exposition of the work. The US$5,000 prize is awarded every three years.

The David P. Robbins Prize is awarded by the AMS Council acting on the recommendation of a selection committee. The members of the 2016 David P. Robbins Prize Committee were:
• Nola Alon
• Robert Calderbank (Chair)
• Timothy Chow
• Sylve Corteel
• Avi Wigderson

A list of previous recipients of the David P. Robbins Prize can be found on the AMS website at: http://www.ams.org/profession/prizes-awards/ams-prizes/robbins-prize

Credits
Photo of Roger Behrend is courtesy of Roger Behrend.
Photo of Ilse Fischer is by Barbara Mair ©University of Vienna.
Photo of Matjaž Konvalinka is by Peter Legiša.
2019 Oswald Veblen Prize in Geometry

The 2019 Oswald Veblen Prize in Geometry was presented at the 125th Annual Meeting of the AMS in Baltimore, Maryland, in January 2019. The prize was awarded to Xiuxiong Chen, Simon Donaldson, and Song Sun.

Citation

The 2019 Oswald Veblen Prize in Geometry is awarded to Xiuxiong Chen, Simon Donaldson, and Song Sun for the three-part series entitled “Kähler–Einstein Metrics on Fano Manifolds, I, II and III” published in 2015 in the Journal of the American Mathematical Society, in which Chen, Donaldson, and Sun proved a remarkable nonlinear Fredholm alternative for the Kähler–Einstein equations on Fano manifolds. They show that this fully nonlinear PDE can be solved if and only if a certain stability condition involving only finite-dimensional algebro-geometric data holds.

In 1982 Shing-Tung Yau received the Fields Medal in part for his 1978 proof of the so-called Calabi Conjecture. In particular Yau proved that if the first Chern class of a compact Kähler manifold vanishes (respectively, is negative), then it admits a Kähler–Einstein metric, i.e., there is a unique Kähler metric in the same class with vanishing (respectively, constant negative) Ricci curvature.

Yau later conjectured that a solution in the case of Fano manifolds, i.e., those with positive first Chern class, would necessarily involve an algebro-geometric notion of stability. Seminal work of Gang Tian and then Donaldson clarified and generalized this idea. The resulting conjecture—that a Fano manifold admits a Kähler–Einstein metric if and only if it is K-stable—became one of the most active topics in geometry. In 1997 Tian introduced the notion of K-stability used in the cited papers, and used this to demonstrate that there are Fano manifolds with trivial automorphism group which do not admit Kähler–Einstein metrics.

Proving this conjecture had long been understood to involve a vast combination of ideas from symplectic and complex geometry, infinite-dimensional Hamiltonian reduction, and geometric analysis. All methods involved some kind of continuity method; in 2011 Donaldson proposed one involving Kähler–Einstein metrics with cone singularities (published by Springer in Essays in Mathematics and Its Applications in 2012).

One of the main technical obstacles then was how to control certain limits of sequences of Kähler metrics on Fano manifolds (equivalently, how to obtain the “partial $C^0$-estimate”). One can take the so-called Gromov–Hausdorff limit, but a priori this could be a metric space with no algebro-geometric description.

It was a huge breakthrough when, in 2012, Donaldson and Sun managed to use Bergman kernels to put the structure of a normal projective algebraic variety on the Gromov–Hausdorff limit of a noncollapsing sequence of

Chen, Donaldson, and Sun gave a complete solution of the conjecture for Fano manifolds a few months later. The announcement was published in International Mathematics Research Notices in 2014, and full proofs followed in “Kähler–Einstein metrics on Fano manifolds. I: Approximation of metrics with cone singularities,” “Kähler–Einstein metrics on Fano manifolds. II: Limits with cone angle less than $2\pi$,” and “Kähler–Einstein metrics on Fano manifolds. III: Limits as cone angle approaches $2\pi$ and completion of the main proof,” all published in 2015 in the Journal of the AMS.

As one nominator put it, “This is perhaps the biggest breakthrough in differential geometry since Perelman’s work on the Poincaré conjecture. It is certainly the biggest result in Kähler geometry since Yau’s solution of the Calabi conjecture thirty-five years earlier. It is already having a huge impact that will only grow with time.”

Biographical Note: Xiuxiong Chen
Xiuxiong Chen received his undergraduate degree in 1987 from the University of Science and Technology of China (USTC) and a master’s degree from the graduate school of USTC and the Academia Sinica in 1989, supervised by JiaGui Peng in geometry and Weiyue Ding in analysis. He then moved to the University of Pennsylvania in 1989 for his doctoral degree under the supervision of E. Calabi. He held positions at McMaster University (1994–1996), Stanford University (1996–1998), Princeton University (1998–2002), and the University of Wisconsin–Madison (2002–2009). Since 2009 he has been a professor of mathematics at Stony Brook University. He was an invited speaker at ICM 2002 in Beijing and is a 2015 Fellow of the American Mathematical Society and a 2016 Simons Fellow in mathematics. Over his career, he has supervised around twenty PhD students in mathematics.

Biographical Note: Simon Donaldson
Simon Donaldson received his undergraduate degree in 1978 from Cambridge University and moved to Oxford for his doctorate, supervised by Michael Atiyah and Nigel Hitchin. He held positions in Oxford and Stanford before moving to Imperial College, London, in 1998. At present he is a permanent member of the Simons Center for Geometry and Physics, Stony Brook. Over his career he has supervised about forty-five doctoral students, many of whom are now leading figures in mathematical research. Donaldson was awarded a Fields Medal in 1986 for his work on gauge theory and four-dimensional manifolds, and he has made contributions to several other branches of differential geometry. He was an invited speaker at ICMs in 1983, 1986, 1998, and 2018. He has held a number of editorial positions (including, currently, the Journal of the AMS), and served on a variety of committees, including the Executive Committee of the International Mathematical Union (1994–2002).

Biographical Note: Song Sun
Song Sun was born in 1987 in Huaining, Anhui province, China. He received a BS from the University of Science and Technology of China in 2006 and a PhD from the University of Wisconsin–Madison in 2010, supervised by Xiuxiong Chen. He held a postdoctoral position at Imperial College London from 2010–2013, and then became an assistant professor at Stony Brook University. In 2018, he joined the faculty at University of California, Berkeley. Sun received an Alfred P. Sloan Research Fellowship in 2014, and was an invited speaker at ICM 2018 in Rio de Janeiro.

Response from Xiuxiong Chen, Simon Donaldson, and Song Sun
It is a great honor to be awarded the 2019 Oswald Veblen Prize for our work on Kähler–Einstein metrics. Our work builds on that of many others. In 1954, Calabi proposed his vision of far-reaching existence theorems for canonical metrics on Kähler manifolds—a vast extension of the classical theory for Riemann surfaces. The foundation for this vision came from the developments of complex differential geometry over the preceding decades by Kähler, Hodge, Chern, and others. In its general formulation, involving “extremal” Kähler metrics, Calabi’s problem remains to a large extent open, but in the case of Kähler–Einstein metrics the existence theory is now in a relatively satisfactory state. A crucial breakthrough by S.-T. Yau, which famously dealt with the cases of negative or zero first Chern class, was recognized in the 1981 Veblen Prize. Many mathematicians have contributed to the understanding of the remaining “positive” case over the four decades since Yau’s work. We feel very fortunate and privileged to have had the opportunity to play a part in this long story.

Our cited work interweaves strands from several different fields. One is the theory of the complex Monge–Ampère equation, with estimates in the style going back to Calabi and Yau, but also with modern developments which extend the theory to singular varieties. Another is the convergence theory of Riemannian manifolds with Ricci curvature bounds: our work blends these ideas with complex geometry through the $L^2$ or “Hörmander” method. A third strand brings in the circle of ideas linking geometric invariant theory in algebraic geometry, and notions of “stability,” to symplectic geometry. In the few years following our cited work, several other proofs of the main result have appeared, but all sharing a similar diversity of techniques. This diversity is an intrinsic feature of the problem, which seeks a bridge between differential and algebraic geometry. While our work provides an answer to one long-standing question, these recent developments open up wonderful
new vistas, for example in the study of moduli spaces and singularities, within this grand theme.

We are very glad to have this opportunity to thank our wives—Holly, Nora, and Jiajia—for their wonderful support, which was crucial for us in completing this work. Xiuxiong Chen wishes to take this opportunity to thank his advisor, E. Calabi, for his mathematical guidance and inspiration.

**About the Prize**

The Oswald Veblen Prize in Geometry is awarded every three years for a notable research memoir in geometry or topology that has appeared during the previous five years in a recognized North American journal (until 2001 the prize was usually awarded every five years). Established in 1964, the prize honors the memory of Oswald Veblen (1880–1960), who served as president of the AMS during 1923–1924. It was established in 1961 in memory of Veblen through a fund contributed by former students and colleagues and later doubled by Veblen’s widow. In 2013, Cathleen Synge and Herbert Morawetz made a major donation that substantially increased the prize fund. Cathleen S. Morawetz served as president of the AMS in 1995–1996. The Veblen Prize carries a cash award of US$5,000.

The Veblen Prize is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2019 prize, the members of the selection committee were:

- Danny C. Calegari,
- Albert Marden (Chair),
- Ulrike Tillmann.

A list of previous recipients of the Oswald Veblen Prize in Geometry may be found on the AMS website at [https://www.ams.org/profession/prizes-awards/pabrowse?pur1 fabulous=veblen-prize](https://www.ams.org/profession/prizes-awards/pabrowse?pur1 fabulous=veblen-prize).

**Credits**

Photo of Xiuxiong Chen is by Holly Chen.
Photo of Simon Donaldson is courtesy of Simon Donaldson.
Photo of Song Sun is by Jia Jia He.
2019 Norbert Wiener Prizes in Applied Mathematics

The 2019 Norbert Wiener Prizes in Applied Mathematics were presented at the 125th Annual Meeting of the AMS in Baltimore, Maryland, in January 2019. The prizes were awarded to **Marsha Berger** and to **Arkadi Nemirovski**.

**Citation: Marsha Berger**
The 2019 Norbert Wiener Prize in Applied Mathematics is awarded to Marsha Berger for her fundamental contributions to Adaptive Mesh Refinement and to Cartesian mesh techniques for automating the simulation of compressible flows in complex geometry.

In solving partial differential equations, Adaptive Mesh Refinement (AMR) algorithms can improve the accuracy of a solution by locally and dynamically resolving complex features of a simulation. Marsha Berger is one of the inventors of AMR. The block-structured approach to AMR was introduced by Berger in her 1982 thesis, and, from this, the Berger–Oliger algorithm and the Berger–Colella algorithm were developed by Berger, Joseph Oliger, and Phillip Colella. Berger provided the mathematical foundations, algorithms, and software that made it possible to solve many otherwise intractable simulation problems, including those related to blood flow, climate modeling, and galaxy simulation. Her mathematical contributions include local error estimators to identify where refinement is needed, stable and conservative grid interface conditions, and embedded boundary and cut-cell methods. She is part of the team that created Cart3D, a NASA code based on her AMR algorithms that is used extensively for aerodynamic simulations and which was instrumental in understanding the Columbia Space Shuttle disaster. She also helped build GeoClaw, an open source software project for ocean-scale wave modeling. It is used to simulate tsunamis, debris flows, and dam breaks, among other applications.

**Biographical Note: Marsha Berger**
Marsha Berger received her PhD in computer science from Stanford in 1982. She started as a postdoc at the Courant Institute of Mathematical Sciences at NYU, and is currently a Silver Professor in the computer science department, where she has been since 1985.

She is a frequent visitor to NASA Ames, where she has spent every summer since 1990 and several sabbaticals. Her honors include membership in the National Academy of Sciences, the National Academy of Engineering, and the American Academy of Arts and Science. She is a fellow of the Society for Industrial and Applied Mathematics. Berger was a recipient of the Institute of Electrical and Electronics Engineers Fernbach Award and was part of the team that won the 2002 Software of the Year Award from NASA for their Cart3D software.

**Response from Marsha Berger**
What a thrill to learn that I will be one of the recipients of the 2019 Norbert Wiener Prizes! One of the main enjoyments I get from my research is developing tools to solve real problems in aerodynamics, tsunami modeling, etc., that others can use. This has been possible because of collaborators I have been fortunate to meet, starting with Phil Colella and Antony Jameson, and later Randy LeVeque and Michael Aftosmis, along with a number of postdocs.

I am particularly pleased that this kind of research is being recognized. The Adaptive Mesh Refinement (AMR) and Cartesian grid projects have both required the creation of new techniques in mathematics and computer science. They were decade-long efforts where I and my collaborators developed theory and algorithms, while paying attention...
to important practical aspects of their use in realistic geometries. Complicated algorithms have complicated implementations, and accuracy, robustness, and performance are all essential parts of the research.

About the Prize
The AMS-SIAM Norbert Wiener Prize in Applied Mathematics is awarded every three years to recognize outstanding contributions to applied mathematics in the highest and broadest sense. Established in 1967 in honor of Norbert Wiener (1894–1964), the prize was endowed by the Department of Mathematics of the Massachusetts Institute of Technology. The prize is given jointly by the AMS and the Society for Industrial and Applied Mathematics (SIAM). The recipient must be a member of one of these societies. The prize carries a cash award of US$5,000.

For the 2019 prize, the members of the AMS-SIAM selection committee were:
- Emmanuel Candès (Chair),
- James Weldon Demmel,
- Charles R. Doering.

A list of the previous recipients of the Norbert Wiener Prize in Applied Mathematics may be found on the AMS website at https://www.ams.org/profession/prizes-awards/pabrowse?purl=wiener-prize.

Credits
Photo of Marsha Berger is courtesy of Marsha Berger.
FROM THE AMS SECRETARY

2019 Norbert Wiener Prizes in Applied Mathematics

The 2019 Norbert Wiener Prizes in Applied Mathematics were presented at the 125th Annual Meeting of the AMS in Baltimore, Maryland, in January 2019. The prizes were awarded to Marsha Berger and to Arkadi Nemirovski.

Citation: Arkadi Nemirovski

The 2019 Norbert Wiener Prize in Applied Mathematics is awarded to Arkadi Nemirovski for his fundamental contributions to high-dimensional optimization and for his discovery of key phenomena in the theory of signal estimation and recovery.

A powerful and original developer of the mathematics of high-dimensional optimization, Nemirovski, with D. Yudin, invented the ellipsoid method used by Leonid Khachiyan to show for the first time that linear programs can be solved in polynomial time. With Yurii Nesterov, he extended interior point methods in the style of Narendra Karmarkar to general nonlinear convex optimization. This foundational work established that a rich class of convex problems, called semidefinite programs, are solvable in polynomial time; semidefinite programs are nowadays routinely used to model concrete applied problems or to study deep problems in theoretical computational complexity. A third breakthrough, with Aharon Ben-Tal, was the invention of methods of robust optimization to address problems in which the solution may be very sensitive to problem data. Nemirovski also, and rather amazingly, made seminal contributions in mathematical statistics, establishing the optimal rates at which certain classes of nonparametric signals can be recovered from noisy data and investigating limits of performance for estimation of nonlinear functionals from noisy measurements. All in all, Nemirovski’s contributions have become bedrock standards with tremendous theoretical and practical impact on the field of continuous optimization and beyond.

Biographical Note: Arkadi Nemirovski

Arkadi Nemirovski was born in 1947 in Moscow, Russia. He earned his PhD (1974) from Moscow State University, under the supervision of Georgi Evgen'evich Shilov. His research areas are convex optimization (information-based complexity of convex optimization, design of efficient first order and interior point algorithms, robust optimization) and nonparametric statistics. He held research associate positions at the Moscow Research Institute for Automatic Equipment (1973–1987) and the Central Economic Mathematical Institute of USSR/Russian Academy of Sciences (1987–1993) and was professor at the Faculty of Industrial Engineering and Management, Technion, Israel (1993–2005). Since 2005, he has held a professorship at the H. Milton Stewart School of Industrial and Systems Engineering at Georgia Institute of Technology.


Response from Arkadi Nemirovski

I am deeply honored and grateful to receive the 2019 Norbert Wiener Prize in Applied Mathematics—a distinction I never dreamt of. As a student, I have been fortunate to be taught by brilliant mathematicians at the Mechanical
and Mathematical Faculty of Moscow University, where I was mentored by Georgi Shilov. During my professional life, I had the honor and privilege to collaborate with outstanding colleagues, first and foremost, with Yuri Nesterov, Aharon Ben-Tal, and Anatoli Juditski, to whom I am extremely grateful for their indispensable roles in our joint research and for decades of friendship. I owe a lot to the excellent working conditions I enjoyed at the Central Economic Mathematical Institute in Moscow, at Technion—the Israel Institute of Technology, and at Georgia Institute of Technology.

I always thought that the key word in “applied mathematics” is “mathematics”—even when all we need at the end of the day is a number, I believe that what matters most are rigorous results on how fast this number could be found and how accurate it is, which poses challenging and difficult mathematical problems. I am happy to observe how my research area—convex optimization—thrives due to the effort of new generations of researchers, and how rapidly extends the scope of its applications.

**About the Prize**

The AMS-SIAM Norbert Wiener Prize in Applied Mathematics is awarded every three years to recognize outstanding contributions to applied mathematics in the highest and broadest sense. Established in 1967 in honor of Norbert Wiener (1894–1964), the prize was endowed by the Department of Mathematics of the Massachusetts Institute of Technology. The prize is given jointly by the AMS and the Society for Industrial and Applied Mathematics (SIAM). The recipient must be a member of one of these societies. The prize carries a cash award of US$5,000.

For the 2019 prize, the members of the AMS-SIAM selection committee were:

- Emmanuel Candes (Chair)
- James Weldon Demmel
- Charles R. Doering.

A list of the previous recipients of the Norbert Wiener Prize in Applied Mathematics may be found on the AMS website at https://www.ams.org/profession/prizes-awards/pabrowse?pur1=wiener-prize.

**Credits**

Photo of Arkadi Nemirovski is courtesy of Arkadi Nemirovski.
2019 Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student

Ravi Jagadeesan was awarded the 2019 Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student at the 125th Annual Meeting of the AMS in Baltimore, Maryland, in January 2019.

Citation

The recipient of the 2019 AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student is Ravi Jagadeesan of Harvard University. Jagadeesan was selected as the winner of the Prize for “[his] fundamental contributions across several topics in pure and applied mathematics, including algebraic geometry, statistical theory, mathematical economics, number theory, and combinatorics” from a pool with outstanding candidates who impressed the selection committee. His papers have been published or accepted for publication in journals such as Proceedings of the London Mathematical Society, Electronic Journal of Combinatorics, Research in Number Theory, American Economic Journal: Microeconomics, and Games and Economic Behavior. Additionally, he has presented three papers at the Association for Computing Machinery Conference on Economics and Computation.

Jagadeesan’s research in mathematics began early, when he published combinatorics papers on pattern avoidance for permutations in the context of (i) alternating permutations and (ii) Young’s diagrams and tableaux (joint with Nihal Gowravaram). Then he went on to derive a new invariant for the action of the absolute Galois group of \( \mathbb{Q} \) on the set of isomorphism classes of the so-called dessins d’enfants (children’s drawings). In another paper, he gave a new proof of Serre’s characterization of regular local rings (joint with Aaron Landesman). At Harvard, he has worked on the birational geometry of elliptic fibrations and its connections to the combinatorics of hyperplane arrangements. His resulting award-winning senior thesis and three related papers (joint with Mboyo Esole, Steven Jackson, Monica Kang, and Alfred Noël) lie at the interface of algebraic geometry, combinatorics, and string theory.

Jagadeesan’s work in mathematical economics is in the fields of matching theory, market design, and public finance. In the view of his references, he brings deep mathematical insights and connections from multiple areas to the table. His papers in matching theory (joint with Tamás Fleiner, Zsuzsanna Jankó, Scott Kominers, Ross Rheingans-Yoo, and Alex Teytelboym) leverage topological fixed-point theorems and ideas from general equilibrium to yield insights into the structure of equilibria in markets with frictions. His work in market design streamlined the analysis of proposed market-clearing mechanisms and clarified the role of key mathematical assumptions. His paper on optimal taxation with an endogenous growth rate is described as being an important contribution to theoretical public finance.
FROM THE AMS SECRETARY

In addition to the above work, Jagadeesan has extended Ramsey theory via quasi-colorings to write a paper on causal statistical inference in the presence of an underlying graph or a network. Regarding this contribution, a reference letter writer states that they were most satisfied by Jagadeesan’s “harnessing the beauty and power of mathematics to find structure in a messy real-world problem...making fundamental progress on an important problem of our times.” Indeed, the committee members felt that this statement could be applied as well to much of Jagadeesan’s work in economics and other areas. Case in point: he has used ideas from category theory to coauthor a Python library, Matriarch, for biomaterials architecture (joint with Tristan Giesa, David Spivak, and Markus Buehler).

Biographical Note: Ravi Jagadeesan

Ravi Jagadeesan grew up in Naperville, Illinois. His interest in mathematics was inspired at a young age by his grandparents—all four of them mathematicians—and his parents—who are both computer scientists. He attended Phillips Exeter Academy in Exeter, New Hampshire, for high school, where he had the opportunity to take advanced courses in mathematics and develop his problem-solving skills. He graduated from Harvard with an AB summa cum laude in mathematics (with a minor in economics) and with an AM in statistics.

He had the opportunity to work in several different areas of pure and applied mathematics—including algebraic geometry, combinatorics, number theory, statistical theory, and mathematical economics—under a host of advisors. His first experience with mathematical research was during high school, when he was a student in the MIT math department’s Program for Research in Mathematics, Engineering, and Science (PRIMES). He then became interested in exploring applied work and spent summers working on research in applied mathematics at the Center for Excellence in Education’s Research Science Institute (RSI) at MIT and as an Economic Design Fellow at the Harvard Center of Mathematical Sciences and Applications (CMSA). He is currently a student in Harvard’s PhD program in Business Economics, where he is a National Science Foundation Graduate Research Fellow.

Jagadeesan earned a gold medal at the International Mathematical Olympiad in 2012 and was named a Putnam Fellow in 2014. He received Harvard’s Jacob Wendell Scholarship Prize, and his senior thesis on “Crepant resolutions of $\mathbb{Q}$-factorial threefolds with compound Du Val singularities” was awarded the Thomas Temple Hoopes Prize.

Outside of mathematics and economics, he enjoys dancing and is a member of the Harvard Ballroom Dance Team.

Response from Ravi Jagadeesan

It is a great honor to receive the 2019 AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. I would like to thank Mrs. Morgan, as well as the AMS, MAA, and SIAM, for establishing this prize and for recognizing me.

I would also like to thank my many mentors—Markus Buehler, Noam Elkes, Mboyo Esole, Pavel Etingof, Zuming Feng, John Geanakoplos, Tristan Giesa, Jerry Green, Joel Lewis, Akhil Mathew, Natesh Pillai, John Rickert, David Spivak, Stefanie Stantcheva, Alex Teytelboym, Alex Volfovsky, Shing-Tung Yau, and, especially, Scott Kominers—for their advice and support over the years.

I am grateful to the MIT Program for Research in Mathematics, Engineering and Science, the Research Science Institute, and the Harvard Center of Mathematical Sciences and Applications for providing excellent work environments.

I am also grateful for research and travel grants from Harvard Business School, the Harvard College Research Program, and the Harvard math department. Most of all, I would like to thank my family—including my wonderful grandparents, parents, and sister—for their love and support.

Citation for Honorable Mention: Evan Chen

Evan Chen is recognized with an Honorable Mention for the 2019 Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. He has authored many papers in combinatorics and number theory, some as a single author and some in collaboration. He has had papers accepted to the Proceedings of the AMS, the Electronic Journal of Combinatorics, Research in Number Theory, and the International Journal of Number Theory. In joint work, he proved an elliptic curve version of Linnik’s theorem. He answered an open question on balance constants of posets and, in joint work, made progress on the long-studied problem of classification of Wilf-equivalence classes of patterns. He is currently a PhD student at the Massachusetts Institute of Technology, where he is supported by an NSF Graduate Fellowship.

Biographical Sketch: Evan Chen

Evan Chen was born and raised in California and completed his undergraduate degree in Cambridge, Massachusetts. He is currently pursuing a PhD in mathematics at the Massachusetts Institute of Technology, supported by an NSF fellowship.

Besides research, Evan is deeply involved in the training of the USA team for the International Math Olympiad (IMO), after having won a gold medal himself in high school. Among other roles, he is the assistant academic director for the USA’s training camp and the coordinator for the USA team selection tests. He is also the current chief of staff for the Harvard–MIT math tournament and the author of a popular MAA-published book in competitive geometry.

Outside of math and teaching, Evan enjoys board games and Korean pop dance.
Response from Evan Chen
It is a wonderful privilege to receive an Honorable Mention for the 2019 Frank and Brennie Morgan Prize. I would like to thank Mrs. Morgan and the AMS, MAA, and SIAM for their generosity and support of undergraduate research.

I would like to acknowledge and thank Joe Gallian and Ken Ono for their mentorship and support during my undergraduate years. The three summers I spent at these REU programs were immensely productive learning and research experiences and contributed greatly to my development. I am also deeply grateful for their encouragement and advice.

I would also like to extend thanks to my professors and teachers from the past several years, with particular thanks to Zuming Feng, Po-Shen Loh, Zvezda Stankova, and Yan Zhang. Finally I would like to thank my family and friends for their constant care and support.

Citation for Honorable Mention: Huy Tuan Pham
Huy Tuan Pham is recognized with an Honorable Mention for the 2019 Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. He has jointly authored several papers in additive combinatorics. These papers compose his undergraduate thesis, for which he won the Kennedy Thesis Prize at Stanford University. Two of his papers have been accepted to International Mathematical Research Notices and to Discrete Analysis. His work uses tools from combinatorics, number theory, and analysis to show that tower-type bounds are needed in some natural applications of Szemerédi’s regularity method, including Green’s generalization of Roth’s theorem for popular difference. He is currently at the University of Cambridge supported by a Trinity Studentship and will start his PhD studies at Stanford this fall.

Biographical Note: Huy Tuan Pham
Huy Tuan Pham was born and raised in Ho Chi Minh City, Vietnam. After finishing high school at High School for the Gifted at Vietnam National University, Ho Chi Minh City, he attended Stanford University, where he received a BS in Mathematics with Honors and a minor in Computer Science, and an MS in Statistics. He is now at Cambridge University pursuing Part III of the Mathematical Tripos and will return to Stanford University for his PhD.

Huy’s initial interest in combinatorics was developed during International Math Olympiad trainings in Vietnam. Since his sophomore year, he has been working with Jacob Fox on probabilistic and additive combinatorics. He plans to continue his study of combinatorics and probability in his PhD.

Response from Huy Tuan Pham
I am honored to receive an Honorable Mention for the 2019 Frank and Brennie Morgan Prize. I would like to thank Mrs. Frank Morgan and the AMS, MAA, and SIAM for sponsoring this meaningful award. I am extremely thankful to my advisor Jacob Fox for his help and support throughout my undergraduate years, which has shaped my passion and understanding of combinatorics. I am also grateful to Yufei Zhao, who has given me useful advice throughout our collaboration. I am fortunate to have learned great mathematics from Stanford math professors, particularly Amir Dembo, Persi Diaconis, Andrea Montanari, Lenya Ryzhik, Ravi Vakil, and Jan Vondrak. Last but not least, I would like to thank my family and friends for their support, especially to my friend Phan-Minh Nguyen, who has provided me with tremendous encouragement and insights through our endless conversations in mathematics and statistics.

About the Prize
The Frank and Bernie Morgan Prize is awarded annually for outstanding research in mathematics by an undergraduate student (or students having submitted joint work). Students in Canada, Mexico, or the United States or its possessions are eligible for consideration for the prize. Established in 1995, the prize was endowed by Mrs. Frank (Brennie) Morgan of Allentown, Pennsylvania, and carries the name of her late husband. The prize is given jointly by the AMS, the Mathematical Association of America (MAA), and the Society for Industrial and Applied Mathematics (SIAM) and carries a cash award of US$1,200.

Recipients of the Frank and Bernie Morgan Prize are chosen by a joint AMS-MAA-SIAM selection committee. For the 2019 prize, the members of the selection committee were:
• Nathan Louis Gibson,
• Anant P. Godbole (Chair),
• V. Kumar Murty,
• Ken Ono,
• Catherine Sulem,
• Melanie Matchett Wood.

A list of previous recipients of the Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student may be found on the AMS website at https://www.ams.org/profession/prizes-awards/pabrowse?purI=morgan-prize.

Credits
Photo of Ravi Jagadeesan is by Ross Campbell Photography.
The 2019 JPBM Communications Award is presented to Margot Lee Shetterly for her book and subsequent movie *Hidden Figures*, which opened science and mathematics to a new generation of women and people of color by bringing into the light the stories of the African American women who made significant contributions to aeronautics and astronautics and, ultimately, to America’s victory in the Space Race.

Margot Lee Shetterly is a writer, researcher, and entrepreneur. She is the author of *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race*, which was a top book of 2016 for both TIME and Publisher’s Weekly (William Morrow and Company, New York, 2016), a USA Today bestseller, and a no. 1 New York Times bestseller. Shetterly is also the founder of the Human Computer Project, a digital archive of the stories of NASA’s African American “Human Computers,” whose work tipped the balance in favor of the United States in World War II, the Cold War, and the Space Race. According to the New York Times, the 2017 film adaptation of her book introduces viewers to “real people you might wish you had known more about earlier...[who] can fill you with an outrage at the persistence of injustice and gratitude towards those who had the grit to stand up against it.”

About the Prize
The JPBM Communications Award is presented annually to reward and encourage journalists and other communicators who, on a sustained basis, bring mathematical ideas and information to nonmathematical audiences. JPBM represents the American Mathematical Society, the American Statistical Association, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. The award carries a cash prize of US$2,000.

A list of previous recipients of the JPBM Communications Award may be found on the AMS website at [https://www.ams.org/profession/prizes-awards/pabrowse?purl=jpbm-comm-award](https://www.ams.org/profession/prizes-awards/pabrowse?purl=jpbm-comm-award).

Credits
Photo of Margot Lee Shetterly is by Aran Shetterly.