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 Moore Prize is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2013 prize, the members of the selection committee were: Sergiu Klainerman, Howard Masur, Bjorn Poonen, Kenneth A. Ribet, and Ulrike L. Tillman.

The previous recipients of the Moore Prize are Mark Haiman (2004), Ivan Shestakov and Ualbai Umirbaev (2007), and Sorin Popa (2010).

—Elaine Kehoe

2013 Robbins Prize

Alexander Razborov received the David P. Robbins Prize at the 119th Annual Meeting of the AMS in San Diego, California, in January 2013.

Citation

The 2013 David P. Robbins Prize is awarded to Alexander Razborov of the University of Chicago for his paper "On the minimal density of triangles in graphs", *Combinatorics, Probability and Computing* **17** (2008), no. 4, 603–618, and for introducing a new powerful method, flag algebras, to solve problems in extremal combinatorics.

Razborov solves an old extremal problem about the minimum possible number of triangles in a graph with n vertices and m edges. The origin of this problem goes back more than one hundred years to one of the oldest results in extremal combinatorics, by Mantel, who proved that any such graph with more than $n^2/4$ edges must have a triangle. This leads to the natural question of how many such triangles (as a function of the number of edges) should exist. Although the problem has been studied by leading combinatorialists for decades, it remained open until its recent solution by Razborov.

The paper by Razborov not only settled a longstanding open problem; much more importantly, it introduced a new method, called flag algebra calculus, for attacking a large class of extremal questions. This method was originally invented by Razborov to study the triangle density problem and was developed in full generality in his closely related paper, "Flag algebras", *Journal of Symbolic Logic* **72** (2007), no. 4, 1239–1282.

The solution of many extremal problems requires finding inequalities involving densities of small subgraphs of large graphs. Until recently this was done by ingenuity and the trial-and-error method. Remarkably, the work of Razborov gives a systematic approach to these arguments. His flag algebra calculus provides a formalism through which the problem of finding relations between subgraph densities can be reduced to a semidefinite programming (SDP) problem. This in turn enables the use of computers to find solutions, with rigorous proofs, to problems in extremal combinatorics. This method already had a great impact on the area, and it has been used to settle a number of longstanding open problems in extremal graph theory.

Alexander Razborov

Biographical Sketch

Alexander Razborov was born in 1963 in the small Siberian town of Belovo. He received his B.Sc. in mathematics from Moscow State University and his Ph.D. from the Steklov Mathematical Institute (Moscow). Currently, he is an Andrew MacLeish Distinguished Service Professor at the Department of Computer Science at the University of Chicago, with part-time appointments at the Steklov Mathematical Institute and Toyota Technological Institute at Chicago. He received the Rolf Nevanlinna Prize in 1990 and the Gödel Prize in 2007, was an invited speaker at the ICM in Berkeley (1986), and was elected as a corresponding member of the Russian Academy of Sciences in 2000. His research spans several areas in theoretical computer science, including computational complexity, proof complexity, quantum computing, and computational complexity, as well as related mathematical areas, notably discrete mathematics and combinatorial group theory.

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Response

I am truly grateful and honored to receive this prize, and I am equally delighted to receive it for this particular topic, which is very close to my heart.

All my professional career so far has been spent on the interface between computer science and mathematics, and I genuinely believe that certain amusing cultural differences between the two communities look really insignificant when compared to the amount of inspiration and fresh and novel ideas their interaction brings to both disciplines. In a sense, the work I am being awarded for is a quintessence of this philosophy. In order to be able to do something really computational (computer-aided theorem proving in extremal combinatorics using packages for semidefinite programming), one has to be able to reveal and understand fundamental, albeit somewhat simple by mathematical standards, algebraic and analytical structures behind this activity and be guided by them. Thank you again, both for the recognition of my own contribution and for promoting this important interdisciplinary ideology!

I would like to use this opportunity and thank all institutions I have been fortunate to be affiliated with (Steklov Mathematical Institute, IAS, University of Chicago, Toyota Technological Institute) for the stimulating intellectual environment that encouraged work on difficult and interesting problems. I am very grateful to my own collaborators on the project (Hamed Hatami, Jan Hladky, Daniel Kral, Sergei Norin, Oleg Pikhurko), as well as to many other young "flag algebraists" for developing this theory. Last but not the least my special thanks go to my wife, Iren, and my children, Andrew and Maria, for humorously bearing with the half-absence of their husband and daddy even when he appears to be fully present physically.

About the Prize

The Robbins Prize was established in 2005 in memory of David P. Robbins by members of his family. Robbins, who died in 2003, received his Ph.D. 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 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 Robbins Prize is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2013 prize, the members of the selection committee were: Daniel J. Allcock, J. P. Buhler, Maria Chudnovsky, Bernd Sturmfels, and Benjamin Sudakov.

The previous recipients of the Robbins Prize are Samuel Ferguson and Thomas C. Hales (2007) and Ileana Streinu (2010).

—Elaine Kehoe

2013 Satter Prize

Maryam Mirzakhani received the 2013 AMS Ruth Lyttle Satter Prize in Mathematics at the 119th Annual Meeting of the AMS in San Diego, California, in January 2013.

Citation

The 2013 Ruth Lyttle Satter Prize in Mathematics is awarded to Maryam Mirzakhani for her deep contributions to the theory of moduli spaces of Riemann surfaces.

Her earliest work, the topic of her thesis, was a volume formula for the moduli space of bordered Riemann surfaces of genus g with n geodesic boundary components, a formula that expresses this volume as a polynomial in the lengths of the boundary components. That there exists a formula of this nature was itself surprising, but more surprising were the results she was able to extract from it: a new proof of the celebrated conjecture of Witten on the intersection numbers of tautology classes on moduli space and, in a completely different direction, an asymptotic formula for the lengths of simple closed geodesics on a compact hyperbolic surface.

Much of her work subsequent to this has focused on the Teichmüller dynamics of moduli space. In particular, she was able to construct a measure-preserving conjugacy between Thurston's earthquake flow on Teichmüller space and horocycle flow on the associated space of quadratic differentials and as an immediate and long sought-after consequence of this to prove that earthquake flow

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