



AMERICAN MATHEMATICAL SOCIETY
MATHEMATICAL ASSOCIATION OF AMERICA
SOCIETY FOR INDUSTRIAL AND APPLIED MATHEMATICS

FRANK AND BRENNIE MORGAN PRIZE FOR OUTSTANDING RESEARCH IN MATHEMATICS BY AN UNDERGRADUATE STUDENT

THE Morgan Prize is awarded each year to an undergraduate student (or students for joint work) for outstanding research in mathematics. Any student who was enrolled as an undergraduate in December at a college or university in the United States or its possessions, Canada, or Mexico is eligible for the prize. The prize recipient's research need not be confined to a single paper; it may be contained in several papers. However, the paper (or papers) to be considered for the prize must be completed while the student is an undergraduate. Publication of research is not required. The prize was established in 1995. It is entirely endowed by a gift from Mrs. Frank (Brennie) Morgan. It is made jointly by the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.

CITATION

Ashwin Sah and Mehtaab Sawhney

The recipient of the 2021 AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student is the team of Ashwin Sah and Mehtaab Sawhney, both of the Massachusetts Institute of Technology. The award recognizes the duo's groundbreaking results across a broad range of topics in combinatorics, discrete geometry, and probability. Working alongside one another, Sah and Sawhney settled longstanding conjectures and improved results by established mathematicians. They have "solved several significant open problems and developed new techniques while working on exciting and central areas in the field." Combined, they have authored 30 papers (11 of these together), and published in top journals including *Inventiones Mathematicae*, *Advances in Mathematics*, *Mathematical Proceedings of the Cambridge Philosophical Society*, the *Journal of Combinatorial Theory Series B*, and *Combinatorica*. This is the first award to coauthors of joint work in the Morgan Prize history. The two were chosen from an especially strong slate of candidates due to the "quality and quantity [of their] collective work." The committee considered that, while each

independently would be top contenders for the prize, as a team they have contributed significantly more to mathematical scholarship, which should be lauded. Their expansive list of coauthors, including many other impressive young mathematicians, is an excellent example of the enormous benefit of collaboration in mathematics.

The pair were recognized with Honorable Mention last year (along with D. Stoner). Since then, they have produced numerous additional significant results, including the “recent improvement of Sah of the best known upper bound for the diagonal Ramsey numbers”, making progress on what is “arguably the most famous problem in extremal combinatorics.” Their joint work on “local limit theorems for subgraph counts” extends the previous results of Gilmer, Kopparty and Berkowitz and provides counterexamples to the conjectures of Fox, Kwan, and Sauermann. This is an “important and technically challenging problem, which was not even solved [in the simplest case] until about five years ago.” In a joint paper with Zhao on “Cayley graphs without a bounded eigenbasis,” they extend a result from Naor in spectral graph theory from abelian groups to “not necessarily abelian” groups. In the study of graph limits (with Tidor and Zhao), they found a counterexample to several conjectures of Bollobas and Riordan aimed towards extending the theory of graph limits to the sparse regime. These “appealing conjectures had stood open for more than ten years, but their short, elegant counterexample had escaped many of the leading researchers in the area”. The research of Sah and Sawhney is both deep and broad, “tackling questions at the very forefront of current research, yet extending across the entire gamut of modern combinatorics”, with significant contributions to extremal graph theory, graph limits, additive combinatorics, Ramsey theory, algebraic combinatorics, combinatorial geometry, random graphs and random matrix theory. They have demonstrated a “significant amount of ingenuity, originality and technical ability” resulting in a research record which is “extremely rare for undergraduate students”.

Biographical Note

Ashwin Sah was born and raised in Portland, Oregon. In high school, he won a gold medal at the 2016 International Mathematical Olympiad as a member of the winning US team. Ashwin is currently a graduate student studying mathematics at the Massachusetts Institute of Technology. Other than combinatorics, Ashwin is also interested in pursuing analytic number theory, Fourier analysis, and random matrix theory. Beyond math, Ashwin spends his time helping organize math contests and participating in the effective altruism community. He is also interested in economics, game theory, and artificial intelligence.

Biographical Note

Mehtaab Sawhney grew up in Commack, New York. Mehtaab is currently a graduate student studying mathematics at the Massachusetts Institute of Technology. In addition to combinatorics, Mehtaab is interested in statistics, probability, and random matrix theory. Outside of math, Mehtaab enjoys playing table tennis, playing Texas hold 'em and Pot Limit Omaha, and watching classical movies. He is also interested in economics, theoretical machine learning, and finance.

Response from Ashwin Sah and Mehtaab Sawhney

It is a tremendous honor to receive the 2021 Frank and Brennie Morgan Prize. We extend our deepest gratitude towards Mrs. Morgan and the AMS, MAA, and SIAM for promoting and supporting undergraduate mathematical research.

We would also like to sincerely thank two of our research mentors, Professor Yufei Zhao from the MIT math department and Professor Joseph Gallian from the Duluth REU, who have each been instrumental in our mathematical endeavors. Professor Yufei Zhao has been an exceptionally kind and generous mentor for both of us for the past three years and it has truly been a pleasure to interact with him closely over this time period. In particular, he has spent a great deal of time teaching us how to become better mathematicians and how to communicate our results. Professor Gallian introduced us to an amazing community of peers and mentors, informally known as “Duluthians”, and the summers we each spent at the Duluth REU were incredibly enjoyable due in large part to his passion and expert guidance.

We would further like to thank a number of joint collaborators including David Stoner, Vishesh Jain, and Ross Berkowitz.

Ashwin Sah would like to thank his older brother Varun for support in all his pursuits, and to thank Dr. John Gorman for playing a key role in guiding him towards higher mathematics. He also thanks Professor Ken Ono and Professor Jesse Thorner for their mentorship and support at the 2019 Emory REU.

Mehtaab Sawhney would like to thank Mr. Robert Minott, Mrs. Barbara Gerson, and Mr. Richard Kurtz for helping cultivate an interest in mathematics and research more broadly. He also thanks Dr. Per Alexandersson and Professor Jonathan Weed for their mentorship in his initial steps into research, especially in their guidance regarding how to broadly approach mathematical research.

Finally, and most importantly, we would each individually like to thank our parents for their incredible support and encouragements along all our mathematical adventures.