2018 Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student

ASHVIN SWAMINATHAN was awarded the 2018 Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student at the 124th Annual Meeting of the AMS in San Diego, California, in January 2018.


Ashvin Swaminathan

Citation

Ashvin Anand Swaminathan is the recipient of the 2018 AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student for his research in the areas of algebraic geometry, number theory, and combinatorics. Ashvin has authored ten papers, of which six have been published; one has been accepted; and three have been submitted. Seven of his papers have appeared or will appear in the *Electronic Journal of Combinatorics*, *Journal of Algebra*, *Journal of Logic and Analysis*, *Proceedings of the American Mathematical Society*, *Research in Number Theory*, and *International Journal of Number Theory*. He is described as a passionate and focused researcher with deep technical knowledge, which allows his work to be original and remarkable, making breakthroughs that are of substantial interest to experts in long established areas ofmathematics.

Ashvin did research in the 2014 and 2015 University of Minnesota Duluth Research Experiences for Undergraduates (REU) program under the mentorship of Professors Joseph Gallian and Noam Elkies in the areas of combinatorial number theory and Galois representations. In addition, he also participated in the 2015 and 2016 Emory University REU program under the mentorship of Professor Ken Ono, Dr. Jesse Thorner, and Professor David Zureick-Brown, focusing on analytic number theory and arithmetic geometry. His senior thesis at Harvard was in the area of algebraic geometry and was mentored by Professors Joseph Harris and Anand Patel. While in high school, Ashvin completed research at Stanford in the areas of logic and analysis and analytic number theory under the direction of Dr. Simon Rubinstein-Salzedo and Professor Daniel Kane, respectively.

Ashvin has also been awarded Princeton's Centennial Fellowship, a National Science Foundation Graduate Research Fellowship, the Paul and Daisy Soros Fellowship for New Americans, a Barry M. Goldwater Scholarship, and the David B. Mumford Prize (for most promising mathematics concentrator at Harvard). As a high school student, he was the national winner of the Siemens AP Science Award and was a regional finalist for the Siemens Competition in Math, Science, and Technology.

Biographical Sketch

Ashvin Swaminathan was born in New Jersey and raised in California. He graduated as the valedictorian from the Harker School in San Jose. He then attended Harvard University, where he received an AB in mathematics and an AM in physics, graduating summa cum laude and Phi Beta Kappa. Currently, Ashvin is pursuing a PhD in mathematics at Princeton University, where he is supported by three fellowships. Motivated by his undergraduate studies at Harvard and his work at the NSF Duluth and Emory REUs, Ashvin plans to pursue research in number theory and arithmetic geometry.

Besides research, Ashvin is passionate about teaching and has received certificates of distinction for his service as a course assistant in the Harvard mathematics department. In his spare time, Ashvin plays the violin and was fortunate to have performed with the San Francisco Symphony Youth Orchestra and in the Music@Menlo chamber music program. Ashvin also maintains interests in art history, music theory, and the classics.

Response from Ashvin Swaminathan

It is a wonderful honor for me to receive the 2018 Frank and Brennie Morgan Prize. I am deeply grateful

to Mrs. Morgan for her vision and generosity and to the AMS, MAA, and SIAM for helping to support undergraduate research in mathematics. Many thanks are due to Simon Rubinstein-Salzedo for first kindling my interest in mathematics and research. Besides being fantastic advisors, Joe Gallian and Ken Ono have been wonderful sources of inspiration, advice, and help. I am grateful to both of them for providing me with opportunities to hone my research skills at their respective REU programs. I thank Jesse Thorner and David Zureick-Brown for working closely with me during my two summers at the Emory REU. Moreover, I would like to thank Joe Harris for being an incredibly generous teacher and advisor and for offering me a glimpse of the wondrous world of algebraic geometry from his cultured perspective. I would also like to thank Anand Patel for coadvising my senior thesis with Joe Harris and for his limitless flexibility and optimism. I extend thanks to my Harvard professors, particularly Noam Elkies, Dennis Gaitsgory, Curtis McMullen, Alison Miller, and Arul Shankar, for helping to cement my interest in mathematics. Finally, I thank my parents and grandparents for their unflinching faith in my abilities and for their undying love and support.

Citation for Honorable Mention: Greg Yang

Greg (Ge) Yang is recognized with an Honorable Mention for the 2018 Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. He has several published and submitted papers on many different fields, such as logic, neural networks, dynamical statistical mechanics, and commutative algebra. In his master's thesis, submitted as part of the Harvard AB/SM program, Greg lays out a new mathematical theory of neural memory and algorithmic learning based on Lie groups. Noteworthy is his senior thesis developing a homological theory of functions, which is at the intersection of computational complexity theory, learning theory, and algebraic topology. Greg won the prestigious Thomas Temple Hoopes Prize for this work.

Biographical Sketch

Greg Yang was born in Hunan Province of China, but soon moved to Guangzhou for kindergarten, then to Beijing for elementary school, to Houston, Texas, for middle and high school, and finally to Cambridge, Massachusetts, for his undergraduate education at Harvard College.

In his first two years at Harvard, Greg was involved in many different activities, such as the Harvard Undergraduate Drummers, Freshman Arts Collaborative Experience Showcase, Harvard College Mathematics Review, Harvard College Consulting Group, and so on. At the end of his sophomore year, he decided to pursue music full time, and for the next year and a half he worked as an EDM (electronic dance music) producer and DJ under the name Zeta. During this time, he became exposed to the ideas of artificial intelligence, and, serendipitously, the realization of human-level AI became his single focus in life.

After coming back to school for what would have been his senior spring semester, he took another two years off. During this period he quickly learned most major branches of mathematics and theoretical computer science, along with the forefront of artificial intelligence, and in addition became fluent in physics, biology, and neuroscience. At the end of the 2016–2017 school year, Greg finally obtained an AB in mathematics and SM in computer science from Harvard after accelerating his remaining course load. Greg now works as a researcher at Microsoft Research, with focus on AI and theoretical computer science.

Response from Greg Yang

It is an incredible privilege to receive Honorable Mention for the 2018 AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. Thank you, Mrs. Morgan and the AMS, MAA, and SIAM, for establishing this award and for promoting undergraduate research in mathematics. I would like to thank Professor Madhu Sudan for many hours of discussion and advising and teaching me coding theory. I would also like to thank Professors Shing-Tung Yau and Michael Freedman for believing in me and introducing me to researchers in mathematics and computer science. I am eternally grateful for Scott Kominers, now a professor of economics at Harvard, who from the very beginning has been steadfast in his support of me and my works. Thanks are due to Professor Alexander Rush, who provided invaluable advice on research in AI. I am also extremely thankful for Nate Ackerman, who guided me through my first research paper and was incredibly generous with his time. I thank Rutger Kuyper, who allowed me to consult his expertise when I was working on my first paper. I thank Professor Alexander Postnikov for an insightful discussion about combinatorial commutative algebra and for his support of my work. I would like to show my appreciation for Sam Schoenholz, whose paper "Deep information propagation" inspired me to conduct my own research into the dynamics of neural networks and who contributed to my research by running experiments verifying my predictions. In addition, thanks are due to Günter Ziegler, Ezra Miller, Bernd Sturmfels, and Fatemeh Mohammadi, who provided references and discussion on algebra and combinatorics during the formative period of my work on homological theory of functions. Thanks to Professors Leslie Valiant and Boaz Barak for listening to my babbles and providing encouragement. Of course, I need to give thanks to all my friends who in one way or another helped me, especially Felix Wong, who did a lot of favors for me as a tutor in Quincy House and often provided insights into my problems through statistical mechanics.

Last, and most of all, I am grateful for my family's support through thick and thin, especially during my leaves of absence from Harvard when I stayed at home. Without those years of quiet thought, I would not be here today.

About the Prize

Recipients of the Morgan Prize are chosen by a joint AMS-MAA-SIAM selection committee. For the 2018 prize, the members of the selection committee were:

- Anant P. Godbole
- V. Kurmar Murty
- Sarah Dianne Olson (Chair)
- Ken Ono
- Catherine Sulem
- Melanie Matchett Wood

The 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.

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:
`www.ams.org/profession/prizes-awards/ams-prizes/morgan-prize`.

Photo Credit

Photo of Ashvin Anand Swaminathan by Chris Smith.