2004 Morgan Prize

The 2004 AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student was awarded at the Joint Mathematics Meetings in Atlanta in January 2005.

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, and the United States or its possessions are eligible for consideration for the prize. Established in 1995, the prize was endowed by Mrs. Frank 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 $1,000.

Recipients of the Morgan Prize are chosen by a joint AMS-MAA-SIAM selection committee. For the 2004 prize the members of the selection committee were: Svetlana R. Katok, Herbert A. Medina, Kris Stewart, Philippe M. Tondeur (chair), and Paul Zorn.

Previous recipients of the Morgan Prize are: Kannan Soundararajan (1995), Manjul Bhargava (1996), Jade Vinson (1997), Daniel Biss (1998), Sean McLaughlin (1999), Jacob Lurie (2000), Ciprian Manolescu (2001), Joshua Greene (2002), and Melanie Wood (2003).

The 2004 Morgan Prize was awarded to REID W. BARTON. Receiving an honorable mention was PO-SHEN LOH. The text that follows presents the selection committee's citation, a brief biographical sketch, and the awardee's response upon receiving the prize. The same information is provided for the honorable mention.

Reid W. Barton

Citation
The winner of the 2004 Morgan Prize for Outstanding Research in Mathematics by an Undergraduate is Reid W. Barton. The award is based on the research paper "Packing densities of patterns".

Packing densities were introduced by Herb Wilf in 1992–93. Some of the early questions were settled by Alkes Price, Fred Galvin, and Walter Stromquist. Recent contributions were made by M. H. Albert, M. D. Atkinson, C. C. Handley, D. A. Holton, W. Stromquist, A. Burstein, P. Hästö, and T. Mansour. The main goal of Barton's paper is to extend the theory of packing densities of permutations to that of patterns, i.e. words allowing repetition of letters. After resolving the basic conceptual issues elegantly, Barton delves into the study of packing densities for specific families of layered patterns. He proves several important results, some generalizing earlier results by the above-mentioned authors, some opening up new vistas. Barton also outlines a possible program to tackle open questions and formulates new conjectures. This is all in all a remarkable debut paper in the area of pattern research in combinatorics, an area of considerable current interest. Commentators consider Barton's paper the best paper so far on packing densities and praise it for its clarity, new techniques, and new results.

Biographical Sketch
Reid W. Barton is a senior at the Massachusetts Institute of Technology majoring in mathematics. A resident of Arlington, Massachusetts, Reid began his formal studies in mathematics at Tufts University while in middle school. As a high school student, he earned four gold medals at the International Mathematical Olympiad, placing first with a perfect score in 2001. That year he also placed first at the International Olympiad in Informatics, earning his second IOI gold medal. As an undergraduate, he has been designated a Putnam Fellow the past three years and has been a member of MIT's Putnam team, which placed first in 2003 and second in 2001. Reid has also competed on MIT's ACM International Collegiate Programming Contest team, finishing fifth and second at the 2003 and 2001 World Finals respectively. An accomplished pianist, Reid performs in

MIT Chamber Music Society groups. He is an avid bridge player and also enjoys playing intramural soccer, hockey, and ultimate.

Response
I am very honored to receive the 2004 Frank and Brennie Morgan Prize. I would like to thank the AMS-MAA-SIAM Morgan Prize Committee for selecting me for this award. I would also like to thank Joe Gallian, director of the Duluth REU [Research Experiences for Undergraduates], for providing the opportunity to do research on a challenging problem in a stimulating environment, and all those affiliated with the Duluth REU who gave me feedback on my research.

Honorable Mention: Po-Shen Loh

Citation
The Morgan Prize Committee is pleased to award honorable mention for the 2004 Morgan Prize for Outstanding Research in Mathematics by an Undergraduate to Po-Shen Loh. This recognition is based on his senior thesis at Caltech on "Random graphs and the second eigenvalue problem".

His result is a probabilistic estimate. It extends the work of Alon and Roichman involving the second-largest eigenvalue of the Cayley graph of a sufficiently large group with respect to a subset of a certain size. The improvement upon the Alon/Roichman result comes from replacing the order of the group by the sum of degrees of its irreducible representations. This is considerably smaller for nonabelian groups in general.

The second-largest eigenvalue of a graph is a characterization of the expansion of the graph, which is an important concept in combinatorics and the theory of computation. Graphs with large expansion are used in the derandomization of algorithms, the design of error correcting codes, and other applications. Their investigations have been an active research area for two decades. Po-Shen Loh's contribution is a nice result and the promise of great things to come.

Biographical Sketch
Po-Shen Loh received his mathematics degree from Caltech in 2004 and is currently studying mathematics at the University of Cambridge on a one-year Winston Churchill Foundation Scholarship. This fall he will start his Ph.D. at Princeton University, aided by fellowships from the Hertz Foundation and the National Science Foundation. As a grade-school student in Madison, Wisconsin, Po-Shen first developed his dual interests in mathematics and computer science through competitions, representing the United States at the international level in both subjects. At Caltech these interests migrated to research, thanks to many supportive faculty in the mathematics, applied mathematics, and computer science departments and to Caltech's Summer Undergraduate Research Fellowship program.

Po-Shen's research interests, combinatorics and its applications, are the product of this varied background. In his spare time at Cambridge, Po-Shen explores topics in other fields, tinkers with computers, and enjoys the British countryside with his wife, a fellow Caltech graduate.

Response
I feel very honored to be designated Honorable Mention for this award, and I am very grateful to all of the people involved in organizing this prize competition. I would like to mention several institutions and individuals who contributed significantly to this final result. Caltech provided a special close-knit academic and social atmosphere that allowed my creativity and imagination to flourish, and its Summer Undergraduate Research Fellowship program gave me the opportunity to explore various fields of research during the summers of 2000, 2001, 2002, and 2003. During those summers I worked for three wonderful Caltech advisors: Alain Martin and Leonard Schulman from computer science, and Emmanuel Candes from applied mathematics. Leonard Schulman supervised my 2003 project, which evolved into the senior thesis that won this Honorable Mention. His guidance was essential. I would also like to recognize the mathematics department at Caltech, in whose supportive company I developed the bulk of my mathematical knowledge. Finally, thank you to Debbie, my family, and my friends for your consistent support and encouragement.