

# 2000 Morgan Prize

Today undergraduate students are working on problems of current research interest, proving theorems, writing up results for publication, and giving talks on their work. There is undergraduate research at the highest level of professional excellence.

The AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student recognizes and encourages high-caliber mathematical research by undergraduate students. Sponsored by the AMS, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics, the prize was endowed by Mrs. Frank Morgan and carries the name of her late husband.

At the Joint Mathematics Meetings in New Orleans in January 2001, the 2000 Morgan Prize was awarded to JACOB LURIE. WAI LING YEE received an Honorable Mention.

The prize selection committee consisted of George E. Andrews, Kelly J. Black, Robert O. Robson (chair), Martha J. Siegel, and Robert Strichartz.

The following text contains the committee's citation, a brief biographical sketch of Jacob Lurie, and his response upon receiving the award. The same information is presented for Wai Ling Yee.

## Jacob Lurie

### Citation

Jacob Lurie is cited for his paper "On simply laced Lie algebras and their miniscule representations", an original and penetrating work that may well become a standard reference in the subject, according to the nominating letter of Benedict Gross.

Simply laced Lie algebras include some of the classical families, but also some of the exceptional Lie algebras that are not as well understood. Lurie began with the problem of understanding a certain 27-dimensional representation of the exceptional Lie algebra  $E_6$ , in particular identifying explicitly the invariant cubic polynomial for the representation. After solving this problem, Lurie went on to build

a coherent theory that contains and generalizes his solution. He constructs the Lie algebra, its miniscule representations (those whose weight vectors lie in a single orbit of the Weyl group), and natural multilinear maps between miniscule representations, working over the integers, all using initial data consisting of a double cover of the root lattice of the Lie algebra. He further applies his constructions to the exceptional Lie algebra  $E_7$  and its 56-dimensional representations, giving an explicit expression for its invariant quartic polynomial.

This work is impressive for several reasons:

- It involves both abstract machinery and concrete examples, and it makes the connection between them.
- It uses ideas that are ultimately seen as simple, but required great originality and cleverness to discover and implement.
- It makes an important contribution to an area of active interest.
- It was independent work conceived and carried out by the author.

For any mathematician this would be an outstanding work. For an undergraduate it is truly exceptional.

### Biographical Sketch

Jacob Lurie is a first-year graduate student at Princeton University. His primary mathematical interests are algebraic geometry, representation theory, and mathematical logic.

### Response

I would like to thank Dick Gross and Joe Harris for all the help they have given me with my thesis and throughout my (undergraduate) time at Harvard.



Jacob Lurie

## Honorable Mention: Wai Ling Yee

### Citation

The members of the 2000 Morgan Prize committee are pleased to award Wai Ling Yee with an Honorable Mention. Ms. Yee's application focused on her extension of the theory developed by D. Ragozin on the properties of the convolution on compact Lie groups of continuous measures that are invariant under conjugations (central measures). Ragozin showed that a convolution product of sufficiently many such measures yields an absolutely continuous measure. Ms. Yee improved the result, showing that absolutely continuous measure can be made to have an  $L^2$  density function, and she gave sharp estimates for the minimum number of factors required, depending on the particular group. Her work was based on precise pointwise estimates on the characters of the groups, which in itself is an important contribution.

Ms. Yee is a student at the University of Waterloo, and her work is the result of a summer research program with her advisor. As part of her research program she first had to familiarize herself with and understand the basic theory of Lie algebras and representation theory. Not only was she able to master the necessary material but was able to simplify an earlier result of her advisor as well as extend those results to all classical Lie algebras. Ms. Yee's joint work with Kathryn Hare, her advisor, and David Wilson has been accepted for publication in the *Journal of the Australian Mathematics Society*, and a second paper on their work has been submitted to *Studia Mathematica*.

The 2000 Morgan Prize committee recognizes that Wai Ling Yee is not only an outstanding undergraduate student but has also contributed to the profession. It is our great pleasure to name Ms. Yee as this year's Honorable Mention.

### Biographical Sketch

Wai Ling Yee is presently a first-year graduate student at the Massachusetts Institute of Technology. Her primary mathematical interests are analysis and representation theory.

### Response

It is a remarkable honor to be awarded Honorable Mention for the 2000 Morgan Prize. I am indebted to the Natural Sciences and Engineering Research Council of Canada and the faculty of mathematics of the University of Waterloo for providing opportunities to work as an undergraduate research assistant. I am also very grateful to the many people, especially Professors Davidson, Forrest, Hare, and Nica of the University of Waterloo's analysis research group, who supported me in my endeavors. In particular, I would like to thank my advisor, Professor Kathryn Hare, who deserves the highest praise for her dedication, encouragement, and guidance.