Madhu Sudan Receives Nevanlinna Prize

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On August 20, 2002, the Rolf Nevanlinna Prize was awarded at the opening ceremonies of the International Congress of Mathematicians (ICM) in Beijing, China. The prizewinner is MADHU SUDAN.

In 1982 the University of Helsinki granted funds to award the Nevanlinna Prize, which honors the work of a young mathematician (less than 40 years of age) in the mathematical aspects of information science. The prize is presented every four years in conjunction with the ICM. Previous recipients of the Nevanlinna Prize are: Robert Tarjan (1982), Leslie Valiant (1986), Alexander Razborov (1990), Avi Wigderson (1994), and Peter Shor (1998).

The Nevanlinna Prize is awarded by the International Mathematical Union on the advice of a selection committee. The selection committee for the 2002 prize consisted of: Andrei Agrachev, Ingrid Daubechies, Wolfgang Hackbusch, Michael O. Rabin (chair), and Alexander Schrijver.

Madhu Sudan was born on September 12, 1966, in Madras (now Chennai), India. He received his B. Tech. degree in computer science from the Indian Institute of Technology in New Delhi (1987) and his Ph.D. in computer science at the University of California at Berkeley (1992). He was a research staff member at the IBM Thomas J. Watson Research Center in Yorktown Heights, New York (1992–7). He is currently an associate professor in the Department of Electrical Engineering and Computer Science at the Massachusetts Institute of Technology.

Madhu Sudan has made important contributions to several areas of theoretical computer science, including probabilistically checkable proofs, nonapproximability of optimization problems, and error-correcting codes.

Sudan has been a main contributor to the development of the theory of probabilistically checkable proofs. Given a proof of a mathematical statement, the theory provides a way to recast the proof in a form where its fundamental logic is encoded as a sequence of computer bits. A "verifier" can, by checking only some of the bits, determine with high probability whether the proof is correct. What is extremely surprising, and quite counterintuitive, is that the number of bits the verifier needs to examine can be made extremely small. The theory was developed in papers by Sudan, S. Arora, U. Feige, S. Goldwasser, C. Lund, L. Lovász, R. Motwani, S. Safra, and M. Szegedy. For this work, these authors jointly received the 2001 Gödel Prize of the Association for Computing Machinery.

Also together with other researchers, Sudan has made fundamental contributions to understanding the nonapproximability of solutions to combinatorial optimization problems. This work connects to the fundamental outstanding question in theoretical computer science: Does P equal NP? A problem is in P if there is a polynomial-time algorithm that solves it. A problem is in NP if it has the property that a proposed solution can be checked in polynomial-time but that no polynomial-time algorithm is known to solve it. What Sudan and others showed is that, for certain combinatorial optimization problems, approximating an optimal solution is just as hard as finding an optimal solution. This result is closely related to the work on probabilistically checkable proofs.

The third area in which Sudan made important contributions is error-correcting codes. A class of widely used codes is the Reed-Solomon codes (and their variants), which were invented in the 1960s. For forty years it was assumed that the codes could correct only a certain number of errors. By creating a new decoding algorithm, Sudan demonstrated that the Reed-Solomon codes could correct many more errors than previously thought possible.

—Allyn Jackson