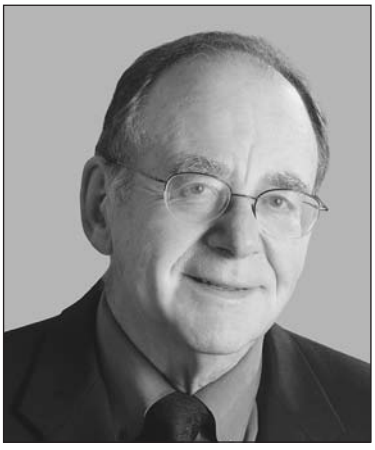
Karp Receives 2008 Kyoto Prize



Richard M. Karp

RICHARD M. KARP has received the 2008 Kyoto Prize in the category of Advanced Technology, for "fundamental contributions to the development of the theory of computational complexity". The presentation ceremony will be held at the Kyoto International Conference Center on November 10, 2008. At the ceremony, each Kyoto laureate will be awarded a diploma, a Kyoto Prize medal of 20 karat gold, and prize money of 50 million yen (about US$470,000). In the Basic Sciences category, the prize goes to molecular biologist Anthony James Pawson, and in the Arts and Philosophy category, to philosopher Charles Margrave Taylor.

The Work of Richard M. Karp

Richard M. Karp has made fundamental contributions to the development of the theory of computational complexity which began in the early 1970s by establishing the theory of NP-completeness, having a profound influence on the guiding principles for analysis and design of algorithms. He has also developed many practically relevant computer algorithms.

In particular, Karp created a technique for measuring the computational complexity of combinatorial problems by establishing complexity classes of equally hard-to-solve problems in accordance with the concept of polynomial-time reduction, and determining the class to which each problem would belong. In more concrete terms, Karp established the theory of NP-completeness by defining the complexity class P as problems for which polynomial-time algorithms of deterministic solutions exist, the complexity class NP as problems for which polynomial-time algorithms of nondeterministic solutions exist, and the NP-complete, which is a subclass of the complexity class NP to which the hardest-to-solve problems belong. With this achievement, he revealed that many familiar problems which often appear in a wide range of optimization problems in operation research, and in areas related to computer science, are equally hard-to-solve problems belonging to the NP-complete class. He also deduced and disseminated a standard methodology for this process, making a dramatic leap in the theory of computation and algorithms that underpin computer science.

Among researchers of the theory of computation, the issue of whether complexity class P and complexity class NP are the same class or not is referred to as the "P versus NP problem", which is an open problem of central interest in computer science, having also caught the interest of the mathematical community. As indicated by this fact, Karp not only added a new page to human wisdom by bringing computational complexity within the scope of scientific research, but also accelerated the development of algorithm engineering and had a significant influence on the guiding principles for the evaluation and design of algorithms for many of the problems extant in technological fields. Before his pioneering contributions, algorithms had to be designed individually for each of a plethora of technological problems. Karp freed algorithm design from this condition of manual labor and elevated it to a scientific technology.

In addition to these achievements, Karp has developed numerous individual algorithms with practical relevance, the most notable being the Edmonds-Karp algorithm. He played a central role in the development of computational complexity theory, which made notable advances in the early 1970s and after, and built a frame for the study of the theoretical computer science centered at the University of California, Berkeley, where he held a professorship and mentored many young researchers, thereby playing a leading role in the establishment of the theories of parallel algorithms and probabilistic algorithms. Over the last decade, he has stayed true to his belief that computer scientists should work on research themes that are

useful to other academic fields, particularly the life sciences, thereby making significant contributions to the study of algorithms in the bioinformatics field.

Biographical Sketch

Richard Manning Karp was born in 1935 in Boston, Massachusetts. He received his Ph.D. in applied mathematics in 1959 from Harvard University, under the direction of Anthony Oettinger. Karp was a research staff member at the IBM Thomas J. Watson Research Center from 1959 until 1968, when he became a professor at the University of California, Berkeley. He was a research scientist at the International Computer Science Institute (ICSI) from 1988 until 1995. He then spent four years at the University of Washington before returning to Berkeley, where he is now a University Professor. He is also a senior research scientist at ICSI.

His honors include the Delbert Ray Fulkerson Prize in Discrete Mathematics of the AMS and the Mathematical Programming Society (1979), the A. M. Turing Award of the Association for Computing Machinery (1985), the National Medal of Science (1996), the Harvey Prize of Technion-Israel Institute of Technology (1998), and the Benjamin Franklin Medal (2004). He is a member of the U.S. National Academy of Sciences and the U.S. National Academy of Engineering.

About the Prize

The Inamori Foundation was founded in 1984 by Kazuo Inamori (now chairman emeritus of Kyocera Corporation) and began its operations in 1985. The activities of the Inamori Foundation reflect the lifelong beliefs of its founder that people have no higher calling than to strive for the greater good of humankind and society and that the future of humanity can be assured only when there is a balance between scientific development and the enrichment of the human spirit. The foundation presents the Kyoto Prizes annually to honor those who have contributed significantly to the scientific, cultural, and spiritual betterment of mankind.

Previous Kyoto Prize winners who have made contributions to the mathematical sciences are: Rudolf E. Kalman (1985), Claude E. Shannon (1985), John McCarthy (1988), I. M. Gelfand (1989), Edward Lorenz (1991), André Weil (1994), Donald E. Knuth (1996), Kyosi Itô (1998), Mikhael Gromov (2002), Simon A. Levin (2005), and Hirotugu Akaike (2006).

—From Inamori Foundation announcements

Mathematics People

SIAM Prizes Awarded

The Society for Industrial and Applied Mathematics (SIAM) awarded a number of prizes at its annual meeting in July 2008 in San Diego, California.

VAN H. VU of Rutgers University has been awarded the George Pólya Prize for his work in combinatorial theory. He has developed fundamental concentration inequalities for random polynomials that are applicable to broader contexts than earlier inequalities. These inequalities have enabled the solution of long-standing problems in projective geometry, convex geometry, extremal graph theory, number theory, and theoretical computer science. The prize is given every two years for a notable application of combinatorial theory, approximation theory, complex analysis, number theory, orthogonal polynomials, probability theory, or mathematical discovery and learning. The prize carries a cash award of US$20,000.

MAX GUNZBURGER of Florida State University has been awarded the W. T. and Idalia Reid Prize in Mathematics. He was recognized for his fundamental contributions to control of distributed parameter systems and computational mathematics. The prize is given for outstanding work in, or other contributions to, the broadly defined areas of differential equations and control theory. It carries a cash award of US$10,000.

PHILIPPE TONDEUR of the University of Illinois, Urbana-Champaign, received the SIAM Prize for Distinguished Service to the Profession. He was honored for his extensive and highly effective advocacy for and support of the mathematical sciences.

DAVID I. GOTTLIEB of Brown University was named the John von Neumann Lecturer. He was honored for his work on spectral and high-order accurate numerical methods for partial differential equations and the applications of these methods to significant problems in science and engineering, including computational fluid dynamics, weather forecasting, and computational electromagnetism. The lectureship is awarded for outstanding and distinguished contributions to the field of applied mathematical sciences and for the effective communication of these ideas to the community.

DAAN HUYBRECHS of Katholieke Universiteit Leuven was awarded the DiPrima Prize for his dissertation "Multiscale and hybrid methods for the solution of oscillatory integral equations", in which he developed new solution methods for oscillatory integral methods and numerical methods to solve these equations. He showed how they can be applied to problems such as wave phenomena in engineering.

The SIAM Outstanding Paper Prizes have been awarded to the following researchers. VICENT CASELLES, Universitat Pompeu Fabra, Barcelona; ANTONIN CHAMBOLLE, École Polytechnique; and MATTEO NOVAGA, University of Pisa, were honored for their joint paper "The discontinuity set of solutions of the TV denoising problem and some extensions". The paper was published in *Multiscale Modeling and Simulation* **6**, no. 3, (2007). SUBHASH KHOT, Georgia Institute of Technology, was honored for the paper "Ruling out PTAS for graph min-bisection, dense k-subgraph, and bipartite clique", published in the *SIAM Journal on Computing* **36**, no. 4, (2006). TODD KAPITULA, Calvin College; P. G. KEVREKIDIS, University of Massachusetts, Amherst; and ZHIGANG CHEN, San Francisco State University, were selected for their joint paper "Three is a crowd: Solitary waves in photorefractive media with three potential wells", published in the *SIAM Journal on Applied Dynamical Systems* **5**, no. 4, (2006).

The SIAM Awards in the Mathematical Contest in Modeling were awarded to the following students. For Problem A, The Continuous Problem: Take a Bath, the awardees were AMY M. EVANS and TRACY L. STEPIEN of the University of Buffalo, State University of New York, for "Fighting the Waves: The Effect of North Pole Ice Cap Melt on Florida". Their faculty advisor was John Ringland. For Problem B, The Discrete Problem: Creating Sudoku Puzzles, the winners were CHRISTOPHER CHANG, ZHOU FAN, and YI SUN of Harvard University for "hsolve: A Difficulty Metric and Puzzle Generator for Sudoku". Their faculty advisor was Clifford Taubes.

The SIAM Student Paper Prizes were awarded to the following students: JEREMY BRANDMAN, University of California, Los Angeles, for "A Level-Set Method for Computing the Eigenvalues of Elliptic Operators Defined on Compact Hypersurfaces"; ROLAND GRIESMAIER, Johannes Gutenberg University of Mainz, Germany, for "An Asymptotic Factorization Method for Inverse Electromagnetic Scattering in Layered Media"; and DAVID KETCHESON,

University of Washington, for "Highly Efficient Strong Stability Preserving Runge-Kutta Methods with Low-Storage Implementations".

—From a SIAM announcement

Prizes Presented at the ECM

The European Mathematical Society (EMS) awarded several prizes at the European Congress of Mathematics (ECM), held in Amsterdam in July 2008. The EMS prizes are awarded every four years in conjunction with the congress to recognize distinguished contributions in mathematics by young researchers not older than thirty-five years. The prize carries a cash value of €5,000 (approximately US$8,000). The names of the awardees, their institutions, and brief descriptions of their honored work follow.

Artur Avila of the Clay Mathematics Institute and Instituto Nacional de Matemática Pura e Aplicada (IMPA) in Brazil has achieved many important results in dynamical systems, especially in the theory of iterated rational maps and the Teichmüller geodesic flow, some of which provide final solutions to long-standing major problems. These include his proof (with Lyubich) that there are infinitely renormalizable Julia sets in the quadratic family $f(z) = z^2 + c$ with Hausdorff dimension strictly less than 2; his proof (with Jitomirskaya) of the "ten Martini conjecture" of B. Simon; his proof (with Viana) of the Kontsevich-Zorich conjecture on simplicity of the Lyapunov spectrum for the Teichmüller geodesic flow; his proof (with Forni) that almost every interval exchange that does not have the combinatorics of a rotation is weakly mixing; and his proof (with Gouëzel and Yoccoz) of exponential mixing for the Teichmüller flow.

Alexei Borodin of the California Institute of Technology has made substantial contributions to the representation theory of "big" groups, combinatorics, interacting particle systems, and random matrix theory. A key observation of Borodin and Olshanski in the representation theory of big groups is that the irreducible characters for the group are associated with stochastic point processes. Borodin found a determinantal formula for the correlation functions of the so-called generalized regular representation of the infinite symmetric group and, with Olshanski, of the unitary group as well. Borodin analyzed the irreducible character associated with the generalized regular representation.

Ben Green of the University of Cambridge is best known for his result (with Terence Tao) that there exist arbitrarily long arithmetic progressions of primes. In earlier work he proved that every relative dense subset of the primes contains an arithmetic progression of length 3. One of the essential steps in the proof of the famous result with Tao is the discovery by Green that the work of Goldston and Yildirim on short intervals between primes provided precisely the "random-like" superset of the primes that they needed.

Olga Holtz of Technische Universität Berlin, Germany, and the University of California, Berkeley, has made substantial contributions to several mathematical areas, including algebra, numerical linear algebra, approximation theory, theoretical computer science, and numerical analysis. Some of these include the proof of the Newton inequalities for M matrices, fundamental work on accurately evaluating polynomials in finite arithmetic, and the proof that all group-theory-based fast matrix multiplication methods are numerically stable.

Boáz Klartag of the Clay Mathematics Institute and Princeton University has solved a number of outstanding problems in asymptotic geometric analysis. He broke the record on the minimum number of symmetrization steps of convex bodies required to transform them into near balls. He proved a central limit theorem for convex bodies, a result that brought ideas in convex geometry into probability theory. With Fefferman he solved a fundamental problem on optimal extrapolation of smooth functions.

Alexander Kuznetsov of the Steklov Mathematical Institute in Moscow has made fundamental contributions to birational projective geometry, representation theory, mathematical physics, homological algebra, and noncommutative geometry. His work on birational projective geometry includes theories of homological Lefschetz decompositions, homological projective duality, and categorical resolutions of singularities.

Assaf Naor of the Courant Institute of Mathematical Sciences, New York University, has made groundbreaking contributions to functional analysis, the theory of algorithms, and combinatorics. He is the leading architect of the modern theory of nonlinear functional analysis. He and a variety of collaborators discovered an unpredicted threshold phenomenon in the nonlinear Dvoretsky theorem, found a nonlinear analogue of the cotype invariant, and proved a sophisticated nonlinear analogue of the celebrated Maurey-Pisier theorem.

Laure Saint-Raymond of École Normale Supérieure (ENS), Paris, has achieved outstanding results in nonlinear partial differential equations in the dynamics of gases and plasmas and also in fluid dynamics. Her most striking work concerns the study of the hydrodynamic limits of the equation of Boltzmann in the kinetic theory of gases, in which she answered a question posed by Riemann within the framework of his sixth problem. Recently, in collaboration with I. Gallagher, she has tried to understand the equations of rotation fluids within the limit where the number of Rossby tends to zero.

Agata Smoktunowicz of the University of Edinburgh and the Institute of Mathematics of the Polish Academy of Sciences has solved a number of outstanding problems in noncommutative algebra. She has made the first significant progress in decades on some fundamental problems concerning nil rings. The most spectacular of these results is the construction, over any countable field, of a simple nil algebra. Other outstanding problems she has solved include the problem of polynomial rings over nil rings first posed by Amitsur in 1971, the proof of the Artin-Stafford Gap theorem for graded domains, and the first examples of finitely generated nil, but not nilpotent, algebras with polynomially bounded growth.

CÉDRIC VILLANI of the École Normale Supérieure, Lyon, has contributed greatly to the theory of nonequilibrium statistical mechanics, in particular in connection with the Boltzmann equation and the Landau equation in plasma physics. He proved the Cercignani conjecture and obtained (with Desvillettes) the first convergence result to a global Gaussian equilibrium for the Boltzmann equation without any smallness assumption. With Otto, he studied the link between diffusion equations, Talagrand inequalities, and logarithmic Sobolev inequalities. More recently, with Lott, he obtained a new characterization of Riemannian manifolds with bounded Ricci curvature from below in terms of convexity of the Boltzmann entropy with respect to optimal transportation (Monge-Kantorovich-Wasserstein) metrics.

The Felix Klein Prize, awarded to young scientists "for using sophisticated methods to give an outstanding solution to a concrete and difficult industrial problem", has been awarded to JOSSELIN GARNIER of Université Paris 7. Garnier's research is at the interface of stochastics and applied analysis and is applied to optics, wave propagation, and plasma physics. The prize citation notes that Garnier "is a leading scientist dealing with probabilistic aspects in the framework of partial differential equations, and has shown his ability to apply powerful theoretical tools to deal with real industrial problems."

—From an EMS announcement

2008 D'Alembert and Decerf Prizes Announced

Every two years the Société Mathématique de France (SMF) presents the d'Alembert Prize. Established in 1984, the prize is intended to encourage mathematical works in the French language and the exposition of mathematics for the general public. The prize recognizes an article, book, radio or television broadcast, film, or other project that is designed to improve understanding of mathematics and its recent developments.

The d'Alembert Prize for 2008 has been awarded to MARIE-JOSÉ PESTEL, president of the Comité International des Jeux Mathématiques (CIJM). The cash value of the prize is €2,000 (approximately US$3,170).

In addition, the SMF has awarded the Anatole Decerf Prize to ROBERT FERRÉOL for the website MATHCURVE, the Encyclopedia of Remarkable Mathematical Forms. The Decerf Prize was established to promote the pedagogy of mathematics.

—From an SMF announcement

YouTube Video Contest Winner

MACE MATEO of British Columbia is the winner of the "What Does 'Math and Voting' Mean to You?" YouTube video contest. Mateo received a warm congratulations and a check for US$500 for his entry, *The Beatles—We Can Work It Out,* in which music from the Beatles accompanies illustrations of different voting methods. Participants were judged on creativity, how well their message was conveyed, the level of entertainment, quality of the video, and relevance to the theme. Resources for this year's Mathematics Awareness Month help explain what makes votes matter, as well as how the voting system used affects the outcome, regardless of the context of the voting. A link to the video is available on the Mathematics Awareness Month website, `http://www.mathaware.org/index.html`.

—AMS Public Awareness Office

Prizes of the LMS

The London Mathematical Society (LMS) has awarded several prizes for 2008.

DAVID PREISS of the University of Warwick has been awarded the Pólya Prize in recognition of his outstanding contributions to analysis and geometric measure theory. NICHOLAS HIGHAM of the University of Manchester received the Fröhlich Prize in recognition of his leading contributions to numerical linear algebra and numerical stability analysis. KEVIN BUZZARD of Imperial College London was awarded the Senior Berwick Prize for his paper "Eigenvarieties", published in volume 320 of the LMS Lecture Note Series, *L-functions and Galois Representations*, in 2007.

Four Whitehead Prizes were awarded. TIMOTHY BROWNING of the University of Bristol was selected for his "significant contributions on the interface of analytic number theory and arithmetic geometry concerning the number and distribution of rational and integral solutions to Diophantine equations". TAMÁS HAUSEL of the University of Oxford was honored "for his investigations into hyperkähler geometry, which have led him to prove deep results in fields as diverse as the representation theory of quivers, mirror symmetry and Yang-Mills instantons". MARTIN HAIRER of the University of Warwick was honored for his contributions to the theory of stochastic differential equations. NINA SNAITH of the University of Bristol was recognized for her work at the interface of random matrix theory and number theory.

—From an LMS announcement

Meza Awarded Blackwell-Tapia Prize

JUAN C. MEZA of Lawrence Berkeley National Laboratory has been awarded the 2008 Blackwell-Tapia Prize. According to the prize citation, he "has an exceptionally distinguished record as a mathematical scientist; an accomplished and effective head of a large department doing cutting-edge explorations in the computational sciences, computational mathematics, and future technologies;

and a role model and active advocate for others from groups underrepresented in the mathematical sciences." His research interests are in nonlinear optimization with an emphasis on methods for parallel computing, and he has also worked on various scientific and engineering applications, including scalable methods for nanoscience, power grid reliability, molecular conformation problems, optimal design of chemical vapor deposition furnaces, and semiconductor device modeling.

Meza has chaired the Mathematical Sciences Research Institute (MSRI) Human Resources Advisory Committee and cochaired the annual Diversity Day workshops of the Society for Industrial and Applied Mathematics (SIAM). He has served on high-level advisory committees on diversity for major scientific organizations. He is also the recipient of the 2008 Distinguished Scientist Award from the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS).

The Blackwell-Tapia Prize is awarded every two years in honor of the legacy of David H. Blackwell and Richard A. Tapia, two distinguished mathematical scientists who have been inspirations to more than a generation of African American, Latino/Latina, and Native American students and professionals in the mathematical sciences. The prize recognizes a mathematical scientist who has contributed and continues to contribute significantly to research in his or her field of expertise and who has served as a role model for mathematical scientists and students from underrepresented minority groups or contributed in other significant ways to addressing the problem of the underrepresentation of minorities in mathematics.

—Michael L. Minion, University of North Carolina

Iovita Awarded Ribenboim Prize

ADRIAN IOVITA of Concordia University has been awarded the 2008 Ribenboim Prize in Number Theory by the Canadian Number Theory Association (CNTA). The prize is given every two to four years for distinguished research in number theory by a mathematician who is Canadian or has connections to Canadian mathematics. Previous winners of the prize are Andrew Granville (1999), Henri Darmon (2002), Michael Bennett (2004), and Vinayak Vatsal (2006). Iovita received a certificate and medal and gave a plenary talk at the CNTA meeting in July 2008.

—From a Fields Institute announcement

Rao Receives National Award in Statistics

B. L. S. PRAKASA RAO of the University of Hyderabad, India, has been selected to receive the 2007–2008 National Award in Statistics for Senior Statisticians from the government of India.

According to the prize citation, "Rao is recognized internationally as a pioneer who laid the foundation of modern statistics, with multifaceted distinctions as a mathematician, researcher, scientist, and teacher." He has made significant contributions to mathematics and to the theory and application of statistics. His work in multivariate analysis has been used in economic planning, weather prediction, medical diagnosis, tracking the movements of spy planes, and monitoring the course of spacecraft.

The National Award in Statistics was instituted by the Ministry of Statistics and Programme Implementation of the government of India to recognize "outstanding and meritorious research work in statistics". The award, established in memory of P. V. Sukhatme, is given to senior Indian statisticians for lifetime contributions to the development of statistical systems in the field of applied/official statistics.

—Elaine Kehoe

Paul Erdős Award Recipients Announced

The 2008 recipients of the Paul Erdős Awards have been announced. They are HANS-DIETRICH (DIETER) GRONAU, Germany; BRUCE HENRY, Australia; and LEOU SHIAN, Taiwan.

Gronau has been chairman of the United Mathematical Olympiad Organization of Germany and is chief trainer, deputy leader, and team leader. He has also been a member of the organization of the Bundeswettbewerbes Mathematik in West Germany and has overseen the unification of the two German competition organizations. Henry founded the Mathematics Challenge for Young Australians in 1991, an enrichment program supported by the Australian government that attracts about twenty-three thousand students annually. Shian founded the Invitational World Youth Mathematics Intercity Competition, which has been hosted by cities in Taiwan, the Philippines, India, and China. He founded the Regional Internet Mathematics Competition in Taiwan, has served as a member of the Taiwan Mathematical Olympiad Committee, and has been actively involved in training students to represent Taiwan in the International Mathematical Olympiad.

The Paul Erdős National Award is given by the World Federation of National Mathematics Competitions in recognition of mathematicians who have contributed to the development of mathematical challenges at the national level and to the enrichment of mathematics learning.

—World Federation of National Mathematics Competitions

Krzysztof P. Wojciechowski (1953–2008)

Krzysztof P. Wojciechowski was born in Szczecin, Poland, in 1953. He received his Ph.D. degree from the Polish Academy of Sciences under Bogdan Bojarski. He arrived in the U.S. in 1987, spent one year at Stony Brook University, and then moved to Indiana University-Purdue University Indianapolis (IUPUI), where he remained. He had a powerful impact on all who knew him, both mathematically and in many other ways. The main thrust of his work from the start was on the index theory of elliptic boundary value problems. His book, jointly written with Bernhelm Booß-Bavnbek, *Elliptic Boundary Problems for Dirac Operators*, established a language and provided tools for a generation of workers in the field. A central theme there was the study of the space of projections defining the boundary conditions as an infinite-dimensional Grassmannian. Using these ideas, the authors were able to prove the Bojarski conjecture relating the index of an elliptic operator on a closed manifold to the indices of boundary value problems obtained by cutting the manifold in pieces.

Krzysztof went on to study—partly with various other collaborators who were drawn into his world of extremely intricate and powerful calculations—secondary invariants of operators such as eta invariants and determinants on the Grassmannian, in particular cutting and pasting properties and the relation between zeta-function regularization and the Fredholm determinant.

Krzysztof loved life, his family, mathematics, literature, music, and judo. He was a world-class athlete and was actually World Judo Champion (for over-forty-five-year-olds). His enthusiasm about mathematics and his penetrating insights strongly influenced his colleagues and coworkers. He died far too young and was at the peak of his work. We can only imagine what he would have accomplished with more time.

—Bernhelm Booß-Bavnbek, Roskilde University, and Jerry Kaminker, IUPUI