

Mathematics People

Braverman Receives NSF Waterman Award



Mark Braverman

Mark Braverman of Princeton University has been selected as a cowinner of the 2019 Alan T. Waterman Award of the National Science Foundation (NSF) for his work in complexity theory, algorithms, and the limits of what is possible computationally. According to the prize citation, his work “focuses on complexity, including looking at algorithms for optimization, which,

when applied, might mean planning a route—how to get from point A to point B in the most efficient way possible.

“Algorithms are everywhere. Most people know that every time someone uses a computer, algorithms are at work. But they also occur in nature. Braverman examines randomness in the motion of objects, down to the erratic movement of particles in a fluid.

“His work is also tied to algorithms required for learning, which serve as building blocks to artificial intelligence, and has even had implications for the foundations of quantum computing.

“Braverman’s work includes mechanism design with applications in health care. His multidisciplinary approach is developing algorithms to address issues such as a new way to match medical residents to US hospitals and ways to implement new incentive structures in health insurance.

“Braverman has solved two puzzles that eluded researchers for decades: the Grothendieck constant and the Linial-Nisan conjecture.”

Braverman received his PhD from the University of Toronto in 2008. He served on the faculty of the University of Toronto until joining Princeton in 2011. His honors include an NSF CAREER Award (2012), a Packard Fellowship (2013), the Stephen Smale Prize (2014), and the Presburger Award of the European Association for Theoretical Computer Science (2016).

The Waterman Award annually recognizes an outstanding young researcher in any field of science or engineering supported by NSF. Researchers forty years of age or younger,

or up to ten years post-PhD, are eligible. Awardees receive US\$1 million distributed over five years.

—From an NSF announcement

Prizes of the Association for Women in Mathematics

The Association for Women in Mathematics (AWM) has awarded a number of prizes in 2019.



Catherine Sulem

Catherine Sulem of the University of Toronto has been named the Sonia Kovalevsky Lecturer for 2019 by the Association for Women in Mathematics (AWM) and the Society for Industrial and Applied Mathematics (SIAM). The citation states: “Sulem is a prominent applied mathematician working in the area of nonlinear analysis and partial differential equations. She has specialized on

the topic of singularity development in solutions of the nonlinear Schrödinger equation (NLS), on the problem of free surface water waves, and on Hamiltonian partial differential equations. Her work on the subtle $1/\sqrt{2t \log(\log t)}$ behavior of H^1 -solutions of the NLS at the singularity time resolved a major outstanding scientific question. Her book on the NLS is the central and most highly cited reference monograph in the field. Her continuing work on the problem of water waves, their time evolution, and their approximation by model dispersive equations is opening new territory, both in studies of wave propagation and in the analysis of the Euler equations.” Sulem received her PhD from the University of Paris-Nord under the direction of Claude Bardos and held positions with CNRS and Ben Gurion University before joining the faculty at Toronto. She is a recipient of the Krieger-Nelson Prize of the Canadian Mathematical Society and of a Simons Foundation Fellowship and is a Fellow of the AMS and of the Royal Society of Canada. She is also an accomplished violinist who performs regularly in small ensembles and local orchestras. She will deliver the Kovalevsky Lecture at the 2019 ICIAM meeting in Valencia, Spain.



Anna Skripka

Anna Skripka of the University of New Mexico was awarded the Ruth I. Michler Memorial Prize of the AWM for the years 2019–2021. She proposes to connect some of her recent work in noncommutative analysis with the research of Michael Nussbaum of Cornell University on statistical problems of estimation, regression, and asymptotic analysis.

She also hopes that interactions with other Cornell faculty members will enhance her research program. Skripka received her PhD from the University of Missouri in 2007 under the direction of Konstantin A. Makarov. She worked at Texas A&M University and the University of Central Florida before joining the faculty at New Mexico. She held invited positions at the University of California at Berkeley, Université de Franche-Comté, Besançon, and the University of New South Wales. Skripka has been awarded four single-investigator NSF awards, including a CAREER award. The Michler Prize grants a mid-career woman in academia a residential fellowship in the Cornell University mathematics department without teaching obligations.



Michelle Snider

Michelle Snider of the Institute for Defense Analyses (IDA) Center for Computing Sciences has been selected to receive the 2019 Service Award “for her concern, care and tireless efforts to bring AWM’s message to members through aiding in building the new AWM website. Snider launched herself into learning a new piece of software, problem solving, as well as teaching and working with the

rest of the website team, so as to create a communication channel for women to feel connected and to find their place in the mathematics community. Snider’s goals for a renovated AWM website were for each page to communicate values, goals, and a vision for this important organization.” Snider received her PhD from Cornell University in 2011 and is presently a research staff member at IDA. The prize is given for helping to promote and support women in mathematics through exceptional voluntary service to the Association for Women in Mathematics.

—From AWM announcements

Prizes of the Canadian Mathematical Society



Jeremy Quastel

Jeremy Quastel of the University of Toronto has been awarded the 2019 Jeffery–Williams Prize for Research Excellence of the Canadian Mathematical Society (CMS) for his exceptional contributions to mathematics research. The citation reads: “Dr. Quastel is awarded the 2019 Jeffery-Williams prize for his ground-breaking results in probability and non-equilibrium statistical

mechanics, in particular, his recent discovery with Matetski and Remenik of the complete integrability of TASEP, and through a scaling limit, the strong coupling fixed point of the KPZ universality class. The class contains random interface growth models and directed polymer free energies. An example is the famous Kardar–Parisi–Zhang non-linear stochastic partial differential equation, which gives the class its name; TASEP is its most popular discretization. The KPZ fixed point is expected to describe the universal long time large scale fluctuations for all such systems.” Quastel received his undergraduate degree from McGill University and his PhD from the Courant Institute in 1990 under the direction of S. R. S. Varadhan. He is professor and chair of the Department of Mathematics at the University of Toronto, where he has taught since 1998. He received the CRM–Fields–PIMS prize in 2018 and is a Fellow of the Royal Society of Canada. The prize recognizes mathematicians who have made outstanding contributions to mathematical research.



Jacob Tsimerman

Jacob Tsimerman of the University of Toronto has been awarded the 2019 Coxeter–James Prize for his exceptional contributions to mathematics research. The prize citation reads in part: “His work is a mixture of transcendence theory, analytic number theory, and arithmetic geometry. Early in his career, Dr. Tsimerman obtained remarkable results related to the Andre-Oort conjecture. This conjecture is concerned with the behavior of collections of special points inside Shimura varieties. Dr. Tsimerman made several breakthrough advancements towards a proof of the conjecture and removing unnecessary (Riemann) hypothesis conditions. He built a reputation for his creativity and insight in this area.” Tsimerman was born in Kazan, Russia, and received his PhD in pure mathematics from Princeton University in 2011 under the supervision of

Peter Sarnak, after which he held a postdoctoral position at Harvard University. He won gold medals in the International Mathematical Olympiad (IMO) in both 2003 and 2004 (perfect score), and his honors include the SASTRA Ramanujan Prize (2015) and the André Aisenstadt Prize (2017). He was an invited speaker at the 2018 International Congress of Mathematicians. The prize recognizes young mathematicians who have made outstanding contributions to mathematical research.



Julia Gordon

Julia Gordon of the University of British Columbia has been awarded the 2019 Krieger–Nelson Prize “for her exceptional contributions to mathematics research.” The prize citation reads: “Julia Gordon works in representation theory of p -adic groups related to the Langlands Program, and motivic integration. In many of her results, she applies model theory (specifically, motivic integration) to arithmetic questions. In rough terms, motivic integration makes it possible to do integration on p -adic fields uniformly in p . With Raf Cluckers and Immanuel Halupczok, Gordon used this technique to prove uniform estimates on orbital integrals that have an application in the study of L -functions.” Gordon received her PhD at the University of Michigan in 2003 under the supervision of Thomas Hales. She was a Fields Institute Postdoctoral Fellow in 2003 and a University of Toronto Postdoctoral Fellow from 2004 to 2006. She received the Michler Prize of AWM and Cornell University in 2017. The Krieger–Nelson Prize recognizes outstanding contributions in the area of mathematical research by a woman mathematician.



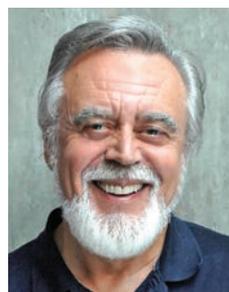
Andrea Fraser

Andrea Fraser of Dalhousie University has been awarded the 2019 Excellence in Teaching Award. The prize citation states in part: “There is an overwhelming amount of positive student feedback that speaks to Dr. Fraser’s dedication and commitment to student success, and to the originality and exceptional clarity of her presentation. Students praise her ability to make difficult concepts easy and intuitive, and her lecturing style, which makes students feel they are ‘discovering’ the material. . . . Dr. Fraser’s innovation in designing courses extends to the development of textbooks that contain stimulating visuals and clear explanations, and sets her apart as an outstanding instructor of mathematics.” Fraser received her PhD from Princeton University in 1997 under Elias M. Stein. After a four-year lecturer position at the University of New South Wales in Australia, she returned to Canada, where she has been a faculty member at Dalhousie University since 2001. Her

research interests include multiplier operators and analysis on the Heisenberg group. She tells the *Notices*: “I am an avid hiker, and enjoy kayaking and windsurfing. I also paint landscapes en plein air, a pursuit I started while living on the spectacular coastline in Sydney, Australia, during the time I was a research associate at UNSW.”

—From CMS announcements

Bertsekas and Tsitsiklis Awarded 2018 von Neumann Theory Prize



Dimitri P. Bertsekas

Dimitri P. Bertsekas and **John N. Tsitsiklis**, both of the Massachusetts Institute of Technology, have been awarded the 2018 Institute for Operations Research and the Management Sciences (INFORMS) John von Neumann Theory Prize “for contributions to parallel and distributed computation as well as neurodynamic programming.”



John N. Tsitsiklis

The prize citation reads: “Working together and independently, Bertsekas and Tsitsiklis have made seminal contributions to both these fields. They unified ideas and built solid theoretical foundations while these fields were still relatively nascent, thus greatly enhancing subsequent development of rigorous theory.

“Their monograph *Parallel and Distributed Computation: Numerical Methods* represents a significant

achievement in the field. The work builds on and extends the authors’ extensive previous work in this area, identifying the tolerance of algorithms to asynchronous implementations and a number of positive convergence results. An antecedent work of particular significance to the operations research community is the paper by Tsitsiklis, Bertsekas, and Athans, which provides seminal analysis of asynchronous implementations of deterministic and stochastic gradient algorithms. This line of inquiry has recently found application in the analysis of descent algorithms for neural network training and other machine learning problems. Their work in distributed computation has also had significant impact on the areas of distributed network control and distributed detection.

“Their monograph *Neuro-Dynamic Programming* helped provide a unified theoretical treatment of the wide variety

of reinforcement learning algorithms by building connections to the dynamic programming and distributed computation literature. This has proven extremely valuable in bringing theoretical rigor to a field of rapid, empirical innovation. The authors' contributions in this area go beyond providing a theoretical foundation that others could build on. The authors have made significant original contributions to value function learning, temporal difference methods and actor-critic algorithms.

"The work of Bertsekas and Tsitsiklis is characterized by its innovation, depth, and clarity, and it has had tremendous impact, as evident from the large number of citations. Their two joint monographs are among their individual five most cited works, making the award of a joint prize particularly appropriate. Bertsekas and Tsitsiklis have brought the fields of computer science and operations research closer together through unifying theory."

Dimitri Bertsekas was born in Athens, Greece, and received his PhD in system science from the Massachusetts Institute of Technology in 1971. Before joining the MIT faculty he taught at Stanford University and the University of Illinois at Urbana–Champaign. He is the author or co-author of sixteen textbooks and monographs. Among his honors are the 2014 INFORMS Khachiyan Prize and the 2015 Dantzig Prize of the Society for Industrial and Applied Mathematics (SIAM) and the Mathematical Optimization Society (MOS). He was elected to the US National Academy of Engineering in 2001. He tells the *Notices*: "I remember the periods I spent researching and writing *Parallel and Distributed Computation* and *Neurodynamic Programming* as among the most exciting of my career. Both books share the characteristic that they were the first to focus on speculative fields of marginal interest at the time they were written, only to emerge as major research areas twenty years later. Asynchronous distributed algorithms became a major subject of continuing interest in machine learning in the late 2000s, while neurodynamic programming, essentially a synonym for reinforcement learning, is currently of great interest in artificial intelligence. Sharing the journey with my longtime research collaborator and friend John Tsitsiklis added greatly to this memorable experience."

John Tsitsiklis was born in Thessaloniki, Greece, and received his PhD from the Massachusetts Institute of Technology in 1984. After a year at Stanford University, he joined the MIT faculty in 1984. He currently serves as the director of the Laboratory for Information and Decision Systems and is affiliated with the Institute for Data, Systems, and Society (IDSS), the Statistics and Data Science Center, and the MIT Operations Research Center. His honors include the 1997 ICS Prize, the ACM SIGMETRICS Achievement Award (2016), and the IEEE Control Systems Award (2018). He is a member of the National Academy of Engineering and a Fellow of the IEEE and INFORMS. He tells the *Notices* that, while growing up in Greece, his hobbies were

Euclidean geometry and skiing in the Greek mountains. These days, skiing has been replaced by rock climbing, his favorite outdoor activity.

—From an INFORMS announcement

Prizes of the Mathematical Society of Japan

The Mathematical Society of Japan (MSJ) has awarded several prizes for 2019.



Yasunori Maekawa

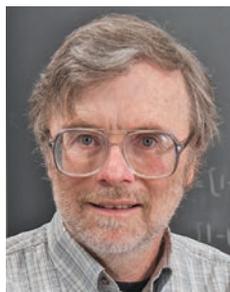
Yasunori Maekawa of Kyoto University was awarded the MSJ Spring Prize for "outstanding contributions to new developments for mathematical analysis of fluid mechanics." The Spring Prize and the Autumn Prize are the most prestigious prizes awarded by the MSJ to its members. The Spring Prize is awarded to those under the age of forty who have obtained outstanding mathematical results.

The Algebra Prizes were awarded to **Shinichi Kobayashi** of Kyushu University for contributions to the Iwasawa theory of elliptic curves and to **Shunsuke Takagi** of the University of Tokyo for work on singularities in characteristic zero and F -singularities.

The Outstanding Paper Prizes, given for papers published in the *Journal of the Mathematical Society of Japan*, were awarded to the following: **Masato Tsujii**, Kyushu University, for "Exponential Mixing for Generic Volume-Preserving Anosov Flows in Dimension Three," 70 (2018), no. 2; **Xun Yu**, Tianjin University, for "Elliptic Fibrations on $K3$ Surfaces and Salem Numbers of Maximal Degree" 70, no. 3; and **Akito Futaki**, University of Tokyo and Tsinghua University, and **Hajime Ono** for "Volume Minimization and Conformally Kähler, Einstein–Maxwell Geometry," 70, no. 4.

—From MSJ announcements

Lawler and Le Gall Awarded 2019 Wolf Prize



Gregory F. Lawler

Gregory F. Lawler of the University of Chicago and **Jean-François Le Gall** of Université Paris-Sud Orsay have been awarded the Wolf Foundation Prize for Mathematics for 2019 by the Wolf Foundation. Lawler was honored “for his comprehensive and pioneering research on erased loops and random walks,” and Le Gall was selected “for his profound and elegant works on stochastic processes.” According to the prize citation, “the work undertaken by these two mathematicians on random processes and probability, which [has] been recognized by multiple prizes, became the stepping stone for many consequent breakthroughs.”



Jean-François Le Gall

Citation

The prize citation for Lawler reads as follows: “Gregory Lawler has made trailblazing contributions to the development of probability theory. He obtained outstanding results regarding a number of properties of Brownian motion, such as cover times, intersection exponents, and dimensions of various subsets. Studying random curves, Lawler introduced a now-classical model, the Loop-Erased Random Walk (LERW), and established many of its properties. While simple to define, it turned out to be of a fundamental nature, and was shown to be related to uniform spanning trees and dimer tilings. This work formed much of the foundation for a great number of spectacular breakthroughs, which followed Oded Schramm’s introduction of the SLE curves. Lawler, Schramm, and Werner calculated Brownian intersection exponents, proved Mandelbrot’s conjecture that the Brownian frontier has Hausdorff dimension $4/3$, and established that the LERW has a conformally invariant scaling limit. These results, in turn, paved the way for further exciting progress by Lawler and others.”

The prize citation for Le Gall states that he “has been at the forefront of probability since 1983, when he established what still are the best results on pathwise uniqueness for one-dimensional stochastic differential equations. His current groundbreaking discoveries on the Brownian map ensure he remains at the cutting edge of the field today.

“Jean-François Le Gall has made several deep and elegant contributions to the theory of stochastic processes. His work on the fine properties of Brownian motions solved many difficult problems, such as the characterization of

sets visited multiple times and the behavior of the volume of its neighborhood—the Brownian sausage. Le Gall made groundbreaking advances in the theory of branching processes, which arise in many applications. In particular, his introduction of the Brownian snake and his studies of its properties revolutionized the theory of super-processes—generalizations of Markov processes to an evolving cloud of dying and splitting particles. He then used some of these tools for achieving a spectacular breakthrough in the mathematical understanding of 2D quantum gravity. Le Gall established the convergence of uniform planar maps to a canonical random metric object, the Brownian map, and showed that it almost surely has Hausdorff dimension 4 and is homeomorphic to the 2-sphere.”

Biographical Notes

Gregory Lawler was born in Alexandria, Virginia, in 1955 and received his PhD from Princeton University in 1979 under the direction of Edward Nelson. He was a faculty member at Duke University from 1979 to 2001 and at Cornell University from 2001 to 2006 before joining the University of Chicago in 2006. With Oded Schramm and Wendelin Werner, he was a corecipient of the George Pólya Prize of the Society for Industrial and Applied Mathematics (SIAM) in 2006. He was a member of the Inaugural Class of AMS Fellows in 2012 and is also a Fellow of the American Academy of Arts and Sciences, the Alfred P. Sloan Foundation, and the Institute of Mathematical Statistics. He was elected to the National Academy of Sciences in 2013. He has authored or coauthored six books. He served as editor-in-chief of the *Annals of Probability* from 2006 to 2008 and was an editor of the *Journal of the American Mathematical Society* from 2009 to 2013. He cofounded the *Electronic Journal of Probability* in 1995 and served as its coeditor until 1999.

Professor Lawler studies random walks, especially strongly interacting walks “with memory” that arise in critical phenomena in statistical physics. He introduced the loop-erased random walk, which is one of the important models in the field. With Oded Schramm and Wendelin Werner, he developed the theory of the Schramm-Loewner Evolution (SLE) as a continuum limit of two-dimensional random curves. This machinery, along with Lawler’s earlier work relating intersection exponents for Brownian motion with fractal properties of curve, proved a conjecture of Benoit Mandelbrot that the Hausdorff dimension of the Brownian coastline is $4/3$.

Besides his research, Lawler has been involved in the tournament bridge world in investigations of cheating among top competitors, especially the use of statistics to verify allegations. When not doing math, he plays guitar and is in charge of music at the Beverly Unitarian Church in Chicago. In summers he plays on the mathematics department softball team at University of Chicago.

Jean-François Le Gall was born in 1959 in Morlaix, France, and received his PhD from the Université Pierre et Marie Curie (Paris VI) in 1982 under the direction of Marc Yor. After twenty years on the faculty of Université Pierre et Marie Curie, he joined the Université Paris-Sud Orsay in 2007. He received the Rollo Davidson Prize in 1986, the Loève Prize in 1997, and the Sophie Germain and Fermat Prizes in 2005. He was elected to the French Academy of Sciences in 2013. He is the author of the books *Spatial Branching Processes*, *Random Snakes and Partial Differential Equations* (Birkhäuser Verlag, 1999) and *Brownian Motion, Martingales, and Stochastic Calculus* (Springer, 2016).

About the Prize

The Wolf Prize carries a cash award of US\$100,000. The science prizes are given annually in the areas of agriculture, chemistry, mathematics, medicine, and physics. Laureates receive their awards from the President of the State of Israel in a special ceremony at the Knesset Building (Israel's Parliament) in Jerusalem. The list of previous recipients of the Wolf Prize in Mathematics is available on the website of the Wolf Foundation, www.wolffund.org.il.

—Elaine Kehoe

2019 Rollo Davidson Prize



Tom Hutchcroft

Tom Hutchcroft of the University of Cambridge and **Vincent Tassion** of ETH Zurich have been named recipients of the Rollo Davidson Prize for 2019. Hutchcroft was recognized for his many beautiful results in probability theory, including on random and self-avoiding walks, random forests, and percolation theory. Tassion was recognized for his extensive achievements in disordered systems

and percolation. Hutchcroft received his PhD from the University of British Columbia under the supervision of Asaf Nachmias and Omer Angel. He received the CMS Doctoral Prize in 2018. He tells the *Notices*: "I grew up in rural England in the small town of Glastonbury, which is known for its music festival, magic trees, and monastic ruins, and according to legend is the final resting place of the Holy Grail." Tassion studied at Ecole Normale Supérieure de Lyon and did postdoctoral work with Hugo Duminil-Copin at the University of Geneva. His research involves phase transitions in statistical physics using discrete models such as percolation and the Ising model. The prize is awarded annually to early career probabilists by the Rollo Davidson Trust.

—From a Davidson Trust announcement

Harrington and Veraart Awarded Adams Prize



Heather Harrington



Luitgard Veraart

Heather Harrington of the University of Oxford and **Luitgard Veraart** of the London School of Economics and Political Science (LSE) have been awarded the 2019 Adams Prize in this year's chosen field, the Mathematics of Networks. According to Mihalis Dafermos, chair of the prize adjudicators, "Dr. Harrington has adapted ideas from areas such as algebraic geometry and algebraic topology and applied them in a novel way to real-world problems, with particular emphasis on those arising in biology. Her broad work ranges from the mathematics of biological networks to detailed empirical studies. Dr. Veraart has developed new tools and concepts relevant for the representation and analysis of financial stability and systemic risk in banking networks. Her work has had considerable visibility and impact, both within academia and outside."

Harrington received her PhD from Imperial College London in 2010 under the supervision of Jaroslav Stark and Dorothy Buck. She was awarded a Whitehead Prize of the London Mathematical Society in 2018. She is head of the Algebraic Systems Biology group at the Mathematical Institute at Oxford. She is a member of the AMS, the London Mathematical Society, and the Society for Industrial and Applied Mathematics (SIAM). Veraart received her PhD in 2007 from the University of Cambridge. She was postdoctoral research associate at the Bendheim Center for Finance at Princeton University and an assistant professor of financial mathematics at Karlsruhe Institute of Technology before joining the Department of Mathematics at LSE. She received a George Fellowship from the Bank of England in 2016 for research on systemic risk in financial networks. She is associate editor of *Applied Mathematical Finance* and the *SIAM Journal on Financial Mathematics*.

—From a University of Cambridge announcement

Wigderson Awarded Knuth Prize



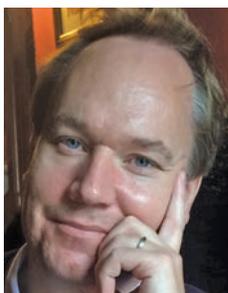
Avi Wigderson

Avi Wigderson of the Institute for Advanced Study has been awarded the 2019 Donald E. Knuth Prize “for fundamental and lasting contributions in areas including randomized computation, cryptography, circuit complexity, proof complexity, parallel computation, and our understanding of fundamental graph properties” and for his contributions to education and as a mentor. He is the

author of the book *Mathematics and Computation* (Princeton University Press). The prize is awarded by the Association for Computing Machinery (ACM) Special Interest Group on Algorithms and Computation Theory and the IEEE Technical Committee on the Mathematical Foundations of Computing to recognize major research accomplishments and contributions to the foundations of computer science over an extended period of time.

—From an ACM/IEEE announcement

Hansen Awarded 2018 IMA Prize



Anders Hansen

Anders Hansen of the Cambridge Centre for Analysis at the University of Cambridge and the University of Oslo has been awarded the 2018 IMA Prize of the Institute for Mathematics and Its Applications (IMA). He was honored for his “work in computational mathematics, and in particular for his development of the solvability complexity index and its corresponding classification

hierarchy.” His work involves foundations of computational mathematics and applied functional and harmonic analysis. He is currently working on enhancing resolution in medical imaging.

Hansen received his PhD from the University of Cambridge in 2008. He received a Leverhulme Prize in Mathematics and Statistics in 2017 and is an editor of the *Proceedings of the Royal Society Series A*. Hansen tells the *Notices*: “I have a slightly unorthodox background as my original plan was to become a jazz guitarist, and I even spent some time at Berklee College of Music pursuing an education in music. And, although I have always had a strong interest

in mathematics, I was a bit torn regarding the final career path. However, after spending a year sailing across the Indian Ocean, I decided to focus on math, move to California and study at UC Berkeley.”

The IMA Prize is awarded annually to a mathematical scientist who received his or her PhD degree within ten years of the nomination year. The award recognizes an individual who has made a transformative impact on the mathematical sciences and their applications.

—From an IMA announcement

ANZIAM Prizes Awarded

Australian and New Zealand Industrial and Applied Mathematics (ANZIAM), a division of the Australian Mathematical Society, has awarded medals for 2019 to three mathematical scientists. **Peter Taylor**, director of the Australian Research Council Centre of Excellence for Mathematical and Statistical Frontiers, has been awarded the 2019 ANZIAM Medal “for his contributions to the theory and applications of mathematics, particularly in the area of applied probability.” The medal is awarded for outstanding merit in research achievements, activities enhancing applied or industrial mathematics, or both, and contributions to ANZIAM. **Scott McCue** of Queensland University of Technology has been awarded the 2019 E. O. Tuck Medal for research focusing on developing and applying theoretical and computational techniques to problems in interfacial dynamics and mathematical biology, as well as his broader contributions to industrial mathematics. The medal is a midcareer award given for outstanding research and distinguished service to the field of applied mathematics. **Ryan Loxton** of Curtin University was selected to receive the J. H. Michell Medal for research in areas such as nonlinear optimization, operations research, and system identification. The medal recognizes an outstanding young researcher in applied/industrial mathematics.

—From an ANZIAM announcement

Putnam Prizes Awarded

The winners of the seventy-ninth William Lowell Putnam Mathematical Competition have been announced. The Putnam Competition is administered by the Mathematical Association of America (MAA) and consists of an examination containing mathematical problems that are designed to test both originality and technical competence. Prizes are awarded both to individuals and to teams.

The six highest ranking individuals each received a cash award of US\$2,500. Listed in alphabetical order, they are:

- **Dongryul Kim**, Harvard University
- **Shyam Narayanan**, Harvard University
- **David Stoner**, Harvard University
- **Yuan Yao**, Massachusetts Institute of Technology
- **Shengtong Zhang**, Massachusetts Institute of Technology

Institutions with at least three registered participants obtain a team ranking in the competition based on the rankings of three designated individual participants. The five top-ranked teams (with members listed in alphabetical order) were:

- Harvard University, **Dongryul Kim**, **Shyam Narayanan**, **David Stoner**
- Massachusetts Institute of Technology, **Junyao Peng**, **Ashwin Sah**, **Yunkun Zhou**
- University of California, Los Angeles, **Ciprian Mircea Bonciocat**, **Xiaoyu Huang**, **Konstantin Miagkov**
- Columbia University, **Quang Dao**, **Myeonhu Kim**, **Matthew Lerner-Brecher**
- Stanford University, **David Kwei Lin**, **Hanzhi Zheng**, **Yifan Zhu**

The first-place team receives an award of US\$25,000, and each member of the team receives US\$1,000. The awards for second place are US\$20,000 and US\$800; for third place, US\$15,000 and US\$600; for fourth place, US\$10,000 and US\$400; and for fifth place, US\$5,000 and US\$200.

Danielle Wang of the Massachusetts Institute of Technology was awarded the Elizabeth Lowell Putnam Prize for outstanding performance by a woman in the competition. She received an award of US\$1,000.

—From an MAA announcement

AWM Essay Contest Winners

The Association for Women in Mathematics (AWM) has announced the winners of its 2019 essay contest, “Biographies of Contemporary Women in Mathematics.” The grand prize was awarded to **Dominique Alexander** of Douglas High School, Minden, Nevada, for the essay “How Bees Sting,” about Christine Ensign of Douglas High School. The essay

also won first place in the high school level category and will be published in the *AWM Newsletter*. First place in the college undergraduate category was awarded to **Liyaan Mas-kati** of Brown University for the essay “Nothing Ventured, Nothing Gained” about Ellie Pavlick of Brown University. First place in the middle school category was awarded to **Farren Stainton** of the Sharon Academy, Sharon, Vermont, for the essay “My Teacher Makes the Irrational Perfectly Rational,” about Sandy Thorne of the Sharon Academy.

—From an AWM announcement

Simons Fellows in Mathematics

The Simons Foundation Mathematics and Physical Sciences (MPS) division supports research in mathematics, theoretical physics, and theoretical computer science. The MPS division provides funding for individuals, institutions, and science infrastructure. The Fellows Program provides funds to faculty for up to a semester-long research leave from classroom teaching and administrative obligations. The mathematical scientists who have been awarded 2019 Simons Fellowships are:

- **Federico Ardila**, San Francisco State University
- **Nir Avni**, Northwestern University
- **Yuri Berest**, Cornell University
- **Christopher Bishop**, Stony Brook University
- **Sergey Bobkov**, University of Minnesota–Twin Cities
- **Vyjayanthi Chari**, University of California, Riverside
- **Ivan Cherednik**, University of North Carolina at Chapel Hill
- **Gheorghe Craciun**, University of Wisconsin–Madison
- **Philippe Di Francesco**, University of Illinois at Urbana–Champaign
- **William Duke**, University of California, Los Angeles
- **Sergey Fomin**, University of Michigan
- **Joshua Greene**, Boston College
- **Changfeng Gui**, University of Texas at San Antonio
- **Robert Guralnick**, University of Southern California
- **Juhi Jang**, University of Southern California
- **Victor Kac**, Massachusetts Institute of Technology
- **Matthew Kahle**, Ohio State University
- **Nets Katz**, California Institute of Technology
- **Rinat Kedem**, University of Illinois at Urbana–Champaign
- **Autumn Kent**, University of Wisconsin–Madison

- **Inwon Christina Kim**, University of California, Los Angeles
- **Sergiu Klainerman**, Princeton University
- **Slava Krushkal**, University of Virginia
- **Kai-Wen Lan**, University of Minnesota–Twin Cities
- **Xiaochun Li**, University of Illinois at Urbana–Champaign
- **Irina Mitrea**, Temple University
- **Toan Nguyen**, Pennsylvania State University
- **Denis Osin**, Vanderbilt University
- **Dmitry Panchenko**, University of Toronto
- **Irena Peeva**, Cornell University
- **Malabika Pramanik**, University of British Columbia
- **Eric Rowell**, Texas A&M University
- **Andreas Seeger**, University of Wisconsin–Madison
- **Evgueni Tevelev**, University of Massachusetts, Amherst
- **Tatiana Toro**, University of Washington
- **Jared Weinstein**, Boston University
- **Michael Wolf**, William Marsh Rice University
- **Paul Yang**, Princeton University
- **Guoliang Yu**, Texas A&M University

—From a Simons Foundation announcement

Guggenheim Fellowship Awards to Mathematical Scientists

The John Simon Guggenheim Memorial Foundation has announced the names of the scholars, artists, and scientists who were selected as Guggenheim Fellows for 2019. Selected as fellows in the mathematical sciences were:

- **Mohammad T. Hajiaghayi**, University of Maryland, applied mathematics
- **David Jerison**, Massachusetts Institute of Technology, mathematics
- **Per A. Mykland**, University of Chicago, applied mathematics

Selected as a Fellow in computer sciences was **Georg Essl**, University of Wisconsin–Milwaukee.

Guggenheim Fellows are appointed on the basis of impressive achievement in the past and exceptional promise for future accomplishments.

—From a Guggenheim Foundation announcement

Regeneron Science Talent Search

Two young scientists whose work involves the mathematical sciences are among the top winners in the 2019 Regeneron Science Talent Search.

Ana Humphrey, eighteen, of Alexandria, Virginia, received the first-place award of US\$250,000 for her mathematical model to determine the possible locations of exoplanets—planets outside our solar system—that may have been missed by NASA’s Kepler Space Telescope. She used her model to find “unpacked” spaces where as many as 560 new planets might fit and identified ninety-six locations as primary search targets. Her research could aid our understanding of the formation of planets and inform our search for life in outer space. **Adam Areishar**, seventeen, of Alexandria, Virginia, was awarded third place and US\$150,000 for his project combining a classic previously unsolved math problem called the “coupon collector problem” with extreme value theory. The theory is used to determine the likelihood of a maximal event, such as a 1,000-year flood. He developed a way to calculate the average maximum values of distributional datasets, which could be applied to predicting the expected amount of time for a given number of different randomly-timed events to occur.

The Regeneron Science Talent Search is the United States’ oldest and most prestigious science and mathematics competition for high school seniors. It is administered by the Society for Science and the Public.

—From a Society for Science and the Public announcement

2019 SIAM Fellows Elected

The Society for Industrial and Applied Mathematics (SIAM) has elected its class of fellows for 2019. Their names and institutions follow.

- **Mihai Anitescu**, Argonne National Laboratory and University of Chicago
- **David A. Bader**, Georgia Institute of Technology
- **Francesco Bullo**, University of California, Santa Barbara
- **José Antonio Carrillo de la Plata**, Imperial College London
- **Stephen Jonathan Chapman**, University of Oxford
- **Pierre Comon**, CNRS
- **Wolfgang A. Dahmen**, University of South Carolina, Columbia
- **Jesus Antonio De Loera**, University of California, Davis
- **Froilán Dopico**, Universidad Carlos III de Madrid

- **Ernesto Estrada**, University of Zaragoza and ARAID Foundation
- **Fariba Fahroo**, Air Force Research Laboratory
- **Andreas Frommer**, Universität Wuppertal
- **Roger G. Ghanem**, University of Southern California
- **Sigal Gottlieb**, University of Massachusetts, Dartmouth
- **Michael Allen Heroux**, Sandia National Laboratories and St. John's University
- **Misha Kilmer**, Tufts University
- **Ron Kimmel**, Technion-Israel Institute of Technology and Intel Corporation
- **Gitta Kutyniok**, Technische Universität Berlin
- **Irena Lasiecka**, University of Memphis
- **Juan C. Meza**, University of California, Merced
- **Jill C. Pipher**, Brown University
- **Mason A. Porter**, University of California, Los Angeles
- **Sebastian Reich**, Universität Potsdam
- **Carla D. Savage**, North Carolina State University
- **Zuowei Shen**, National University of Singapore
- **Joel A. Tropp**, California Institute of Technology
- **Yin Zhang**, Rice University and Chinese University of Hong Kong, Shenzhen
- **Jun Zou**, Chinese University of Hong Kong

—From a SIAM announcement

AAAS Fellows Elected

The American Academy of Arts and Sciences (AAAS) has elected its new Fellows and foreign honorary members for 2019. The new members in the section on Mathematical and Physical Sciences are:

- **Michael H. Harris**, Columbia University
- **Mikhail Lyubich**, Stony Brook University
- **Sylvia Serfaty**, New York University
- **Michael J. Shelley**, New York University
- **András Vasy**, Stanford University
- **Ofer Zeitouni**, Weizmann Institute of Science

Elected in the section on Computer Sciences were:

- **Francine D. Berman**, Rensselaer Polytechnic Institute
- **David R. Karger**, Massachusetts Institute of Technology

—From an AAAS announcement

Fellows of the Royal Society

The Royal Society has announced the names of fifty-one new fellows, ten foreign members, and one honorary fellow for 2019. The new fellows whose work involves the mathematical sciences are:

- **Manjul Bhargava**, Princeton University
- **Caucher Birkar**, University of Cambridge
- **Sarah C. Darby**, University of Oxford
- **Christopher Hacon**, University of Utah
- **Peter Haynes**, University of Cambridge
- **Richard Jozsa**, University of Cambridge
- **Roy Kerr**, University of Cambridge, New Zealand
- **Marta Kwiatkowska**, University of Oxford
- **Robert Tibshirani**, Stanford University
- **Ashkay Venkatesh**, Princeton University

Elected as a foreign member was **Jack Dongarra**, University of Tennessee, Oak Ridge National Laboratory, and the University of Manchester.

—From a Royal Society announcement

NAE Elections

The National Academy of Engineering (NAE) has elected eighty-six new members and eighteen foreign members. Below are the mathematical scientists who were elected for 2019:

- **Joseph Halpern**, Cornell University
- **William Jordan**, Jordan Analytics
- **Mahta Moghaddam**, University of Southern California

Elected as foreign members were:

- **Michael Cates**, University of Cambridge
- **Gilbert Laporte**, HEC Montreal

—From an NAE announcement

Hertz Foundation Fellowships

The Fannie and John Hertz Foundation has announced its Graduate Fellowship awards for 2019. The new Fellows whose work involves the mathematical sciences are **Noah Golowich**, Harvard University; **Melissa Mai**, Johns Hopkins University; **Nitya Mani**, Stanford University; and **Nina Zubrilina**, Stanford University. The new Fellows will receive up to five years of academic support valued at up to US\$250,000 to pursue innovative research without constraints.

—From a Hertz Foundation announcement

NSF Graduate Research Fellowships

The National Science Foundation (NSF) has awarded a number of Graduate Research Fellowships for fiscal year 2019. Further awards may be announced later in the year. This program supports students pursuing doctoral study in all areas of science and engineering and provides a stipend of US\$30,000 per year for a maximum of three years of full-time graduate study. Information about the solicitation for the 2020 competition will be published in the “Mathematics Opportunities” section of an upcoming issue of the *Notices*.

Following are the names of the awardees in the mathematical sciences selected so far in 2019, followed by their undergraduate institutions (in parentheses) and the institutions at which they plan to pursue graduate work.

- **David J. Altizio** (Carnegie-Mellon University), Carnegie-Mellon University
- **Allen Alvarez Loya** (California State University, Fullerton), University of Colorado at Boulder
- **Montie S. Avery** (University of New Mexico), University of Minnesota–Twin Cities
- **Julius Baldauf-Lenschen** (Massachusetts Institute of Technology), Massachusetts Institute of Technology
- **William J. Barham** (University of Colorado at Boulder), University of Colorado at Boulder
- **Savannah V. Bates** (Jacksonville University), North Carolina State University
- **Olivia M. Bernstein** (Biola University), University of California, Irvine
- **Adam B. Block** (Columbia University), Columbia University
- **Sarah Brauner** (Reed College), University of Minnesota–Twin Cities
- **Thomas Brazelton** (Johns Hopkins University), University of Pennsylvania
- **Madelyne M. Brown** (Bucknell University), University of North Carolina at Chapel Hill
- **Katherine Brumberg** (Yale University), Yale University
- **Amanda Burcroff** (University of Michigan–Ann Arbor), University of Michigan–Ann Arbor
- **Alois Cerbu** (Yale University), University of California, Berkeley
- **Ryan C. Chen** (Princeton University), Princeton University
- **Tyler Chen** (Tufts University), University of Washington
- **Karina Cho** (Harvey Mudd College), Harvey Mudd College
- **Sarah (Sally) Collins** (Boston College), Georgia Institute of Technology
- **Destiny Diaz** (State University of New York at Buffalo), State University of New York at Buffalo
- **Michael Dotzel** (University of Missouri–Columbia), University of Missouri–Columbia
- **Hindy Drillick** (Stony Brook University), Stony Brook University
- **Rebecca F. Durst** (Williams College), Brown University
- **Patrick J. Dynes** (Clemson University), University of Oklahoma–Norman
- **Yael Eisenberg** (Yeshiva University), Yeshiva University
- **Sabrina E. Enriquez** (University of Southern California), University of California, Davis
- **Katherine Gallagher** (University of Notre Dame), University of Notre Dame
- **Aaron S. George** (University of Maryland), University of Maryland
- **Shay Gilpin** (University of California, Santa Cruz), University of Colorado at Boulder
- **Nikolay D. Grantcharov** (University of California, Berkeley), University of California, Berkeley
- **Jiajing Guan** (George Mason University), George Mason University
- **Mitchell S. Harris** (Yale University)
- **Brice Huang** (Massachusetts Institute of Technology), Massachusetts Institute of Technology
- **DeVon M. Ingram** (Georgia Institute of Technology), Georgia Institute of Technology
- **Adam Q. Jaffe** (Stanford University), Stanford University
- **Jennifer N. Jones** (Universidad de Guanajuato/CIMAT), Universidad de Guanajuato/CIMAT
- **Sydney N. Kahmann** (University of California, Los Angeles), University of California, Los Angeles
- **Caleb Ki** (Amherst College), University of Michigan–Ann Arbor
- **Yujin Hong Kim** (Columbia University), Columbia University
- **Nathaniel J. Kroeger** (Baylor University), William Marsh Rice University
- **Cameron Krulewski** (Harvard University), Harvard University
- **Andrew Kwon** (Carnegie-Mellon University), Carnegie-Mellon University
- **Jaylen M. Lee** (James Madison University), University of California, Irvine
- **Ishan Levy** (Princeton University), Princeton University
- **Jared D. Lichtman** (Dartmouth College), University of Cambridge
- **Hyun Jae Lim** (Harvard College), University of California, Berkeley

- **Jessica Maghakian** (Massachusetts Institute of Technology), Stony Brook University
- **Scott A. Mahan** (Arizona State University), University of California, San Diego
- **Yelena Mandelshtam** (Stanford University), Stanford University
- **Nitya Mani** (Stanford University), Stanford University
- **Sofia R. Martinez Alberga** (University of California, Riverside), University of California, Riverside
- **Amanda S. Mason** (Wofford College), University of Colorado at Boulder
- **Bijan H. Mazaheri** (Williams College), California Institute of Technology
- **Sean McGrath** (McGill University)
- **Theo McKenzie** (Harvard University), University of California, Berkeley
- **Andres N. Mejia** (Bard College), Yale University
- **Anya Michaelsen** (Williams College), Williams College
- **Samantha C. Moore** (University of Northern Colorado), University of North Carolina at Chapel Hill
- **Keshav B. Patel** (University of North Carolina at Chapel Hill), University of North Carolina at Chapel Hill
- **Luke K. Peilen** (Yale University), New York University
- **Thomas Reeves** (Princeton University), Cornell University
- **Tristan Reynoso** (University of Central Florida), University of Central Florida
- **Daniel D. Richman** (Massachusetts Institute of Technology)
- **Ryan A. Robinett** (Massachusetts Institute of Technology), Massachusetts Institute of Technology
- **Sarah Robinson** (University of Georgia), William Marsh Rice University
- **Samuel P. Rosin** (Harvard College), University of North Carolina at Chapel Hill
- **Bryce T. Rowland** (Centre College of Kentucky), University of North Carolina at Chapel Hill
- **Gabriel Ruiz** (University of California, Riverside), University of California, Los Angeles
- **Andrew I. Sack** (University of Florida), University of Florida
- **Sandeep B. Silwal** (Massachusetts Institute of Technology), Massachusetts Institute of Technology
- **Yousuf Soliman** (Carnegie-Mellon University), California Institute of Technology
- **Melissa I. Spence** (University of California, Davis), University of California, Merced
- **Samuel A. Spiro** (University of Miami), University of California, San Diego
- **Chandler Squires** (Massachusetts Institute of Technology), Massachusetts Institute of Technology
- **Stephanie E.-T. Stacy** (Williams College), University of California, Los Angeles
- **Zofia Stanley** (Brown University), University of Colorado at Boulder
- **George Stepaniants** (University of Washington), University of Washington
- **David W. Stoner** (Harvard University), Harvard University
- **Austin J. Stromme** (University of Washington), Massachusetts Institute of Technology
- **Naomi Sweeting** (University of Chicago), University of Chicago
- **Tiffany Tang** (William Marsh Rice University), University of California, Berkeley
- **Evan H. Toler** (William Marsh Rice University), New York University
- **Matthew Tyler** (Princeton University), Princeton University
- **Dario Verta** (Johns Hopkins University), George Washington University
- **Alexander M. Vetter** (Villanova University), Villanova University
- **Nathan A. Wagner** (Bucknell University), Washington University
- **Danielle Y. Wang** (Massachusetts Institute of Technology), Massachusetts Institute of Technology
- **Joshua X. Wang** (Princeton University), Harvard University
- **Luya Wang** (Princeton University), University of California, Berkeley
- **Scott Weady** (Yale University), New York University
- **Michael C. Wigal** (West Virginia University), Georgia Institute of Technology
- **Emily T. Winn** (College of the Holy Cross), Brown University
- **David H. Yang** (Massachusetts Institute of Technology), Harvard University
- **Andrew Yarger** (Saint Olaf College), University of Michigan–Ann Arbor
- **Michelle Yu** (College of the Holy Cross), University of California, Berkeley
- **David K. Zhang** (Vanderbilt University), Vanderbilt University
- **Edith Zhang** (University of Virginia), University of Virginia
- **John C. Zito** (Kenyon College)
- **Nina Zubrilina** (Stanford University), Stanford University

—NSF announcement

Credits

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James L. Cornette and Ralph A. Ackerman

Freshman and sophomore life sciences students respond well to the modeling approach to calculus, difference equations, and differential equations presented in this book. Examples of population dynamics, pharmacokinetics, and biologically relevant physical processes are introduced in Chapter 1, and these and other life sciences topics are developed throughout the text. Readers should have studied algebra, geometry, and trigonometry.

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