

ACM TURING CENTENARY CELEBRATION

OFFICIAL PROGRAM

JUNE 15 - 16, 2012
PALACE HOTEL, SAN FRANCISCO



Association for
Computing Machinery

Advancing Computing as a Science & Profession



WELCOME TO THE ACM TURING CENTENARY CELEBRATION!



Alan Turing's contributions to the foundations of our field are monumental—from fundamental contributions in computation, computing machinery, and artificial intelligence to seminal work in mathematics and mathematical logic, philosophy, and theoretical biology.

This year will see hundreds of events worldwide—large and small—celebrating the 100th anniversary of Alan Turing's birth and raising awareness of Turing, his contributions, and the fundamental importance of computing and computer science. At ACM we had a long discussion of how best to mark this special anniversary and serve the memory and significance of Alan Turing and celebrate our field. In the end, we decided to focus the ACM Turing Centenary Celebration on our most visible and relevant connection to Turing—the ACM Turing Award and its winners.

When I wrote to all living Turing Award winners about our idea of organizing ACM's celebration of Turing as a one-and-a-half day conference built around their views of the past and the future of computing, the response was overwhelming. Every one of the Turing Award winners loved the idea, and in the end, 34 agreed to participate.

With the support of ACM SIGs, an organizing committee was formed. Vint Cerf (2004 Turing Award Winner) agreed to serve as General Chair. Mike Schroeder (Microsoft Research), John Thomas (IBM Research), and Moshe Vardi (Rice University) volunteered to serve as Program Chairs. Vint, Mike, John, and Moshe did a remarkable job of working with the 34 Turing Award winners and the panel chairs to build a program that highlights the perspectives of these remarkable individuals on our chosen field.

The ACM Turing Centenary Celebration is underwritten by ACM and ACM SIGs. Google, Microsoft, and Intel are providing funding for 70 student scholarships. The event is being webcast live worldwide, and a video record of the Turing Centenary will be posted on the ACM website.

On behalf of ACM, welcome to the ACM Turing Centenary Celebration and to what everyone at ACM believes will be a unique and memorable experience.

JOHN R. WHITE

Chief Executive Officer

ASSOCIATION FOR COMPUTING MACHINERY

WELCOME TO THE ACM TURING CENTENARY PROGRAM

As we celebrate the life of the man who asked whether machines could think, we welcome the ACM Turing Award winners and members of the computing community who have joined together to commemorate this pioneer whose work laid many of the foundations of our discipline.

Alan Turing's wide-ranging interests ranged from the purely theoretical to the eminently practical. He contributed to our fundamental understanding of what can be computed through the invention of what we now refer to as the Universal Turing Machine. On the practical side, his work on the design of the ACE (Automatic Computing Engine) drew upon his wartime experience at Bletchley Park and blazed trails toward the breakthrough technology of stored-program computing.

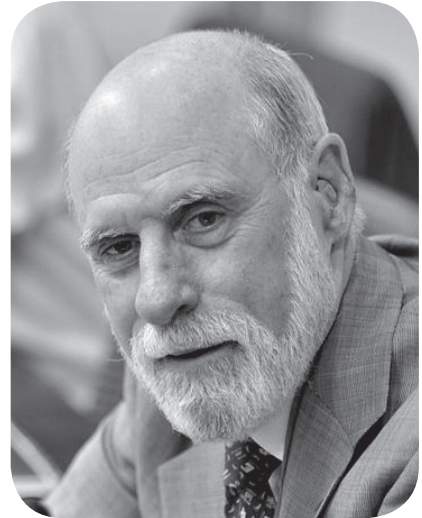
The accomplishments of the Turing Award winners represented at this celebration continue to validate the enduring power of Turing's work. This program is organized to reflect facets of Turing's contributions that have placed him in prominence in the history of computing.

Individual speakers will focus on the use of computable reals in successful verification techniques for safety-critical systems; transformational thinking about programming language and computer design; examining computers that engage with the physical world in ways not previously possible; and the future of Lambda Calculus: the smallest universal programming language in the world.

Panelists will discuss a range of topics that reflect connections to Turing and his legacy: personal stories of Turing the man; imagining the future of artificial intelligence; how the Turing machine model shaped Computer Science; and information, data and security in a networked world.

Additional panel discussions include: programming language design legacies and lessons; the extension of Turing's vision of human memory via computer architecture research; how systems research and engineering practices complement and challenge each other; and the impact of algorithmic thinking beyond computation.

Alan Turing's genius has inspired generations of computer scientists and engineers, and it is fitting that his legacy and life should be recognized and celebrated by the community that carries on and extends his work.



VINTON G. CERF

General Chair

ACM TURING CENTENARY CELEBRATION



PROGRAM

FRIDAY – JUNE 15, 2012

9:00

John White, ACM CEO
Vint Cerf, General Chair

OPENING REMARKS

9:15

CHAIR:
Keith Van Rijsbergen

PANELISTS:
Charles W. Bachman
Kelly Gotlieb
Wendy Hall
William Newman

PANEL - TURING THE MAN

The panelists will discuss Alan Turing and Sara Turing, his mother, based on the personal experiences of the panelists. William Newman will recount amusing incidents during the time Turing was a regular visitor at the Newman home. Kelly Gotlieb will describe his meetings with Turing at Manchester University during the early 1950s. Charlie Bachman and his wife met with Sara Turing in the mid-1970s, and Charlie will give an account of that meeting. Finally, Wendy Hall will describe the Turing Archive project in the UK and the Turing exhibition in the London Science Museum.

10:15**BREAK**

10:45

CHAIR:
Barbara Grosz

PANELISTS:
Edward A. Feigenbaum
Marvin Minsky
Judea Pearl
Raj Reddy

PANEL - HUMAN AND MACHINE INTELLIGENCE

In his 1950 Mind paper, Alan Turing reframed the question of whether machines could think as an operational or behavioral question: Could a computer be built that was indistinguishable from people in playing the “imitation game,” now known as “the Turing Test”? He conjectured that by the end of the 20th century “one [would] be able to speak of machines thinking without expecting to be contradicted” and that computers would succeed in the Turing Test.

Turing’s first conjecture proved right. Although his second has not yet been realized, research in Artificial Intelligence (AI) has generated a variety of algorithms and techniques regularly deployed in systems enabling them to behave in ways that are broadly considered to be intelligent. The performances of Watson, Siri, and driverless cars are but a few examples in the public eye. This session’s panelists will highlight some of the major accomplishments of research in AI and its influential role in the development of computer science and computer systems more broadly, considering not only progress in individual subfields, but also designs for integrating these into well-functioning systems. They will also consider the ways in which AI theories and methods have influenced research on human cognition in behavioral sciences and neuroscience as well as scientific research more generally, and they will discuss major challenges and opportunities for the decades ahead.

11:45

Butler Lampson

**TALK – “WHAT COMPUTERS DO:
MODEL, CONNECT, AND ENGAGE”**

Every 30 years there is a new wave of things that computers do. Around 1950 they began to model events in the world (simulation), and around 1980 to connect people (communication). Since 2010 they have begun to engage with the

physical world in a non-trivial way (embodiment—giving them bodies). Today there are sensor networks like the Inrix traffic information system, robots like the Roomba vacuum cleaner, and cameras that can pick out faces and even smiles. But these are just the beginning. In a few years we will have cars that drive themselves, glasses that overlay the person you are looking at with their name and contact information, telepresence systems that make most business travel unnecessary, and other applications as yet unimagined.

All computer systems are built on the physical foundation of hardware (steadily improving, according to Moore's law) and the intellectual foundations of algorithms, abstraction and probability. Their performance is determined by basic issues of latency, bandwidth, availability and complexity. In the future they will deal with uncertainty much better than today, and many of them will be safety-critical and hence much more dependable.

12:15**LUNCH****1:30**

CHAIR:

Dahlia Malkhi

PANELISTS:

Fernando J. Corbato

E. Allen Emerson

Joseph Sifakis

Ken Thompson

PANEL - SYSTEMS ARCHITECTURE, DESIGN, ENGINEERING, AND VERIFICATION - THE PRACTICE IN RESEARCH AND RESEARCH IN PRACTICE

More than any other area in computer science, the interaction and boundary between science and engineering is blurred in the systems area, with cross fertilization from both directions. The systems panel will explore the past, present and future relationship between systems research and engineering practice.

Panel members will review their past award-winning research in perspective, and describe its impact on the computing world.

They will discuss the relationship between systems research and engineering practices: when does systems innovation emanating from industry become an invention and when does academic research stop being science and become engineering? How does practice-driven research impact the real world and how does the real world reflect back on foundations? In what forms does technology create research challenges, and in what manner does applied research give solid base for development?

They will surmise about the future of systems research: What are the fundamental challenges posed by the scale of today's cloud computing systems and mega-size data centers? How to organize software of large-scale distributed executions or mega-ton lines of code? What new opportunities are enabled by novel technologies like flash memory and transactional memory? How to integrate hand-in-hand design of software and architecture?

2:45

Alan C. Kay

TALK - "EXTRACTING ENERGY FROM THE TURING TARPIT!"

Part of Turing's fame and inspiration came from showing how a simple computer can simulate every other computer, and so "anything is possible". The "Turing Tarpit" is getting caught by "anything is possible but nothing is easy". One way to get caught is to stay close to the underlying machine with our languages so that things seem comprehensible in the small but the code blows up into intractable millions of lines. What if we used "anything is possible" to make very different kinds of computers which require new learning but the code compactly fits the problem and stays small?

3:15**BREAK**

3:45

CHAIR:

Juris Hartmanis

PANELISTS:

Stephen Cook

William Kahan

Richard E. Stearns

Andrew C. Yao

PANEL - THE TURING COMPUTATIONAL MODEL AND HOW IT SHAPED COMPUTER SCIENCE

The panel presentations will discuss the beauty and simplicity of the Turing machine formulation of the previously elusive concept of computability and the intuitively satisfying explanation of the power and limitations of computability. They will also review how the Turing machine model provided simple proofs of deep results in logic, including Gödel's incompleteness theorem. The panel will also examine specific results in computer science influenced by the Turing machine model as well as how it shaped the development of computational complexity theory. Quantum computing will be discussed and its relationship to the classic Turing machine model. The panel will also discuss what Alan Turing might say about the Inevitable Fallibility of Software.

5:00

Dana S. Scott

TALK - "LAMBDA CALCULUS THEN AND NOW"

A very fast development in the early 1930s, following Hilbert's codification of Mathematical Logic, led to the Incompleteness Theorems, Computable Functions, Undecidability Theorems, and the general formulation of Recursive Function Theory. The so-called Lambda Calculus played a key role. The history of these developments will be traced, and the much later place of Lambda Calculus in Mathematics and Programming-Language Theory will be outlined.

5:30

Edmund Clarke

TALK - "THE COMPUTABLE REALS AND WHY THEY ARE STILL IMPORTANT TODAY"

Although every undergraduate in computer science learns about Turing Machines, it is not well known that they were originally proposed as a means of characterizing computable real numbers. For a long time, formal verification paid little attention to computational applications that involve the manipulation of continuous quantities, even though such applications are ubiquitous. In recent years, however, there has been great interest in safety-critical hybrid systems involving both discrete and continuous behaviors, including autonomous automotive and aerospace applications, medical devices of various sorts, control programs for electric power plants, and so on. As a result, the formal analysis of numerical computation can no longer be ignored.

This talk focuses on one of the most successful verification techniques, temporal logic model checking. Current industrial model checkers do not scale to handle realistic hybrid systems. The key to handling more complex systems is to make better use of the theory of the computable reals, and computable analysis more generally. New formal methods for hybrid systems should combine existing discrete methods in model checking with new algorithms based on computable analysis. In particular, this talk discusses a model checker currently being developed along these lines.

6:00**ADJOURN/RECEPTION**

SATURDAY – JUNE 16, 2012

8:30

CHAIR:

David Patterson

PANELISTS:

Frederick P. Brooks, Jr.

Ivan Sutherland

Charles P. (Chuck) Thacker

PANEL - COMPUTER ARCHITECTURE

Sixty-five years ago, Alan Turing produced a proposal for the construction of a general-purpose computer, the Automatic Computing Engine, or ACE. Subsequently built at the U.K. National Physical Laboratory, it was briefly the fastest computer in the world. Although its architecture was quite different from the arrangement proposed by Von Neumann and others that eventually came to dominate the computing landscape, examining it gives us a chance to understand some of the tradeoffs that early computer architects explored.

The panel will examine the ACE to provide a setting for the discussions that follow, in which they will explore some of the architectural tradeoffs that have been made in the past, are still being made today, and which will shape the direction of computing in the future. What would Alan Turing have thought about the impact that computers have had on society? What would he have thought about the warehouse-scale computing that makes possible a realization of Vannevar Bush's 1945 Memex vision? What about the possibility of quantum computing? The panelists will discuss these topics as well as the progress and future of academic computer architecture research.

9:30

CHAIR:

Susan Graham

PANELISTS:

Frances E. Allen

Barbara Liskov

Niklaus Wirth

PANEL - PROGRAMMING LANGUAGES - PAST ACHIEVEMENTS AND FUTURE CHALLENGES

The design of programming languages and their compile-time and run-time implementation are closely related, and are dependent on the underlying computational model. In the 1960s, 70s, and 80s many languages were designed, and many implementation strategies and computational models were explored. Since then, the commercial world has largely settled on a few legacy languages. Meanwhile, both the capabilities of computing systems and the ways in which they are used have changed dramatically. The panelists will summarize the lessons they have learned about language design, and also what has not been learned. They will consider how those lessons can be applied to the myriad application domains, architectural frameworks, user needs, and economic considerations that exist today, and will speculate about the future.

10:30

BREAK

11:00

CHAIR:

Christos Papadimitriou

PANELISTS:

Leonard Adleman

Richard M. Karp

Donald E. Knuth

Robert Tarjan

Leslie G. Valiant

PANEL - THE ALGORITHMIC UNIVERSE

In the years since Alan Turing, and following his lead, computer scientists advanced their understanding of computational phenomena by developing a very specialized, original and penetrating way of rigorous thinking. Now it turns out that this "algorithmic" way of thinking can be applied productively to the study of important phenomena outside computation proper (examples: the cell, the brain, the market, the universe, indeed mathematical truth itself). This development is an exquisite unintended consequence of the fact that there is latent computation underlying each of these phenomena, or the ways in which science studies them.

12:30

CHAIR:

Vint Cerf

PANELISTS:

John Hopcroft

Bob Kahn

Ron Rivest

Adi Shamir

**PANEL – INFORMATION, DATA, SECURITY
IN A NETWORKED FUTURE**

The digital information revolution begins as giants such as Alan Turing, Claude Shannon and John von Neumann, among many others, recognize the power of digital representations and programmable computers. Although rooted in the technology of his time, Vannevar Bush's portrait of the information revolution has emerged and flourished especially in the form of the World Wide Web resting atop the global Internet.

The panelists will explore some specifics of the digital information revolution, notably theory and practice in securing, authenticating and maintaining the integrity of information (Cerf); and roots of modern cryptography and current topics in this area (Rivest and Shamir). They will also gain insight into the long-term problem of identifying, finding, and assuring the integrity of digital objects in the most general sense of that term (Kahn). Finally, they look at how our understanding of computer science is changing (Hopcroft) and how that evolution will affect the digital world in which we are spending an increasing fraction of our daily lives.

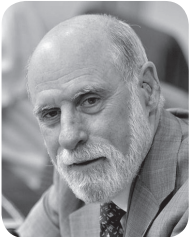
1:45**ADJOURN****2:00****FILM – "CODEBREAKER"**

A special preview screening in the Gold Ballroom of Patrick Sammon's new film about Alan Turing's heroic life, tragic death, and lasting legacy.

This drama documentary will be released later this year in the U.S. Don't miss the chance to get a sneak peek at this powerful film. Patrick Sammon, executive producer and creator, will provide an introduction before the screening. If you are interested in scheduling an academic or corporate screening of this film, please email Patrick at ps@turingfilm.com.

SPEAKERS' BIOS

GENERAL CHAIR

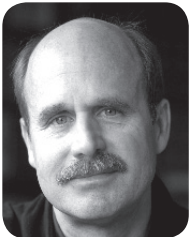


VINTON G. CERF

2004 ACM Turing Award winner. Vice President and Chief Internet Evangelist at Google Inc.

At Stanford University, with funding from the US Defense Advanced Research Projects Agency, Cerf developed the TCP/IP protocols to transmit data that enables computers in diverse environments to communicate with each other. This computer networking protocol, widely used in information technology for a variety of applications, allows networks to be joined into a network of networks now known as the Internet. An ACM Fellow, he received the Kilby Award, and the IEEE Alexander Graham Bell Medal. He is a former Vice President of Digital Information Services at MCI, and of the Corporation for National Research Initiatives (CNRI). He was Board Chairman of the Internet Corporation for Assigned Names and Numbers (ICANN). He holds an M.S. degree from Stanford University and a Ph.D. degree from the University of California, Los Angeles.

MODERATOR



PAUL SAFFO

Forecaster with over two decades experience exploring the dynamics of large-scale, long-term change.

Saffo is Managing Director of Foresight at Discern Analytics, and teaches at Stanford University where he is also a Visiting Scholar in the Stanford Media X research network. He serves on a variety of not-for-profit boards including the Long Now Foundation, and the Bay Area Council Economic Institute. His essays have appeared in a wide range of publications including *The Harvard Business Review*, *Fortune*, *Wired*, *The Los Angeles Times*, *Newsweek*, *The New York Times*, and *The Washington Post*. He holds degrees from Harvard College, Cambridge University and Stanford University.

PROGRAM CO-CHAIRS



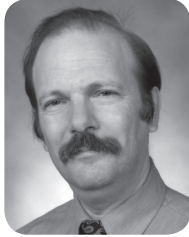
MIKE SCHROEDER

Assistant Managing Director at Microsoft Research Silicon Valley. Schroeder was on the faculty at MIT and the Computer Science Laboratory at Xerox PARC, and the Digital/Compaq Systems Research Center. He was co-inventor of the Needham-Schroeder authentication protocol, and a designer/builder of the Multics time-sharing system, the Grapevine distributed email system, the Topaz distributed operating system, the Autonet and AN2 switch-based LANs, and the Pachyderm web-based email system. He is a Fellow of ACM and recipient of the ACM Special Interest Group on Security, Audit and Control (SIGSAC) Outstanding Innovations Award. He received the NIST/NSA National Computer Systems Security Award, and was twice recognized with the Hall of Fame Award from the ACM Special Interest Group on Operating Systems (SIGOPS). He is a graduate of Washington State University, with M.S., E.E., and Ph.D. degrees from MIT.



JOHN C. THOMAS

Research staff member at IBM Watson Research Center. Thomas led the Artificial Intelligence Laboratory at NYNEX Science and Technology, an artificial intelligence facility for machine vision, human-computer interaction, intelligent tutoring systems, robotics, speech recognition and advanced tools for software design. After an initial stint at IBM Research, he rejoined IBM to work in knowledge management and human-computer interaction. He helped form the ACM Special Interest Group on Computer Human Interaction (SIGCHI), and co-leads the doctoral consortium at ACM's Conference on Creativity and Cognition. He holds a Ph.D. degree from the University of Michigan.

**MOSHE Y. VARDI**

Karen Ostrum George Professor of Computational Engineering and Director of the Ken Kennedy for Information Technology Institute at Rice University. Vardi is editor-in-chief of *Communications of the ACM*. He is a co-recipient of the ACM Special Interest Group on Algorithms and Computation Theory (SIGACT) Gödel Prize, and a recipient of the ACM Kanellakis Award and the ACM Special Interest Group on Management of Data (SIGMOD) Codd Award. He co-authored two books, *Reasoning about Knowledge* and *Finite Model Theory and Its Applications*. A Fellow of ACM, the Association for the Advancement of Artificial Intelligence, the American Association for the Advancement of Science, and the IEEE, he is a member of the National Academy of Engineering, the American Academy of Arts and Sciences, and the European Academy of Science. He received a Ph.D. degree from Hebrew University.

PANEL CHAIRS

**VINTON G. CERF**

2004 ACM Turing Award winner. Vice President and Chief Internet Evangelist at Google Inc.

SUSAN GRAHAM

Pehong Chen Distinguished Professor at the University of California, Berkeley.

Graham developed computer programming tools that have significantly advanced software development. Her recent projects include Harmonia, a language-based framework for interactive software development; and Titanium, a Java-based parallel programming language, compiler, and runtime system to support high-performance scientific computing on large-scale multiprocessors. A recipient of the ACM/IEEE Ken Kennedy Award, she is a Fellow of ACM, a Fellow of the American Academy of Arts and Sciences, and of AAAS. She is also a member of National Academy of Engineering, and the founding editor-in-chief of *ACM Transactions on Programming Languages and Systems*. She currently serves as vice-chair of the Council of the Computing Community Consortium, which is sponsored by the National Science Foundation. She received her A.B. from Harvard University, and M.S. and Ph.D. degrees from Stanford University.

**BARBARA J. GROSZ**

Higgins Professor of Natural Sciences at Harvard University. The first dean of science at Radcliffe Institute for Advanced Study. Grosz developed early computer dialogue systems, and established computational modeling of discourse, which provides the framework for collaborative multi-agent systems and human computer interface systems. She co-founded the Center for the Study of Language and Information at Stanford University. She is a member of the National Academy of Engineering, and the American Academy of Arts and Sciences, and a Fellow of ACM, the Association for the Advancement of Artificial Intelligence, and the American Association for the Advancement of Science. A recipient of the ACM/AAAI Allen Newell Award, she received a B.A. degree from Cornell University, and M.A. and Ph.D. degrees from the University of California, Berkeley.

**JURIS HARTMANIS**

1993 ACM Turing Award winner. Professor Emeritus at Cornell University. Hartmanis co-wrote a seminal paper which established the foundations for computational complexity theory. He served on the Cornell faculty before joining the General Electric Research Laboratory. He rejoined Cornell and was a founder and first chairman of its Computer Science department. He was awarded the Bolzano Gold Medal of the Academy of Sciences of the Czech Republic and the Grand Medal of the Latvian Academy of Sciences. A Fellow of ACM, he is a member of the National Academy of Engineering, the American Academy of Arts and Sciences, and the Latvian Academy of Sciences. He graduated with the equivalent of a B.S. degree from the University of Marburg in Germany. He received an M.S. degree from the University of Missouri-Kansas City, and a Ph.D. degree from the California Institute of Technology.



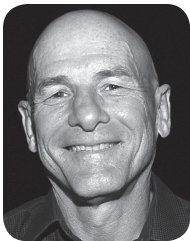
DAHLIA MALKHI

A principal researcher at Microsoft Research, Silicon Valley. Malkhi works on algorithmic aspects of distributed computing and reliability. Prior to joining Microsoft Research, she was an associate professor at the Hebrew University of Jerusalem and a senior researcher at AT&T Bell Labs. She has served as associate editor of the *Distributed Computing Journal* and co-authored several articles on solid state devices including CORFU, a novel storage cluster design that breaks the seeming tradeoff between consistency and performance. A Fellow of ACM, she is a winner of the IBM Faculty Award and the German-Israeli Foundation (G.I.F.) Young Scientist Award. She holds a Ph.D. degree from the Hebrew University.



CHRISTOS PAPADIMITRIOU

C. Lester Hogan Professor of Electrical Engineering and Computer Science at the University of California, Berkeley. Papadimitriou previously taught at Harvard University, Massachusetts Institute of Technology, the National Technical University of Athens, Stanford University, and the University of California, San Diego. He authored *Computational Complexity*, one of the most widely used textbooks in the field. He co-authored *Algorithms*, and the graphic novel, *Logicomix*, with Apostolos Doxiadis. He has written a novel about computation titled *Turing*. A recipient of the ACM Special Interest Group on Algorithms and Computer Theory (SIGACT) Knuth Award, he earned a B.S. degree from the National Technical University of Athens, a M.S. degree from Princeton University, and a Ph.D. degree from the University of California, Berkeley.



DAVID PATTERSON

Pardee Professor of Computer Science at the University of California, Berkeley and former President of ACM. Patterson led the design and implementation of RISC I (Reduced Instruction Set Computer), the foundation of SPARC architecture. He was a leader of the Redundant Arrays of Inexpensive Disks (RAID) project. His current focus includes Reliable Adaptive Distributed systems. The co-author of five books, he is a member of the National Academy of Engineering and the National Academy of Sciences, and a Fellow of ACM, the IEEE Computer Society, and the American Association for the Advancement of Science. A recipient of the ACM Karl V. Karlstrom Outstanding Educator Award, he shared the IEEE John von Neumann Medal with John Hennessy. Elected to the American Academy of Arts and Sciences, he received A.B., M.S., and Ph.D. degrees from UCLA.



KEITH VAN RIJSBERGEN

Professor of Computer Science at Glasgow University. Van Rijsbergen's research on theoretical and experimental information retrieval and the design of logics to model the flow of information has demonstrated how different information retrieval models can be combined in frameworks used to formulate quantum mechanics principles. He is a former chair of panels on Computer Science and Informatics for the Royal Engineers Association and the European Research Council. He held a Royal Society Information Research Fellowship at Cambridge Computer Laboratory, UK, and is a Fellow of the Royal Academy of Engineering, Institute for Electrical and Electronics Engineers, British Computer Society, and ACM, and was editor-in-chief of *The Computer Journal*. He has written and co-written several books, including *The Geometry of Information Retrieval*. He holds degrees from the University of Western Australia and Cambridge University.

PANELISTS & SPEAKERS



LEONARD ADLEMAN

2002 ACM Turing Award winner. Henry Salvatori Professor of Computer Science and Molecular Biology at the University of Southern California. Adleman is a co-inventor of the RSA (Rivest-Shamir-Adleman) cryptosystem, and of DNA computing. The RSA encryption was a significant advance in enabling secure communication among computers using public-key cryptography. It is still used in everyday emails as well as web browsers, secure shells, virtual private networks and mobile phones. He received the Paris Kanellakis Theory and Practice Award from ACM. He is a member of the National Academy of Engineering and the National Academy of Sciences. He received B.A. and Ph.D. degrees from the University of California, Berkeley.



FRANCES E. ALLEN

2006 ACM Turing Award winner. IBM Fellow Emerita at the T.J. Watson Research Center.

Allen made pioneering contributions to the theory and practice of optimizing compiler techniques that laid the foundation for modern optimizing compilers and automatic parallel execution. She was president of the IBM Academy of Technology. She is a member of the National Academy of Engineering, the American Academy of Arts and Sciences, and the American Philosophical Society. A Fellow of ACM, Allen graduated from Albany State Teachers College—now the State University of New York at Albany—with a B.S. degree and received an M.S. degree from the University of Michigan.



CHARLES W. BACHMAN

1973 ACM Turing Award winner. A lifelong practicing software engineer, Bachman has made outstanding contributions to database technology.

He began his career at Dow Chemical Co, and joined General Electric, where he developed the Integrated Data Store, one of the first database management systems. He founded Bachman Information Systems, where he developed Computer-Aided Software Engineering (CASE) products. A key product was the BACHMAN/Data Analyst, which provided graphic support for diagrams used to design systems that separated the data model from the way data is stored in the system. He is a Distinguished Fellow of the British Computer Society. He received a B.S. degree from Michigan State College and an M.S. degree from the University of Pennsylvania.



FREDERICK P. BROOKS, JR.

1999 ACM Turing Award winner. Brooks has made landmark contributions to computer architecture, operating systems, and software engineering.

He worked for IBM where he managed the development of IBM's System/360 family of computers and the OS/360 software support package. He founded the Department of Computer Science at the University of North Carolina, Chapel Hill. A member of the National Academy of Engineering and the National Academy of Sciences, he won the National Medal of Technology and the IEEE John von Neumann Medal. He is a Fellow of ACM and a Distinguished Fellow of the British Computer Society. He won the ACM Allen Newell Award and ACM/IEEE Eckert-Mauchly Award. He earned an A.B. degree from Duke University, and S.M. and Ph.D. degrees from Harvard University.



EDMUND CLARKE

2007 ACM Turing Award winner. Professor of Computer Science and of Electrical and Computer Engineering at Carnegie Mellon University.

Clarke is known for original and continuing research in a quality assurance process known as Model Checking, which transformed this tool from a theoretical technique to a highly effective verification technology that enables computer hardware and software engineers to find errors efficiently in complex system designs. He has held academic positions at Duke University and Harvard University. A Fellow of ACM and the IEEE Computer Society, he was elected to the National Academy of Engineering and the American Academy of Arts and Sciences. He was awarded a B.A. degree from the University of Virginia, an M.A. degree from Duke University, a Ph.D. degree in computer science from Cornell University, and an Honorary Doctorate from the Technical University of Vienna.



STEPHEN A. COOK

1982 ACM Turing Award winner. University Professor of Computer Science at the University of Toronto. Cook is considered one of the forefathers of computational complexity theory. He advanced our understanding of the complexity of computation in a significant and profound way. His paper "The Complexity of Theorem Proving Procedures" laid the foundations for the theory of NP-Completeness. He formulated the most famous problem in computer science, which is whether every optimization problem whose answers can be efficiently verified for correctness/optimality can be solved optimally with an efficient algorithm. He was a professor at the University of California, Berkeley. He is a Fellow of ACM and a member of the National Academy of Sciences and the American Academy of Arts and Sciences. He received a B.Sc. degree from the University of Michigan, and S.M. and Ph.D. degrees from Harvard University.



FERNANDO CORBATÓ

1990 ACM Turing Award winner. Professor Emeritus of Electrical Engineering and Computer Science at MIT. Corbató did pioneering work organizing the concepts and leading the development of the general-purpose, large-scale, time-sharing and resource-sharing computer systems, CTSS (Compatible Time Sharing System) and Multics (Multiplexed Information and Computer Service), a joint project of MIT, Bell Telephone Laboratories, and General Electric. CTSS was the first file system to permit controlled sharing of files among users. Multics influenced the design of operating systems like UNIX. He headed the MIT Electrical Engineering and Computer Science Department. A Fellow of ACM, IEEE, and the American Academy of Arts and Sciences, he was elected to the National Academy of Engineering. He received a B.S. degree from the California Institute of Technology and a Ph.D. degree from MIT.



E. ALLEN EMERSON

2007 ACM Turing Award winner. Regents Chair and Professor of Computer Science at the University of Texas at Austin. Emerson is known for his role in developing Model-Checking into a highly effective verification technology that is widely adopted in the hardware and software industries, including verification of communication protocols, software device drivers, real-time embedded systems, and security algorithms. This technology provides an algorithmic means of determining whether an abstract model such as a hardware or software design satisfies a formal specification, which is expressed as a pattern for a sequence of events. A recipient of the ACM Paris Kanellakis Theory and Practice Award, he won the Allen Newell Award for Research Excellence from Carnegie Mellon University. He earned a B.S. degree at University of Texas at Austin, and a Ph.D. degree from Harvard University.



EDWARD A. FEIGENBAUM

1994 ACM Turing Award winner. Professor Emeritus of Computer Science at Stanford University. Feigenbaum pioneered the design and construction of large-scale artificial intelligence systems, demonstrating the practical importance and potential commercial impact of artificial intelligence technology. He taught at the University of California, Berkeley. He co-founded three companies involved in applied artificial intelligence. A Fellow of the Association for the Advancement of Artificial Intelligence, he served on the National Science Foundation Computer Science Advisory Board and the National Research Council's Computer Science and Technology Board. He was Chief Scientist of the U.S. Air Force, and is a member of the National Academy of Engineering and the American Academy of Arts and Sciences. He was awarded B.S. and Ph.D. degrees from Carnegie Mellon University.



KELLY GOTLIEB

Professor Emeritus at the University of Toronto. Gotlieb co-founded the university's computation center and created the first university courses on computing in Canada. He was on the first team in Canada to build computers and provide computing services. He chaired the ACM Fellows Committee and the ACM A.M. Turing Award Committee. He is a member of the Order of Canada, a Fellow of the Royal Society of Canada, a Fellow of ACM, and a founding Fellow of the Canadian Information Processing Society. He also received the IFIP Isaac L. Auerbach Medal. He was editor-in-chief of *Communications of the ACM* and *Journal of the ACM*. He holds B.S., M.A. and Ph.D. degrees from the University of Toronto.



WENDY HALL

Professor of Computer Science at the University of Southampton, UK and past president of ACM. With her team at the University, Hall invented the ground-breaking Microcosm hyper-media system, which pre-dated the Web, and for which a patent was granted. She is founding director, along with Professor Sir Tim Berners-Lee, Professor Nigel Shadbolt, and Daniel J. Weitzner, of the Web Science Research Initiative, a research collaboration between the University of Southampton and MIT. She became a Dame Commander of the British Empire and was recently elected a Fellow of the Royal Society. She holds graduate and undergraduate degrees from the University of Southampton.



JOHN HOPCROFT

1986 ACM Turing Award winner. IBM Professor of Engineering and Applied Mathematics in Computer Science at Cornell University. Hopcroft is known for fundamental achievements in the design and analysis of algorithms and data structures. A former faculty member at Princeton University, he joined the Cornell faculty and chaired the Department of Computer Science. He is a member of the National Academy of Sciences and the National Academy of Engineering. He is a Fellow of ACM and a Fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Science, and the IEEE. He was appointed to the National Science Board, which oversees the National Science Foundation. He earned an undergraduate degree from Seattle University and was awarded M.S. and Ph.D. degrees from Stanford University.



WILLIAM KAHAN

1989 ACM Turing Award winner. Emeritus Professor at the University of California, Berkeley. Kahan is known for fundamental contributions to numerical analysis. Called "The Father of Floating Point," he was the primary architect behind the IEEE 754-1985 standard for floating-point computation, a method of representing real numbers in a way that can support a wide range of values. He was a Professor of Mathematics at the University of Toronto. He is an ACM Fellow and won the IEEE Emanuel R. Piore Award. A member of the National Academy of Engineering, he earned B.Sc., M.Sc., and Ph.D. degrees from the University of Toronto.



ROBERT E. KAHN

2004 ACM Turing Award winner. Chairman, CEO and President of the Corporation for National Research Initiatives. With Vinton Cerf, Kahn developed the TCP/IP protocols, which allowed ARPANET to expand into the Internet. A researcher at AT&T Bell Labs, and a professor at MIT before moving to Bolt, Beranek and Newman, he was a Program Manager/Director for the Defense Advanced Research Projects Agency (DARPA). A recipient of the National Medal of Technology and the Presidential Medal of Freedom, he twice received the Secretary of Defense Civilian Service Award. He won the IEEE Alexander Graham Bell Medal and the ACM Software System Award. A member of the National Academy of Engineering and the American Academy of Arts and Sciences, he is a Fellow of ACM, IEEE, and AAAI. He received a B.E.E. degree from City College of New York, and M.A. and Ph.D. degrees from Princeton University.



RICHARD M. KARP

1985 ACM Turing Award winner. Research Scientist at the University of California, Berkeley. Karp developed efficient algorithms for network flow and other combinatorial optimization problems, and is known for his contributions to the theory of NP-completeness. Formerly a Research Staff Member at IBM T.J. Watson Research Center. He was Professor of Computer Science and Adjunct Professor of Molecular Biotechnology at the University of Washington. He is the founding director of the Simons Foundation's Institute for Theory of Computing. A member of the National Academies of Sciences and Engineering, he is a Fellow of ACM, the American Academy of Arts and Sciences, and the American Association for the Advancement of Science. He was awarded the IEEE John von Neumann Theory Prize, and the National Medal of Science. He received A.B., S.M., and Ph.D. degrees from Harvard University.



ALAN C. KAY

2003 ACM Turing Award winner. President and Founder of Viewpoints Research Institute.

Kay joined Xerox Corporation's Palo Alto Research Center (PARC), where he led the team that invented Smalltalk, an influential programming language that used object-oriented concepts, and windowing graphical user interface design. He was a member of the University of Utah's research team that developed 3-D graphics work for the Advanced Research Projects Agency (ARPA). He was Chief Scientist of Atari, a Fellow of Apple Computer, Vice President of Research and Development at The Walt Disney Company, and a Senior Fellow at Hewlett Packard Labs. His Smalltalk team received the ACM Software System Award. A Fellow of the American Academy of Arts and Sciences and the National Academy of Engineering, he received a B.S. degree from the University of Colorado, and M.S. and Ph.D. degrees from the University of Utah.



DONALD E. KNUTH

1974 ACM Turing Award winner. Professor Emeritus at Stanford University. Knuth was a professor at California Institute of Technology before joining Stanford University. He made major contributions to the analysis of algorithms and the design of programming languages, and authored a series of well-known books on the art of computer programming. He is a Fellow of the American Academy of Arts and Sciences, and a member of the National Academy of Science and the National Academy of Engineering. He won the National Medal of Science and the IEEE John von Neumann Medal. He earned B.S. and M.S. degrees from the Case Institute of Technology, and a Ph.D. degree from the California Institute of Technology.



BUTLER LAMPSON

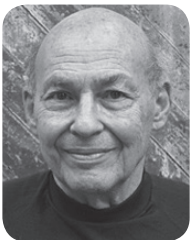
1992 ACM Turing Award winner. Technical Fellow at Microsoft and adjunct professor at MIT.

Lampson contributed to the development of distributed, personal computing environments and the technology to implement them, through workstations, networks, operating and programming systems, displays, security and document publishing. Before joining Microsoft, he was on the faculty at the University of California, Berkeley. He was a founding member of the Computer Science Laboratory at Xerox PARC before moving to Digital Equipment Corp.'s Systems Research Center. A Fellow of ACM, he was awarded the IEEE John von Neumann Medal. He earned a B.S. degree from Harvard University and a Ph.D. degree from the University of California, Berkeley.



BARBARA LISKOV

2008 ACM Turing Award winner. Ford Professor of Engineering at MIT. Liskov's contributions helped make software more reliable, consistent and resistant to errors and hacking. Her early innovations in software design have been the basis of every important programming language since 1975, including Ada, C++, Java and C#. After working at Mitre Corporation, she joined MIT and was named an Institute Professor. She is a member of the National Academy of Engineering and a Fellow of ACM and the American Academy of Arts and Sciences. She was awarded the IEEE John Von Neumann Medal. She earned B.A. degree from the University of California, Berkeley and a Ph.D. degree from Stanford University.



MARVIN MINSKY

1969 ACM Turing Award winner. Professor Emeritus at MIT, where he has been a faculty member throughout his career. Minsky founded the MIT Computer Science and Artificial Intelligence Laboratory. His research has led to both theoretical and practical advances in artificial intelligence, cognitive psychology, neural networks, computational linguistics, and the theory of Turing Machines and recursive functions. A pioneer of robotics and computer-aided learning technologies, he used computational ideas to characterize human psychological processes. He is a Fellow of the American Academy of Arts and Sciences and of IEEE, and a member of the National Academy of Engineering and the National Academy of Sciences. He was awarded the Benjamin Franklin Medal. He received a B.A. degree from Harvard University and a Ph.D. degree from Princeton University.



WILLIAM NEWMAN

Visiting Professor, University College London. Newman jointly teaches a Perspectives on Design course and is the author of two successful textbooks, *Interactive Computer Graphics* with R.F. Sproull, and *Interactive System Design* with M.G. Lamming. He pioneered research in computer graphics and human-computer interaction at Xerox Corporation and Cambridge University. A consultant, he advises clients on the application, design, evaluation and study of interactive technologies for human use. As the son of Alan Turing's friend and collaborator Max Newman, he knew Turing as a boy in Manchester, England. He is a member of ACM's CHI (Special Interest Group on Computer-Human Interaction) Academy.



JUDEA PEARL

2011 ACM Turing Award winner. Professor of Computer Science at the University of California, Los Angeles. Pearl was Director of the Cognitive Systems Laboratory at UCLA. His innovations in probabilistic and causal reasoning enabled remarkable advances in the partnership between humans and machines that is the foundation of artificial Intelligence. Before joining UCLA, he worked at RCA Research Laboratories and Electronic Memories. He is President of the Daniel Pearl Foundation, named after his son. He is a member of the National Academy of Engineering and a Fellow of the Association for the Advancement of Artificial Intelligence and IEEE. A recipient of the Benjamin Franklin Medal, he also won the ACM/AAAI Allen Newell Award. He received a B.S. degree from the Technion, the Israel Institute of Technology, an M.S. degree from Rutgers University, and a Ph.D. degree from New York University Polytechnic Institute.



RAJ REDDY

1994 ACM Turing Award winner. University Professor of Computer Science and Robotics at Carnegie Mellon University. Reddy was Founding Director of the Robotics Institute at CMU. He pioneered the design and construction of large-scale artificial intelligence systems, demonstrating the practical importance and potential commercial impact of artificial intelligence technology. Before joining CMU, he worked at IBM (Australia). He is a Fellow of the IEEE, a Founding Fellow of the Association for the Advancement of Artificial Intelligence, and a member of the National Academy of Engineering and the American Academy of Arts and Sciences. A recipient of France's Legion d'Honneur, and India's Padma Bhushan Award, he earned a B.S. degree from Anna University in India, an M.Tech. degree from the University of New South Wales in Australia, and a Ph.D. degree from Stanford University.



RONALD RIVEST

2002 ACM Turing Award winner. Viterbi Professor of Computer Science at MIT, and a leader of the Cryptography and Information Security research group at MIT's Computer Science and Artificial Intelligence Laboratory. Rivest is one of the inventors of the RSA algorithm, the world's most widely used public-key cryptography system. This technology has enabled entrepreneurial activity on a large scale, and facilitated major advances in political and social interactions. He is a Fellow of ACM and the American Association for the Advancement of Science. A member of the American Academy of Arts and Sciences and the National Academy of Engineering, he received the ACM Paris Kanellakis Theory and Practice Award. He earned a B.A. degree from Yale University and a Ph.D. from Stanford University.



DANA S. SCOTT

1976 ACM Turing Award winner. Emeritus Hillman University Professor of Computer Science, Philosophy, and Mathematical Science at Carnegie Mellon University. Scott introduced the idea of nondeterministic machines to the study of mathematical objects and the computational problems that can be solved using them. With Christopher Strachey, he provided a mathematical foundation for the semantics of programming languages known as denotational semantics. His work combined a concern for elucidating fundamental concepts in the manner of informal rigor, with a cultivation of mathematically hard problems that bear on these concepts. He has held professorships at Stanford University and Oxford University, among others. He is the recipient of the Bolzano Medal for Merit in the Mathematical Sciences. He received a B.A. degree from the University of California, Berkeley and a Ph.D. degree from Princeton University.



ADI SHAMIR

2002 ACM Turing Award winner. Paul and Marlene Borman Professor of Applied Mathematics at the Weizmann Institute, and invited professor at École Normale Supérieure. Shamir is known for his ingenious contribution of making public-key cryptography useful in practice, and specifically for the construction of the RSA (Rivest-Shamir-Adleman) public-key encryption system. He and his collaborators co-founded the RSA Group, which became RSA Security, a respected security company. He was an instructor at MIT's Laboratory of Computer Science before returning to the Weizmann Institute. He earned a B.S. degree from Tel Aviv University, and obtained M.S.C. and Ph.D. degrees from the Weizmann Institute.



JOSEPH SIFAKIS

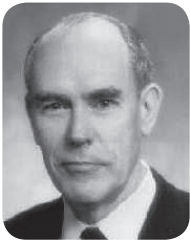
2007 ACM Turing Award winner. Research Director of Centre National de la Recherche Scientifique, and Director of the CARNOT Institute on Intelligent Software and Systems.

With his colleagues, Sifakis contributed to the development of Model-Checking, with innovations that transformed this approach from a theoretical technique to a highly effective verification technology that enables computer hardware and software engineers to find errors efficiently in complex system designs. He is the founder of Verimag Laboratory in Grenoble, France. He is co-founder of the International Conference on Computer Aided Verification (CAV). He earned a B.S. degree from the Technical University of Athens, and a Ph.D. degree from the University of Grenoble.



RICHARD E. STEARNS

1993 ACM Turing Award winner. Distinguished Professor Emeritus of Computer Science at the University of Albany. Stearns and Juris Hartmanis co-wrote the paper "On the Computational Complexity of Algorithms" that provided a precise definition of the complexity measure defined by computation time on Turing machines. This contribution led to the establishment of computational complexity theory as a fundamental part of the discipline, enabling it to direct the explosive growth of computer technology. Computational complexity, the study of the quantitative laws that govern computation, is an essential part of the science base for advancing computer science. Prior to joining Albany, he worked at General Electric Corporation. A Fellow of ACM, he earned a B.S. degree from Carleton College, and a Ph.D. degree from Princeton University.



IVAN SUTHERLAND

1988 ACM Turing Award winner. Research leader at Portland State University.

Sutherland invented Sketchpad, which led to the first Graphical User Interface, and he demonstrated that computer graphics could be used for both artistic and technical purposes. He was a leader at DARPA's Information Processing Techniques Office, and held professorships at Harvard University, the University of Utah, and California Institute of Technology. He co-founded Sutherland, Sproull and Associates, which was purchased by Sun Microsystems, where he was a Fellow and Vice President. He is a Fellow of ACM and a member of the National Academy of Engineering and the National Academy of Sciences. He received the ACM Software System Award and the IEEE John von Neumann Medal. He earned a B.S. degree from Carnegie Mellon University, an M.S. degree from the California Institute of Technology, and a Ph.D. degree from MIT.



ROBERT TARJAN

1986 ACM Turing Award winner. James S. McDonnell Distinguished University Professor of Computer Science at Princeton University, and a Senior Fellow at Hewlett-Packard.

Tarjan invented or co-invented the most efficient algorithms for problems in a wide variety of applications. He has held academic positions at Princeton University, Cornell University, University of California, Berkeley, Stanford University, and New York University. He was a fellow of the NEC Research Institute, and worked at AT&T Bell Labs, InterTrust Technologies and Compaq. An ACM Fellow, he was awarded Nevanlinna Prize in Information Science and the ACM Paris Kanellakis Award in Theory and Practice. He earned a B.A. degree from California Institute of Technology, and M.S. and Ph.D. degrees from Stanford University.



CHARLES (CHUCK) THACKER

2009 ACM Turing Award winner. Microsoft Research Technical Fellow. Thacker was project leader of the Xerox Alto personal computer system, the first modern PC, and the prototype for networked personal computers. He was a co-inventor of the Ethernet local area network, which enables multiple computers to communicate and share resources. He was a founder of the Systems Research Center of Digital Equipment Corporation, and joined Microsoft Research to help establish Microsoft Research Cambridge in the UK. A Fellow of ACM, he is a member of the American Academy of Arts and Sciences and the National Academy of Engineering. He was awarded the ACM Software System Award and the IEEE John von Neumann medal. He earned a B.S. degree from the University of California, Berkeley.



KENNETH THOMPSON

1983 ACM Turing Award winner. Google Distinguished Engineer and former Member of Technical Staff at Bell Laboratories. Thompson was co-inventor of the UNIX operating system, which is widely used in servers, workstations, and mobile devices. It led to the reshaping of computing as centered in networks rather than in individual computers. He was awarded the ACM Software System Award and the IEEE Emmanuel R. Piore Award. He was presented with the National Medal of Technology and the Japan Prize for Information and Communications. He was elected to the National Academy of Engineering and holds B.S. and M.S. degrees from the University of California, Berkeley.



LESLIE G. VALIANT

2010 ACM Turing Award winner. T. Jefferson Coolidge Professor of Computer Science and Applied Mathematics at Harvard University's School of Engineering and Applied Sciences. Valiant made transformative contributions to the theory of computation, including the theory of Probably Approximately Correct (PAC) learning, the complexity of enumeration and of algebraic computation, and the theory of parallel and distributed computing. He held academic positions at Carnegie Mellon University, Leeds University, and the University of Edinburgh. He is a Fellow of the Royal Society (London), the Association for the Advancement of Artificial Intelligence, and a member of the National Academy of Sciences. He earned a B.A. degree from the University of Cambridge, a Diploma of the Imperial College, London, and a Ph.D. degree from the University of Warwick.



NIKLAUS E. WIRTH

1984 ACM Turing Award winner. IBM Professor of Engineering and Applied Mathematics in Computer Science at Cornell University. Wirth developed a sequence of innovative computer languages including PASCAL, which has provided a foundation for future computer language, systems, and architectural research. PASCAL is an efficient language intended to encourage good programming practices using structured programming and data structuring. He had a major part in the design and implementation team for the Lilith and Oberon operating systems, and for the Lola digital hardware design and simulation system. He held several academic positions at Stanford University and the University of Zurich. A Fellow of ACM, he earned a B.S. degree from the Swiss Federal Institute of Technology Zürich (ETH Zürich) and a M.Sc. degree from Université Laval, Canada. He was awarded a Ph.D. degree from the University of California, Berkeley.



ANDREW C. YAO

2000 ACM Turing Award winner. Distinguished Professor-at-Large at the Chinese University of Hong Kong. Yao made fundamental contributions to the theory of computation, including the complexity-based theory of pseudorandom number generation, cryptography, and communication complexity. He has held academic positions at Stanford University, Princeton University, and Tsinghua University. A Fellow of ACM, the American Association for the Advancement of Science, and the American Academy of Arts and Sciences, he is a member of the National Academy of Sciences, and a foreign member of the Chinese Academy of Sciences. He received an undergraduate degree at National Taiwan University, and earned a Ph.D. degree at Harvard University and a second Ph.D. degree from the University of Illinois at Urbana-Champaign.

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