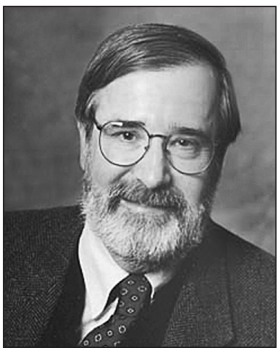
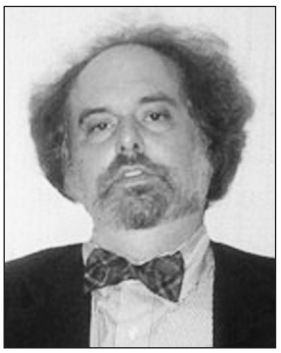
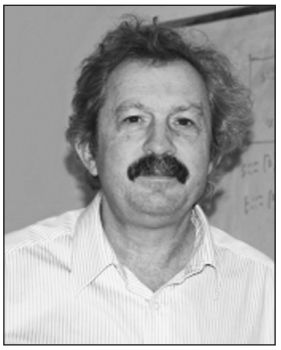
Clarke, Emerson, and Sifakis Receive 2007 ACM Turing Award



Edmund M. Clarke



E. Allen Emerson



Joseph Sifakis

The Association for Computing Machinery (ACM) has named Edmund M. Clarke, E. Allen Emerson, and Joseph Sifakis the winners of the 2007 A.M. Turing Award, widely considered the most prestigious award in computing, for their original and continuing research in a quality assurance process known as model checking. Their innovations 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. This transformation has resulted in increased assurance that the systems perform as intended by the designers. Clarke and Emerson, working together, and Sifakis, working independently, developed this fully automated approach that is now the most widely used verification method in the hardware and software industries.

The Turing Award carries a US$250,000 prize, with financial support provided by Intel Corporation and Google Inc.

Description of the Prizewinners' Work

Model checking as a standard procedure for quality assurance has enabled designers and manufacturers to address verification problems that span both hardware and software. It has also helped them to gain mathematical confidence that complex computer systems meet their specifications, and it has provided added security for a range of both common and critical computing applications.

Logical errors in digital circuit designs, software, and communication protocols are an important problem for system designers. They often result in delays in getting new products to market, failures of critical systems already in use, and expensive replacement of faulty hardware and patching of flawed software.

Model checking started as an academic research idea. The continuing research of Clarke, Emerson, and Sifakis, as well as others in the international research community over the last 27 years, led to the creation of new logics, as well as new algorithms and surprising theoretical results. This in turn has stimulated the creation of many model checking tools by both academic and industrial teams, resulting in the widespread industrial use of model checking.

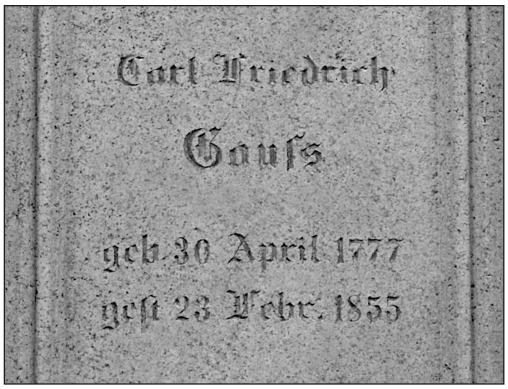
Many major hardware and software companies now rely heavily on model checking. Common examples include verification of the designs for integrated circuits such as microprocessors, as well as communication protocols, software device drivers, real-time embedded systems, and security algorithms.

Among the beneficiaries of model checking are personal computer users, medical device makers, and nuclear power plant operators. As computerized systems pervade daily life, consumers rely on digital controllers to supervise critical functions of cars, airplanes, and industrial plants. Digital switching technology has replaced analogue

About the Cover

The grave of Carl Friedrich Gauss

All seems serene in the cemetery and park of St. Albani in Göttingen where Carl Friedrich Gauss and some of his family are interred.



But beneath the superficial serenity, ah! the soul of Gauss writhes in contemplation of how Danel Kehlmann has distorted his life in his recent novel whose English title is *Measuring the World*.

Frans Oort's review of Kehlmann's book in this issue is quite negative, as are some, but not all, of the other reviews of the original German edition by European mathematicians. These include an extremely critical one by Winfried Scharlau in the *Mitteilungen* of the German Mathematical Society, and one by Ivo Schneider in the *Mitteilungen* of the Gauss Gesellschaft of Göttingen. In view of the book's many faults, the intriguing question is, why has its original German edition been so popular? This is what Norbert Schappacher has tried to answer, with a somewhat more generous look at the book, in his review in the April 2006 issue of the *Mathematische Semesterberichte*.

Göttingen treats one of its most famous and respected inhabitants rather well. Much care was taken in erecting the original monument a few years after Gauss' death, and it has been well cared for since. The Gauss Gesellschaft was founded in 1962, and holds an annual meeting every fall to commemorate some aspect of his work, in addition to publishing its journal.

Our thanks to Benno Artmann for acting as guide in Göttingen, and to Axel Wittmann, president of the Gauss Gesellschaft, for information about Gauss' grave.

—Bill Casselman, Graphics Editor
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components in the telecommunications industry, and security protocols enable e-commerce applications and privacy. Wherever significant investments or human lives are at risk, quality assurance for the underlying hardware and software components becomes paramount.

Biographical Sketches

Edmund M. Clarke is the FORE Systems Professor of Computer Science and Professor of Electrical and Computer Engineering at Carnegie Mellon University. Clarke received a Technical Excellence Award from the Semiconductor Research Corporation in 1995 and the Harry M. Goode Memorial Award from the Institute of Electrical and Electronics Engineers (IEEE) in 2004. A Fellow of the ACM and the IEEE Computer Society, he was elected to the National Academy of Engineering in 2005. Clarke received a bachelor's degree in mathematics from the University of Virginia and a master's degree in mathematics from Duke University. He earned a Ph.D. in computer science from Cornell University and has taught at Duke University and Harvard University.

E. Allen Emerson is an Endowed Professor in Computer Sciences at the University of Texas at Austin. He was a co-recipient of the 2006 Test-of-Time Award from the IEEE Symposium on Logic in Computer Science for his research on efficient model checking in the propositional mu-calculus, a highly expressive temporal logic, with Chin-Laung Lei. Emerson received a bachelor's degree in mathematics from the University of Texas at Austin and a Ph.D. in applied mathematics from Harvard University.

Joseph Sifakis is the founder of Verimag Laboratory, a leading research center for embedded systems in Grenoble, France, where he was director from 1993 until 2006. He is *directeur de recherche* at the Centre National de la Recherche Scientifique and director of the CARNOT Institute on Intelligent Software and Systems in Grenoble. Sifakis earned a degree in electrical engineering from the Technical University of Athens and a Ph.D. in computer science from the University of Grenoble.

About the Turing Award

The A.M. Turing Award was named for Alan M. Turing, the British mathematician who articulated the mathematical foundation and limits of computing and who was a key contributor to the Allied cryptanalysis of the German Enigma cipher during World War II. Since its inception in 1966, the Turing Award has honored the computer scientists and engineers who created the systems and underlying theoretical foundations that have propelled the information technology industry.

—From an ACM news release