Dear reader,

Amir Pnueli has been an active member of the editorial board of SCP from its inception in 1981 until his death in November 2009. In consultation with Michel Sintzoff we have asked Willem Paul de Roever to write an obituary for our journal.

Yours sincerely,

Jan Bergstra on behalf of the editorial board of Science of Computer Programming

Remembering Amir Pnueli, a great scientist and a great friend
(April 22, 1941 – November 2, 2009)

Amir Pnueli, world authority on Program Verification who won the 1996 Turing Award primarily for his 1977 FOCS paper ‘The Temporal Logic of Programs’ and subsequently widened his interests by also publishing key results in such diverse areas as the Semantics of Statecharts, Automatic Synthesis of Concurrent Systems, Run-time Compiler Verification and the Verification of Hybrid Systems, passed away unexpectedly early November in Manhattan.

Below I sketch his life, as told by his wife Ariela and himself, supported by what other people wrote and told me about him, and by the way my family and I experienced Amir, Ariela and their three children Shira, Ishay and Noga. In order to honor one of the best friends I ever met during my working life, I chose a style which lends some personal perspective to his noble personality.

Discussing at home how we would describe his warm and complex character, we felt he was first of all very kind and very friendly. He was very considerate and careful, both diplomatic and discreet, could be very humorous in a graceful manner, was very observant and open-minded, and a real family man.

He had also a very giving personality — indeed, around Christmas 2008 my daughter Joanneke spent a month in their flat near Greenwich Village with her friend, while Ariela and Amir were staying in their home in Rehovoth, Israel; and she wasn’t the only person to whom they extended their hospitality in this way.

On our many visits to him at the Weizmann Institute, he presented us to his mother and his friends (his father had died earlier), showed us his deep love for Israel, its beauty and grace, and the variety of its culture. Since I like to watch birds and nature, he took us to star spots for bird-watching, we saw vultures in the Negev and bitterns in the fish ponds near their holiday home near Ma’agan Michael where we of course stayed.

Amir was a warm and proud father — he supported whole-heartedly the studies of his children. I remember still vividly how, after having helped his children with mathematics, he proudly told me: “WE have passed this exam!” , and how carefully he planned their holidays when they visited their parents in New York.

In order to understand Amir, it helps to know his background. Amir’s father was Shmuel Pineles — after emigration to Israel his name became Pnueli — born in Galicia, Poland, in his later life Professor of Hebrew Literature and founder of the Department of Hebrew Literature at the University of Tel Aviv. Amir’s mother was Henya Thou, also born in Poland, in her
later life teacher at a primary public school and school counselor. They were both regarded by their community as great educators, and are remembered for being such till this day.

From his parents he inherited their love of literature and their broad interests in art and culture. Consequently, Ariela and Amir really loved their cosmopolitan life in New York.

Amir’s parents married in Poland and studied both at the famous Hebrew Seminar in Vilnius (Lithuania), then called Wilna. Amir’s elder brother David, born in Vilnius, too, later became Professor of Mechanical Engineering at the Technion, Haifa, where he founded the Department of Mechanical Engineering, and wrote one of the main Israeli textbooks in that field. After their emigration to Israel, Amir was born in Nahalal on April 22, 1941.

Amir’s wife, born as Ariela Pienik, became high school teacher of Hebrew literature. Amir and Ariela met at high school in Holon, where they belonged to the same class; however, since they were members of different youth movements, initially they moved in different circles. Later, they met again while he was studying applied mathematics at the Technion and she studied at the Teacher Seminar and performed two years of her military service as teacher in a new immigrant town in Northern Galilee.

After they were married, he had finished his studies and she her teaching, the Pnueli couple moved to the Weizmann Institute of Science, Rehovoth, Israel, were he started his Ph.D. research on modeling tides in the ocean, supervised by Chaim Leib Pekenis, Professor of Mathematics and previously attached to MIT, Boston, and the Princeton Institute for Advanced Studies.

Amir told me this was the hardest piece of research he ever performed and the hardest time of his life. Pekenis had very high expectations of him, and peer pressure was very high, being surrounded by some of the most famous professors in their fields. So, for a naturally shy and kind person as Amir this was a rather intimidating atmosphere. And, as an additional complicating factor, he had to learn so many new topics and techniques — e.g., numerical analysis and computer programming. In all, Amir needed 5 years to finish this work successfully, resulting in his thesis ‘Computation of Tides in Simple Basins’ in 1967.

After having finished his Ph.D. studies, Amir realized that he had spent more time on programming, not necessarily related to his thesis, than on his research itself. So, when Pekenis told Amir that he a promising new field was emerging, Computer Science, and that they should move to Palo Alto in order for him to collaborate with John McCarthy at Stanford University, Amir decided to enter this new field and spent his postdoctoral years as fellow at Stanford University and Watson Research Center of IBM in Yorktown Heights, N.Y.

His stay at Stanford University led to his momentous acquaintance and collaboration with Zohar Manna, who had just finished his Ph.D. on Program Verification under Robert W. Floyd and Alan Perlis in 1968 and subsequently became assistant professor at Stanford University. Thus Amir was introduced by Zohar Manna to the field of Program Verification.

Amir then returned to Israel to a position of a Senior Researcher in the Department of Applied Mathematics of the Weizmann Institute, and moved in 1973 to Tel-Aviv University, where he founded the Department of Computer Science.

Amir’s seminal 1977 FOCs paper ‘The Temporal Logic of Programs’ had a decisive influence on program verification in general, eventually leading to the algorithmic verification of finite-state systems, which in turn caused program verification to be accepted by such key organizations as Airbus, Bull, IBM, Intel, Microsoft, NASA and Siemens.

Subsequently he opened up more areas in Computer Science, such as Modeling and Verification of Hybrid Systems and Runtime Compiler Verification. Although it is not generally known, he was also an accomplished systems programmer and entrepreneur, having co-initiated various software firms such as Mini-Systems, later sold to SciTex, a firm specializing in software for the field of publishing, and AdCad, which later evolved into i-Logix, the firm producing ‘Statemate’ and its later derivatives, which was ultimately sold to IBM.

Amir’s description of the way he stumbled upon temporal logic is characteristic of the way great ideas are born:

“Nissim Francez, in his thesis, proposed a compositional approach to the verification of concurrent programs, which is the precursor of temporal logic reasoning as we know it today. The only problem was that we used first-order logic with explicit reference to time instances by parameters $t_1, t_2, \ldots, t_n$, which made the whole thing very cumbersome to read and to comprehend. Then I went on a sabbatical to the University of Pennsylvania at Philadelphia. In a colloquium I described the results obtained in Nissim’s thesis but also frankly complained about the awkwardness of the notation. After the seminar, Saul Gorn, who was one of the old-timers of Computer Science and a very wise man, but notoriously cryptic and difficult to understand, came to me with a book ‘The Logic of Command’, published by Springer Verlag in the series ‘Library of Exact Philosophy’. Saul said “I believe this is what you are looking for.” I started reading the book, and it did not take me more than 5 pages to find out that the material had no relevance to programs and their specification at all. Giving up and closing the book, I noticed that on the back cover of the book there was a list of additional books published in the same series, including the book ‘Temporal Logic’ by Rescher and Urquhart. Since I was in a reading mood, I went to the library and borrowed this one. It also did not take me more than 5 pages to realize the extreme relevance of this text to what I had in mind. This started my interest in Temporal Logic as a language for the specification of reactive systems.”

In 1981 Amir returned to the Weizmann Institute as a Professor of Computer Science, also held in the period 1993–1996 the Grenoble municipal chair at the Université Joseph Fourier of Grenoble, France, from which he received his second honorary doctorate in 1998 — his first one having received in 1997 from the University of Uppsala, Sweden, and his third one from the Carl von Ossietzky Universität in Oldenburg, Germany.
I got to know Ariela and Amir better in the eighties. We cooperated a lot and had a lot of joy, and my own students, visiting him and his colleagues at the Weizmann Institute, shared these happy times, as well.

By suggesting the themes of its more successful summer schools and whom to invite, he played an important rôle in the REX project, organized during 10 years by Jaco de Bakker, Gregor Rozenberg and me in the Netherlands. Indeed, he gave its opening lecture in 1983. The proceedings of these schools played in those years an important rôle in spreading knowledge about the theory of concurrency, and, in retrospect, the first versions of some of Amir’s (sometimes very long) key contributions to his field appeared in them.

With the advent of the scientific research programme ESPRIT of the European Community in 1985, he decided to establish a research base in Europe. And, indeed, from then on, we cooperated in 6 EU Projects; for the agreeable, stimulating and inspiring atmosphere of cooperation in them his presence was the key factor. Looking back, his presence determined the quality of discourse inside these projects and, consequently, contributed to a major extent to their success, and, most importantly, allowed our friendship to be extended to a much larger community. For Amir loved this kind of project work, and, soon, he participated in series of scientifically much more ambitious EU projects with industry and, e.g., with Werner Damm (from the Carl von Ossietzky Universität) and Joseph Sifakis (founder of Vérimag, Grenoble).

In 1999 he joined the Computer Science Department of the Courant Institute of New York University. Amir felt himself very much welcomed in the Courant Institute, and was soon surrounded both by former students, such as Lenore Zuck, and by enthusiastic new gifted students, with whom he kept on publishing, till his very last day, in key conferences and journals.

Strikingly, shortly before his demise, he had organized himself from New York University a most ambitious project together with, amongst others, Ed Clarke and Patrick Cousot, in order to move the combination of static analysis and model checking, on their own already the two most successful techniques in automatic verification, a decisive step forward.

In 1996 he received ACM’s Alan M. Turing Award “For his seminal work introducing temporal logic into computing science and for outstanding contributions to program and system verification”, and in 2000 the Israel Prize, the highest honor of the State of Israel, in the field Computer Sciences.

In 2007, he shared ACM’s Software System Award for the Statemate system, a software engineering tool initiated by his closest colleague at the Weizmann Institute, David Harel, that allows developers to formally specify the precise desired behavior of their programs. Statemate was the first tool to successfully overcome the challenge of designing complex interactive, real-time computer systems.

The last time we met, at CAV 2009 in Grenoble, he proudly showed me a chip which had been automatically synthesized using new techniques discovered by him and his colleagues, on which he gave a talk at the first Workshop on Practical Synthesis for Concurrent Systems co-organized by him at that very conference.

Amir was a unique friend, such as one meets only once in one’s life. His family, many friends, and colleagues in his beloved field, Computer Science, have undergone a deep and irreplaceable loss.

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