The EATCS Award 2012

Laudatio for Moshe Vardi

Moshe Vardi is an extremely active and productive researcher. His work so far has been very influential, certainly in science, but also in dissemination and policy matters. We are pleased to recognise these contributions with an EATCS Award.

Research Contributions

Vardi has made fundamental and lasting research contributions to the development of mathematical logic as a unifying foundational framework for modeling computational systems. His research has focused on applying and developing logic in computing, and has played a major role in our present understanding and use of logic in computing. Vardi has contributed to several areas of Computer Science, in particular: software and hardware verification; databases; complexity theory; and distributed systems.

Automata-theoretic approach to design verification. Vardi has demonstrated that questions about correctness of hardware and software designs can be reduced to algorithmic questions about finite automata on infinitary input structures (infinite words or infinite trees). Carrying out this approach required advances in both automata theory and the theory of program logics. This connection brought a wealth of new techniques to the theory of program logics, and the new application revived the theory of automata on infinitary inputs.

His 1986 paper, "An automata-theoretic approach to automatic program verification", has over 1350 citations, it won an IBM Outstanding Innovation Award in 1989, an ACM-EATCS Goedel Prize in 2000, a LICS Test-of-Time Award in 2006, and an ACM Kanellakis Award for Theory and Practice in 2006.

This line of work is the basis of several academic and industrial automated verification tools, such as the model checker SPIN that won the 2001 ACM's

Software System award. The work has also influenced emerging specifica-
tion languages, such as the IEEE Standard Property Specification Language
(PSL) for writing requirements of hardware designs, and the manner in which
specifications are checked by industrial model checkers.

Theory of database queries. Database management systems have evolved
from unsophisticated databases, which are essentially structured collections
of data, toward *smart* databases possessing deductive capabilities.

Vardi has investigated the theory of database queries, with a focus on the
trade-off between expressiveness and computational complexity. His research
laid the foundations in the following areas: integrity constraints, complex-
ity of query evaluation, querying incomplete information, database updates,
universal-relation interfaces, and database logic programming.

In his 1982 paper "The complexity of relational query languages", Vardi
showed that there are two fundamentally different ways to measure the com-
plexity of queries, referred to as *data complexity* and *expression complexity*,
a classification that is today widely accepted. This paper has over 1150
citations.

His 1998 paper, "Conjunctive-query containment and constraint satisfaction",
which exhibited a deep connection between conjunctive-query evaluation and
constraint-satisfaction solving, received an ACM PODS Mendelzon Test-of-
Time Award in 2008. In 2008 Vardi received the ACM Edgar F. Codd Inno-
vations Award, the top recognition for database research accomplishments.

Descriptive complexity theory. Computational Complexity focuses on
classifying computational problems according to their inherent difficulty in
terms of resource (such as time or space) requirements.

Descriptive complexity theory is a branch of computational complexity the-
ory that characterizes complexity classes by the type of logic needed to
express them. An example is a classical result, proved by Vardi (and in-
dependently by Immerman) in 1982, that characterizes the complexity class
PTIME is terms of first-order logic enriched with the fixpoint operator. (This
work won an IBM Outstanding Innovation Award in 1992.)

His 1993 paper, "Monotone monadic SNP and constraint satisfaction", used
logic, graph theory, and algebra, to study the computational complexity of
constraint-satisfaction problems. The 1998 paper, "The computational struc-
ture of monotone monadic SNP and constraint satisfaction: a study through
Datalog and group theory", has more than 500 citations. Together, these
papers form the basis for work on the complexity of constraint satisfaction.

Knowledge in multi-agent systems. Reasoning about knowledge has applications in such diverse fields as economics, linguistics, artificial intelligence and computer science. In a distributed system a process may need to know whether other processes know that a message has been lost.

Together with his collaborators, Vardi developed an extensive theory of reasoning about knowledge. This work focuses on using reasoning about knowledge to design, analyze and verify the correctness of multi-agent systems. The work provides good formal models of knowledge that are appropriate for multiple applications. This work won an IBM Outstanding Innovation Award in 1987. The book entitled "Reasoning about Knowledge" by Fagin, Moses, Halpern and Vardi, first published by MIT Press in 1995, is now considered a classic, with over 2900 citations.

In additional to fundamental contributions, Vardi also shaped the field by pointing out promising research directions.

Scientific Dissemination and Impact

Vardi's scientific output is impressive and very influential.

- He is author or co-author of over **400 publications**, including **2 books**: "Reasoning about Knowledge" and "Finite Model Theory and its Applications".

- He has more than **20000 citations** and an **h-index above 75**.

- He has a huge number of collaborations, e.g. on publications he has almost **200 co-authors**.

Leadership and Service

Vardi has a long service record and a strong leadership in the field, in particular:

- He has played a central role in the IEEE Symposium on Logic in Computer Science (**LICS**), for which he served as General Chair for several years, and he has been the major force behind the creation of the Federated Logic Conferences (**FLoC**).

- As Editor-in-Chief, he has performed admirably in rethinking and leading **Communications of the ACM**. This service to the whole community is commendable in its own right, but his vision led to important changes, like the introduction of the excellent new section on research highlights.

Conclusions.   For all the above reasons, the EATCS awards Committee unanimously decided to give the EATCS award to Professor Moshe Vardi.

The EATCS awards Committee 2012
Leslie Ann Goldberg
Friedhelm Meyer auf der Heide
Eugenio Moggi (chair)