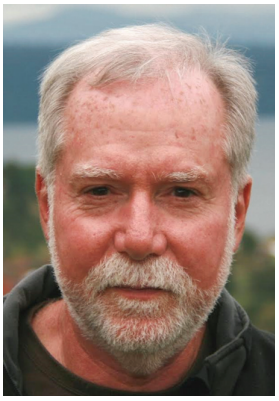

Introducing the MICRO Test of Time Awards: Concept, Process, 2014 Winners, and the Future

Onur Mutlu
Carnegie Mellon University

Rich Belgard

The International Symposium on Microarchitecture (MICRO) has been the flagship conference in microarchitecture and one of the premier computer architecture conferences for nearly five decades. MICRO is currently the premier forum for presenting and discussing new ideas in microarchitecture, compilers, hardware/software interfaces, and design of advanced computing and communication systems. The MICRO community has enjoyed having close interaction between academic researchers and industrial designers since the incarnation of the conference as the Annual Workshop on Microprogramming in 1968. And it continues to do so, as the conference approaches its 50th anniversary in 2017.

Over the course of the past 47 years, a great set of seminal papers has been published at MICRO. Many works published at MICRO have opened up new research areas, affected industrial products, and inspired readers to solve problems in elegant and industrially relevant ways. Many MICRO papers have had long-lasting effects on the way we design computer architectures, compilers, and systems today. And, it is likely that some of these papers will continue to do so, hopefully for time immemorial.

To honor such papers, the conference instituted the MICRO Test of Time (ToT) Award in late 2013 to recognize the most influential papers published in past MICRO conferences that have significantly impacted the field. The first set of MICRO ToT Awards was given in 2014 to 10 papers that were published within the first 25 years of MICRO (from 1968 through 1992). As the past and current chairs of the award committee, it is our pleasure to announce the selected papers here and to describe the process used to select the awardees.

First, a bit of history. We proposed the idea of starting a ToT Award during the business meeting at MICRO 2012, which was held in Vancouver, British Columbia (http://users.ece.cmu.edu/~omutlu/pub/micro2012-tot-award-proposal.pdf) The goal was not only to recognize the individual papers that stood the test of time but also to recognize the achievements of the MICRO community over decades and to even further improve the conference's visibility and prestige. The feedback we received from the community was overwhelmingly positive, so we spent the next year settling on solid rules and processes to select the papers to receive the award. The MICRO steering committee approved the award in late 2013, and the selection process for the first year started afterwards.

The goal of the award, at its steady state, is to recognize an influential MICRO paper whose influence is still felt 18 to 22 years after its initial publication. In other words, in each future year N (where $N \geq 2015$), the award will be given to one paper that was published at MICRO conferences in any of the years $N-22$, $N-21$, $N-20$, $N-19$, or $N-18$.

Selection process for 2014

For this special year (2014) when the award was to be given for the first time, we followed a bootstrapping process, employed similarly to the Test of Time award given by ACM SIGMETRICS (www.sigmetrics.org/ToTa-final.pdf). The 2014 ToT award was designed to recognize at most 10 papers that were published at MICRO conferences held between 1968 and 1992 (inclusive). One could consider this as a selection of the 10 best papers from the first 25 years of the MICRO conference.

For the 2014 award, a call for nominations (www.microarch.org/micro-tot-2014-cfp-v3.pdf) was widely distributed to the community. This call outlined the process of selecting the awards and asked the community to provide nominations. Anyone could nominate a paper except for the author or coauthor of the nominated paper.

An award committee, formed by the MICRO ToT Award committee chair Rich Belgard, was appointed to evaluate all the nominated papers and select at most 10 papers. The committee consisted of Rich Belgard (chair), Pradip Bose (IBM Research), Bill Mangione-Smith (consultant), Onur Mutlu (Carnegie Mellon University), and Uri Weiser (Technion). The

0272-1732/15/$31.00 © 2015 IEEE Published by the IEEE Computer Society

Winners of the 2014 MICRO Test of Time Award

The following are the 10 papers that were awarded the first MICRO Test of Time Award in 2014. The MICRO ToT Award recognizes the most influential papers published in past MICRO conferences that have had a significant impact in the field.

These 10 papers were selected from among the 544 papers published in MICRO conferences between 1968 and 1992 (inclusive).

1. Skip Stritter and Nick Tredennick, "Microprogrammed Implementation of a Single Chip Microprocessor," *Proc. 11th Ann. Workshop Microprogramming* (MICRO), 1978, pp. 8–16.
2. B. Ramakrishna Rau and C.D. Glaeser, "Some Scheduling Techniques and an Easily Schedulable Horizontal Architecture for High Performance Scientific Computing," *Proc. 14th Ann. Workshop Microprogramming* (MICRO), 1981, pp. 183–198.
3. John Hennessy, Norman Jouppi, Steven Przybylski, Christopher Rowen, Thomas Gross, Forest Baskett, and John Gill, "MIPS: A Microprocessor Architecture," *Proc. 15th Ann. Workshop Microprogramming* (MICRO), 1982, pp. 17–22.
4. Yale N. Patt, Stephen W. Melvin, Wen-Mei Hwu, and Michael C. Shebanow, "Critical Issues Regarding HPS, a High Performance Microarchitecture," *Proc. 18th Ann. Workshop Microprogramming* (MICRO), 1985, pp. 109–116.
5. Yale N. Patt, Wen-Mei Hwu, and Michael Shebanow, "HPS, A New Microarchitecture: Rationale and Introduction," *Proc. 18th Ann. Workshop Microprogramming* (MICRO), 1985, pp. 103–108.
6. Stephen W. Melvin, Michael C. Shebanow, and Yale N. Patt, "Hardware Support for Large Atomic Units in Dynamically Scheduled Machines," *Proc. 21st Ann. Workshop Programming* (MICRO), 1988, pp. 60–63.
7. Tse-Yu Yeh and Yale N. Patt, "Two-Level Adaptive Training Branch Prediction," *Proc. 24th Ann. Int'l Symp. Microarchitecture* (MICRO), 1991, pp. 51–61.
8. Scott A. Mahlke, David C. Lin, William Y. Chen, Richard E. Hank, and Roger A. Bringmann, "Effective Compiler Support for Predicated Execution using the Hyperblock," *Proc. 25th Ann. Int'l Symp. Microarchitecture* (MICRO), 1992, pp. 45–54.
9. B. Ramakrishna Rau, Michael S. Schlansker, and P.P. Tirumalai, "Code Generation Schema for Modulo Scheduled Loops," *Proc. 25th Ann. Int'l Symp. Microarchitecture* (MICRO), 1992, pp. 158–169.
10. Andrew Wolfe and Alex Chanin, "Executing Compressed Programs on an Embedded RISC Architecture," *Proc. 25th Ann. Int'l Symp. Microarchitecture* (MICRO), 1992, pp. 81–91.

committee evaluated and discussed the nominated papers over the course of approximately two months and arrived at a total of 10 selections for the 2014 award. A strict conflict of interest policy was followed in the discussions, as described in the call for nominations and as specified by the *IEEE Computer Society Awards Handbook* (www.computer.org/cms/volunteers/docs/awards-handbook-rev-sept-2011.pdf).

2014 MICRO ToT Award winners

The "Winners of the 2014 MICRO Test of Time Award" sidebar presents the 10 papers that won the first MICRO Test of Time Award in 2014. These 10 papers were selected from among the 544 papers published in the first 25 MICRO conferences. They were announced as the winners at the 47th MICRO conference, which was held in Cambridge, UK, in December 2014.

We congratulate the authors of the selected papers. Note that each of these papers has had a significant impact from both an academic and industrial perspective. In addition, the impact continues to be felt in today's microprocessor and compiler designs as well as research directions. Many of these selected papers form reading material for courses taught today!

Each author of the selected papers received (or will receive) a plaque from the conference. Authors have been invited to write a retrospective about their paper to be featured in upcoming issues of *IEEE Micro*. We intend to share these retrospectives as well as testimonies written by the MICRO ToT Award Committee members (describing the impact and merits of each selected paper) with readers over the course of the year. We hope these retrospectives and testimonies will be useful for practitioners, educators, and students.

Going forward: the selection process

In future years, we will be in the steady state of the award: the award will be given to at most one paper per year. Candidate papers should have been published between 18 to 22 years before the award year. The award is designed so that a paper can be eligible for multiple years (within a sliding window of five years); if there are multiple strong papers from the same year that deserve the ToT Award, they can all be considered and awarded over the course of multiple years.

The ToT Award committee consists of at least three rotating members with fixed (three-year) terms, one of whom is the committee chair. The committee chair nominates the members of the committee, who are vetted and approved by the MICRO steering committee. Rotation enables fresh views and diversity within the committee. The new award committee for 2015 will be announced during the course of this year.

Going forward, the award committee will not only solicit nominations from the community but also automatically consider any eligible paper that has received at least 100 citations. This decision was

made to reduce the possibility of overlooking any papers that may have had significant impact. Even though we believe citation counts must be viewed with a large grain of salt, they could be one of the many factors indicative of a paper's impact.

Starting in 2015, the award is being cosponsored by the IEEE Technical Committee on Microarchitecture (TC-uArch) and ACM Special Interest Group on Microarchitecture (SIGMICRO).

2015 MICRO ToT Award nominations

Any paper published in MICRO between 1993 and 1997 (both inclusive) is eligible to receive the 2015 MICRO ToT Award. We encourage all readers to nominate for consideration those papers you strongly believe deserve the award. You can find the new call for nominations and a list of all the eligible papers for the 2015 MICRO ToT Award at www.microarch.org. You can nominate your favorite papers by emailing the requested information to micro-tot-award-nominations@googlegroups.com. We look forward to your nominations!

We believe such awards are important not only for the authors that receive them but also for our community in general. We look forward to any feedback you might have on the process and the logistics of the award, positive or negative. If you have any suggestions on anything related to the award, please feel free to email Onur Mutlu, 2015 Committee Chair, at omutlu@gmail.com, or the entire MICRO ToT Award committee at micro-tot-award-nominations@google-groups.com. We encourage your participation via not only nominations but also feedback on the process. Thank you for your contributions to MICRO! MICRO

Onur Mutlu is the Strecker Early Career Professor in the Electrical and Computer Engineering Department at Carnegie Mellon University. Contact him at omutlu@gmail.com.

Rich Belgard is an independent consultant for computer manufacturers, software companies, and investor groups and an expert and consultant to law firms. Contact him at belgard@gmail.com.