Rajeev Alur
Doron A. Peled (Eds.)

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Computer Aided Verification

16th International Conference, CAV 2004
Boston, MA, USA, July 2004
Proceedings

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Boston, MA, USA, July 13-17, 2004
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Preface

This volume contains the proceedings of the conference on *Computer Aided Verification*, CAV 2004, held in Boston, Massachusetts, USA, July 13–17, 2004. CAV 2004 was the 16th in a series of conferences dedicated to the advancement of the theory and practice of computer-assisted formal analysis methods for software and hardware systems. The conference covers the spectrum from theoretical results to concrete applications, with an emphasis on practical verification tools and the algorithms and techniques that are needed for their implementation. The conference has traditionally drawn participation from researchers as well as practitioners in both academia and industry.

CAV 2004 was colocated with the ACM International Symposium on Software Testing and Analysis (ISSTA 2004), and was partially sponsored by the ACM SIGSOFT. The colocation reflects the increasing synergy between research on verification and testing, and emerging applications of formal verification to software analysis. Joint CAV-ISSTA events included a distinguished plenary lecture by David Harel and a special session exploring various approaches to the specification and verification of concurrent software organized by Shaz Qadeer. The program of the conference consisted of 32 regular papers and 16 tool papers, selected from a total of 144 submissions. The conference was preceded by a tutorial on processor verification, on July 12, 2004, with three invited lectures by Randal E. Bryant, David L. Dill and Warren A. Hunt, Jr. The conference also included invited talks by Mary Jean Harrold and Thomas W. Reps. Two workshops were associated with CAV 2004:

- BMC 2004: Second International Workshop on Bounded Model Checking
- GDV 2004: Games in Design and Verification

We would like to thank all the program committee members and the subreferees for their excellent work in evaluating the submissions and the selection of the program. Our thanks also go to the steering committee members and the organizers of CAV 2003 for their helpful advice. Special thanks go to George Avrunin, the ISSTA General Chair, and Erin Dolan of ACM, for their help with the local organization. We would like to acknowledge the generous sponsorship of Cadence Design Systems, IBM Research, Intel Research, Microsoft Research and the John Von Neumann Minerva Center for Verification of Reactive Systems. Their support helped us reduce the registration fee for the graduate students.

The CAV community is deeply saddened by the sudden demise of Dr. Rob T. Gerth. Rob was a highly regarded researcher with many notable contributions to the theory and practice of formal verification. For CAV 2004, we had invited Rob to join the program committee as well as to give a tutorial on processor verification. This LNCS volume containing the CAV 2004 proceedings is dedicated to Rob, and includes a special presentation, commemorating his scientific accomplishments and collaborations.

May 2004 Rajeev Alur and Doron A. Peled

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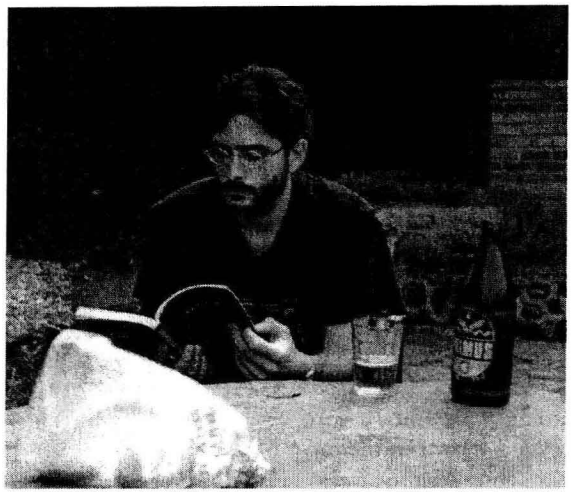

Kijereshi, Tanzania, 1994

HET KOMT WEL VOOR

"Gedaan in het gesloten seizoen der dromen"
Lucebert

het komt wel voor
dat de deur in het slot valt
de stilte plotseling intreedt
de angst toeslaat
men in een leegte staart –

het komt wel voor
dat een man van in de veertig
met ontstelde ogen toeziet
hoe de vingers zich in elkaar
wringen, voelen moet hoe de
adem stokt in de keel –

het komt wel voor
dat men dan de dood ontmoet

Wim Gerth
28 November 2003

Rob Tristan Gerth: 1956–2003

On Friday November 28, 2003, computer scientist and logician Rob Gerth died from sudden cardiac arrest. It is impossible to say all that the loss of Rob means to Intel, to the verification community, and to each of us personally.

As a corporation, Intel has lost a world-renowned authority on formal modeling and verification. Rob brought an independence of thought and agility of mind that are the hallmarks of a rare intellect. He was one of the few people with the knowledge and experience to meet the challenges we face in verifying micro-architectural protocols; we hope we can find a way to carry on his legacy.

As a community, we have lost not just a key technical contributor but part of our scientific conscience. It was in Rob's nature to ask "Why?", even when the answer seemed obvious. He brought a commitment to truth and high standards that was alternately challenging, frustrating, and inspiring; we will sorely miss it.

As family, friends and colleagues, we will remember and cherish Rob's warmth and love, his knowledge and openness in sharing it, his dry sense of humor, the way only he could read Toon Tellegen stories, and – perhaps most of all – his contagious laughter.

Rob's passion for knowledge reached far beyond computer science and logic: it embraced science, history, literature, art and music. The 2004 Proceedings of the 16th International Conference on Computer Aided Verification are dedicated to him. This article in the Proceedings surveys highlights of Rob's scientific career, followed by excerpts taken from some of the many tributes sent for Rob's funeral by friends and colleagues from around the world. The list of contributors, though too long to be printed here, is itself a tribute to Rob's impact on us all.

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Rob Gerth, Program Verifier par Excellence: His Research

Going through Rob Gerth's contributions to program semantics and verification, and tools for the latter, one is struck by his almost incredible versatility, total commitment, and scientific depth.

Starting in 1981 with a proof system for Brinch Hansen's monitor-based language Distributed Processes [1], he followed with an important paper on "Transition Logic: How to Reason about Temporal Properties in a Compositional Way" [2], coauthored papers on "Compositional Semantics for Real-Time Distributed Computing" for the predecessor of LICS [3], with its Full-Abstraction proof [4], a (sound and relatively complete) "Proof System for Concurrent Ada Programs" in *Science of Computer Programming* [5], and a far reaching paper in 1986 "Monitors Revisited: A First Step towards Verifying Object-Oriented Systems" [6], far before the general research public in computer science realized the importance of concepts like compositionality, formalized real-time semantics, or relatively complete proof systems for monitor-based and object-oriented languages.

This list continues to be extended in the same break-through baffling fashion: Coauthor of full-abstract semantics for Statecharts and concurrent Prolog [7, 8], "Rooting UNITY" [9], his Program Refinement and Self-Modifying Code [10, 11], coauthored papers for CONCUR [12, 13] or Reliable Distributed Systems [14]. Who else in those years cared for investigating fully abstract program semantics, verifying fault-tolerant distributed programs, self-modifying programs, interface refinement, and the now crucial concept of compositional refinement?

Having reached the limits of what can reasonably be verified *in principle* by hand, Rob saw that the time of automated verification had arrived and devoted himself with the same ruthless interest and intrepidity to developing foundations of abstract interpretation, model checking and automated refinement tools – to allow applications at industrial scale. The focus in his work now shifts to handling state explosion in (real-time) model checking.

To this end, he developed partial-order techniques [15, 16] and other advanced techniques like on-the-fly model checking [17] and abstraction [18] – the latter with his "very own" Ph.D. student Dennis Dams and with Orna Grumberg. The foundational aspects of abstract interpretation in model checking were first presented at a memorable PROCOMET workshop in San Miniato [19], and culminated in 1997 in a TOPLAS seminal paper [20] and application paper [21].

At the end of this period, Rob organised the ESPRIT project VIRES (Verifying Industrial Reactive Systems) where the developed theory and tools were applied to the verification of an industrial bus protocol. This project was his legacy to Europe, and the beginning of a new era in the verification of large systems. When Rob left the Technical University Eindhoven for Intel at the end of 1997, VIRES found a suitable new project lead in his former Ph.D student Dennis Dams.

Rob's "warming up" exercise at Intel was the ambitious exploratory project of formally verifying arithmetic hardware units to their IEEE specifications [22]. The technology and methodology developed in that project are used routinely

today to verify floating-point functionality in Intel's Microprocessor design projects.

He subsequently went back to a more familiar domain, developing a linear-time temporal logic – dubbed ForSpec [23]. The uniqueness of Forspec lies in its many special features for hardware specification, motivated by many Intel engineering years of both edge-cutting and practical design and validation. Rob's unique blend of theoretical knowledge and practical experience in formal semantics and model checking invariably prevented inconsistencies and efficiency hazards, and helped solve the most difficult roadblocks. ForSpec is widely used in Intel, and has been incorporated in OpenVera^{TM}, a language for hardware testbenches and assertions that is supported by a broad network of CAD companies.

Just weeks before his death, Rob presented the first results of what he called his "bit-vector compiler" – software he had been developing to relate protocol models over abstract data types to ditto models over "hardware" datatypes, i.e. bits and bit-vectors. Following up on [24], the compiler is part of Rob's protocol verification programme and perhaps the most cherished and ambitious project of his life. A life which he did not anticipate would end any time soon.

If Edsger Wiebe Dijkstra, another Dutchman, opened the eyes of computer scientists for the value of proving programs correct, then in Rob Tristan Gerth a worthy modern-day successor and polymath was incarnated, whose own unique vision furthered the feasibility of Dijkstra's programme. We shall all miss Rob's enthusiasm, ruthless intellectual curiosity, and relentless energy.

Selected List of Publications

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