The EATCS Award 2011

Laudatio for Boris Trakhtenbrot

Boris (Boaz) Trakhtenbrot is a very famous pioneer of theoretical computer science who is turning 90 this year. He is unquestionably a principal founding father of the discipline of computer science, a pre-eminent distinguished researcher, and a most illustrious leader and disseminator. His candidacy for the EATCS award was co-signed by 78 (!) Top Scientists, among then the Turing Award winner Edmund Clarke.

Trakhtenbrot is a grand visionary who pioneered many fascinating directions and innovative concepts, which have had enormous impact. Already when working on his doctoral dissertation (in the early 1950s), while every logician was thinking about infinite structures, he proved that the set of first-order formulae valid on finite structures is not recursively enumerable. This epochal result (Doklady 70 [1950]), which bears his name, precludes the possibility of any completeness theorem for first-order predicate calculus of finite structures. As such, it was the first important result in finite model theory, with countless wide-ranging repercussions. As Leonid Libkin aptly writes at the outset of his book (*Elements of Finite Model Theory*, Springer, 2004) on the subject: *The birth of finite model theory is often identified with Trakhtenbrot's result from 1950.* This work heralded a field that rose dramatically in popularity and cachet over the subsequent decades, as more and more researchers have come to realize its centrality and to recognize its multi-varied applications.

Finite model theory was just one of very many ideas of genius that Trakhtenbrot brought to the field of theoretical computer science. One of the most fundamental results connecting mathematical logic to computer science is the so-called Buchi-Elgot-Trakhtenbrot Theorem (Siberian Math. J. 3 [1962]), stating that finite-state automata and monadic second-order logic (over finite words) have equivalent expressive power. Trakhenbrot's justly famous and truly elegant Gap Theorem of 1964 (rediscovered by Allan Borodin in 1972) and his improvement of the crossing sequence method (Algebra & Logic 3 [1964]) were likewise pivotal and groundbreaking.

Trakhtenbrot was virtually the first (Trans. Penza Ped. Inst. 4 [1956]) to consider time and space efficiency of algorithms (using what he called signalizing functions) and speak about abstract complexity measures, at a time when most others cast doubt on the very notion. His paper on autoreducibility (Doklady 11 [1970]) provided a turning point in abstract complexity. In the USSR, these works quickly became very influential, and, in the US, complexity took over as the central preoccupation of theoretical computer scientists.

By the end of the 1970s, Trakhtenbrot recognized (as had Robin Milner) what today is commonplace knowledge - but was quite revolutionary at the time - that the classical conceptual view of computation as a sequential process does not suffice to capture the operation of modern computers. Accordingly, many of his more recent works have dealt with various aspects of concurrency.

In short, for over half a century, Trakhtenbrot has been making seminal contributions to virtually all of the central aspects of theoretical computer science, inaugurating numerous brand new areas of investigation. The list of topics in which Trakhtenbrot has made his lasting mark is breathtaking in its scope: decidability problems in logic and schematology of programs, finite automata theory, the connection between infinite automata and monadic second-order logic, complexity of algorithms, abstract complexity, algorithmic logic, probabilistic computation, program verification, the lambda calculus and foundations of programming languages, programming semantics, type theory, semantics and methodology for concurrent and hybrid systems, and much more. The entire body of his work demonstrates the same unique melding of supreme mathematical prowess, combined with profound depth and thoroughness. His operative style has always been patient in-depth survey of existing literature, uncompromising evaluation and critical comparison of existing approaches, followed by extraordinary and prescient contributions.

It is most unfortunate that Trakhtenbrot's spearheading role in theoretical computer science has all too often been overlooked. He has always exhibited an almost prophetic ability to foresee directions that are destined to take center stage, a decade or more before anyone else takes notice. Moreover, he has never been tempted to slow down or limit his research to areas of endeavor in which he has already earned recognition and honor. Rather, he continues to probe the limits and position himself at the vanguard of a rapidly developing field, while remaining, as always, unassuming and open-minded.

Trakhtenbrot is at the same time a master pedagogue and expositor. He always sets aside time and effort for writing surveys and textbooks. Indeed, a whole generation of information scientists has been shaped by Trakhtenbrot's books. His first, Algorithmic and Automatic Computing Machines, written in Russian in 1957, was translated into English and dozens of other languages, and is universally recognized as the first important text in the field. Another major contribution to computer-science education was his 1973 book on Finite Automata (Behavior and Synthesis), also widely translated. This was the most important monograph on automata theory available at the time and has had a lasting effect on generations of researchers, especially in Russian - and German - speaking countries in both the East and the West. He also played the key role in the dissemination of Soviet computer science research in the West, writing surveys on such topics as Russian approaches to the necessity/elimination of brute -force search (perebor).

The list of Trakhtenbrot's students (including Janis Barzdins, Rusins Freivalds, Valery Nepomniaschy, Vladimir Sazanov) reads like the Who's Who of computer science in the USSR. Trakhtenbrot built the computer science department in Novosibirsk from scratch and collaborated with computer designers in the Soviet Union. In 1980, he emigrated from the Soviet Union and joined Tel Aviv University's School of Mathematical Sciences, where he founded their logic and semantics group. He was the vital driving force behind the rapid growth phase of what is now one of the leading computer science departments in the Mideast and beyond.

Trakhtenbrot has been an inspirational model for many in the Soviet Union; the Latvian school of computer science flourished under his students' tutelage; his influence on the development of computer science in far-flung locations, like Jena (East Germany) and Yerevan (Armenia), was enormous. Later, he established a long-lasting fertile cooperation between computer scientists in Tel Aviv and Edinburgh, beginning with the late Robin Milner's visit to him in the mid-1980s, and with other centers around the world. He also helped disseminate the groundbreaking work of other scientists like Anatol Slissenko and Leonid Levin. While in the East, he maintained a long, intense, and productive correspondence with Albert Meyer in the US, later spending a sabbatical with Meyer and J. Halpern, resulting in their influential work on the semantics of Algol-like languages.

Trakhtebrot's contributions are astounding under any measure; His undaunted spirit should be heralded as an inspiration to the rest of the world.

One can also see Trakhtenbrot's own "scientific biography" from the recent festschrift in his honor (Pillars of Computer Science, LNCS 4800, Springer, 2008).

For all the above reasons, the EATCS awards Committee 2011 unanimously decided to give the EATCS award to Professor Boris Trakhtenbrot.

The EATCS awards Committee

Paul G. Spirakis (chair)
Friedhelm Meyer auf der Heide
Eugenio Moggi