Tribute to Egon Börger on the Occasion of his 60th Birthday

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Egon Börger was born on May 13, 1946, in Westfalia (Germany). After the classic baccalauréat, from 1965-1971 he studied philosophy, logic and mathematics at the Sorbonne (Paris, France), Institut Supérieur de Philosophie de Louvain (Belgium), Université de Louvain and Universität Münster (Germany), where he got his doctoral degree and in 1976 his "Habilitation" in mathematics. The themes of his doctoral dissertation, *Reduction classes in Krom and Horn formulae*, and of his "Habilitationsschrift," *A simple method for determining the degree of unsolvability of decision problems for combinatorial systems*, have their root in the computational view of mathematical logic held at the time at the Institute for Logic and Foundations of Mathematics at the University of Münster, a tradition going back to (among others) Leibniz, Ackermann, Gödel, Post, Turing, Kleene, and associated in Münster with the names of the founder of the institute, Heinrich Scholz, and his followers Hans Hermes, Gisbert Hasenjäger and Dieter Rödding. This heritage determined the focus of Börger's logical investigations in what nowadays is called computability and computational complexity theory and his early interest in applying methods from logic to solve problems in computer science.

Thus, it does not come as a surprise that from 1972 to 1976 Börger followed Edoardo Caianello's call to help create the computer science department at the Università di Salerno (Italy), where he developed the curriculum for and taught the courses on Algorithms, Computational Complexity Theory, Semantics and Logic. After a short period (1976-1978) as Dozent of Mathematical Logic at the University of Münster, Börger became Professor for Theoretical Computer Science at the University of Dortmund (Germany), where he wrote his book on *Computability, Complexity, Logic* [1], which went through numerous editions, for over a decade became the main reference book for courses on the subject in German universities, and has been translated into English and Italian. Börger spent the academic year 1982–1983 as professor at the then new computer science department of the Università di Udine (Italy), and in 1985 accepted a computer science chair at the Università di Pisa (Italy), which he has held since then, rejecting various offers from other universities.

Through editing books and organizing workshops, summer schools, conferences, including various seminars at the Mathematical Research Institute in Oberwolfach and at Schloss Dagstuhl, Börger has been committed since the late 1970s to promoting a concrete interaction between logicians and computer

scientists, based upon his conviction that the major challenges for contemporary logic are to be found in applying logical methods in computer science. To provide an institutional basis for such an interaction, in 1986–1987 he founded together with his colleagues Michael Richter and Hans Kleine Büning the series of annual Computer Science Logic workshops. In their sixth edition, in San Miniato near Pisa, these meetings became the Annual Conference of the European Association for Computer Science Logic (http://www.eacsl.org/). The EACSL was founded on Börger's initiative on July 14, 1992, by 37 computer scientists and logicians from 14 countries gathered in a Dagstuhl Seminar on Computer Science Logic Börger had organized together with his colleagues Richter, Kleine Büning, and Yuri Gurevich. From 1992 to 1997 Börger acted as first EACSL President.

Börger's research activities in logic and complexity theory in the years 1969–1989 culminated in the book on *The Classical Decision Problem* [2], for which he wrote the first half, the one on the classification of undecidable classes of first-order logic formulae, co-authored by Erich Grädel who wrote the chapters on the complexity of the decidable classes, except for the section on the Shelah class that was written by Gurevich. The years 1986–1989 brought a shift of interest. They were characterized by a close cooperation between Börger and Gurevich on the eventual definition, by Gurevich in 1993 [3], of the notion of Abstract State Machines (ASMs)[1]. The idea grew out of Gurevich's foundational concern about sharpening Turing's thesis by a model of computation that explicitly recognizes the finiteness of computers, a theoretical effort that was crowned by success in 2000 when on the basis of three natural axioms Gurevich succeeded to prove that "Sequential Abstract State Machines capture sequential algorithms" [5].

Börger's interest was triggered by an attempt to use ASMs to model the logic programming language Prolog. During his sabbatical from 1989 to 1990, spent at the IBM Scientific Center Heidelberg (Germany), in particular through his work in the ISO Prolog standardization committee, he recognized the potential of ASMs for building and verifying complex software-based systems in an effectively controllable manner, namely, by stepwise refinement of application-domain-focussed abstract ground models to executable code. Since then, he systematically pushed experiments to apply ASMs to real life, in particular industrial software-based systems. He triggered and led the effort of an international group of researchers which developed what is now known as the ASM method for high-level system design and analysis. He did this through multiple activities: through his own *research and publications* carried out at numerous research departments in Europe and the USA, through the *supervision of PhD students* in various European countries, through the definition and realization (including tool development) of academic and industrial *pilot projects* for building verifiable software in areas ranging from programming language implementation over train control to business processes [during sabbaticals at IBM 1989–1990,

[1] Details of the historical development can be found in the AsmBook [4, Ch.9].

Siemens Corporate Research and Development (Munich 1996, 1999), Microsoft Research (Redmond 2000), SAP Research (Karlsruhe, 2005)], through over 500 colloquium and conference *talks* worldwide and through the *organization* of:

- Seminars, e.g., the following Schloss Dagstuhl seminars:
  - *Methods for Semantics and Specification*, organized with Jean-Raymond Abrial (Paris), Hans Langmaack (University of Kiel, Germany), June 5–9, 1995. This seminar became known as the Steam-Boiler Seminar and resulted in a Springer LNCS State-of-the-Art Survey [6].
  - *Practical Methods for Code Documentation and Inspection*, organized with Paul Joannou (Ontario Hydro, Toronto, Canada), Dave Parnas (McMaster University, Canada), May 12–16, 1997.
  - *Requirements Capture/Documentation/Validation*, organized with Bärbel Hörger (Daimler-Benz Research, Germany), Dave Parnas (McMaster University, Canada), Dieter Rombach (Universität Kaiserslautern, Germany), June 14–18, 1999.
  - *Theory and Applications of Abstract State Machines*, organized with Andreas Blass (University of Michigan at Ann Arbor), Yuri Gurevich (Microsoft Research Redmond), March 4–8, 2002.
- Schools, e.g., the following summer schools:
  - *Informatica Matematica*, organized with Neil Jones (DIKU, University of Copenhague), Scuola Matematica Interuniversitaria, Cortona (Italy) July 9–30, 1989.
  - *Specification and Validation Methods for Programming Languages and Systems*, organized with Alfredo Ferro (University of Catania), Lipari (Sicily), June 21–July 3, 1993. See [7].
  - *Architecture Design and Validation Methods*, organized with Ferro (University of Catania), Lipari (Sicily) June 23–July 5, 1997. See [8].
  - *Formal Methods for Engineering of Software*, organized with Furio Honsell and Simone Martine (both University of Udine), CISM, Udine (Italy), September 24–28, 2001.
  - *Software Technology*, organized with Ferro (University of Catania), Lipari (Sicily) July 1–13, 2002.
  - *Advances in Software Engineering*, organized with Ferro (University of Catania), Lipari (Sicily), July 8–21, 2007. See [9].
- Workshops, including the series of (bi-)annual international ASM workshops. This series was started in 1993 at the IFIP World Computer Congress [10, Stream C] in Hamburg (Germany). Börger proposed at this Dagstuhl seminar, whose results are reported in this volume, to merge the regular meetings of the three major state-based formal method user groups, ASMs, B, and Z. This led to the establishment of the ABZ Conferences, the first of which took place in 2008 in London (UK) [11], to be followed by the next one in 2010 in Québec (Canada).

This list shows some of the altogether 25 books and special journal issues Börger edited and of over 30 international conferences, workshops, and schools

he organized in logic (1969–1989) and computer science (since 1990). His publications comprise over 100 research papers in logic (27) and computer science (89) and over 40 papers of technical expository or of epistemological character, written in English, German, French, and Italian. His major publications on ASMs are a book on the method [4] and a book on a characteristic application of the method to Java and its JVM implementation. The latter book exhibits all the main features of the ASM method, namely, (a) *building an abstract ground model* (read: a precise definition) that can be justified to faithfully formalize the language and machine requirements in SUN's manuals, (b) *horizontal and vertical refinements* leading from the ground model to executable code, (c) *validation* (by executing the models), and (d) *verification* (by mathematically proving or model checking properties of interest of the models, such as type safety, compiler correctness, and completness, etc.) [12].

In recognition of his pioneering work in logic and its applications in computer science, Börger was awarded the prestigious *Humboldt Research Award* in 2007–2008.

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