

Marina Lenisa, Marino Miculan (Eds.)

Logics, Types, and Semantics: a Journey in Theoretical Computer Science

Essays Dedicated to Furio Honsell
on the Occasion of His 60th Birthday

All articles have already been published in the regular issues of Logical Methods in Computer Science





Furio Honsell

PREFACE

This Special Issue collects a selection of the papers presented at the Symposium held in Udine on July 22, 2018 in honour of Furio Honsell, on the occasion of his 60th birthday.

Furio was born in 1958. He received his Laurea degree in Mathematics from the University of Pisa in 1981, and the Diploma from the Scuola Normale Superiore in 1983. Furio's thesis was about non-wellfounded Set Theory, under the supervision of Ennio De Giorgi, who introduced him to the Foundations of Mathematics. Furio went on to be a researcher at University of Turin until 1985, then a fellow of the Edinburgh University from 1986 to 1988, and from 1989 professor at the University of Udine, where he became full professor in 1990, which is his current position. His main offices at the University of Udine include: director of the Computing Services (1990-1992), head of the Department of Mathematics and Computer Science (1992-1995), dean of the Faculty of Sciences (1995-1998), rector of the University (2001-2008). He has also held guest positions at University of Edinburgh, Stanford University, École Normale Supérieure de Rue D'Ulm, and Université Paris 7.

Furio has always been moved by a deep curiosity in every field of human knowledge. His interests go well beyond Mathematics and Computer Science, embracing also Philosophy, Sociology, Politics, Linguistics, and other fields. His brilliant personality and mind have inspired a lot of students and collaborators.

Furio's research interests include Foundations of Mathematics, non-wellfounded Set Theory, λ -calculus, Type Theory, Logical Frameworks, Modal Logics, Program Logics, Functional and Object-Oriented Programming, Operational and Denotational Semantics, Concurrency Theory, Game Semantics, Algebraic and Coalgebraic Semantics. Among the many lasting contributions in these fields, we can just mention a few.

In his initial work on non-wellfounded Set Theory, Furio, together with Marco Forti, formulated in 1981 the anti-foundation axiom X_1 , which introduced the notion of bisimulation independently from David Park, and anticipated the anti-foundation axiom AFA. This has had a great impact in the context of (coalgebraic) semantics of infinite and circular processes. Among several works about models and theories of untyped λ -calculus, we mention the work with Simona Ronchi Della Rocca about the topological incompleteness of λ -calculus. Intersection type theories have been studied by Furio in several papers, in collaboration with Fabio Alessi, Mariangiola Dezani, Giuseppe Longo, and others. Another highly influential line of research has been the one in collaboration with Ian Mason, Scott Smith and Carolyn Talcott, on Program Logics for languages with effects.

A landmark work is that on the Edinburgh Logical Framework: the seminal paper *A Framework for Defining Logics*, in collaboration with Gordon Plotkin and Robert Harper, was presented at LICS 1987 and received the LICS Test-of-Time Award in 2007. This line of research has been pursued later on, mainly with Alberto Ciaffaglione, Luigi Liquori, Marino Miculan, Ivan Scagnetto. In collaboration with John Mitchell and Kathleen Fisher, Furio presented one of the first formal models of delegation-based object-oriented languages; this line of research has been later pursued together with Alberto Ciaffaglione, Pietro Di Gianantonio, Luigi Liquori, and others. On a related note, we mention the works about modal logics in collaboration with Arnon Avron and Marino Miculan. The paper *π -calculus in (Co)-Inductive Type Theory* (2001), together with Marino Miculan and Ivan Scagnetto, is a standard reference in the field of process calculus formalization, but moreover it contains

the first definition of the Theory of Contexts (later studied with Martin Hofmann), which is an alternate approach to Nominal Set Theory.

Furio has given important contributions also in the field of Game Semantics and Geometry of Interaction. In collaboration with Pietro Di Gianantonio and Gianluca Franco, Furio has achieved important results on the expressive power of Game Semantics with respect to theories of untyped λ -calculus. Later, intersection type theories based on Game Semantics and the Geometry of Interaction have been developed by Furio in collaboration with Alberto Ciaffaglione, Pietro Di Gianantonio, Marina Lenisa, Ivan Scagnetto. Coalgebraic semantics has been investigated by Furio in many papers, in collaboration with several authors, including Roberto Bruni, Daniela Cancila, Marina Lenisa, Ugo Montanari, Marco Pistore, Rekha Redamalla. These papers cover both the theory of coalgebras and their applications to models of λ -calculus, Concurrency, OOP Languages, infinite Conway games, etc.

Up to now, Furio has produced about 100 publications. He is a great collaborator and has had nearly 50 coauthors and coeditors so far: Fabio Alessi, Arnon Avron, Paolo Baldan, Sonia Brondi, Roberto Bruni, Anna Bucalo, Rod M. Burstall, Daniela Cancila, Alberto Ciaffaglione, Mariangiola Dezani-Ciancaglini, Pietro Di Gianantonio, Lavinia Egidi, Giovanni Ferrin, Kathleen Fisher, Marco Forti, Leopoldina Fortunati, Gianluca Franco, Paola Giannini, Robert Harper, Martin Hofmann, Marina Lenisa, Silvia Liani, Luigi Liquori, John Longley, Giuseppe Longo, Petar Maksimovic, Ian A. Mason, Marino Miculan, John C. Mitchell, Ugo Montanari, Yoko Motohama, Cristian Paravano, Daniel Pellarini, Marco Pistore, Gordon Plotkin, Randy Pollack, Alberto Pravato, Rekha Redamalla, Simona Ronchi Della Rocca, Don Sannella, Mauro Sarrica, Ivan Scagnetto, Scott F. Smith, Carolyn L. Talcott, Andrzej Tarlecki.

In addition, Furio has established fruitful collaborations with friends and colleagues all over the world. He has served as chair or as member in the program committees of many international conferences, he has been a member of the editorial board of the journal *Mathematical Structures in Computer Science* and he has participated in IFIP WG 2.2. Furio has been principal investigator of several national and international research projects; among these we mention the EU-funded cooperation projects between cultural institutions in Europe and India.

Furio inspiring vision has been fruitful for thousands of students. He has supervised about 90 undergraduate theses, and the following PhD students: Pietro Di Gianantonio (*A Functional Approach to Computability on Real Numbers*, 1993), Marino Miculan (*Encoding Logical Theories of Programs*, 1997), Marina Lenisa (*Themes in Final Semantics*, 1998), Gianluca Franco (*Some Intensional Models of Lambda Calculus*, 2001), Ivan Scagnetto (*Reasoning about Names in Higher-Order Abstract Syntax*, 2001), Daniela Cancila (*Investigations in the Categorical Foundations and Applications of Coalgebras and Hypersets*, 2003), Alberto Ciaffaglione (*Certified Reasoning on Real Numbers and Objects in Co-inductive Type Theory*, 2003), Yoko Motohama (*Intersection Types and Lambda Models*, 2005), Rekha Redamalla (*Bialgebraic Description of Generalized Binary Methods and other Topics in the Semantics of Object-Oriented Languages*, 2007).

Furio also carries out an intense activity of scientific popularization and promotes the culture of Mathematics and games as a tool for social inclusion. In this role, from 2003 to 2007, Furio has taken part in the Italian prime time TV program *Che tempo che fa*. He has run, from 2009 to 2011, the column *Matepratica* in the Italian edition of *Wired*, from 2013 he runs the column *Il respiro della Matematica* in the magazine of logic games *Logika*, recently he runs also the column *Giochi Furiosi* in the Saturday supplement of the

national newspaper *Sole 24 ORE*. Furio is author of two books on popular mathematics, *L'algoritmo del parcheggio* (2007), and *Curiosità e divertimenti con i numeri* (2009), this latter co-authored with Giorgio Bagni. From 2011 to 2018, he has been national coordinator of GIONA, the Italian association of Municipalities which promote games and toy libraries.

Furio has also co-authored the essay in political sociology *Prima che sia domani* (2014) with Gabriele Giacomini, and various papers on Public Health, under the aegis of WHO, thus witnessing the wide range of his interests.

In 2008, Furio decided to apply his talent to politics. First, he served as mayor of Udine, being elected on April 28, 2008, and re-elected in May 2013. On April 29, 2018, Furio has been elected in the Regional Assembly of Friuli Venezia Giulia. As mayor of Udine, Furio has been president of the European Covenant on Demographic Change (2015-2018), member of the Political Board of the Covenant of Mayors for Energy and Climate Change of EU (2015-2018), member of the Political Vision Group of the European Healthy Cities Network of WHO (2008-2018), vice-president of the Italian Network of Healthy Cities of WHO (2008-2018), political coordinator of the Task Force on Healthy Ageing of the WHO. Furio has been also Spokesperson for Energy and Climate Change of the Council of European Municipalities and Regions (CEMR, 2015-2018). Despite these important political offices, Furio is still very active in research, as witnessed by his constant scientific production.

Many of Furio's coauthors, collaborators, close colleagues, and former students gathered in Udine, on July 22, 2018, for a symposium in his honor. The presentations were on subjects related to Furio's many technical contributions and they were a tribute to his lasting impact on the field. This special issue collects the revised and expanded versions of papers submitted to the Festschrift. The papers were reviewed by Davide Ancona, Franco Barbanera, Pietro Di Gianantonio, Bruno Dinis, Thomas Hildebrandt, Atsushi Igarashi, Michele Loreti, Franco Parlamento, Alberto Policriti, Michael Rathjen, Jakob Rehof, Paula Severi, Ana Sokolova, Sam Staton, Pawel Urzyczyn, Daniele Varacca. We thank the reviewers for their feedback to the authors that helped them to improve the papers.

We thank the University of Udine, the Department of Mathematics, Computer Science and Physics, and the PRID ENCASE project for logistic and financial support in organizing the symposium in the stunning location of Palazzo Garzolini di Toppo-Wassermann.

Finally, we thank Lars Birkedal and Stefan Milius, Editor-in-Chief and Executive Editor of *Logical Methods in Computer Science*, for accepting to publish this Special Issue and for their support during its preparation.

Marina Lenisa, Marino Miculan
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