# From Physics to Computer Science:
# to Gianpiero Cattaneo for his 70th birthday

## Preface

This special issue of Fundamenta Informaticae is devoted to Gianpiero (Gipo) Cattaneo, in occasion of his retirement and in celebration of his 70th birthday in September 2012. It covers three areas investigated by Gianpiero's research: cellular automata and discrete models, quantum computing and rough sets. The authors of the contributions are friends, pupils and colleagues of Gianpiero from different research f elds and institutions. One of Gianpiero's merit is interdisciplinarity, creating an entanglement between computer scientists, logicians, mathematicians, philosophers, physicists. This is witnessed also by his career: he is Computer Science Full Professor at the Università degli Studi di Milano–Bicocca, after a long career f rst as researcher in "Theoretical Physics", and then as Associate Professor in "Mathematical Methods of Physics".

Enrico Beltrametti, Maria Luisa Dalla Chiara, Roberto Giuntini, Roberto Leporini, and Giuseppe Sergioli have contributed an article titled *Epistemic Quantum Computational Structures in a Hilbert-Space Environment* which deals with epistemic problems connected with quantum computing systems. The main problem in question is: is it possible to interpret the basic epistemic operations as a special kind of Hilbert space operations? The authors show that the answer in general is no, mainly non-trivial knowledge operations cannot be represented by unitary operators. They also introduce the notions of epistemic quantum computational structures, where knowledge operations are identif ed with special examples of quantum operations.

In a paper titled *Completeness of inner product spaces and G. Cattaneo*, David Buhagiar, Emmanuel Chetcuti and Anatolij Dvurencenskij present some algebraic criteria of inner product spaces which have a close connection to the original papers by Gianpiero concerning splitting subspaces and some further state-theoretical criteria. It is a valuable contribution to show how such a theory was developed during the last 25 years.

S. Greco, B. Matarazzo and R. Slowinski in the paper *The bipolar complemented de Morgan Brouwer-Zadeh distributive lattice as an algebraic structure for the Dominance-based Rough Set Approach* extend the notion of BZ lattice def ned by Gianpiero in order to give an algebraic approach to the Dominance-based Rough Set Approach. It is a step forward in the algebraic approach to rough sets and to uncertainty management.

The effect of changes in Information Tables on rough sets is analyzed by D. Ciucci in *Temporal Dynamics in Information Tables*. This is a continuation of a study started in collaboration with Gianpiero. It presents new results and a survey of the actual knowledge about temporal dynamics in rough sets.

There are two contributions about Cellular Automata. In the paper *On the undecidability of attractor properties for Cellular Automata* by P. Di Lena and L. Margara the undecidability of some properties of Cellular Automata attractors is proved. The differences between one-dimensional and two-dimensional Cellular Automata are enlightened in the paper *From One-dimensional to Two-dimensional Cellular Automata* by A. Dennunzio taking into account both dynamical and decidability aspects. Both the papers are a step forward in the understanding of the dynamics, the decidability aspects and the classif cation of Cellular Automata.

In the paper *Computational Complexity of Avalanches in the Kadanoff Sandpile Model*, E. Formenti, B. Martin, and E. Goles prove some computational complexity results (both in dimension one and two) for the Kadanoff Sandpile Model, a well-known discrete dynamical system of sandpiles. It is a valuable contribution on complexity problems in the class of these important discrete models.

A. Bertoni, M. Goldwurm, J. Lin, and F. Saccà in the paper *Size constrained distance clustering: separation properties and some complexity results* focus on clustering problems with size constraints. They prove interesting results on the complexity of these problems.

We thank all the contributors to this special issue in honor of Gianpiero. By means of their contributions that range from computer science, over logics to physics, they demonstrate the interdisciplinary nature of Gianpiero's scientif c activities.

We are also grateful to the reviewers of papers for their work and to the editor-in-chief, prof. D. Niwinski, for his guidance and support in the whole process of editing this volume.

Davide Ciucci
Dipartimento di Informatica, Sistemistica e Comunicazione
Università degli Studi di Milano–Bicocca
Viale Sarca 336, 20126 Milano (Italy)
*ciucci@disco.unimib.it*

Alberto Dennunzio
Dipartimento di Informatica, Sistemistica e Comunicazione
Università degli Studi di Milano–Bicocca
Viale Sarca 336, 20126 Milano (Italy)
*dennunzio@disco.unimib.it*

Roberto Leporini
Dipartimento di Matematica, Statistica, Informatica e Applicazioni
Università di Bergamo
Via Caniana 2, 24127 Bergamo (Italy)
*roberto.leporini@unibg.it*

(Editors of the issue)