

# Lecture Notes in Artificial Intelligence 7360

Subseries of Lecture Notes in Computer Science

## LNAI Series Editors

Randy Goebel

*University of Alberta, Edmonton, Canada*

Yuzuru Tanaka

*Hokkaido University, Sapporo, Japan*

Wolfgang Wahlster

*DFKI and Saarland University, Saarbrücken, Germany*

## LNAI Founding Series Editor

Joerg Siekmann

*DFKI and Saarland University, Saarbrücken, Germany*

Alexander Artikis Robert Craven  
Nihan Kesim Çiçekli  
Babak Sadighi Kostas Stathis (Eds.)

# Logic Programs, Norms and Action

Essays in Honor of Marek J. Sergot  
on the Occasion of His 60th Birthday

## Series Editors

Randy Goebel, University of Alberta, Edmonton, Canada  
Jörg Siekmann, University of Saarland, Saarbrücken, Germany  
Wolfgang Wahlster, DFKI and University of Saarland, Saarbrücken, Germany

## Volume Editors

Alexander Artikis  
National Centre for Scientific Research "Demokritos", 15310 Athens, Greece  
E-mail: a.artikis@iit.demokritos.gr

Robert Craven  
Imperial College London, London SW7 2AZ, UK  
E-mail: robert.craven@imperial.ac.uk

Nihan Kesim Çiçekli  
Middle East Technical University, 06800 Çankaya, Ankara, Turkey  
E-mail: nihan@ceng.metu.edu.tr

Babak Sadighi  
Axiomatics AB, 103 14 Stockholm, Sweden  
E-mail: babak@axiomatics.com

Kostas Stathis  
Royal Holloway, University of London, Egham TW20 0EX, UK  
E-mail: kostas.stathis@cs.rhul.ac.uk

ISSN 0302-9743 e-ISSN 1611-3349  
ISBN 978-3-642-29413-6 e-ISBN 978-3-642-29414-3  
DOI 10.1007/978-3-642-29414-3  
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2012934824

CR Subject Classification (1998): I.2, C.2.4, I.2.11, H.4, F.4.1, H.3

LNCS Sublibrary: SL 7 – Artificial Intelligence

© Springer-Verlag Berlin Heidelberg 2012

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

*Typesetting:* Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)



**Marek J. Sergot**

# Foreword

I could not have anticipated, when Alfons Sergot, noted jurist and political writer, came to visit me at the Inter American University in San Juan, Puerto Rico, sometime in 1966–67, that I would meet his nephew, Marek Sergot, at Imperial College London, some eight years later in 1975.

I had recently arrived from Edinburgh, when Marek knocked on my office door for details about a project on logic and databases. He found the topic interesting and decided to work on it for his MSc. Thus began Marek's 36-year career as a distinguished researcher, developing into an honoured colleague and dedicated teacher.

After a short break working in industry, Marek received a research fellowship in our group at Imperial College. The Japanese Fifth Generation Computer Systems (FGCS) Programme, with logic programming (LP) at its core, had recently been announced, and the British response, the Alvey Programme, was just taking off. Marek's work—on legal reasoning, query-the-user, and the APES expert system shell—amounted very nearly to an FGCS Programme of its own.

The central role of LP in FGCS created a big stir, and our group became a centre of both positive and negative attention, with only half-imaginary concerns that we were intent on reinventing the World of Computing.

Together with our colleagues Peter Hammond and Frank Kriwaczek, Marek and I gave courses on logic programming, expert systems and FGCS mainly in the US, staying in fancy hotels in fancy places like Atlantic City, New York and Stamford Connecticut. Marek jet setted to Japan and Australia. It was on one of those jet-setting flights that Marek and I began discussing the representation of events and the changes they initiate and terminate. It wasn't long afterwards that we completed our paper on the event calculus.

But at the time, it was our work on the logic programming representation of the British Nationality Act that received the most attention. *The Guardian* newspaper published accusations that we were in the employ of government agencies with sinister purposes. But the parliamentary draftsmen, to whom we demonstrated our Prolog implementation, were favourably impressed; and we received support, under Marek's leadership, to undertake similar LP representations of UK Social Benefits and Indian Pension regulations.

Marek's work and engaging personality were too big to circumscribe within the confines of LP and FGCS alone. He was courted by the AI and law community, began hobnobbing with logicians, philosophers and legal scholars, and initiated a programme of research on bioinformatics. His work with Andrew Jones on the formalisation of institutionalised power, for example, eventually became even more widely cited than his work on the British Nationality Act. It also led to more wide-ranging work on normative systems in both law and computing.

Marek's academic contributions also include his outstanding achievements as a supervisor of research students, many of whom have contributed to this volume and have international research reputations in their own right. It is a sign of their great appreciation of his efforts on their behalf, that so many have helped to assemble this collection of papers in his honour.

No tribute to Marek can be complete without an acknowledgement of the mutual support that Marek has given to and received from his family, and from his wife, Dr Teresa Sergot, in particular. It gives me great pleasure to be a messenger of this tribute.

Robert Kowalski

## Editorial Introduction

It is a pleasure and honour to bring together this volume celebrating the career and person of Marek Sergot, on the occasion of his 60th birthday.

Marek's life as a researcher has now spanned more than 30 years, for all of which he has been based at Imperial College in London. As the papers which form this volume demonstrate, Marek's interests in computer science have been wide. However, if we were to attempt to characterise unifying themes, we might say that most of his work has grown from an interest in applying logic-based techniques to normative concepts—whether in the representation of law, artificial agents, security, or other domains—and in certain applications of logic programming. In his early investigations these two themes overlapped to some degree, as much of Marek's early work was devoted to the representation of law and regulation as logic programs.

Other aspects of his research could be related to these early interests more or less closely. We will not attempt to do this here, however, as Marek's achievements in the many different sub-fields of computer science in which he has worked, in the course of his career to date, has been written about by experts in those fields in the 'Scientific Contribution' section of this Festschrift. Instead, in this editorial introduction, we want to take stock of Marek's career and his personality; and to recall the high regard in which he is held and the affection many of us feel towards him.

It seems possible that most people who have undergone a Ph.D. look back on the experience as an oxymoronic combination of pleasure and pain. The pleasures might include the deepening contact with research and induction into a professional community, the intellectual rewards of "hacking back the jungle of ignorance" (to use a phrase borrowed from the subject of this Festschrift), and meeting the challenges of producing a sustained piece of work on a single subject. The pains are typically the fears of not meeting those very challenges, and of being cut loose, without a syllabus, adrift in the ocean of possible research directions.

Marek Sergot is an excellent navigator and companion to have by one's side on this parlous scientific quest. In addition to the qualities one expects—the broad and deep knowledge of many different subject areas in AI, computer science, logic, knowledge representation, AI and law, multi-agent systems; the awareness of the need to balance the student's having to grow into an independent researcher with providing appropriate guidance, support and constructive criticism; and practical, down-to-earth advice on the daily business of life in academe—in addition to all these qualities, Marek brings a great personal care

and warmth to Ph.D. supervision, always leavened with his justly famed sense of humour. It is perhaps this combination of qualities into such a well-rounded whole which has made the editing of this volume, for all of us ex-Ph.D. students of Marek, so rewarding.

### **Biographical Information**

Marek's father, Brunon Mieczysław (Mietek) Sergot, came from Lubawa in northern Poland; he was the youngest of six children. Mietek trained as an engineer in Poland, in the field of plastics, and when 1939 came was taken by the Nazis to work in Germany. When the Allied Forces invaded, he escaped to join them, travelled to the UK and enlisted in the Polish army there. Marek's mother, Janina (Jasia) Wójtowicz, was born in an area of eastern Poland which is now in Belarus. She was deported by the Soviet army, with her family, to Siberia in January 1940. They were released following the invasion of the Soviet Union by the German army in June 1941, and with thousands of other families (including Marek's future mother-in-law) travelled south, making their way through Kazakhstan and Uzbekistan and eventually to Persia (Iran). Marek himself recently travelled to Uzbekistan on holiday, accompanied by his wife and other members of their family; perhaps his eagerness to see this part of the world had something to do with seeing the landscape that his mother and mother-in-law came through as part of their long journey out of Siberia. Be that as it may, Marek's mother arrived in Persia in 1942. She was transferred to a camp in Uganda, and from there finally arrived in Britain in 1948.

The family lived initially in London, where Marek Jozef Sergot was born, in Chiswick, on 3rd May, 1952. He was joined, 18 months later, by a brother, Roman; and then by their sister, Anna. Several years later, the family moved from London to Manchester, and it was here, in Stretford (almost literally in the shadow of Old Trafford, whence grew his passionate support of Manchester United), that Marek grew up. He attended the local primary school, St Anne's, and after the eleven-plus exam (widely used at that time to decide the scholastic fate of children after primary education) moved to De La Salle College, in Salford. The college was run by the De La Salle brothers—the 'Institute of the Brothers of the Christian Schools'—a Roman Catholic congregation dedicated to education, which runs hundreds of such colleges worldwide. At the college Marek excelled both academically and on the sports field—this particular school being well-known for its students' skill in rugby. Indeed, several years before Marek, the former England rugby union international player Tony Neary attended De La Salle College, and a number of old boys have, on an alumnus website, given testament to the centrality of rugby in the school's sports curriculum. So, at De La Salle College was Marek's long love for and engagement with rugby developed and strengthened. During his later years in Salford, Marek played rugby at county level for Lancashire Schoolboys.

After seven years at the school, Marek moved south to Trinity College, Cambridge, to read mathematics. By all accounts, his years at Cambridge were very happy ones, and after the standard three years he stayed on for one more, to



take the demanding Part III in mathematics. At this time his scientific interests were mainly in mathematical physics, and in particular in astrophysics. While at Cambridge, Marek continued to play rugby, including captaining the Trinity College side.

As the end of Part III approached, in 1974, Marek was unsure whether to continue in research for an astrophysics Ph.D., or to take another path. In the end, he moved to London, to begin an M.Sc. in Computing at Imperial College. The Department of Computing at Imperial—at that time, the Department of Computing and Control—was then in its infancy. After a period of being uncertain whether computer science was to be of lasting interest to him, Marek attended a seminar by Bob Kowalski, newly appointed from the University of Edinburgh, and was hooked by the wider scope and methods of Bob's work. It might perhaps not be too much of an exaggeration to say that Marek's course in research and academic life was radically altered at that seminar. He went on to choose an M.Sc. project under Bob's supervision, and as Bob writes in his Foreword to this volume, the subject was logic and databases.

After this first year at Imperial, Marek moved into industry to work in mathematical modelling. He stayed in London, for the first two years employed by the construction firm of George Wimpey & Co. as a scientific programmer and analyst, and later as a mathematician and programmer for the Commonwealth Telecommunications Bureau. According to Marek himself, however, these years were spent "mostly playing rugby". While still at Imperial he had become friends with Chris Lane, then also taking an M.Sc. in the engineering faculty, and the two of them played union, first for Imperial itself and later, when Marek moved into industry, for Rosslyn Park in Barnes. The club has an illustrious history: it was the first English club to play an international match (in 1892, thirteen years after the club was founded), and the roll-call of former members who have been England internationals is impressive. Later Marek played for a club based at the Sun Inn, also in Barnes.

In July 1978, Marek and Teresa were married. They had known each other for many years; Teresa's mother, as mentioned above, followed a similar route to England during and after the Second World War, and the two families lived in Manchester, where Marek and Teresa attended the same Polish Saturday school. After marriage, they lived in Streatham, where they raised four children—Antoni, Leon, Stefan and Izabela. The boys' sporting prowess and interests have been enthusiastically encouraged by Marek, who has been a staunch touch-line supporter. Family occasions, by Teresa's account, are full of laughter and good spirits, and when Marek is joined by his brother and sister, the laughter is amplified, as Roman and Anna share his sense of humour and wit. Colleagues also fondly remember the years when Marek's children were growing up, with Izabela and the boys familiar faces in the department during school holidays, and later when Antoni and Leon, the two eldest, became medical students at Imperial, and would often drop in to see their father at work.

Marek's strong practical side perhaps reveals itself, in its greatest variety, in his family life. With his brother-in-law, Marek renovated the family's holiday

home in Wales, shared with his sister—including, one summer, building the verandah mostly in the dark, late into the night. He is a versatile handyman, able to turn his hand to electrics and carpentry and many other skills around the house, and he brings panache and creativity to his cooking, making dishes with a skill and naturalness that rarely needs to stick to the recipe.

In 1979, Marek returned to Imperial College to begin a Ph.D. with Bob Kowalski. Although Marek's research interests at this point also involved more general theoretical and practical questions on logic programming, he quickly began to pursue the application of formal and computational methods to law. The law afforded ubiquitous examples of kinds of reasoning that were and are considered difficult areas for formal treatment, in particular forms of defeasible inference and inference with deontic and normative concepts, which were to go on to become the central themes of Marek's research. He became familiar with Layman Allen's early, pioneering work in the intersection of computer science with the law, and was soon attending Ronald Stamper's seminars at LSE on the representation of law in formal languages. One of the papers which emerged from these early investigations was [2], in which Marek and Bob Kowalski described the potential application of logic and computing to three kinds of law: definitional, normative and case law. The account of Marek's scientific contributions to AI and law in the present volume describes the full development of Marek's work in this area, which has mostly concentrated on the definitional and normative aspects of law.

From 1981 Marek was a Research Assistant in the Department of Computing, continuing to work with Bob Kowalski. Research on logic programming and its applications in the department was growing to its full strength, and Marek was involved in many aspects of this work, with successive projects supported by the Alvey Programme—which paralleled the 'Fifth Generation' project in Japan. Many of the early projects on which Marek worked concerned the application of logic—whether computational logic or the APES expert system that Marek had developed with Peter Hammond—to the representation of law and regulation. Together with Bob Kowalski, he worked on the 'Large Demonstrator' for the Department of Housing and Social Security, a five-year project aimed at showing the effectiveness of intelligent decision support for large, regulation-based organisations, and during which Marek formed his friendship and collaboration with Trevor Bench-Capon. Half-way through the 'Large Demonstrator', Marek also began work on another Alvey-funded project, on 'Logic for representing legislation', and many more projects were to follow over the next two decades, on themes in the representation of law, temporal reasoning, the formalisation of interactions between human and artificial agents, trust, and bioinformatics. From this point, however, Marek's scientific contributions and research interests are covered in full detail elsewhere in this Festschrift, so for the remainder of this introduction we concentrate on other aspects of his academic life and on his character.

Marek's teaching has revolved around the same leitmotifs as his research, with additional forays into core areas of computer science and foundational courses on

mathematics. Many generations of students at Imperial, starting in 1985 when he was appointed as a lecturer, have been taught Prolog by Marek. There have been courses on Discrete Mathematics and Reasoning about Programs, and several courses of lectures on the theory of databases, one of them taught jointly with James Jacobson. Also beginning in 1985, there was an introductory course on Artificial Intelligence, and another on Expert Systems.

While continuing programming courses in Prolog, since 2000 Marek's teaching has mostly focussed on modal and temporal Logic (taught jointly with Ian Hodkinson and Michael Huth), and on knowledge representation. The course on modal and temporal Logic has introduced undergraduates and master's students to neighbourhoods of modal-logical research not often seen, until recently, by cohorts elsewhere, including modal treatments of conditional logic, first-order modal logic, and applications in epistemic and deontic reasoning. After the bioinformatics centre was set up early in the new millennium, (after significant work by Marek during a sabbatical year), Marek co-founded the new interdisciplinary M.Sc. in bioinformatics, for which he also lectured.

Marek's unpretentious ability to work with students is almost unique. He is towards the informal and egalitarian end of one dimension of supervisory style, with a clear sense that Ph.D. students are to be treated as collaborators and companions towards knowledge. The editors of this volume have experienced hours of interesting, challenging and amusing discussions in which Marek always showed great generosity with his time and ideas; sometimes these discussions continued late in the evenings, when he would finally get a phone call from home asking when he was planning to leave the office. The spirit of interest and support extends effortlessly outside the office, for Marek is also a very enjoyable person to travel with to meetings and conferences, whether one is a student or colleague. In the former case, he is always very supportive before a presentation, and full of ready, genuine praise for students when the presentation is done. Many people have spoken of Marek's conscientious attitude to student project supervision, and he is a very responsive and attentive marker and provider of detailed commentary on drafts.

For many years Marek chaired the committee for awarding prizes for the best undergraduate and masters' student projects, when this readiness to praise good work was shown on innumerable occasions. Other administrative roles at Imperial have included chairing the sabbatical committee, and, more recently, being RA mentor. In all his interactions with students, Marek is approachable and genuinely concerned for the students' well-being and education, as those who have been lectured or supervised by him readily attest.

Marek is a regular contributor and attendee of the series of DEON workshops on 'Deontic Logic in Computer Science'. The first DEON was held in Amsterdam in 1991, with Marek submitting joint research with Andrew Jones on the use of deontic logic in characterising normative systems, and Marek has spoken at, or submitted work to, most other instances of DEON in the 20 years since its inception. He was Co-Programme Chair of the second DEON workshop, held in Oslo, and in 2002 when DEON was at Imperial College in London, Marek served

as General Chair. Marek is a very highly valued member of the diverse group of researchers—logicians, computer scientists, lawyers and philosophers—who gather here, and the work he has presented at the workshop, whether joint research or his alone, has been amongst his most influential. Alongside the DEON series, Marek has also been involved for over 20 years with ICAIL, the International Conference on AI and Law, serving as president of the International Association for Artificial Intelligence and Law which organises the conference, and often publishing work there since the first ICAIL in 1987.

In 2000, Marek served as General Chair of Computational Logic (CL2000). Discussions with John Lloyd had borne the original idea for the conference, which was to allow a unification of the various communities working on different fields in computational logic and logic programming. There were seven streams within the week-long programme, with seven invited speakers, an industrial exhibition, many workshops and tutorials, and collocation with ILP2000. Marek enthusiastically embraced his duties as conference chair, readily involving himself at all levels of planning and arrangement, from the high-level conception and structure, down to writing program scripts for automatic registration.

Marek brings several admired qualities to administration and organisation. What stands out is his ability to find a uniquely good solution to a problem where there are opposing views and conflicting interests; this is something that has emerged many times in the conversations we had with colleagues and collaborators in preparing this editorial. Marek is respected as someone who can provide a modestly authoritative solution to a problem, whether, in fact, the problem is scientific or one of bureaucratic tangle. He expresses his views with calmness, with the result that clarity and unity are brought to a discussion that would otherwise have been confused; and the intention is always to contribute to finding the best resolution, with all parties' needs respected. In interviewing and recommending candidates for positions at Imperial, he has held a noteworthy impartiality, urging acceptance of the best candidate for the department's interests as a whole.

In the same year that Marek was Chair for Computational Logic, he was also working to establish the Imperial College Centre for Bioinformatics. He had been involved in coordinating bioinformatics research at Imperial since the late 1990s, with a grant from the Royal Society and Wolfson Trust to help refurbish and equip a computational bioinformatics laboratory in the Department of Computing, and he was later influential in securing the funding for the bioinformatics centre, acquiring a grant from the UK joint research council to support a Chair in Bioinformatics (occupied by Stephen Muggleton) in the centre.

The early 2000s saw Marek collaborating on the European ALFEBIITE project, coordinated by Jeremy Pitt from the Department of Electrical and Electronic Engineering at Imperial. The project was intended to apply a conception of norm-governed interaction to artificial agent 'societies', and Marek's 1996 paper with Jones on the formal characterisation of institutional power [1] was central to the approach taken. It was during these years that Marek began to work on the various extensions of  $\mathcal{C}+$  that have been the focus of his recent and current

research, and also started working with Alexander Artikis on executable specifications of regulation for agent interaction. At the same time, outside the scope of ALFEBIITE, Marek was working with Alessio Lomuscio on deontic interpreted systems and applying model-checking to other forms of modal logic; after Alessio returned to Imperial in 2006, their shared focus moved to model-checking temporal and epistemic properties of contracts and Web-service compositions.

Marek is currently Professor of Computational Logic and Head of the Logic and Artificial Intelligence section in the Department of Computing at Imperial, which has been his appointment since 2000. His current work on a complex, sophisticated account of the logic of action is incorporating aspects of action which have not yet found a satisfactory formal treatment, but which promise great benefit to AI research and its applications in law; this work has been received with great interest by colleagues in deontic logic, action and normative systems.

Anybody who knows Marek personally, or who has attended any of his seminars or lectures, knows of his great sense of humour, his large and ready store of reminiscences and stories, and his ability to deliver them with wit and erudition. (His facility and style is just as present on paper as in speech—as any who have read his portrait of Bob Kowalski in the latter’s *Festschrift* will know.) It is a great pleasure to know Marek and see the warmth that he brings to a gathering. One of us remembers the occasion of Keith Clark and Frank Kriwacek’s retirement from the Department of Computing at Imperial, when Marek’s speeches celebrating both brought together and expressed the good feeling of the group of academics, staff and students present—but such instances could easily be multiplied. This ease in bringing a good mood to a social gathering or conversation, by his openness, warmth and magnanimity, is one of Marek’s most appreciated qualities. It will come as no surprise that he is often called on to give speeches: at conferences and departmental occasions, at family gatherings, and other social events. Marek’s talent of making a scientific presentation interesting and amusing was once ably given tribute after Marek spoke about his work on normative positions and demonstrated the software he had written to automate reasoning about them, *Norman-G* (for a full account, see [3]). A respected professional in the conference audience commented that it had been “a beautiful presentation by a beautiful man with a beautiful machine”.

Another of Marek’s admired qualities is his intellectual curiosity, which extends not only to many areas in computer science and artificial intelligence—as evinced by Marek’s publications and the wide thematic range, on subjects dear to him, of the papers in the present volume—but also to other scientific and humanistic disciplines, and to practical life. The power of being absorbed in something for its inherent interest is fresh and strong in him. Outside his professional life, he has always read very widely, and conversation with Marek in an academic context always has the potential to turn to broader subjects. He has long loved classical music (when his Ph.D. student Björn Bjurling, also a composer, gave him a recording of his compositions, Marek quipped that he’d house it “between Berlioz and Brahms”), and this has in recent years extended

into opera. History is a particular love, with Polish history being prominent but certainly not exclusive. And of course, Marek's work in deontic logic, AI and law, and the logic of action has connections with philosophy, law, and other social sciences; these other subjects have been sustained interests.

## Conclusion

In many respects the writing of this editorial introduction has been easy: it is not at all difficult to find many good things to say about Marek's life, career, and personality. The job has been made easier still by the great deal of help from friends and colleagues of Marek we enjoyed—all of whom clearly also relished the opportunity to reminisce and recount stories about Marek, or stories that he himself had told them (most of them printable).

Yet there is also an inevitable yawning gap of incompleteness, and that not only, or principally, in the factual side of career milestones, service to the profession, teaching, or scientific contribution. So for all that has been written about here, and for everything else that has not but which is so well known to those fortunate enough to know him, we would like to thank Marek again and wish him a very happy 60th birthday.

## Acknowledgements

We first very warmly thank Dr Teresa Sergot, for several conversations about Marek and for obtaining the list of Marek's Ph.D. students and the photograph, and for being so willing to help and enthusiastic about the Festschrift.

Very many other people have spent time and effort in bringing this Festschrift together, whether as contributing authors, in discussions over Marek's life and career, or as reviewers for papers. It is a pleasure to acknowledge the help of the following people: Marco Alberti, Dalal Alrajeh, Steve Barker, Trevor Bench-Capon, Justin Blount, Stefano Bragaglia, Federico Chesani, Ilyas Cicekli, Aspasia Daskalopulu, Paul Dunne, Esra Erdem, Jason Filipou, Dov Gabbay, Marco Gavanelli, Michael Gelfond, Guido Governatori, Evgenios Hadjisoteriou, Koen Hindriks, Wiebe Van Der Hoek, Andrew J.I. Jones, Antonis Kakas, Lloyd Kamara, Steven Kimbrough, Bob Kowalski, Evelina Lamma, Alessio Lomuscio, Jiefei Ma, Paolo Mancarella, Paola Mello, John-Jules Meyer, Loizos Michael, Naftaly Minsky, Sanjay Modgil, Dario Della Monica, Marco Montali, Angelo Montanari, Irene Papatheodorou, Xavier Parent, Wojciech Penczek, Jeremy Pitt, Henry Prakken, Orkunt Sabuncu, Fariba Sadri, Pietro Sala, Konstantinos Stamatakis, Francesca Toni, Leon Van Der Torre, Paolo Torroni, Silvano Colombo Tosatto, Son Tran, Paolo Turrini, George Vouros and Pinar Yolum.

## Steve Barker

We were very sad to hear, late in organising this volume, that Steve Barker died on Monday 30th January, 2012 after a long struggle with illness. Steve was supervised by Marek for his Ph.D., and they continued to work together

afterwards on shared themes. Steve was very involved in working on his paper for this Festschrift and writing about Marek's scientific contribution until very shortly before his death, which made the news of it all the more shocking. He will be greatly missed.

January 2012

Alexander Artikis  
Robert Craven  
Nihan Kesim  
Babak Sadighi  
Kostas Stathis

## References

1. Andrew J. I. Jones and Marek J. Sergot. A formal characterisation of institutionalised power. *Logic Journal of the IGPL*, 4(3):427–443, 1996.
2. Robert A. Kowalski and Marek J. Sergot. Computer representation of the law. In *IJCAI*, pages 1269–1270, 1985.
3. Marek J. Sergot. A computational theory of normative positions. *ACM Trans. Comput. Log.*, 2(4):581–622, 2001.

## PhD Students

1. U.J. Schild, Open-textured Law, Expert Systems, and Logic Programming, 1989.
2. C.S. Kwok, A Mechanism for Structuring Logic Programs, 1989.
3. R.W. Southwick, Reason Maintenance for Logic Programs and Backward Reasoning Systems, 1991.
4. V. Milosevic, A Forms Management System for Interactive Logic Programs, 1992.
5. F.N. Kesim, Temporal Objects in Deductive Databases, 1993.
6. C. Evans, Non-monotonic Aspects of Temporal Reasoning, 1994.
7. P.J. Azevedo, Techniques for Preventing Recomputation in Logic Programs, 1995.
8. K.J. Dryllarakis, Domain Logic Programming: Theory and Application in Scientific Knowledge Representation, 1996.
9. K. Stathis, Game-Based Development of Interactive Systems, 1996.
10. D.H. Evans, An Investigation of Persistence in Temporal Reasoning, 1997.
11. A-K. Daskalopulu, Logic-based Tools for the Analysis and Representation of Legal Contracts, 1999.
12. R.J. Clifford, Indexed Strings for Large Scale Genomic Analysis, 2002.
13. S.G. Barker, Database Access Control by Logic Programming, 2002.
14. A. Artikis, (joint supervision with J. Pitt), Executable Specification of Open Norm-Governed Computational Systems, 2003.
15. D. Huntley, Software for Customised Annotation of Genome Regions, 2005.
16. B. Sadighi Firozabadi, Decentralised Privilege Management for Access Control, 2005.
17. B. Bjurling (joint supervision with K. Broda), A Labelled Deductive System for Reasoning about Random Experiments, 2006.
18. I.V. Papatheodorou, Inference of Gene Relations from Microarray Experiments by Abductive Reasoning, 2006.
19. R.A. Craven, Execution Mechanisms for the Action Language C+, 2007.
20. A.D.H. Farrell, Modelling Contracts and Workflows for Verification and Enforcement, 2009.
21. D. Gaertner (joint supervision with K.L. Clark and F. Toni), Argumentation and Normative Reasoning, 2009.



# Table of Contents

Marek Sergot: A Memoir . . . . .	1
<i>Trevor Bench-Capon</i>	
The Scientific Contribution of Marek Sergot . . . . .	4
<i>Steve Barker, Andrew J.I. Jones, Antonis Kakas,</i> <i>Robert A. Kowalski, Alessio Lomuscio, Rob Miller,</i> <i>Stephen Muggleton, and Giovanni Sartor</i>	
<b>Part I: Logic Programming</b>	
Teleo-Reactive Abductive Logic Programs . . . . .	12
<i>Robert A. Kowalski and Fariba Sadri</i>	
Semi-negative Abductive Logic Programs with Implicative Integrity Constraints: Semantics and Properties . . . . .	33
<i>Paolo Mancarella and Francesca Toni</i>	
What Is Negation as Failure? . . . . .	52
<i>Dov M. Gabbay</i>	
<b>Part II: Temporal Reasoning and Action Languages</b>	
The Importance of the Past in Interval Temporal Logics: The Case of Propositional Neighborhood Logic . . . . .	79
<i>Dario Della Monica, Angelo Montanari, and Pietro Sala</i>	
Argumentation and the Event Calculus . . . . .	103
<i>Eugenios Hadjisoteriou and Antonis Kakas</i>	
Reactive Event Calculus for Monitoring Global Computing Applications . . . . .	123
<i>Stefano Bragaglia, Federico Chesani, Paola Mello,</i> <i>Marco Montali, and Paolo Torroni</i>	
Reasoning about the Intentions of Agents . . . . .	147
<i>Justin Blount and Michael Gelfond</i>	
Symbolic Model Checking for Temporal-Epistemic Logic . . . . .	172
<i>Alessio Lomuscio and Wojciech Penczek</i>	
GOAL Agents Instantiate Intention Logic . . . . .	196
<i>Koen V. Hindriks, Wiebe van der Hoek, and John-Jules Ch. Meyer</i>	

**Part III: AI and Law**

Open Texture and Argumentation: What Makes an Argument  
Persuasive? ..... 220  
*Trevor Bench-Capon*

Irrationality in Persuasive Argumentation ..... 234  
*Paul E. Dunne*

Some Reflections on Two Current Trends in Formal Argumentation ... 249  
*Henry Prakken*

**Part IV: Deontic Logic and Norm-Governed Systems**

On the Representation of Normative Sentences in FOL ..... 273  
*Andrew J.I. Jones and Steven O. Kimbrough*

Why Be Afraid of Identity? Comments on Sergot and Prakken’s  
Views ..... 295  
*Xavier Parent*

*Deon*<sup>+</sup>: Abduction and Constraints for Normative Reasoning ..... 308  
*Marco Alberti, Marco Gavanelli, and Evelina Lamma*

Contrary-To-Duties in Games ..... 329  
*Paolo Turrini, Xavier Parent, Leendert van der Torre, and  
Silvano Colombo Tosatto*

**Part V: Logical Approaches to Policies  
and Authorization**

Logical Approaches to Authorization Policies ..... 349  
*Steve Barker*

Decentralized Governance of Distributed Systems via Interaction  
Control ..... 374  
*Naftaly H. Minsky*

Managing User-Generated Content as a Knowledge Commons ..... 401  
*Jeremy Pitt*

**Author Index** ..... 425