

Commenced Publication in 1973

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison, UK

Josef Kittler, UK

Alfred Kobsa, USA

John C. Mitchell, USA

Oscar Nierstrasz, Switzerland

Bernhard Steffen, Germany

Demetri Terzopoulos, USA

Gerhard Weikum, Germany

Takeo Kanade, USA

Jon M. Kleinberg, USA

Friedemann Mattern, Switzerland

Moni Naor, Israel

C. Pandu Rangan, India

Madhu Sudan, USA

Doug Tygar, USA

FoLLI Publications on Logic, Language and Information

Subline of Lectures Notes in Computer Science

Subline Editors-in-Chief

Valentin Goranko, *Technical University, Lyngby, Denmark*

Erich Grädel, *RWTH Aachen University, Germany*

Michael Moortgat, *Utrecht University, The Netherlands*

Subline Area Editors

Nick Bezhanishvili, *Imperial College London, UK*

Anuj Dawar, *University of Cambridge, UK*

Philippe de Groote, *Inria-Lorraine, Nancy, France*

Gerhard Jäger, *University of Tübingen, Germany*

Fenrong Liu, *Tsinghua University, Beijing, China*

Eric Pacuit, *Tilburg University, The Netherlands*

Ruy de Queiroz, *Universidade Federal de Pernambuco, Brazil*

Ram Ramanujam, *Institute of Mathematical Sciences, Chennai, India*

Nick Bezhanishvili Valentin Goranko (Eds.)

Lectures on Logic and Computation

ESSLLI 2010, Copenhagen, Denmark, August 2010
ESSLLI 2011, Ljubljana, Slovenia, August 2011
Selected Lecture Notes

Volume Editors

Nick Bezhanishvili
Imperial College London
Department of Computing
180 Queen's Gate
London SW7 2AZ, UK
E-mail: nbezhani@doc.ic.ac.uk

Valentin Goranko
Technical University of Denmark
Department of Informatics
and Mathematical Modelling
Asmussens Alle, Bld. 305
2800 Kgs. Lyngby, Denmark
E-mail: vfgo@imm.dtu.dk

ISSN 0302-9743 e-ISSN 1611-3349
ISBN 978-3-642-31484-1 e-ISBN 978-3-642-31485-8
DOI 10.1007/978-3-642-31485-8
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2012940662

CR Subject Classification (1998): F.4.1, F.1, F.2.2, I.2.3, I.2.11, F.3

LNCS Sublibrary: SL 1 – Theoretical Computer Science and General Issues

© 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)

Preface

Nick Bezhanishvili¹ and Valentin Goranko²

¹ Imperial College London, UK

² Technical University of Denmark, Denmark

This volume comprises a collection of lecture notes for courses in the area of logic and computation presented at the 22nd European Summer School in Logic, Language and Information (ESSLI 2010), held in Copenhagen, Denmark, during August 9–20, 2010, and the 23rd European Summer School in Logic, Language and Information (ESSLI 2011), held in Ljubljana, during August 1–12, 2011.

The lecture notes are suitable both as study materials and as research references and address a wide audience, ranging from students to researchers in the respective fields.

All contributions have been refereed and commented in detail by anonymous reviewers and official second readers and then accordingly revised and polished. The scope of the volume is wide and diverse. It includes:

- *Proof Complexity of Non-classical Logics*, by Olaf Beyersdorff and Oliver Kutz. Second readers: Rosalie Iemhoff and Emil Jerabek.
- *Ten Problems of Deontic Logic and Normative Reasoning in Computer Science*, by Jan Broersen and Leendert van der Torre. Second reader: Guido Governatori.
- *A Short Introduction to Implicit Computational Complexity*, by Ugo Dal Lago. Second readers: Martin Hoffman and Kazushige Terui.
- *Strategies in Games: A Logic-Automata Study*, by Sujata Ghosh and Ram Ramanujam. Second readers: Nils Bulling and Dirk Wählter.
- *Introduction to Judgment Aggregation*, by Davide Grossi and Gabriella Pigozzi. Second readers: Franz Dietrich and Ulle Endriss.
- *Specification and Verification of Multi-agent Systems*, by Wojciech Jamroga and Wojciech Penczek. Second reader: Catalin Dima.

We would like to thank all authors, second readers and anonymous reviewers for their hard work and the good quality of their contributions.

Table of Contents

Proof Complexity of Non-classical Logics.....	1
<i>Olaf Beyersdorff and Oliver Kutz</i>	
Ten Problems of Deontic Logic and Normative Reasoning in Computer Science	55
<i>Jan Broersen and Leendert van der Torre</i>	
A Short Introduction to Implicit Computational Complexity	89
<i>Ugo Dal Lago</i>	
Strategies in Games: A Logic-Automata Study.....	110
<i>Sujata Ghosh and R. Ramanujam</i>	
Introduction to Judgment Aggregation.....	160
<i>Davide Grossi and Gabriella Pigozzi</i>	
Specification and Verification of Multi-Agent Systems	210
<i>Wojciech Jamroga and Wojciech Penczek</i>	
Author Index	265