

CAMBRIDGE

New Computer Science Titles from Cambridge!



Process Algebra: Equational Theories of Communicating Processes

J. C. M. Baeten, T. Basten,
and M. A. Reniers

*Cambridge Tracts in
Theoretical Computer Science*

\$80.00: Hb: 978-0-521-82049-3: 440 pp.

Revised [6] Report on the Algorithmic Language Scheme

Edited by Michael Sperber, R. Kent Dybvig,
Matthew Flatt, and Anton van Straaten

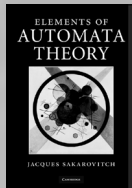
\$95.000: Hb: 978-0-521-19399-3: 320 pp.

Elements of Automata Theory

Jacques Sakarovitch

Translated by Reuben Thomas

\$145.00: Hb: 978-0-521-84425-3: 785 pp.



Constraint Handling Rules

Thom Frühwirth

\$80.00: Hb: 978-0-521-87776-3: 320 pp.

From Semantics to Computer Science

Essays in Honour of Gilles Kahn

Edited by Yves Bertot,
G rard Huet, Jean-Jacques L vy,
and Gordon Plotkin

\$130.00: Hb: 978-0-521-51825-3: 570 pp.



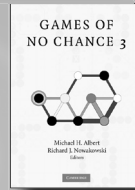
Games of No Chance 3

Edited by Michael H. Albert
and Richard J. Nowakowski

*Mathematical Sciences Research
Institute Publications*

\$99.00: Hb: 978-0-521-86134-2: 576 pp.

\$39.99: Pb: 978-0-521-67854-4



Modelling Systems

Practical Tools and Techniques
in Software Development
SECOND EDITION

John Fitzgerald, J rge
Peter Gorm Larsen

John Fitzgerald
and Peter Gorm Larsen

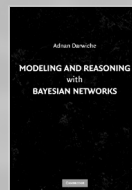
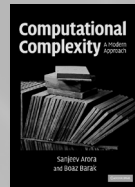
\$75.00: Hb: 978-0-521-89911-6: 304 pp.

2nd
Edition!

Computational Complexity A Modern Approach

Sanjeev Arora
and Boaz Barak

\$55.00: Hb: 978-0-521-42426-4: 594 pp.



Modeling and Reasoning with Bayesian Networks

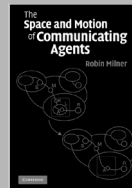
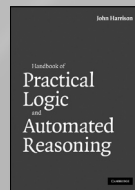
Adnan Darwiche

\$95.00: Hb: 978-0-521-88438-9: 560 pp.

Handbook of Practical Logic and Automated Reasoning

John Harrison

\$135.00: Hb: 978-0-521-89957-4: 702 pp.



The Space and Motion of Communicating Agents

Robin Milner

\$90.00: Hb: 978-0-521-49030-6: 214 pp.

\$45.00: Pb: 978-0-521-73833-0

Prices subject to change.

www.cambridge.org/us/computerscience



CAMBRIDGE
UNIVERSITY PRESS

1584 • 2009

425 YEARS OF CAMBRIDGE
PRINTING AND PUBLISHING

INSTRUCTIONS TO AUTHORS

Scope

Papers may describe original technical work, survey an area, or present a tutorial; and may be either short or long. Anything related to functional programming is of interest, including: *foundations* (semantics, abstract interpretation, lambda calculi, rewriting, logic, type theory, category theory); *implementation* (compilation, architectures, parallelism, garbage collection, I/O, debugging, profiling); *linguistics* (pure and impure language features, non-determinism, side effects, logical variables, relation to other programming paradigms, proofs about programs, program transformation, program synthesis, partial evaluation); *applications* (applications programs, practical experience, programming techniques, prototyping).

Book Reviews

Books for review, or suggestions for reviews, should be sent to the reviews editor, Simon Thompson (address on inside front cover).

Submission of manuscripts

Papers may be submitted to the Editors-in-Chief or any of the editors or directly to JFP-ed@cambridge.org. Please choose an Editor whose research interests most closely match your paper; if in doubt, send your paper to one of the Editors-in-Chief. E-mail and postal addresses for the editors appear on the inside front cover.

Please refer to journals.cambridge.org/JFP for all detailed information associated with the submission of papers to the journal.

Offprints

No paper offprints are provided, but a pdf of the published article will be sent to the corresponding author.

Incremental Publishing and DOIs

The Journal of Functional Programming now publishes articles incrementally online (at Cambridge Journals Online: journals.cambridge.org) as soon as author corrections have been completed and before they join a printed issue. A new reference has now been added to the first page of the article in the journal catchline. This is the DOI—The Digital Object Identifier. This is a global publishers' standard. A unique DOI number is created for each published item. It can be used for citation purposes instead of volume, issue and page numbers. It therefore suits the early citation of articles which are published on the web before they have appeared in a printed issue. journals.cambridge.org/JFP

SUBSCRIPTIONS

Journal of Functional Programming (ISSN: 0956-7968 print, 1469-7653 electronic) is published in five parts in 2009, January, March, May/July, September and November. The subscription price (excluding VAT) of Volume 19, 2009, is £400 net (USA, Canada and Mexico US\$800) institutions print and electronic; institutions electronic only is £350, \$700; individuals print only is £130, \$260; Member rates available—please enquire; single parts cost £60 net (USA, Canada and Mexico US\$120) plus postage. Five parts, including one double issue, form a volume in 2009. EU subscribers (outside the UK) who are not registered for VAT should add VAT at their country's rate. VAT registered subscribers should provide their VAT registration number. Orders, which must be accompanied by payment, may be sent to any bookseller, subscription agent or to the publisher: Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 8RU, or in the USA, Canada and Mexico to Cambridge University Press, Journals Fulfillment Department, 100 Brook Hill Drive, West Nyack, New York 10994–2133. Prices include delivery by air where appropriate. Application to mail at periodicals postage rates is pending at New York, NY and at additional mailing offices. Japanese prices for institutions are available from Kinokuniya Company Ltd, P.O. Box 55, Chitose, Tokyo 156, Japan. Postmaster: send address changes in USA, Canada and Mexico to *Journal of Functional Programming*, Cambridge University Press, 100 Brook Hill Drive, West Nyack, New York 10994–2133. Claims for missing issues should be made immediately on receipt of the subsequent issue.

COPYING

This journal is registered with the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA, 01923, USA. Organisations in the USA who are also registered with the C.C.C. may therefore copy material (beyond the limits permitted by sections 107 and 108 of US copyright law) subject to payment to C.C.C. of the per-copy fee of \$16. This consent does not extend to multiple copying for promotional or commercial purposes. Code 0956-7968/09 \$16.

Organisations authorised by the Copyright Licensing Agency may also copy material subject to the usual conditions.

ISI Tear Service, 3501 Market Street, Philadelphia, Pennsylvania 19104, USA, is authorised to supply single copies of separate articles for private use only.

For all other use, permission should be sought from Cambridge or the American branch of Cambridge University Press.

JOURNAL OF
Functional Programming

VOLUME 19 PARTS 5 SEPTEMBER 2009

CONTENTS

| | |
|--|-----|
| Editorial XAVIER LEROY AND MATTHIAS FELLEISEN | 489 |
| FUNCTIONAL PEARLS The Bird Tree RALF HINZE | 491 |
| Finally tagless, partially evaluated: Tagless staged interpreters for simpler typed languages JACQUES CARETTE, OLEG KISELYOV AND CHUNG-CHIEH SHAN | 509 |
| Algebra of programming in Agda: Dependent types for relational program derivation SHIN-CHENG MU, HSIANG-SHANG KO AND PATRIK JANSSON | 545 |
| The λ -calculus with constructors: Syntax, confluence and separation ARIEL ARBISER, ALEXANDRE MIQUEL AND ALEJANDRO RÍOS | 581 |

Cambridge Journals Online
For further information about this journal
please go to the journal website at:
journals.cambridge.org/jfp



Mixed Sources
Product group from well-managed
forests and other controlled sources
www.fsc.org Cert no. SA-COC-1527
© 1996 Forest Stewardship Council

CAMBRIDGE
UNIVERSITY PRESS