CAMBRIDGE

New Functional Programming Titles from Cambridge University Press!



CATEGORY

THEORY

Web Data Management

Serge Abiteboul, Ioana Manolescu, Philippe Rigaux, Marie-Christine Rousset, and Pierre Senellart \$75.00: Hb: 978-1-107-01243-1: 450 pp.

Advanced Topics in **Bisimulation** and Coinduction

Edited by Davide Sangiorgi and Jan Rutten Cambridge Tracts in Theoretical Computer Science \$99.00: Hb: 978-1-107-00497-9: 340 pp.

Proofs and Computations

Helmut Schwichtenberg and Stanley S. Wainer Perspectives in Logic \$90.00: Hb: 978-0-521-51769-0: 480 pp.

An Introduction to **Category Theory**

Harold Simmons

\$90.00: Hb: 978-1-107-01087-1 \$29.99: Pb: 978-0-521-28304-5: 236 pp.

www.cambridge.org/us/computerscience 800.872.7423

CAMBRIDGE UNIVERSITY PRESS



Nissim Francez and Shulv Wintner \$95.00: Hb: 978-1-107-01417-6: 324 pp.

Introduction to **Bisimulation and** Coinduction

Davide Sangiorgi \$80.00: Hb: 978-1-107-00363-7:

Product Lines The AMPLE Way

Edited by Awais Rashid, Jean-Claude Royer, and Andreas Rummler \$75.00: Hb: 978-0-521-76722-4: 472 pp.

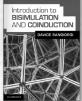
Programming in Haskell

Graham Hutton \$55.00: Pb: 978-0-521-69269-4: 184 pp.



UNIFICATION

GRAMMAR





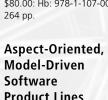


Graham Hutto

Programming

Prices subject to change.

in Haskell



CAMBRIDGE

JOURNALS

Robotica

Editor-in-Chief

G. S. Chirikjian, Johns Hopkins University, USA

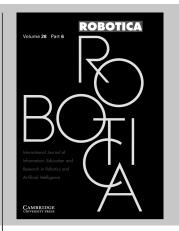
An Official Journal of the International Federation of Robotics

Robotica provides an international forum for the multidisciplinary subject of robotics and encourages developments in this important field of automation with regard to industry, education and research. It covers the many aspects of robotics, including sensory perception, software, kinematics and dynamics involved in robot design, robot task planning and description, intelligibility of skilled motion, applications of robots in the service industries, world model representation, artificial intelligence, development of relevant educational courses, training methods, economic and cost problems and other items of theoretical and practical interest.

Price information is available at: http://journals.cambridge.org/rob

Free email alerts Keep up-to-date with new material – sign up at http://journals.cambridge.org/rob-alerts

For free online content visit: http://journals.cambridge.org/rob



Robotica is available online at: http://journals.cambridge.org/rob

To subscribe contact Customer Services

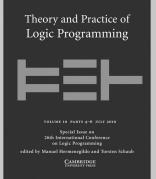
in Cambridge: Phone +44 (0)1223 326070 Fax +44 (0)1223 325150 Email journals@cambridge.org

in New York: Phone +1 (845) 353 7500 Fax +1 (845) 353 4141 Email subscriptions_newyork@cambridge.org



Theory and Practice of Logic Programming

Published for the Association for Logic programming



Editor-in-Chief I Niemelä, Helsinki University of Technology, Finland

Theory and Practice of Logic Programming emphasises both the theory and practice of logic programming. Logic programming applies to all areas of artificial intelligence and computer science and is fundamental to them. Among the topics covered are AI applications that use logic programming, logic programming methodologies, specification, analysis and verification of systems, inductive logic programming, multi-relational data mining, natural language processing, knowledge representation, non-monotonic reasoning, semantic web reasoning, databases, implementations and architectures and constraint logic programming. Theory and Practice of Logic Programming is available online at: http://journals.cambridge.org/tlp

To subscribe contact Customer Services

in Cambridge: Phone +44 (0)1223 326070 Fax +44 (0)1223 325150 Email journals@cambridge.org

in New York: Phone +1 (845) 353 7500 Fax +1 (845) 353 4141 Email subscriptions_newyork@cambridge.org

Price information is available at: http://journals.cambridge.org/tlp

Free email alerts

Keep up-to-date with new material – sign up at http://journals.cambridge.org/tlp-alerts

> For free online content visit: http://journals.cambridge.org/tlp



Natural Language Engineering

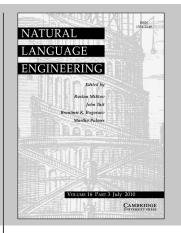
Executive Editor Ruslan Mitkov, *University of Wolverhampton, UK*

Natural Language Engineering meets the needs of professionals and researchers working in all areas of computerised language processing, whether from the perspective of theoretical or descriptive linguistics, lexicology, computer science or engineering. Its aim is to bridge the gap between traditional computational linguistics research and the implementation of practical applications with potential real-world use. The journal publishes research articles on a broad range of topics, an industry-watch column and book reviews. JNLE now includes surveys, as well as squibs discussing specific problems.

Price information is available at: http://journals.cambridge.org/nle

Free email alerts Keep up-to-date with new material – sign up at http://journals.cambridge.org/nle-alerts

For free online content visit: http://journals.cambridge.org/nle



Natural Language Engineering is available online at: http://journals.cambridge.org/nle

To subscribe contact Customer Services

in Cambridge: Phone +44 (0)1223 326070 Fax +44 (0)1223 325150 Email journals@cambridge.org

in New York: Phone +1 (845) 353 7500 Fax +1 (845) 353 4141 Email subscriptions_newyork@cambridge.org



Organised Sound

electroacoustic composition. It provides a unique forum

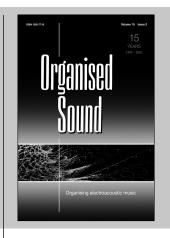
results of their research as they affect musical issues. An

for anyone interested in electroacoustic music studies,

its creation and related developments to share the

accompanying DVD is sent to subscribers annually.

Editor Leigh Landy, De Montfort University, Leicester, UK



Organised Sound is an international peer-reviewed journal
which focuses on the rapidly developing methods and
issues arising from the use of technology in music today.Organised Sound
is available online at:
http://journals.cambridge.org/osoIt concentrates upon the impact which the application of
technology is having upon music in a variety of genres,
including multimedia, performance art, sound sculpture
and music ranging from popular idioms to experimentalOrganised Sound
is available online at:
http://journals.cambridge.org/oso

To subscribe contact Customer Services

in Cambridge: Phone +44 (0)1223 326070 Fax +44 (0)1223 325150 Email journals@cambridge.org

in New York: Phone (845) 353 7500 Fax (845) 353 4141 Email subscriptions_newyork@cambridge.org

Free email alerts Keep up-to-date with new material – sign up at

journals.cambridge.org/register

For free online content visit: http://journals.cambridge.org/oso



The Knowledge Engineering Review

Editors-in-Chief

Peter McBurney, University of Liverpool, UK Simon Parsons, Brooklyn College, City University of New York, USA

The Knowledge Engineering Review is committed to the development of the field of artificial intelligence and the clarification and dissemination of its methods and concepts. *KER* publishes analyses – high quality surveys providing balanced but critical presentations of the primary concepts in an area; technical tutorials – detailed introductions to an area; application and country surveys commentaries and debates; book reviews; and a popular 'from the journals' section, providing the contents of current journals in theoretical and applied artificial intelligence.



The Knowledge Engineering Review is available online at: http://journals.cambridge.org/ker

To subscribe contact Customer Services

in Cambridge: Phone +44 (0)1223 326070 Fax +44 (0)1223 325150 Email journals@cambridge.org

in New York: Phone +1 (845) 353 7500 Fax +1 (845) 353 4141 Email subscriptions_newyork@cambridge.org

Price information is available at: http://journals.cambridge.org/ker

Free email alerts Keep up-to-date with new material – sign up at http://journals.cambridge.org/ker-alerts

For free online content visit: http://journals.cambridge.org/ker



Mathematical Structures in Computer Science

Editor-in-Chief

G. Longo, CNRS and Ecole Normale Supérieure, Paris, France

Mathematical Structures in Computer Science is a journal of theoretical computer science which focuses on the application of ideas from the structural side of mathematics and mathematical logic to computer science. The journal aims to bridge the gap between theoretical contributions and software design, publishing original papers of a high standard and broad surveys with original perspectives in all areas of computing, provided that ideas or results from logic, algebra, geometry, category theory or other areas of logic and mathematics form a basis for the work.



Mathematical Structures in Computer Science is available online at: http://journals.cambridge.org/msc

To subscribe contact Customer Services

in Cambridge: Phone +44 (0)1223 326070 Fax +44 (0)1223 325150 Email journals@cambridge.org

in New York: Phone +1 (845) 353 7500 Fax +1 (845) 353 4141 Email subscriptions_newyork@cambridge.org

Price information is available at: http://journals.cambridge.org/msc

Free email alerts Keep up-to-date with new material – sign up at http://journals.cambridge.org/msc-alerts

For free online content visit: http://journals.cambridge.org/msc



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 as First View (at Cambridge Journals Online: journals.cambridge.org) as soon as author corrections have been completed and before they join a printed issue. A reference is 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 2012, January, March/May, July, September and November. The subscription price (excluding VAT) of Volume 22, 2012, is £395 net (USA, Canada and Mexico US\$640) institutions print and electronic; institutions electronic only is £336, \$525; individuals print only is £110, \$170; Member rates available – please enquire; single parts cost £60 net (USA, Canada and Mexico US\$120) plus postage. 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.

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 0956-7968/12 \$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.





VOLUME 22 PART 1 JANUARY 2012

CONTENTS

ARTICLES	
CUFP 2011 Workshop Report	
ANIL MADHAVAPEDDY, YARON MINSKY AND MARIUS ERIKSEN	1
A compiled implementation of normalisation by evaluation	
KLAUS AEHLIG, FLORIAN HAFTMANN AND TOBIAS NIPKOW	9
Semantic subtyping with an SMT solver	
GAVIN M. BIERMAN, ANDREW D. GORDON, CĂTĂLIN HRIȚCU	
AND DAVID LANGWORTHY	31

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

Aperor



MIX Paper from responsible sources FSC[®] C018127

