# Lecture Notes in Computer Science

6546

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

#### **Editorial Board**

David Hutchison

Lancaster University, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Alfred Kobsa

University of California, Irvine, CA, USA

Friedemann Mattern

ETH Zurich, Switzerland

John C. Mitchell

Stanford University, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz

University of Bern, Switzerland

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

TU Dortmund University, Germany

Madhu Sudan

Microsoft Research, Cambridge, MA, USA

Demetri Terzopoulos

University of California, Los Angeles, CA, USA

Doug Tygar

University of California, Berkeley, CA, USA

Gerhard Weikum

Max Planck Institute for Informatics, Saarbruecken, Germany

Rex Page Zoltán Horváth Viktória Zsók (Eds.)

# Trends in Functional Programming

11th International Symposium, TFP 2010 Norman, OK, USA, May 17-19, 2010 Revised Selected Papers



#### Volume Editors

Rex Page

University of Oklahoma, School of Computer Science 110 West Boyd Street, Norman, OK 73019, USA

E-mail: page@ou.edu

Zoltán Horváth

Eötvös Loránd University, Faculty of Informatics Department of Programming Languages and Compilers Pázmány Péter sétány 1/C, 1117 Budpest, Hungary E-mail: hz@inf.elte.hu

Viktória Zsók

Eötvös Loránd University, Faculty of Informatics Department of Programming Languages and Compilers Pázmány Péter sétány 1/C, 1117 Budpest, Hungary

E-mail: zsv@inf.elte.hu

ISSN 0302-9743 e-ISSN 1611-3349 ISBN 978-3-642-22940-4 e-ISBN 978-3-642-22941-1 DOI 10.1007/978-3-642-22941-1 Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2011934807

CR Subject Classification (1998): D.1.1, D.1, D.3.2, F.3.3, D.1-2

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

#### © Springer-Verlag Berlin Heidelberg 2011

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

The 11th Symposium on Trends in Functional Programming took place on the University of Oklahoma campus in Norman, Oklahoma, May 17-19, 2010. The program included presentations of 26 papers submitted by researchers from six nations and an invited talk by J. Strother Moore on machine reasoning so well received that the question/answer session continued for a full hour beyond the talk, well into the lunch period. Most of the authors submitted revisions of their papers, based in part on responses to their presentations. The revisions were reviewed and discussed in detail by the Program Committee, and 13 of them were accepted for publication in this volume.

A little over half of the revisions accepted for publication were student papers (that is, papers with a student as first author). Following a long-established custom, the Program Committee designated one of them as the best student paper. This year the award went to Stephen Chang for his paper, with co-authors David van Horn and Matthias Felleisen, describing a way to evaluate a call-byneed  $\lambda$ -calculus on the control stack. The Program Committee appreciates the originality and insight in this work and congratulates Stephen Chang on earning the award.

TFP aspires to be a forum for new directions in functional programming research. This year was no exception. Presentations covered new ideas for refactoring, managing source-code complexity, functional language implementation, graphical languages, applications of functional programming in pure mathematics, type theory, multitasking and parallel processing, distributed systems, scientific modeling, domain-specific languages, hardware design, education, and testing.

The editors want to thank the Program Committee and all of the referees for their diligence and for their well-considered reviews. We also want to thank the University of Oklahoma and Erlang Solutions Ltd, for their generous support. Finally, we thank the participants for their lively attention during the symposium. We trust that a good time was had by all.

December 2010

Rex Page Zoltán Horváth Viktória Zsók

## Organization

### **Program Committee**

Peter Achten

Emil Axelsson Francesco Cesarini John Clements Daniel Cooke

Nils Anders Danielsson

Jared Davis Martin Erwig Ruben Gamboa Jurriaan Hage Kevin Hammond Michael Hanus

Zoltán Horváth (symposium

co-chair) Garrin Kimmell Pieter Koopman

Hans-Wolfgang Loidl

Rita Loogen Jay McCarthy Greg Michaelson Marco T. Morazán Rodney Oldehoeft Rex Page (Chair) Ricardo Peña Walid Taha Sam Tobin-Hochstadt

Simon Thompson

Phil Trinder

Marko van Eekelen

Viktória Zsók (symposium

co-chair)

Radboud University Nijmegen,

The Netherlands

Chalmers University of Technology, Sweden Erlang Training and Consulting, Ltd., UK California Polytechnic State University, USA

Texas Tech University, USA University of Nottingham, UK Centaur Technology, USA Oregon State University, USA University of Wyoming, USA

Utrecht University, The Netherlands

University of St. Andrews, UK

Christian Albrechts University zu Kiel,

Germany

Eötvös Loránd University, HU University of Kansas, USA Radboud University Nijmegen,

The Netherlands

Heriot-Watt University, UK

Philipps University Marburg, Germany Brigham Young University, USA

Heriot-Watt University, UK Seton Hall University, USA

Krell Institute, USA

University of Oklahoma, USA

Complutense University of Madrid, Spain

Rice University, USA

Northeastern University, USA

University of Kent, UK Heriot-Watt University, UK

Radboud University Nijmegen and Open

University, The Netherlands

Eötvös Loránd University, HU

## VIII Organization

# **Sponsoring Institutions**

Erlang Solutions Ltd. (UK) The University of Oklahoma (USA)

# **Table of Contents**

Evaluating Call-by-Need on the Control Stack	1
Typing Coroutines	16
An Expression Processor: A Case Study in Refactoring Haskell Programs	31
Static Balance Checking for First-Class Modular Systems of Equations	50
Graphical and Incremental Type Inference: A Graph Transformation Approach	66
Hygienic Macros for ACL2	84
What's the Matter with Kansas Lava?	102
Types and Type Families for Hardware Simulation and Synthesis: The Internals and Externals of Kansas Lava	118
Testing with Functional Reference Implementations	134
Every Animation Should Have a Beginning, a Middle, and an End: A Case Study of Using a Functor-Based Animation Language  Kevin Matlage and Andy Gill	150
Functional Video Games in the CS1 Classroom	166

## X Table of Contents

ComputErl—Erlang-Based Framework for Many Task Computing Michał Ptaszek and Maciej Malawski	184
Monad Factory: Type-Indexed Monads	198
Author Index	215