First International Workshop on Rewriting Techniques for Program Transformations and Evaluation

WPTE'14, July 13, 2014, Vienna, Austria

Edited by

Manfred Schmidt-Schauß
Masahiko Sakai
David Sabel
Yuki Chiba

Editors

Manfred Schmidt-Schauß
Institute for Informatics
Computer Science and Mathematics Department
Goethe-University Frankfurt am Main
schauss@ki.cs.uni-frankfurt.de

Masahiko Sakai
Graduate School of Information Science
Department of Computer Science
and Mathematical Informatics
Nagoya University
sakai@is.nagoya-u.ac.jp

David Sabel
Institute for Informatics
Computer Science and Mathematics Department
Goethe-University Frankfurt am Main
sabel@ki.cs.uni-frankfurt.de

Yuki Chiba
School of Information Science
Japan Advanced Institute of Science
and Technology
chiba@jaist.ac.jp

ACM Classification 1998
A.0 Conference proceedings, D.3.1 Formal Definitions and Theory, D.3.4 Translator writing systems and compiler generators, F.3.1 Specifying and Verifying and Reasoning about Programs, F.3.2 Semantics of Programming Languages, F.4.1 Mathematical Logic, F.4.2 Grammars and Other Rewriting Systems, I.2.2 Automatic Programming

ISBN 978-3-939897-70-5

Published online and open access by
Schloss Dagstuhl – Leibniz-Zentrum für Informatik GmbH, Dagstuhl Publishing, Saarbrücken/Wadern, Germany. Online available at http://www.dagstuhl.de/dagpub/978-3-939897-70-5.

Publication date
July, 2014

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de.

Digital Object Identifier: 10.4230/OASIcs.WPTE.2014.i

ISBN 978-3-939897-70-5 **ISSN 2190-6807** **http://www.dagstuhl.de/oasics**

OASIcs – OpenAccess Series in Informatics

OASIcs aims at a suitable publication venue to publish peer-reviewed collections of papers emerging from a scientific event. OASIcs volumes are published according to the principle of Open Access, i.e., they are available online and free of charge.

ISSN 2190-6807

www.dagstuhl.de/oasics

Contents

1st International Workshop on Rewriting Techniques for Program Transformations and Evaluation (WPTE'14).
Editors: Manfred Schmidt-Schauß, Masahiko Sakai, David Sabel, and Yuki Chiba
OpenAccess Series in Informatics
OASICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Workshop Organization

FLoC 2014 Workshop Chair

Stefan Szeider	Vienna University of Technology, Austria

RTA/TLCA 2014 Workshop Chair

Aleksy Schubert	Warsaw University, Poland

WPTE 2014 Organizers

Manfred Schmidt-Schauß	Goethe-University Frankfurt am Main, Germany
Masahiko Sakai	Nagoya University, Japan
David Sabel	Goethe-University Frankfurt am Main, Germany
Yuki Chiba	Japan Advanced Institute of Science and Technology, Japan

WPTE 2014 Sponsor

Vereinigung von Freunden und Förderern
der Johann Wolfgang Goethe-Universität Frankfurt am Main e.V.

Program Chairs

Masahiko Sakai	Nagoya University, Japan
Manfred Schmidt-Schauß	Goethe-University Frankfurt am Main, Germany

Program Committee

Takahito Aoto	RIEC, Tohoku University, Japan
Yuki Chiba	Japan Advanced Institute of Science and Technology, Japan
Fer-Jan de Vries	University of Leicester, United Kingdom
Santiago Escobar	Universitat Politècnica de València, Spain
Maribel Fernández	King's College London, United Kingdom
Johan Jeuring	Open Universiteit Nederland & Universiteit Utrecht, The Netherlands
Delia Kesner	Université Paris-Diderot, France
Sergueï Lenglet	Université de Lorraine, France
Elena Machkasova	University of Minnesota, Morris, United States
Joachim Niehren	INRIA Lille, France
David Sabel	Goethe-University Frankfurt am Main, Germany
Masahiko Sakai	Nagoya University, Japan
Manfred Schmidt-Schauß	Goethe-University Frankfurt am Main, Germany
Eijiro Sumii	Tohoku University, Japan
Janis Voigtländer	University of Bonn, Germany
Harald Zankl	University of Innsbruck, Austria

External Reviewers

Tom Ridge
Haruhiko Sato

1st International Workshop on Rewriting Techniques for Program Transformations and Evaluation (WPTE'14).
Editors: Manfred Schmidt-Schauß, Masahiko Sakai, David Sabel, and Yuki Chiba
OpenAccess Series in Informatics
OASICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Preface

This volume contains the papers presented at the *First International Workshop on Rewriting Techniques for Program Transformations and Evaluation (WPTE 2014)* which was held on July 13, 2014 in Vienna, Austria during the *Vienna Summer of Logic 2014 (VSL 2014)* as a workshop of the *Sixth Federated Logic Conference (FLoC 2014)*. WPTE 2014 was affiliated with the *25th International Conference on Rewriting Techniques and Applications joined with the 12th International Conference on Typed Lambda Calculi and Applications (RTA/TLCA 2014)*.

Scope of WPTE

Verification and validation of properties of programs, optimizing and compiling programs, and generating programs can benefit from the application of rewriting techniques. Source-level program transformations are used in compilation to simplify and optimize programs, in code refactoring to improve the design of programs; and in software verification and code validation, program transformations are used to translate and/or simplify programs into the forms suitable for specific verification purposes or tests. Those program transformations can be translations from one language into another one, transformations inside a single language, or the change of the evaluation strategy within the same language.

Since rewriting techniques are of great help for studying correctness of program transformations, translations and evaluation, the aim of WPTE is to bring together the researchers working on program transformations, evaluation, and operationally based programming language semantics, using rewriting methods, in order to share the techniques and recent developments and to exchange ideas to encourage further activation of research in this area.

Topics in the scope of WPTE include the correctness of program transformations, optimizations and translations; program transformations for proving termination, confluence and other properties; correctness of evaluation strategies; operational semantics of programs, operationally-based program equivalences such as contextual equivalences and bisimulations; cost-models for arguing about the optimizing power of transformations and the costs of evaluation; program transformations for verification and theorem proving purposes; translation, simulation, equivalence of programs with different formalisms, and evaluation strategies; program transformations for applying rewriting techniques to programs in specific programming languages; program inversions and program synthesis.

WPTE 2014

For WPTE 2014 six regular research papers were accepted out of the submissions. Additionally the program of WPTE contained the following talks on work in progress

- Yuki Chiba: *Verifying the Correctness of Tupling Transformations based on Conditional Rewriting*
- Guillaume Madelaine, Cédric Lhoussaine and Joachim Niehren: *Attractor Equivalence: An Observational Semantics for Reaction Networks*
- Georg Moser and Michael Schaper: *A Complexity Preserving Transformation from Jinja Bytecode to Rewrite Systems*

WPTE 2014 had two Program Chairs to allow submissions from the program committee and also from the chairs. Each submission was reviewed by at least three members of the

1st International Workshop on Rewriting Techniques for Program Transformations and Evaluation (WPTE'14).
Editors: Manfred Schmidt-Schauß, Masahiko Sakai, David Sabel, and Yuki Chiba
OpenAccess Series in Informatics
OASICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Program Committee, with the help of two external reviewers. Reviewing of submissions with a program chair as coauthor was handled by the respective other program chair. This politics also permitted to cope with other conflicts of interest where a chair was involved.

Paper submission, reviewing, and the electronic meeting of the program committee used the great EasyChair system of Andrei Voronkov, which was also indispensable for preparing the WPTE program and collecting the papers for these proceedings. However, in its current state, the conflicts of interest between a chair and a submission cannot be properly dealt and are solved without EasyChair.

In addition to the contributed papers, the WPTE program contained an invited talk by Andrew Gill with title "*HERMIT: An Equational Reasoning Model to Implementation Rewrite System for Haskell*".

Acknowledgment

We thank the "Vereinigung von Freunden und Förderern der Johann Wolfgang Goethe Universität Frankfurt am Main e.V." for its financial support of WPTE 2014. Particularly, we thank Dustin Ortlepp for his advice during the application and the Dean of the Computer Science and Mathematics Department of the Goethe-University Thorsten Theobald for his support on our application.

Many people helped to make WPTE a successful event. We thank the organizers of VSL 2014: Florian Aigner, Matthias Baaz, Katinka Böhm, Agata Ciabattoni, Barbara Dolezal-Rainer, Thomas Eiter, Chris Fermüller, Sy David Friedman, Ursula Gerber, Georg Gottlob, Bernhard Gramlich, Franziska Gusel, Thomas Henzinger, Elisabeth Hofmann, Katarina Jurik, Jakob Kellner, Konstantin Korovin, Laura Kovács, Oliver Lehmann, Alexander Leitsch, Nysret Musliu, Thomas Pani, Anna Petukhova, Markus Pichlmair, Toni Pisjak, Norbert Preining, Vesna Sabljakovic-Fritz, Gernot Salzer, Matthias Schlögel, Martina Seidl, Stefan Szeider, Helmut Veith, Daniel Weller and the organizers of FLoC 2014 Matthias Baaz, Azadeh Farzan, Thomas Krennwallner, Moshe Y. Vardi, Helmut Veith, and especially the FLoC Workshop Chair Stefan Szeider and the FLoC Workshop Co-Chair Stefan Rümmele.

We thank the organizers of RTA/TLCA 2014 for hosting our workshop, we are particularly indebted to the RTA/TLCA Workshop Chair Aleksy Schubert for his help in applying for this workshop.

We thank our publisher Schloss Dagstuhl – Leibniz-Zentrum für Informatik for publishing our proceedings in the OpenAccess Series in Informatics (OASIcs). In particular we would like to thank Marc Herbstritt for his very helpful and always prompt support during production of the OASIcs proceedings.

Finally we thank the members of the program committee for their careful reviewing of all submissions and we thank the participants for their valuable contributions.

June 2014

Manfred Schmidt-Schauß
Masahiko Sakai
David Sabel
Yuki Chiba

The Collection of all Abstracts of the Talks at WPTE 2014

The aim of this chapter is to document all talks of the "First International Workshop on Rewriting Techniques for Program Transformations and Evaluation" (WPTE 2014). Hence, this collection contains all abstracts of talks held at WPTE 2014. The abstracts are ordered alphabetically by author names. Further information and e.g. extended abstracts on the talks on work in progress, can also be found on the handouts of the Vienna Summer of Logic 2014 (VSL 2014) which were distributed on USB flash drives to all participants of VSL 2014. For a majority of the contributions the full versions of the papers are available in these proceedings.

Verifying the Correctness of Tupling Transformations based on Conditional Rewriting

Author: Yuki Chiba

Abstract:

Chiba et al. (2010) proposed a framework of program transformation by templates based on term rewriting. Their framework can deal with tupling, which improves efficiency of programs. Outputs of their framework, however, may not always be more efficient than inputs. In this paper, we propose a technique to show the correctness of tupling based on conditional term rewriting. We give an extended equational logic in order to add conditional rules.

HERMIT: An Equational Reasoning Model to Implementation Rewrite System for Haskell

Author: Andrew Gill

Abstract:

HERMIT is a rewrite system for Haskell. Haskell, a pure functional programming language, is an ideal candidate for performing equational reasoning. Equational reasoning, replacing equals with equals, is a tunneling mechanism between different, but equivalent, programs. The ability to be agile in representation and implementation, but retain equivalence, brings many benefits. Post-hoc optimization is one obvious application of representation agility.

1st International Workshop on Rewriting Techniques for Program Transformations and Evaluation (WPTE'14).
Editors: Manfred Schmidt-Schauß, Masahiko Sakai, David Sabel, and Yuki Chiba
OpenAccess Series in Informatics
OASICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Notes on Structure-Preserving Transformations of Conditional Term Rewrite Systems

Authors: Karl Gmeiner and Naoki Nishida

Abstract:

Transforming conditional term rewrite systems (CTRSs) into unconditional systems (TRSs) is a common approach to analyze properties of CTRSs via the simpler framework of unconditional rewriting. In the past many different transformations have been introduced for this purpose. One class of transformations, so-called unravelings, have been analyzed extensively in the past.

In this paper we provide an overview on another class of transformations that we call structure-preserving transformations. In these transformations the structure of the conditional rule, in particular their left-hand side is preserved in contrast to unravelings. We provide an overview of transformations of this type and define a new transformation that improves previous approaches.

Attractor Equivalence: An Observational Semantics for Reaction Networks

Authors: Guillaume Madelaine, Cédric Lhoussaine and Joachim Niehren

Abstract:

We study observational semantics for networks of chemical reactions as used in systems biology. Reaction networks without kinetic information, as we consider, can be identified with Petri nets. We present a new observational semantics for reaction networks that we call the attractor equivalence. The main idea of the attractor equivalence is to observe reachable attractors and reachability of an attractor divergence in all possible contexts. The attractor equivalence can support powerful simplifications for reaction networks as we illustrate at the example of the *Tet-On* system. Alternative semantics based on bisimulations or traces, in contrast, do not support all needed simplifications.

Verifying Optimizations for Concurrent Programs

Authors: William Mansky and Elsa L. Gunter

Abstract:

While program correctness for compiled languages depends fundamentally on compiler correctness, compiler optimizations are not usually formally verified due to the effort involved, particularly in the presence of concurrency. In this paper, we present a framework for stating and reasoning about compiler optimizations and transformations on programs in the presence of relaxed memory models. The core of the framework is the PTRANS specification language, in which program transformations are expressed as rewrites on control flow graphs with temporal logic side conditions. We demonstrate our technique by verifying the correctness of a redundant store elimination optimization in a simple LLVM-like intermediate language, relying on a theorem that allows us to lift single-thread simulation relations to simulations on multithreaded programs.

A Complexity Preserving Transformation from Jinja Bytecode to Rewrite Systems

Authors: Georg Moser and Michael Schaper

Abstract:

We revisit known transformations from object-oriented bytecode programs to rewrite systems from the viewpoint of runtime complexity. Suitably generalising the constructions proposed in the literature, we define an alternative representation of Jinja bytecode (JBC) executions as *computation graphs* from which we obtain a representation of JBC executions as *constrained rewrite systems*. We show that the transformation is *complexity preserving*. We restrict to non-recursive methods and make use of heap shape pre-analyses.

Inverse Unfold Problem and Its Heuristic Solving

Authors: Masanori Nagashima, Tomofumi Kato, Masahiko Sakai, and Naoki Nishida

Abstract:

Unfold/fold transformations have been widely studied in various programming paradigms and are used in program transformations, theorem proving, and so on. This paper, by using an example, show that restoring an one-step unfolding is not easy, i.e., a challenging task, since some rules used by unfolding may be lost. We formalize this problem by regarding one-step program transformation as a relation. Next we discuss some issues on a specific framework, called pure-constructor systems, which constitute a subclass of conditional term rewriting systems. We show that the inverse of T preserves rewrite relations if T preserves rewrite relations and the signature. We propose a heuristic procedure to solve the problem, and show its successful examples. We improve the procedure, and show examples for which the improvement takes effect.

On Proving Soundness of the Computationally Equivalent Transformation for Normal Conditional Term Rewriting Systems by Using Unravelings

Authors: Naoki Nishida, Makishi Yanagisawa, and Karl Gmeiner

Abstract:

In this paper, we show that the SR transformation, a computationally equivalent transformation proposed by Şerbănuţă and Roşu, is sound for weakly left-linear normal conditional term rewriting systems (CTRS). Here, soundness for a CTRS means that reduction of the transformed unconditional term rewriting system (TRS) creates no undesired reduction for the CTRS. We first show that every reduction sequence of the transformed TRS starting with a term corresponding to the one considered on the CTRS is simulated by the reduction of the TRS obtained by the simultaneous unraveling. Then, we use the fact that the unraveling is sound for weakly left-linear normal CTRSs.

Structural Rewriting in the π-Calculus

Author: David Sabel

Abstract:

We consider reduction in the synchronous π-calculus with replication, without sums. Usual definitions of reduction in the π-calculus use a closure w.r.t. structural congruence of processes. In this paper we operationalize structural congruence by providing a reduction relation for pi-processes which also performs necessary structural conversions explicitly by rewrite rules. As we show, a subset of structural congruence axioms is sufficient. We show that our rewrite strategy is equivalent to the usual strategy including structural congruence w.r.t. the observation of barbs and thus w.r.t. may- and should-testing equivalence in the pi-calculus.

Contextual Equivalences in Call-by-Need and Call-By-Name Polymorphically Typed Calculi (Preliminary Report)

Authors: Manfred Schmidt-Schauß and David Sabel

Abstract:

This paper presents a call-by-need polymorphically typed lambda-calculus with letrec, case, constructors and seq. The typing of the calculus is modelled in a system-F style. Contextual equivalence is used as semantics of expressions. We also define a call-by-name variant without letrec. We adapt several tools and criteria for recognizing correct program transformations to polymorphic typing, in particular an inductive applicative simulation.

List of Authors

Yuki Chiba
School of Information Science
Japan Advanced Institute of Science and Technology, Japan

Andrew Gill
Department of Electrical Engineering and Computer Science
The University of Kansas, USA

Karl Gmeiner
Institute of Computer Science
UAS Technikum Wien, Austria

Elsa Gunter
Department of Computer Science
University of Illinois at Urbana-Champaign, USA

Tomofumi Kato
Graduate School of Information Science
Nagoya University, Japan

Cédric Lhoussaine
BioComputing, Lifl /
University of Lille 1, France

Guillaume Madelaine
BioComputing, Lifl /
University of Lille 1, France

William Mansky
Department of Computer Science
University of Illinois at Urbana-Champaign, USA

Georg Moser
Institute of Computer Science
University of Innsbruck, Austria

Masanori Nagashima
Graduate School of Information Science
Nagoya University, Japan

Joachim Niehren
BioComputing, Lifl /
Inria Lille, France

Naoki Nishida
Graduate School of Information Science
Nagoya University, Japan

David Sabel
Computer Science and Mathematics Department
Goethe-University Frankfurt am Main, Germany

Masahiko Sakai
Graduate School of Information Science
Nagoya University, Japan

Michael Schaper
Institute of Computer Science
University of Innsbruck, Austria

Manfred Schmidt-Schauß
Computer Science and Mathematics Department
Goethe-University Frankfurt am Main, Germany

Makishi Yanagisawa
Graduate School of Information Science
Nagoya University, Japan

1st International Workshop on Rewriting Techniques for Program Transformations and Evaluation (WPTE'14).
Editors: Manfred Schmidt-Schauß, Masahiko Sakai, David Sabel, and Yuki Chiba
OpenAccess Series in Informatics
OASICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany