Proceedings of the ACM on Programming Languages



Proceedings of the ACM

on Programming Languages

ABOUT ACM

ACM is the world's largest educational and scientific computing society, uniting educators, researchers and professionals to inspire dialogue, share resources and address the field's challenges. ACM strengthens the computing profession's collective voice through strong leadership, promotion of the highest standards, and recognition of technical excellence. ACM supports the professional growth of its members by providing opportunities for life-long learning, career development, and professional networking.

Executive Director and CEO

Vicki L. Hanson

Deputy Executive Director and COO Patricia Ryan

Director, Office of

Information Systems

Wayne Graves

Director, Office of Financial Services Darren Ramdin

Director, Office of SIG Services

Donna Cappo

Director, Office of Publications

Scott E. Delman

ACM COUNCIL

President

Vicki L. Hanson

Vice-President

Cherri M. Pancake

Secretary/Treasurer

Elizabeth Churchill

Past President

Alexander L. Wolf

Chair, SGB Board

Jeanna Matthews

Co-Chairs, Publications Board

Jack Davidson and Joseph Konstan

Members-at-Large

Gabriele Anderst-Kotis; Susan Dumais; Elizabeth D. Mynatt; Pamela Samuelson; Eugene H. Spafford

SGB Council Representatives

Paul Beame; Jenna Neefe Matthews; Barbara Boucher Owens

REGIONAL COUNCIL CHAIRS

ACM Europe Council

Dame Professor Wendy Hall

ACM India Council

Srinivas Padmanabhuni

ACM China Council

Jiaguang Sun

BOARD CHAIRS

Education Board

Mehran Sahami and Jane Chu Prey

Practitioners Board

Terry Coatta and Stephen Ibaraki

COMPUTER SCIENCE TEACHERS ASSOCIATION

Mark R. Nelson, Executive Director

PUBLICATIONS BOARD

Co-Chairs

Jack Davidson Joseph A Konstan

Board Members

Phoebe Ayers Chris L. Hankin

Tulika Mitra

Michael Nelson

Sharon Oviatt

Eugene H Spafford

Stephen N Spencer

Divesh Srivastava Robert A. Walker

Julie R Williamson

SGB Liaison

Nenad Medvidovic

HEADQUARTERS JOURNALS STAFF

ACM Director of Publications

Scott Delman

Publications Operations Manager

Craig Rodkin

ACM Journals Manager

Laura A. Lander

Print Production Manager

Bernadette Shade

Assistant Editor

Stacey Schick

Administrative Assistant

Emily Eng

Bibliographic Processing Coordinator

Anna Lacson

EDITORIAL BOARD

Editor-in-Chief

Philip Wadler, University of Edinburgh, UK

Advisory Board

Giuseppe Castagna,

Paris Diderot University & CNRS, France

Jeremy Gibbons,

University of Oxford, United Kingdom

Michael Hicks,

University of Maryland, United States

Cristina Lopes,

University of California, Irvine, United

Jens Palsberg,

University of California, Los Angeles,

United States

Benjamin C. Pierce, University of Pennsylvania

Senior Editors

Matthew Flatt,

University of Utah, United States

Richard Gabriel.

Dream Songs, Inc. & HPI

Andrew Myers,

Cornell University, United States

Manu Sridharan, Uber, United States

Guy Steele, Oracle Labs

Associate Editors

François Pottier, INRIA, France

Felco Visser.

Delft University of Technology,

Delft, Netherland

Stephanie Weirich.

University of Pennsylvania, United States

Assistant Editor

Lars Birkedal.

Aarhus University, Denmark

Information Director

Harry Xu,

UCLA, Engineering VI, Rm 496A Computer Science Department, UCLA Los Angeles, CA 90095, United States



ABOUT PROCEEDINGS OF THE ACM ON PROGRAMMING LANGUAGES

Proceedings of the ACM on Programming Languages (PACMPL) is a Gold Open Access journal publishing research on all aspects of programming languages, from design to implementation and from mathematical formalisms to empirical studies. Each issue of the journal is devoted to a particular subject area within programming languages and will be announced through publicized Calls for Papers. All accepted papers receive two rounds of reviewing and authors can expect initial decisions regarding submissions in under 3 months. The journal operates in close collaboration with the Special Interest Group on Programming Languages (SIGPLAN) and is committed to making high-quality peer-reviewed scientific research in programming languages free of restrictions on both access and use.

JOURNAL WEBSITE pacmpl.acm.org

SUBMISSIONS

More details, including instructions for submitting to *PACMPL*, can be found at http://pacmpl.acm.org/.

Send orders to:

ACM Member Services Dept. General Post Office PO Box 30777 New York, NY 10087-0777

MEMBERSHIP INFORMATION

ACM Member Services Dept. 1601 Broadway, 10th Floor New York, NY 10019-7434 T; (212) 626-0500 F: (212) 944-1318 Email: acmhelp@acm.org

PACMPL (ISSN: 2475-1421) is published quarterly in Spring, Summer, Fall, and Winter by the Association for Computing Machinery (ACM), 1601 Broadway, 10th Floor New York, NY 10019-7434



PACM is also available in the ACM Digital Library (DL), the most comprehensive collection of full-text articles and bibliographic records in existence today covering the fields of computing and information technology. The full-text database includes the complete collection of ACM's publications, including journals, conference proceedings, magazines, newsletters, and multimedia titles.

dl.acm.org/pacmpl

CONTACT POINTS

Copyright permission permissions@hg.acm.org

Change of address

acmhelp@acm.org

ACM Code of Ethics

http://www.acm.org/about-acm/code-of-ethics



ACM COPYRIGHT NOTICE

Copyright ©2019 by the Association for Computing Machinery (ACM). Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted.

Authors refer to the retained rights section of ACM rights forms for exceptions around posting the accepted version. The full notice is available at www.acm.org/publications/policies/copyright-policy#permanent_rights. To copy or otherwise redistribute requires prior specific permission and/or a fee. Request permission to republish from: permissions@acm.org or fax Publications Department, ACM, Inc. Fax +1 212-869-0481.

Editorial Message

EELCO VISSER, Delft University of Technology, The Netherlands, Associate Editor

The Proceedings of the ACM series presents the highest quality research conducted in diverse areas of computer science, as represented by the ACM Special Interest Groups (SIGs). The ACM Proceedings of the ACM on Programming Languages (PACMPL) focuses on research on all aspects of programming languages, from design to implementation and from mathematical formalisms to empirical studies. The journal operates in close collaboration with the Special Interest Group on Programming Languages (SIGPLAN) and is committed to making high-quality peer-reviewed scientific research in programming languages free of restrictions on both access and use.

This issue of the PACMPL journal publishes 73 articles that were submitted in response to a call for papers seeking contributions on all aspects of programming languages and software engineering with articles targeting any stage of software development, including requirements, modeling, prototyping, design, implementation, generation, analysis, verification, testing, evaluation, maintenance, and reuse of software systems, and contributions including the development of new tools (such as language front-ends, program analyses, and runtime systems), new techniques (such as methodologies, design processes, and code organization approaches), new principles (such as formalisms, proofs, models, and paradigms), and new evaluations (such as experiments, corpora analyses, user studies, and surveys).

The articles were selected from 201 submissions — submitted by the April 2019 deadline for this issue — by means of a rigorous reviewing process. In the two-stage process, articles were evaluated with respect to the novelty and importance of their results, the evidence for these results, and the clarity of their presentation. In the first stage, each article was reviewed by at least three reviewers during a nine week review period. Additional reviews were sollicited for several articles to obtain additional expert opinions. Reviews were conducted by the members of a primary review committee, a secondary review committee, and external reviewers. Authors were invited to submit a detailed response to the reviews. Based on the reviews, the author response, a one week online discussion, and a two day physical meeting of the primary review committee in Phoenix, Arizona, 10 articles were accepted with minor revisions and 63 articles required major revisions. The first stage was double blind; submissions were anonymous and the identity of authors was only revealed after the review period when that was necessary for the evaluation process, which happened only in a couple of cases. In the second stage, authors submitted non-anonymous revisions after a six week revision period with a cover letter explaining how they addressed the feedback from reviewers. Major revisions were re-reviewed by the original reviewers during a two week review period, determining whether the required revisions were satisfied. The authors of two articles were asked to make further required revisions.

I am excited by the compelling and thought-provoking work that resulted in this PACMPL issue. To provoke further discussion and dissemination, the authors were invited to also present their work to the programming languages community at the next ACM OOPSLA conference. I hope that you will also join us in October 20-25, 2019 in Athens, Greece for SPLASH/OOPSLA 2019. The conference will provide many opportunities to share ideas with programming language researchers and practitioners from institutions around the world.

It was an honor and a privilege to serve as *Associate Editor* for this issue of PACMPL, and I would like to thank the many people who contributed to make this a success. First, I would like to thank all the authors for contributing their work.

Second, I would like to thank the reviewers for their hard work. They have provided very useful feedback to the authors, helping them to improve their work. The high quality of the articles in this issue is also the result of their work. The Primary Review Committee consisted of Sara Achour, Nada Amin, Bor-Yuh Evan Chang, Arthur Charguéraud, Yufei Ding, Alastair Donaldson, Sebastian Erdweg, Ronald Garcia, David Grove, Görel Hedin, Martin Hirzel, Marieke Huisman, Gail Kaiser, Eric Koskinen, Ondřej Lhoták, Yu David Liu, Brandon Lucia, Heather Miller, Todd Mytkowicz, Alex Potanin, Tiark Rompf, Manu Sridharan, Friedrich Steimann, Éric Tanter, Ross Tate, Emina Torlak, David Van Horn, Eric Van Wyk, Harry Xu, Nobuko Yoshida, and Francesco Zappa Nardelli. The Secondary Review Committee consisted of Aggelos Biboudis, Gavin Bierman, Walter Binder, Eva Darulova, Werner Dietl, Isil Dillig, Sophia Drossopoulou, Susan Eisenbach, Matthew Flatt, Jeremy Gibbons, Elisa Gonzalez Boix, Sam Guyer, Christine H. Flood, Jeff Huang, Ranjit Jhala, Stephen Kell, Viktor Kuncak, Christian Kästner, Crista Lopes, Sasa Misailovic, Andrew Myers, Iulian Neamtiu, Benjamin C. Pierce, G. Ramalingam, Grigore Rosu, Malavika Samak, Jennifer B. Sartor, Peter Sewell, Xipeng Shen, Michael Steindorfer, Peter Thiemann, and Viktor Vafeiadis. The External Reviewers were Aws Albarghouthi, Timothy Bourke, Edwin Brady, David Darais, Julian Dolby, Marco Gaboardi, Rahul Gopinath, Andrew D. Gordon, Marco Guarnieri, Holger Hermanns, Felienne Hermans, Jeroen Keiren, Dan Kifer, Robbert Krebbers, Shuvendu Lahiri, Mohsen Lesani, Christof Lofi, Roman Manevich, Darya Melicher, Leo Meyerovich, Peter Müller, Bruno Oliveira, Aurojit Panda, Alexander Ratner, John Regehr, Thomas Reps, Manuel Serrano, Alexander J. Summers, Petar Tsankov, Alex Weddell, Andy Zaidman, and Hengchu Zhang.

Third I would like to thank the SPLASH 2019 conference and its General Chair, Yannis Smaragdakis, for providing the authors of this issue the opportunity to present their work.

Finally, I would like to thank the PACMPL Editorial Board and its Editor in Chief Philip Wadler for their advise, and I would like to thank SIGPLAN and its Executive Committee chaired by Jens Palsberg for supporting the gold open access publication of the articles in PACMPL and for organizing a thriving programming language community that produces high quality research as exemplified in this issue.

Contents

Editorial Message	
CLOTHO: Directed Test Generation for Weakly Consistent Database Systems Kia Rahmani, Kartik Nagar, Benjamin Delaware, and Suresh Jagannathan — <i>Purdue University, USA</i>	117
Probabilistic Verification of Fairness Properties via Concentration Osbert Bastani, Xin Zhang, and Armando Solar-Lezama — University of Pennsylvania, USA; Massachusetts Institute of Technology, USA	118
Verifying Safety and Accuracy of Approximate Parallel Programs via Canonical Sequential-	
ization Vimuth Fernando, Keyur Joshi, and Sasa Misailovic — University of Illinois at Urbana-Champaign, USA	119
Qubit Allocation as a Combination of Subgraph Isomorphism and Token Swapping Marcos Yukio Siraichi, Vinícius Fernandes dos Santos, Caroline Collange, and Fernando Magno Quintão Pereira — Federal University of Minas Gerais, Brazil; Inria, France; University of Rennes, France; CNRS, France; IRISA, France	120
Modular Verification of Heap Reachability Properties in Separation Logic	
Arshavir Ter-Gabrielyan, Alexander J. Summers, and Peter Müller — $\it ETH Zurich$, $\it Switzerland$	121
Complete Monitors for Gradual Types	
Ben Greenman, Matthias Felleisen, and Christos Dimoulas — Northeastern University, USA; Northwestern University, USA	122
TLA+ Model Checking Made Symbolic	
Igor Konnov, Jure Kukovec, and Thanh-Hai Tran — Inria, France; LORIA, France; University of Lorraine, France; CNRS, France; TU Vienna, Austria	123
Value-Centric Dynamic Partial Order Reduction Krishnendu Chatterjee, Andreas Pavlogiannis, and Viktor Toman — <i>IST Austria, Austria; EPFL, Switzer</i>	101
land	124
Seq: A High-Performance Language for Bioinformatics Ariya Shajii, Ibrahim Numanagić, Riyadh Baghdadi, Bonnie Berger, and Saman Amarasinghe — Massachusetts Institute of Technology, USA	125
Staged Abstract Interpreters: Fast and Modular Whole-Program Analysis via Meta-programmin	ng
Guannan Wei, Yuxuan Chen, and Tiark Rompf — <i>Purdue University, USA</i>	126
Derivative Grammars: A Symbolic Approach to Parsing with Derivatives	
Ian Henriksen, Gianfranco Bilardi, and Keshav Pingali — <i>University of Texas at Austin, USA; University of Padua, Italy</i>	127
Efficient Lock-Free Durable Sets	
Yoav Zuriel, Michal Friedman, Gali Sheffi, Nachshon Cohen, and Erez Petrank — <i>Technion, Israel</i> ; <i>Amazon, Israel</i>	128
Modular Verification for Almost-Sure Termination of Probabilistic Programs	
Mingzhang Huang, Hongfei Fu, Krishnendu Chatterjee, and Amir Kafshdar Goharshady — Shanghai Jiao Tong University, China; East China Normal University, China; IST Austria, Austria	129
IVT: An Efficient Method for Sharing Subtype Polymorphic Objects	
Yu-Ping Wang, Xu-Qiang Hu, Zi-Xin Zou, Wende Tan, and Gang Tan — Tsinghua University, China; Pennsylvania State University, USA	130
Refinement Kinds: Type-Safe Programming with Practical Type-Level Computation	
Luís Caires and Bernardo Toninho — Nova University of Lisbon, Portugal; NOVA-LINCS, Portugal .	131

Program Synthesis with Algebraic Library Specifications	
Benjamin Mariano, Josh Reese, Siyuan Xu, ThanhVu Nguyen, Xiaokang Qiu, Jeffrey S. Foster, and Armando Solar-Lezama — <i>University of Maryland at College Park, USA; Purdue University, USA; University of Nebraska-Lincoln, USA; Tufts University, USA; Massachusetts Institute of Technology, USA</i>	132
	132
Weakening WebAssembly Conrad Watt, Andreas Rossberg, and Jean Pichon-Pharabod — University of Cambridge, UK; Dfinity Stiftung, Germany	133
Generating a Fluent API with Syntax Checking from an LR Grammar	
Tetsuro Yamazaki, Tomoki Nakamaru, Kazuhiro Ichikawa, and Shigeru Chiba — <i>University of Tokyo, Japan</i>	134
Weak Persistency Semantics from the Ground Up: Formalising the Persistency Semantics of ARMv8 and Transactional Models	
Azalea Raad, John Wickerson, and Viktor Vafeiadis — MPI-SWS, Germany; Imperial College London, UK	135
DeepSEA: A Language for Certified System Software	
Vilhelm Sjöberg, Yuyang Sang, Shu-chun Weng, and Zhong Shao — Yale University, USA; CertiK, USA	136
BDA: Practical Dependence Analysis for Binary Executables by Unbiased Whole-Program	
Path Sampling and Per-Path Abstract Interpretation	
Zhuo Zhang, Wei You, Guanhong Tao, Guannan Wei, Yonghwi Kwon, and Xiangyu Zhang — Purdue University, USA; Renmin University of China, China; University of Virginia, USA	137
Asphalion: Trustworthy Shielding against Byzantine Faults	
Ivana Vukotic, Vincent Rahli, and Paulo Esteves-Veríssimo — <i>University of Luxembourg, Luxembourg; University of Birmingham, UK</i>	138
Automatic Repair of Regular Expressions	
Rong Pan, Qinheping Hu, Gaowei Xu, and Loris D'Antoni — <i>University of Texas at Austin, USA; University of Wisconsin-Madison, USA</i>	139
Static Analysis with Demand-Driven Value Refinement	
Benno Stein, Benjamin Barslev Nielsen, Bor-Yuh Evan Chang, and Anders Møller — <i>University of Colorado Boulder, USA; Aarhus University, Denmark</i>	140
Relational Verification using Reinforcement Learning	
Jia Chen, Jiayi Wei, Yu Feng, Osbert Bastani, and Isil Dillig — University of Texas at Austin, USA; University of California at Santa Barbara, USA; University of Pennsylvania, USA	141
A Formalization of Java's Concurrent Access Modes	
John Bender and Jens Palsberg — University of California at Los Angeles, USA	142
On the Fly Synthesis of Edit Suggestions Anders Miltner, Sumit Gulwani, Vu Le, Alan Leung, Arjun Radhakrishna, Gustavo Soares, Ashish	
Tiwari, and Abhishek Udupa — Princeton University, USA; Microsoft, USA	143
A Fault-Tolerant Programming Model for Distributed Interactive Applications Ragnar Mogk, Joscha Drechsler, Guido Salvaneschi, and Mira Mezini — TU Darmstadt, Germany.	144
A Path to DOT: Formalizing Fully Path-Dependent Types Marianna Rapoport and Ondřej Lhoták — University of Waterloo, Canada	145
Reliable and Fast DWARF-Based Stack Unwinding	
Théophile Bastian, Stephen Kell, and Francesco Zappa Nardelli — ENS, France; University of Kent, UK; Inria, France	146
Leveraging Rust Types for Modular Specification and Verification	
Vytautas Astrauskas, Peter Müller, Federico Poli, and Alexander J. Summers — ETH Zurich, Switzer-	
land	147

Precision-Preserving Yet Fast Object-Sensitive Pointer Analysis with Partial Context Sensitivity Jingbo Lu and Jingling Xue — $UNSW$, $Australia$	148
Formal Foundations of Serverless Computing Abhinav Jangda, Donald Pinckney, Yuriy Brun, and Arjun Guha — University of Massachusetts Amherst, USA	149
Optimal Stateless Model Checking for Reads-From Equivalence under Sequential Consistency Parosh Aziz Abdulla, Mohamed Faouzi Atig, Bengt Jonsson, Magnus Lång, Tuan Phong Ngo, and	
Konstantinos Sagonas — Uppsala University, Sweden	150 151
Aroma: Code Recommendation via Structural Code Search Sifei Luan, Di Yang, Celeste Barnaby, Koushik Sen, and Satish Chandra — Facebook, USA; University of California at Irvine, USA; University of California at Berkeley, USA	152
On the Design, Implementation, and Use of Laziness in R Aviral Goel and Jan Vitek — Northeastern University, USA; Czech Technical University, Czechia	153
Mergeable Replicated Data Types Gowtham Kaki, Swarn Priya, KC Sivaramakrishnan, and Suresh Jagannathan — Purdue University, USA; IIT Madras, India	154
Compiler Fuzzing: How Much Does It Matter? Michaël Marcozzi, Qiyi Tang, Alastair F. Donaldson, and Cristian Cadar — Imperial College London, UK	155
DProf: Distributed Profiler with Strong Guarantees Zachary Benavides, Keval Vora, and Rajiv Gupta — University of California at Riverside, USA; Simon Fraser University, Canada	156
Precise Reasoning with Structured Time, Structured Heaps, and Collective Operations Grégory M. Essertel, Guannan Wei, and Tiark Rompf — <i>Purdue University, USA</i>	157
Casting about in the Dark: An Empirical Study of Cast Operations in Java Programs Luis Mastrangelo, Matthias Hauswirth, and Nathaniel Nystrom — USI Lugano, Switzerland	158
Getafix: Learning to Fix Bugs Automatically Johannes Bader, Andrew Scott, Michael Pradel, and Satish Chandra — <i>Facebook, USA</i>	159
Generating Precise Error Specifications for C: A Zero Shot Learning Approach Baijun Wu, John Peter Campora III, Yi He, Alexander Schlecht, and Sheng Chen — University of Louisiana at Lafayette, USA	160
Specifying Concurrent Programs in Separation Logic: Morphisms and Simulations Aleksandar Nanevski, Anindya Banerjee, Germán Andrés Delbianco, and Ignacio Fábregas — IMDEA Software Institute, Spain; IRIF, France; University of Paris, France	161
Improving Bug Detection via Context-Based Code Representation Learning and Attention-Based Neural Networks Yi Li, Shaohua Wang, Tien N. Nguyen, and Son Van Nguyen — New Jersey Institute of Technology, USA; University of Texas at Dallas, USA	162
Scala Implicits Are Everywhere: A Large-Scale Study of the Use of Scala Implicits in the Wild Filip Křikava, Heather Miller, and Jan Vitek — Czech Technical University, Czechia; Carnegie Mellon University, USA; Northeastern University, USA	163
Optimization of Swift Protocols Rajkishore Barik, Manu Sridharan, Murali Krishna Ramanathan, and Milind Chabbi — Uber Technologies, USA; University of California at Riverside, USA	164

On the Complexity of Checking Transactional Consistency Ranadeep Biswas and Constantin Enea — <i>University of Paris, France; IRIF, France; CNRS, France</i>	165
System FR: Formalized Foundations for the Stainless Verifier Jad Hamza, Nicolas Voirol, and Viktor Kunčak — EPFL, Switzerland	166
Language-Integrated Privacy-Aware Distributed Queries Guido Salvaneschi, Mirko Köhler, Daniel Sokolowski, Philipp Haller, Sebastian Erdweg, and Mira Mezini — <i>TU Darmstadt, Germany; KTH, Sweden; Johannes Gutenberg University Mainz, Germany</i>	167
AutoPandas: Neural-Backed Generators for Program Synthesis Rohan Bavishi, Caroline Lemieux, Roy Fox, Koushik Sen, and Ion Stoica — University of California at Berkeley, USA; University of California at Irvine, USA	168
Ryū Revisited: Printf Floating Point Conversion Ulf Adams — Google, Germany	169
IntelliMerge: A Refactoring-Aware Software Merging Technique Bo Shen, Wei Zhang, Haiyan Zhao, Guangtai Liang, Zhi Jin, and Qianxiang Wang — Peking University, China; Huawei Technologies, China	170
Certifying Graph-Manipulating C Programs via Localizations within Data Structures Shengyi Wang, Qinxiang Cao, Anshuman Mohan, and Aquinas Hobor — National University of Singapore, Singapore; Shanghai Jiao Tong University, China	171
Duet: An Expressive Higher-Order Language and Linear Type System for Statically Enforcing Differential Privacy Joseph P. Near, David Darais, Chike Abuah, Tim Stevens, Pranav Gaddamadugu, Lun Wang, Neel Somani, Mu Zhang, Nikhil Sharma, Alex Shan, and Dawn Song — University of Vermont, USA; University of California at Berkeley, USA; University of Utah, USA	172
Effective Lock Handling in Stateless Model Checking Michalis Kokologiannakis, Azalea Raad, and Viktor Vafeiadis — MPI-SWS, Germany	173
FuzzFactory: Domain-Specific Fuzzing with Waypoints Rohan Padhye, Caroline Lemieux, Koushik Sen, Laurent Simon, and Hayawardh Vijayakumar — University of California at Berkeley, USA; Samsung Research, USA	174
AL: Autogenerating Supervised Learning Programs José P. Cambronero and Martin C. Rinard — Massachusetts Institute of Technology, USA	175
Sound and Reusable Components for Abstract Interpretation Sven Keidel and Sebastian Erdweg — <i>Johannes Gutenberg University Mainz, Germany</i>	176
Design, Implementation, and Application of GPU-Based Java Bytecode Interpreters Ahmet Celik, Pengyu Nie, Christopher J. Rossbach, and Milos Gligoric — <i>University of Texas at Austin</i> ,	4.55
USA; VMware, USA	177
Technology, USA	178
Dependence-Aware, Unbounded Sound Predictive Race Detection Kaan Genç, Jake Roemer, Yufan Xu, and Michael D. Bond — Ohio State University, USA	179
Trace Aware Random Testing for Distributed Systems Burcu Kulahcioglu Ozkan, Rupak Majumdar, and Simin Oraee — <i>MPI-SWS</i> , <i>Germany</i>	180
Coverage Guided, Property Based Testing Leonidas Lampropoulos, Michael Hicks, and Benjamin C. Pierce — University of Maryland, USA; University of Pennsylvania, USA	181
PlanAlyzer: Assessing Threats to the Validity of Online Experiments Emma Tosch, Eytan Bakshy, Emery D. Berger, David D. Jensen, and J. Eliot B. Moss — University of Massachusetts Amherst, USA; Facebook, USA	182

I/O Dependent Idempotence Bugs in Intermittent Systems Milijana Surbatovich, Limin Jia, and Brandon Lucia — Carnegie Mellon University, USA	183
Initialize Once, Start Fast: Application Initialization at Build Time Christian Wimmer, Codrut Stancu, Peter Hofer, Vojin Jovanovic, Paul Wögerer, Peter B. Kessler, Oleg Pliss, and Thomas Würthinger — Oracle Labs, USA; Oracle Labs, Austria; Oracle Labs, Switzerland	184
Safer Smart Contract Programming with Scilla Ilya Sergey, Vaivaswatha Nagaraj, Jacob Johannsen, Amrit Kumar, Anton Trunov, and Ken Chan Guan Hao — Yale-NUS College, Singapore; National University of Singapore, Singapore; Zilliqa Research, India; Zilliqa Research, Denmark; Zilliqa Research, UK; Zilliqa Research, Russia; Zilliqa Research, Malaysia	185
ApproxHPVM: A Portable Compiler IR for Accuracy-Aware Optimizations Hashim Sharif, Prakalp Srivastava, Muhammad Huzaifa, Maria Kotsifakou, Keyur Joshi, Yasmin Sarita, Nathan Zhao, Vikram S. Adve, Sasa Misailovic, and Sarita Adve — University of Illinois at Urbana-Champaign, USA; Cornell University, USA	186
Reflection-Aware Static Regression Test Selection August Shi, Milica Hadzi-Tanovic, Lingming Zhang, Darko Marinov, and Owolabi Legunsen $-$ <i>University of Illinois at Urbana-Champaign, USA; University of Texas at Dallas, USA</i>	187
Automatic and Scalable Detection of Logical Errors in Functional Programming Assignments Dowon Song, Myungho Lee, and Hakjoo Oh $-$ Korea University, South Korea	188
Detecting Nondeterministic Payment Bugs in Ethereum Smart Contracts Shuai Wang, Chengyu Zhang, and Zhendong Su — <i>Hong Kong University of Science and Technology, China; East China Normal University, China; ETH Zurich, Switzerland</i>	189
Author Index	