# Contents

## Frontmatter

Message from the Chairs .............................................................. iii  
Committees ....................................................................................... viii

## Keynotes

On Whose Shoulders? (Keynote)  
Jane Cleland-Huang — DePaul University, USA  ................................. 1  
Checkpoint Alpha (Keynote)  
Boris Debić — Google, USA ............................................................... 2

## Main Research

### Information Retrieval

Modeling the Evolution of Development Topics using Dynamic Topic Models  
Jiajun Hu, Xiaobing Sun, David Lo, and Bin Li — Yangzhou University, China; Nanjing University, China; Singapore Management University, Singapore ......................................................... 3  
Understanding Developers’ Natural Language Queries with Interactive Clarification  
Shihai Jiang, Liwei Shen, Xin Peng, Zhaojin Lv, and Wenyun Zhao — Fudan University, China ......................................................... 13

### APIs and Patterns

Mining Multi-level API Usage Patterns  
Mohamed Aymen Saied, Omar Benomar, Hani Abdeen, and Houari Sahraoui — Université de Montréal, Canada ........................................ 23  
An Observational Study on API Usage Constraints and Their Documentation  
Mohamed Aymen Saied, Houari Sahraoui, and Bruno Dufour — Université de Montréal, Canada ......................................................... 33  
Improving Pattern Tracking with a Language-Aware Tree Differencing Algorithm  
Nicolas Palix, Jean-Rémy Falleri, and Julia Lawall — University of Grenoble, France; LaBRI, France; University of Bordeaux, France; INRIA, France ................................................................. 43  
Measuring the Quality of Design Pattern Detection Results  
Shouzheng Yang, Ayesha Manzer, and Vassilios Tzerpos — York University, Canada ................................................................. 53

### Analysis of Programming Languages

Are PHP Applications Ready for Hack?  
Laleh Eshkevari, Fabien Dos Santos, James R. Cordy, and Giuliano Antoniol — Polytechnique Montréal, Canada; Polytech Montpellier, France; Queen’s University, Canada ........................................ 63  
Does JavaScript Software Embrace Classes?  
Leonardo Humberto Silva, Miguel Ramos, Marco Tulio Valente, Alexandre Bergel, and Nicolas Anquetil — Federal Institute of Northern Minas Gerais, Brazil; Federal University of Minas Gerais, Brazil; University of Chile, Chile; INRIA, France ......................................................... 73  
Evolution Analysis for Accessibility Excessiveness in Java  
Kazuo Kobori, Makoto Matsushita, and Katsuro Inoue — NTT DATA, Japan; Osaka University, Japan ......................................................... 83
A Software Quality Model for RPG
Gergely Ladányi, Zoltán Tóth, Rudolf Ferenc, and Tibor Keresztesi — University of Szeged, Hungary; R&R Software, Hungary

On Crashes and Traces
JCHARMING: A Bug Reproduction Approach using Crash Traces and Directed Model Checking
Mathieu Nayrolles, Abdelwahab Hamou-Lhadj, Sofiène Tahar, and Alf Larsson — Concordia University, Canada; Ericsson, Sweden

Towards a Common Metamodel for Traces of High Performance Computing Systems to Enable Software Analysis Tasks
Luay Alawneh, Abdelwahab Hamou-Lhadj, and Jameleddine Hassine — Jordan University of Science and Technology, Jordan; Concordia University, Canada; KFUPM, Saudi Arabia

Automated Extraction of Failure Reproduction Steps from User Interaction Traces
Tobias Roehm, Stefan Nosovic, and Bernd Bruegge — TU München, Germany

Misery Loves Company: CrowdStacking Traces to Aid Problem Detection
Tommaso Dal Sasso, Andrea Mocci, and Michele Lanza — University of Lugano, Switzerland

Code Reviews
Patanamon Thongtanunam, Chakkrit Tantithamthavorn, Raula Gaikovina Kula, Norihiro Yoshida, Hajimu Iida, and Kenichi Matsumoto — NAIJST, Japan; Osaka University, Japan; Nagoya University, Japan

Code Review: Veni, ViDI, Vici
Yury Tymchuk, Andrea Mocci, and Michele Lanza — University of Lugano, Switzerland

Would Static Analysis Tools Help Developers with Code Reviews?
Sebastiano Panichella, Venera Arnaoudova, Massimiliano Di Penta, and Giuliano Antoniol — University of Zurich, Switzerland; Polytechnique Montréal, Canada; University of Sannio, Italy

Rodrigo Morales, Shane McIntosh, and Foutse Khomh — Polytechnique Montréal, Canada; Queen’s University, Canada

Searching and Cloning
Scaling up Evaluation of Code Search Tools through Developer Usage Metrics
Kostadin Damevski, David C. Shepherd, and Lori Pollock — Virginia State University, USA; ABB, USA; University of Delaware, USA

Optimized Feature Selection towards Functional and Non-functional Requirements in Software Product Lines
Xiaoli Lian and Li Zhang — Beihang University, China

Threshold-Free Code Clone Detection for a Large-Scale Heterogeneous Java Repository
Iman Keivanloo, Feng Zhang, and Ying Zou — Queen’s University, Canada

Detecting Duplicate Bug Reports with Software Engineering Domain Knowledge
Karan Aggarwal, Tanner Rutgers, Finbarr Timbers, Abram Hindle, Russ Greiner, and Eleni Stroulia — University of Alberta, Canada

Change Impact Analysis
Impact Analysis Based on a Global Hierarchical Object Graph
Marwan Abi-Antoun, Yibin Wang, Ebrahim Khalaj, Andrew Giang, and Václav Rajlich — Wayne State University, USA

A Framework for Cost-Effective Dependence-Based Dynamic Impact Analysis
Haipeng Cai and Raul Santelices — University of Notre Dame, USA

Circular Dependencies and Change-Proneness: An Empirical Study
Tosin Daniel Oyetoyan, Jens Dietrich, Jean-Rémy Falleri, and Kamil Jezek — NTNU, Norway; Massey University, New Zealand; LaBRI, France; University of Bordeaux, France; University of West Bohemia, Czech Republic

An Empirical Study of Work Fragmentation in Software Evolution Tasks
Heider Sanchez, Romain Robbes, and Victor M. Gonzalez — University of Chile, Chile; ITAM, Mexico
**Tool Demonstrations**

**A Static Code Analysis Tool for Control System Software**  
Sreeja Nair, Raoul Jetley, Anil Nair, and Stefan Hauck-Stattelmann — ABB Research, India; ABB Research, Germany  
...  
459

**RbG: A Documentation Generator for Scientific and Engineering Software**  
Michael Moser, Josef Pichler, Günter Fleck, and Michael Wittatschil — Software Competence Center Hagenberg, Austria; Siemens Transformers Austria, Austria  
...  
464

**Historef: A Tool for Edit History Refactoring**  
Shinpei Hayashi, Daiki Hoshino, Jumpei Matsuda, Motoshi Saeki, Takayuki Omori, and Katsuhisa Maruyama — Tokyo Institute of Technology, Japan; Ritsumeikan University, Japan  
...  
469

**ClonePacker: A Tool for Clone Set Visualization**  
Hiroaki Murakami, Yoshiki Higo, and Shinji Kusumoto — Osaka University, Japan  
...  
474

**GiLA: GitHub Label Analyzer**  
Javier Luis Cánovas Izquierdo, Valerio Cosentino, Belén Rolandi, Alexandre Bergel, and Jordi Cabot — AtlanMod, France; University of Chile, Chile  
...  
479

**SPCP-Miner: A Tool for Mining Code Clones That Are Important for Refactoring or Tracking**  
Manishankar Mondal, Chanchal K. Roy, and Kevin A. Schneider — University of Saskatchewan, Canada  
...  
484

**TracerJD: Generic Trace-Based Dynamic Dependence Analysis with Fine-Grained Logging**  
Haipeng Cai and Raul Santelices — University of Notre Dame, USA  
...  
489

**Umple: A Framework for Model Driven Development of Object-Oriented Systems**  
Miguel A. Garzón, Hamoud Aljamaan, and Timothy C. Lethbridge — University of Ottawa, Canada  
...  
494

**Assessing the Bus Factor of Git Repositories**  
Valerio Cosentino, Javier Luis Cánovas Izquierdo, and Jordi Cabot — AtlanMod, France  
...  
499

**Industrial Research**

**Old Habits Die Hard: Why Refactoring for Understandability Does Not Give Immediate Benefits**  
Erik Ammerlaan, Wim Veninga, and Andy Zaidman — Exact International Development, Netherlands; Delft University of Technology, Netherlands  
...  
504

**Bash2py: A Bash to Python Translator**  
Ian J. Davis, Mike Wexler, Cheng Zhang, Richard C. Holt, and Theresa Weber — University of Waterloo, Canada; Owl Computing Technologies, USA  
...  
508

**On Implementational Variations in Static Analysis Tools**  
Tukaram Muske and Prasad Bokil — Tata Consultancy Services, India  
...  
512

**Tracking Known Security Vulnerabilities in Proprietary Software Systems**  
Mircea Cadariu, Eric Bouwers, Joost Visser, and Arie van Deursen — Software Improvement Group, Netherlands; Delft University of Technology, Netherlands; Radboud University Nijmegen, Netherlands  
...  
516

**Early Research Achievements**

**Evolution and Reuse**

**Trusting a Library: A Study of the Latency to Adopt the Latest Maven Release**  
Raula Gaikovina Kula, Daniel M. German, Takashi Ishio, and Katsuro Inoue — Osaka University, Japan; University of Victoria, Canada  
...  
520
Evolution of Dynamic Feature Usage in PHP
Mark Hills — East Carolina University, USA ........................................ 525

Towards Incremental Model Slicing for Delta-Oriented Software Product Lines
Sascha Lity, Hauke Baller, and Ina Schaefer — TU Braunschweig, Germany .................. 530

Understanding Software Performance Regressions using Differential Flame Graphs
Cor-Paul Bezemer, Johan Pouwelse, and Brendan Gregg — Delft University of Technology, Netherlands; Netflix, USA ...... 535

Text and Labeling
TextRank Based Search Term Identification for Software Change Tasks
Mohammad Masudur Rahman and Chanchal K. Roy — University of Saskatchewan, Canada ............ 540

Query Expansion via Wordnet for Effective Code Search
Meili Lu, Xiaobing Sun, Shaowei Wang, David Lo, and Yucong Duan — Yangzhou University, China; Nanjing University, China; Singapore Management University, Singapore; Hainan University, China .................. 545

Exploring the Use of Labels to Categorize Issues in Open-Source Software Projects
Jordi Cabot, Javier Luis Cánovas Izquierdo, Valerio Cosentino, and Belén Rolandi — AtlanMod, France .................. 550

Explore the Evolution of Development Topics via On-Line LDA
Jiajun Hu, Xiaobing Sun, and Bin Li — Yangzhou University, China; Nanjing University, China ............ 555

Bugs and Violations
Code Coverage and Test Suite Effectiveness: Empirical Study with Real Bugs in Large Systems
Pavneet Singh Kochhar, Ferdian Thung, and David Lo — Singapore Management University, Singapore ............ 560

Detection of Violation Causes in Reflexion Models
Sebastian Herold, Michael English, Jim Buckley, Steve Counsell, and Mel Ó Cinnéide — Lero, Ireland; University of Limerick, Ireland; Brunel University, UK; University College Dublin, Ireland .................. 565

A Comparative Study on the Effectiveness of Part-of-Speech Tagging Techniques on Bug Reports
Yuan Tian and David Lo — Singapore Management University, Singapore ............ 570

Static and Dynamic Analysis
Efficiently Identifying Object Production Sites
Alejandro Infante and Alexandre Bergel — University of Chile, Chile ............ 575

Where Was This SQL Query Executed? A Static Concept Location Approach
Csaba Nagy, Loup Meurice, and Anthony Cleve — University of Namur, Belgium .................. 580

Taint Analysis of Manual Service Compositions using Cross-Application Call Graphs
Marc-André Laverdière, Bernhard J. Berger, and Ettore Merlo — Tata Consultancy Services, Canada; Polytechnique Montréal, Canada; University of Bremen, Germany ............ 585

Tutorials and Briefings
TXL Source Transformation in Practice
James R. Cordy — Queen’s University, Canada ............ 590

Software Risk Management in Practice: Shed Light on Your Software Product
Jens Knodel, Matthias Naab, Eric Bouwers, and Joost Visser — Fraunhofer IESE, Germany; Software Improvement Group, Netherlands; Radboud University Nijmegen, Netherlands .................. 592

Mehdi Mirakhorli — Rochester Institute of Technology, USA ............ 595

Doctoral Symposium
SKilLed Communication for Toolchains
Timm Felden — University of Stuttgart, Germany ............ 596

The Impact of Column-Orientation on the Quality of Class Inheritance Mapping Specifications
Martin Lorenz — HPI, Germany ............ 597
Improving the Integration Process of Large Software Systems
Yujuan Jiang — Polytechnique Montréal, Canada .......................................................... 598

Handling the Differential Evolution of Software Artefacts: A Framework for Consistency Management
Ildiko Pete and Dharini Balasubramaniam — University of St. Andrews, UK .................. 599

Towards a Framework for Analysis, Transformation, and Manipulation of Makefiles
Doug Martin — Queen’s University, Canada ................................................................. 601

Towards a Framework for Automatic Correction of Anti-patterns
Rodrigo Morales — Polytechnique Montréal, Canada ................................................... 603

Towards an Ontology-Based Context-Aware Meta-Model for the Software Domain
Mostafa Erfani — Concordia University, Canada ........................................................... 605

Investigating Modern Release Engineering Practices
Md Tajmilur Rahman — Concordia University, Canada .................................................. 607

Author Index