

# **2017 IEEE 24th International Conference on Software Analysis, Evolution and Reengineering (SANER 2017)**

**Klagenfurt, Austria  
20-24 February 2017**



**IEEE Catalog Number: CFP17102-POD  
ISBN: 978-1-5090-5502-9**

**Copyright © 2017 by the Institute of Electrical and Electronics Engineers, Inc  
All Rights Reserved**

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

***\*\*\* This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP17102-POD
ISBN (Print-On-Demand):	978-1-5090-5502-9
ISBN (Online):	978-1-5090-5501-2
ISSN:	1534-5351

**Additional Copies of This Publication Are Available From:**

Curran Associates, Inc  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: (845) 758-0400  
Fax: (845) 758-2633  
E-mail: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

# Contents

## Frontmatter

---

<b>Message from the Chairs</b> . . . . .	iii
<b>Committees</b> . . . . .	iv
<b>Sponsors and Supporters</b> . . . . .	x

## Keynote

---

<b>UNVEIL: A Large-Scale, Automated Approach to Detecting Ransomware (Keynote)</b> Engin Kirda — <i>Northeastern University, USA</i> . . . . .	1
---	---

## Main Research

---

### MSR and Open Source

<b>An Empirical Comparison of Dependency Issues in OSS Packaging Ecosystems</b> Alexandre Decan, Tom Mens, and Maëllick Claes — <i>University of Mons, Belgium</i> . . . . .	2
<b>Detecting Similar Repositories on GitHub</b> Yun Zhang, David Lo, Pavneet Singh Kochhar, Xin Xia, Quanlai Li, and Jianling Sun — <i>Zhejiang University, China; Singapore Management University, Singapore; University of California at Berkeley, USA</i> . . . . .	13
<b>Code of Conduct in Open Source Projects</b> Parastou Tourani, Bram Adams, and Alexander Serebrenik — <i>Polytechnique Montréal, Canada; Eindhoven University of Technology, Netherlands</i> . . . . .	24
<b>Socio-Technical Evolution of the Ruby Ecosystem in GitHub</b> Eleni Constantinou and Tom Mens — <i>University of Mons, Belgium</i> . . . . .	34

### Features and Knowledge

<b>StiCProb: A Novel Feature Mining Approach using Conditional Probability</b> Yutian Tang and Hareton Leung — <i>Hong Kong Polytechnic University, China</i> . . . . .	45
<b>HDSKG: Harvesting Domain Specific Knowledge Graph from Content of Webpages</b> Xuejiao Zhao, Zhenchang Xing, Muhammad Ashad Kabir, Naoya Sawada, Jing Li, and Shang-Wei Lin — <i>Nanyang Technological University, Singapore; Australian National University, Australia; Charles Sturt University, Australia; NTT, Japan</i> . . . . .	56
<b>Analyzing Closeness of Code Dependencies for Improving IR-Based Traceability Recovery</b> Hongyu Kuang, Jia Nie, Hao Hu, Patrick Rempel, Jian Lü, Alexander Egyed, and Patrick Mäder — <i>Nanjing University, China; JKU Linz, Austria; TU Ilmenau, Germany</i> . . . . .	68
<b>STRICT: Information Retrieval Based Search Term Identification for Concept Location</b> Mohammad Masudur Rahman and Chanchal K. Roy — <i>University of Saskatchewan, Canada</i> . . . . .	79

### Apps and Energy

<b>Analyzing Reviews and Code of Mobile Apps for Better Release Planning</b> Adelina Ciurumelea, Andreas Schaufelbühl, Sebastiano Panichella, and Harald C. Gall — <i>University of Zurich, Switzerland</i> . . . . .	91
<b>Software-Based Energy Profiling of Android Apps: Simple, Efficient and Reliable?</b> Dario Di Nucci, Fabio Palomba, Antonio Prota, Annibale Panichella, Andy Zaidman, and Andrea De Lucia — <i>University of Salerno, Italy; Delft University of Technology, Italy; University of Luxembourg, Luxembourg; Delft University of Technology, Netherlands</i> . . . . .	103

<b>Investigating the Energy Impact of Android Smells</b>	
Antonin Carette, Mehdi Adel Ait Younes, Geoffrey Hecht, Naouel Moha, and Romain Rouvoy — <i>Université du Québec à Montréal, Canada; Inria, Canada; University of Lille, France</i> . . . . .	115
<b>Software and Model Analysis</b>	
<b>Automated Generation of Consistency-Achieving Model Editors</b>	
Patrick Neubauer, Robert Bill, Tanja Mayerhofer, and Manuel Wimmer — <i>Vienna University of Technology, Austria</i> .	127
<b>Historical and Impact Analysis of API Breaking Changes: A Large-Scale Study</b>	
Laerte Xavier, Aline Brito, Andre Hora, and Marco Tulio Valente — <i>Federal University of Minas Gerais, Brazil</i> . . .	138
<b>Reducing Redundancies in Multi-revision Code Analysis</b>	
Carol V. Alexandru, Sebastiano Panichella, and Harald C. Gall — <i>University of Zurich, Switzerland</i> . . . . .	148
<b>Code and Data Transformations</b>	
<b>Recommending Source Code Locations for System Specific Transformations</b>	
Gustavo Santos, Klérisson V. R. Paixão, Nicolas Anquetil, Anne Etien, Marcelo de Almeida Maia, and Stéphane Ducasse — <i>University of Lille, France; Federal University of Uberlândia, Brazil</i> . . . . .	160
<b>Extracting Executable Transformations from Distilled Code Changes</b>	
Reinout Stevens and Coen De Roover — <i>Vrije Universiteit Brussel, Belgium</i> . . . . .	171
<b>Automatic Generation of Opaque Constants Based on the K-Clique Problem for Resilient Data Obfuscation</b>	
Roberto Tiella and Mariano Ceccato — <i>Fondazione Bruno Kessler, Italy</i> . . . . .	182
<b>The Dark Side of Event Sourcing: Managing Data Conversion</b>	
Michiel Overeem, Marten Spoor, and Slinger Jansen — <i>AFAS Software, Netherlands; Utrecht University, Netherlands</i> .	193
<b>Program Comprehension</b>	
<b>Automatically Generating Natural Language Descriptions for Object-Related Statement Sequences</b>	
Xiaoran Wang, Lori Pollock, and K. Vijay-Shanker — <i>University of Delaware, USA</i> . . . . .	205
<b>Shorter Identifier Names Take Longer to Comprehend</b>	
Johannes Hofmeister, Janet Siegmund, and Daniel V. Holt — <i>University of Passau, Germany; University of Heidelberg, Germany</i> . . . . .	217
<b>Lexical Categories for Source Code Identifiers</b>	
Christian D. Newman, Reem S. AlSuhaibani, Michael L. Collard, and Jonathan I. Maletic — <i>Kent State University, USA; University of Akron, USA</i> . . . . .	228
<b>Computing Counter-Examples for Privilege Protection Losses using Security Models</b>	
Marc-André Laverdière and Ettore Merlo — <i>Tata Consultancy Services, Canada; Polytechnique Montréal, Canada</i> .	240
<b>Software Development Support</b>	
<b>Enriching In-IDE Process Information with Fine-Grained Source Code History</b>	
Sebastian Proksch, Sarah Nadi, Sven Amann, and Mira Mezini — <i>TU Darmstadt, Germany; University of Alberta, Canada</i> . . . . .	250
<b>How to Gamify Software Engineering</b>	
Tommaso Dal Sasso, Andrea Mocci, Michele Lanza, and Ebrisa Mastrodicasa — <i>University of Lugano, Switzerland</i> .	261
<b>Scalable Tag Recommendation for Software Information Sites</b>	
Pingyi Zhou, Jin Liu, Zijiang Yang, and Guangyou Zhou — <i>Wuhan University, China; Western Michigan University, USA; Central China Normal University, China</i> . . . . .	272
<b>Stack Overflow: A Code Laundering Platform?</b>	
Le An, Ons Mlouki, Foutse Khomh, and Giuliano Antoniol — <i>Polytechnique Montréal, Canada</i> . . . . .	283
<b>Code Smells and Refactoring</b>	
<b>An Empirical Study of Code Smells in JavaScript Projects</b>	
Amir Saboury, Pooya Musavi, Foutse Khomh, and Giuliano Antoniol — <i>Polytechnique Montréal, Canada</i> . . . . .	294

<b>Antipatterns Causing Memory Bloat: A Case Study</b>	
Kamil Jezek and Richard Lipka — <i>University of West Bohemia, Czech Republic</i> . . . . .	306
<b>Variant-Preserving Refactorings for Migrating Cloned Products to a Product Line</b>	
Wolfram Fenske, Jens Meinicke, Sandro Schulze, Steffen Schulze, and Gunter Saake — <i>University of Magdeburg, Germany; University of Magdeburg, USA</i> . . . . .	316
<b>Efficient Method Extraction for Automatic Elimination of Type-3 Clones</b>	
Ran Ettinger, Shmuel Tyszberowicz, and Shay Menaia — <i>Ben-Gurion University of the Negev, Israel; Academic College of Tel Aviv-Yaffo, Israel</i> . . . . .	327
<b>Testing and Fault Localization</b>	
<b>Spreadsheet Testing in Practice</b>	
Sohon Roy, Felienne Hermans, and Arie van Deursen — <i>Delft University of Technology, Netherlands</i> . . . . .	338
<b>Dynamic Patch Generation for Null Pointer Exceptions using Metaprogramming</b>	
Thomas Durieux, Benoit Cornu, Lionel Seinturier, and Martin Monperrus — <i>University of Lille, France</i> . . . . .	349
<b>Improving Fault Localization for Simulink Models using Search-Based Testing and Prediction Models</b>	
Bing Liu, Lucia, Shiva Nejati, and Lionel C. Briand — <i>University of Luxembourg, Luxembourg</i> . . . . .	359
<b>An Empirical Investigation into the Cost-Effectiveness of Test Effort Allocation Strategies for Finding Faults</b>	
Yiyang Feng, Wanwangying Ma, Yibiao Yang, Hongmin Lu, Yuming Zhou, and Baowen Xu — <i>Nanjing University, China</i> . . . . .	371

## Early Research Achievements

---

### Learning from and Providing Help to Developers

<b>What Information about Code Snippets Is Available in Different Software-Related Documents? An Exploratory Study</b>	
Preetha Chatterjee, Manziba Akanda Nishi, Kostadin Damevski, Vinay Augustine, Lori Pollock, and Nicholas A. Kraft — <i>University of Delaware, USA; Virginia Commonwealth University, USA; ABB Corporate Research, USA</i> . . . . .	382
<b>Harnessing Twitter to Support Serendipitous Learning of Developers</b>	
Abhishek Sharma, Yuan Tian, Agus Sulistya, David Lo, and Aiko Fallas Yamashita — <i>Singapore Management University, Singapore; Oslo and Akershus University College of Applied Sciences, Norway</i> . . . . .	387
<b>Why Do We Break APIs? First Answers from Developers</b>	
Laerte Xavier, Andre Hora, and Marco Tulio Valente — <i>Federal University of Minas Gerais, Brazil</i> . . . . .	392
<b>An Arc-Based Approach for Visualization of Code Smells</b>	
Marcel Steinbeck — <i>University of Bremen, Germany</i> . . . . .	397
<b>Towards Continuous Software Release Planning</b>	
David Ameller, Carles Farré, Xavier Franch, Danilo Valerio, and Antonino Cassarino — <i>Universitat Politècnica de Catalunya, Spain; Siemens, Austria</i> . . . . .	402

### Evolution of Open Source Systems

<b>An Exploratory Study on Library Aging by Monitoring Client Usage in a Software Ecosystem</b>	
Raula Gaikovina Kula, Daniel M. German, Takashi Ishio, Ali Ouni, and Katsuro Inoue — <i>Osaka University, Japan; University of Victoria, Canada; Osaka University, United Arab Emirates</i> . . . . .	407
<b>Trends on Empty Exception Handlers for Java Open Source Libraries</b>	
Ana Filipa Nogueira, José C. B. Ribeiro, and Mário A. Zenha-Rela — <i>University of Coimbra, Portugal; Polytechnic Institute of Leiria, Portugal</i> . . . . .	412
<b>Analyzing the Evolution of Testing Library Usage in Open Source Java Projects</b>	
Ahmed Zerouali and Tom Mens — <i>University of Mons, Belgium</i> . . . . .	417
<b>On the Evolution of Exception Usage in Java Projects</b>	
Haidar Osman, Andrei Chiş, Jakob Schaerer, Mohammad Ghafari, and Oscar Nierstrasz — <i>University of Bern, Switzerland; Feenk, Switzerland</i> . . . . .	422

<b>Statically Identifying Class Dependencies in Legacy JavaScript Systems: First Results</b>	
Leonardo Humberto Silva, Marco Tulio Valente, and Alexandre Bergel — <i>Federal Institute of Northern Minas Gerais, Brazil; Federal University of Minas Gerais, Brazil; University of Chile, Chile</i> . . . . .	427
<b>CodeCritics Applied to Database Schema: Challenges and First Results</b>	
Julien Delplanque, Anne Etien, Olivier Auverlot, Tom Mens, Nicolas Anquetil, and Stéphane Ducasse — <i>University of Mons, France; University of Lille, France; University of Mons, Belgium</i> . . . . .	432
<b>Patterns and Optimization</b>	
<b>Cloud-Based Parallel Concolic Execution</b>	
Ting Chen, Youzheng Feng, Xiapu Luo, Xiaodong Lin, and Xiaosong Zhang — <i>University of Electronic Science and Technology of China, China; Hong Kong Polytechnic University, China; University of Ontario Institute of Technology, Canada</i> . . . . .	437
<b>Under-Optimized Smart Contracts Devour Your Money</b>	
Ting Chen, Xiaoqi Li, Xiapu Luo, and Xiaosong Zhang — <i>University of Electronic Science and Technology of China, China; Hong Kong Polytechnic University, China</i> . . . . .	442
<b>Pluggable Controllers and Nano-Patterns</b>	
Yossi Gil, Ori Marcovitch, and Matteo Orrù — <i>Technion, Israel</i> . . . . .	447
<b>Query Construction Patterns in PHP</b>	
David Anderson and Mark Hills — <i>East Carolina University, USA</i> . . . . .	452
<b>Supporting Schema Evolution in Schema-Less NoSQL Data Stores</b>	
Loup Meurice and Anthony Cleve — <i>University of Namur, Belgium</i> . . . . .	457

## Tool Demonstrations

---

### Static Analysis and Refactoring

<b>XCore: Support for Developing Program Analysis Tools</b>	
Alexandru Ștefănică and Petru Florin Mihancea — <i>Politehnica University of Timișoara, Romania</i> . . . . .	462
<b>srcQL: A Syntax-Aware Query Language for Source Code</b>	
Brian Bartman, Christian D. Newman, Michael L. Collard, and Jonathan I. Maletic — <i>Kent State University, USA; University of Akron, USA</i> . . . . .	467
<b>UAV: Warnings from Multiple Automated Static Analysis Tools at a Glance</b>	
Tim Buckers, Clinton Cao, Michiel Doesburg, Boning Gong, Sunwei Wang, Moritz Beller, and Andy Zaidman — <i>Delft University of Technology, Netherlands</i> . . . . .	472
<b>The Spartanizer: Massive Automatic Refactoring</b>	
Yossi Gil and Matteo Orrù — <i>Technion, Israel</i> . . . . .	477
<b>c-JRefRec: Change-Based Identification of Move Method Refactoring Opportunities</b>	
Naoya Ujihara, Ali Ouni, Takashi Ishio, and Katsuro Inoue — <i>Osaka University, Japan; United Arab Emirates University, United Arab Emirates</i> . . . . .	482
<b>Lightweight Detection of Android-Specific Code Smells: The aDoctor Project</b>	
Fabio Palomba, Dario Di Nucci, Annibale Panichella, Andy Zaidman, and Andrea De Lucia — <i>Delft University of Technology, Italy; University of Salerno, Italy; University of Luxembourg, Luxembourg; Delft University of Technology, Netherlands</i> . . . . .	487

### Binaries and Evolution

<b>scat: Learning from a Single Execution of a Binary</b>	
Franck de Goër, Christopher Ferreira, and Laurent Mounier — <i>LIG, France; VERIMAG, France</i> . . . . .	492
<b>dynStruct: An Automatic Reverse Engineering Tool for Structure Recovery and Memory Use Analysis</b>	
Daniel Mercier, Aziem Chawdhary, and Richard Jones — <i>University of Kent, UK</i> . . . . .	497
<b>InsDal: A Safe and Extensible Instrumentation Tool on Dalvik Byte-Code for Android Applications</b>	
Jierui Liu, Tianyong Wu, Xi Deng, Jun Yan, and Jian Zhang — <i>Institute of Software at Chinese Academy of Sciences, China</i> . . . . .	502

<b>Columbo: High Performance Unpacking</b>	
Jason Raber — <i>MalwareBytes, USA</i> . . . . .	507
<b>Hindsight: Revealing the Evolution of Dependencies to Developers</b>	
George Ganea — <i>Politehnica University of Timișoara, Romania</i> . . . . .	511
<b>Replan: A Release Planning Tool</b>	
David Ameller, Carles Farré, Xavier Franch, Antonino Cassarino, Danilo Valerio, and Valentin Elvassore — <i>Universitat Politècnica de Catalunya, Spain; Siemens, Austria</i> . . . . .	516

## Industrial Research

---

<b>Bringing Back-in-Time Debugging Down to the Database</b>	
Arian Treffer, Michael Perscheid, and Matthias Uflacker — <i>HPI, Germany; SAP, Germany</i> . . . . .	521
<b>Performance Tuning for Automotive Software Fault Prediction</b>	
Harald Altinger, Steffen Herbold, Friederike Schneemann, Jens Grabowski, and Franz Wotawa — <i>Audi Electronics Venture, Germany; University of Göttingen, Germany; Graz University of Technology, Austria</i> . . . . .	526
<b>Business Process Recovery Based on System Log and Information of Organizational Structure</b>	
Ryota Mibe, Tadashi Tanaka, Takashi Kobayashi, and Shingo Kobayashi — <i>Hitachi, Japan; Tokyo Institute of Technology, Japan; Japan EXPert Clone, Japan</i> . . . . .	531
<b>Multi-language Re-documentation to Support a COBOL to Java Migration Project</b>	
Bernhard Dorninger, Michael Moser, and Josef Pichler — <i>Software Competence Center Hagenberg, Austria</i> . . . . .	536
<b>Proactive Reviews of Textual Requirements</b>	
Vard Antinyan and Miroslaw Staron — <i>University of Gothenburg, Sweden</i> . . . . .	541
<b>Data Access Visualization for Legacy Application Maintenance</b>	
Keisuke Yano and Akihiko Matsuo — <i>Fujitsu Labs, Japan</i> . . . . .	546

## Posters

---

<b>An Empirical Study of Clone Density Evolution and Developer Cloning Tendency</b>	
Brent van Bladel, Alessandro Murgia, and Serge Demeyer — <i>University of Antwerp, Belgium</i> . . . . .	551
<b>Towards Reverse Engineering of Intermediate Code for Documentation Generators</b>	
Michael Moser, Michael Pfeiffer, and Josef Pichler — <i>Software Competence Center Hagenberg, Austria</i> . . . . .	553
<b>A Framework for Classifying and Comparing Source Code Recommendation Systems</b>	
Mohammad Ghafari and Hamidreza Moradi — <i>University of Bern, Switzerland; University of Texas at San Antonio, USA</i> . . . . .	555
<b>Self-Adaptive Systems Framework Based on Agent and Search-Based Optimization</b>	
Liu He, Qingshan Li, Lu Wang, and Jiewen Wan — <i>Xidian University, China</i> . . . . .	557
<b>The Importance of Program Design Patterns Training</b>	
Viggo Holmstedt and Shegaw A. Mengiste — <i>University College of South-East Norway, Norway</i> . . . . .	559
<b>Conventionality Analysis of Array Objects in JavaScript</b>	
Astrid Younang and Lunjin Lu — <i>Oakland University, USA</i> . . . . .	561
<b>Two Improvements to Detect Duplicates in Stack Overflow</b>	
Yuji Mizobuchi and Kuniharu Takayama — <i>Fujitsu Labs, Japan</i> . . . . .	563
<b>Modernizing Domain-Specific Languages with XMLText and IntellEdit</b>	
Patrick Neubauer, Robert Bill, and Manuel Wimmer — <i>Vienna University of Technology, Austria</i> . . . . .	565
<b>Lost Comments Support Program Comprehension</b>	
Takayuki Omori — <i>Ritsumeikan University, Japan</i> . . . . .	567
<b>Does the Release Cycle of a Library Project Influence When It Is Adopted by a Client Project?</b>	
Daiki Fujibayashi, Akinori Ihara, Hirohiko Suwa, Raula Gaikovina Kula, and Kenichi Matsumoto — <i>NAIST, Japan; Osaka University, Japan</i> . . . . .	569
<b>Which Review Feedback Did Long-Term Contributors Get on OSS Projects?</b>	
Takuto Norikane, Akinori Ihara, and Kenichi Matsumoto — <i>NAIST, Japan</i> . . . . .	571

<b>Frame-Based Behavior Preservation in Refactoring</b>	
Katsuhisa Maruyama, Shinpei Hayashi, Norihiro Yoshida, and Eunjong Choi — <i>Ritsumeikan University, Japan; Tokyo Institute of Technology, Japan; Nagoya University, Japan; NAIST, Japan</i>	573
<b>Log Generation for Coding Behavior Analysis: For Focusing on How Kids Are Coding Not What They Are Coding</b>	
Ra-Jeong Moon, Kyu-Min Shim, Hae-Young Lee, and Hyung-Jong Kim — <i>Seoul Women’s University, Korea; Entry Labs, Korea</i>	575
<b>Towards Understanding an Open-Source Bounty: Analysis of Bountysource</b>	
Tetsuya Kanda, Mingyu Guo, Hideaki Hata, and Kenichi Matsumoto — <i>NAIST, Japan; University of Adelaide, Australia</i>	577
<b>Author Index</b>	579