

2020 IEEE 27th International Conference on Software Analysis, Evolution and Reengineering (SANER 2020)

**London, Ontario, Canada
18 – 21 February 2020**



**IEEE Catalog Number: CFP20102-POD
ISBN: 978-1-7281-5144-1**

**Copyright © 2020 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:	CFP20102-POD
ISBN (Print-On-Demand):	978-1-7281-5144-1
ISBN (Online):	978-1-7281-5143-4
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
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

Contents

Frontmatter

Message from the General Chairs and Program Co-Chairs	iii
Program Committees	vi

Main Research

Referee: A Pattern-Guided Approach for Auto Design in Compiler-Based Analyzers Fang Lv, Hao Li, Lei Wang, Ying Liu, Huimin Cui, Jingling Xue, and Xiaobing Feng — <i>Institute of Computing Technology at Chinese Academy of Sciences, China; UNSW, Australia</i>	1
Web APIs in Android through the Lens of Security Pascal Gadiet, Mohammad Ghafari, Marc-Andrea Tarnutzer, and Oscar Nierstrasz — <i>University of Bern, Switzerland</i>	13
SMARTSHIELD: Automatic Smart Contract Protection Made Easy Yuyao Zhang, Siqi Ma, Juanru Li, Kailai Li, Surya Nepal, and Dawu Gu — <i>Shanghai Jiao Tong University, China; Data61 at CSIRO, Australia</i>	23
Automatically Extracting Subroutine Summary Descriptions from Unstructured Comments Zachary Eberhart, Alexander LeClair, and Collin McMillan — <i>University of Notre Dame, USA</i>	35
Resource Race Attacks on Android Yan Cai, Yutian Tang, Haicheng Li, Le Yu, Hao Zhou, Xiapu Luo, Liang He, and Purui Su — <i>Institute of Software at Chinese Academy of Sciences, China; Hong Kong Polytechnic University, China; University of Chinese Academy of Sciences, China; Peng Cheng Laboratory, China</i>	47
We Are Family: Analyzing Communication in GitHub Software Repositories and Their Forks Scott Brisson, Ehsan Noei, and Kelly Lyons — <i>University of Toronto, Canada</i>	59
Exploring Type Inference Techniques of Dynamically Typed Languages C. M. Khaled Saifullah, Muhammad Asaduzzaman, and Chanchal K. Roy — <i>University of Saskatchewan, Canada; Queen's University, Canada</i>	70
How Do Python Framework APIs Evolve? An Exploratory Study Zhaoxu Zhang, Hengcheng Zhu, Ming Wen, Yida Tao, Yepang Liu, and Yingfei Xiong — <i>Southern University of Science and Technology, China; Huazhong University of Science and Technology, China; Shenzhen University, China; Peking University, China</i>	81
Associating Code Clones with Association Rules for Change Impact Analysis Manishankar Mondal, Banani Roy, Chanchal K. Roy, and Kevin A. Schneider — <i>University of Saskatchewan, Canada</i>	93
LibDX: A Cross-Platform and Accurate System to Detect Third-Party Libraries in Binary Code Wei Tang, Ping Luo, Jialiang Fu, and Dan Zhang — <i>Tsinghua University, China</i>	104
EthPloit: From Fuzzing to Efficient Exploit Generation against Smart Contracts Qingzhao Zhang, Yizhuo Wang, Juanru Li, and Siqi Ma — <i>Shanghai Jiao Tong University, China; Data61 at CSIRO, Australia</i>	116
Sequence Directed Hybrid Fuzzing Hongliang Liang, Lin Jiang, Lu Ai, and Jinyi Wei — <i>Beijing University of Posts and Telecommunications, China</i>	127
LESSQL: Dealing with Database Schema Changes in Continuous Deployment Ariel Afonso, Altigran da Silva, Tayana Conte, Paulo Martins, João Cavalcanti, and Alessandro Garcia — <i>Federal University of Amazonas, Brazil; PUC-Rio, Brazil</i>	138
Cross-Dataset Design Discussion Mining Alvi Mahadi, Karan Tongay, and Neil A. Ernst — <i>University of Victoria, Canada</i>	149
C-3PR: A Bot for Fixing Static Analysis Violations via Pull Requests Antônio Carvalho, Welder Luz, Diego Marcílio, Rodrigo Bonifácio, Gustavo Pinto, and Edna Dias Canedo — <i>University of Brasília, Brazil; USI Lugano, Switzerland; Federal University of Pará, Brazil</i>	161
Automated Bug Detection and Replay for COTS Linux Kernel Modules with Concolic Execution Bo Chen, Zhenkun Yang, Li Lei, Kai Cong, and Fei Xie — <i>Intel, USA; Portland State University, USA</i>	172
Ultra-Large-Scale Repository Analysis via Graph Compression Paolo Boldi, Antoine Pietri, Sebastiano Vigna, and Stefano Zacchiroli — <i>University of Milan, Italy; Inria, France; University Paris Diderot, France</i>	184

Studying Developer Reading Behavior on Stack Overflow during API Summarization Tasks	
Jonathan A. Saddler, Cole S. Peterson, Sanjana Sama, Shruthi Nagaraj, Olga Baysal, Latifa Guerrouj, and Bonita Sharif — <i>University of Nebraska-Lincoln, USA; Youngstown State University, USA; Carleton University, Canada; ETS, Canada</i>	195
On the Adoption of Kotlin on Android Development: A Triangulation Study	
Victor Oliveira, Leopoldo Teixeira, and Felipe Ebert — <i>Federal University of Pernambuco, Brazil; Tempest Security Intelligence, Brazil</i>	206
Energy Refactorings for Android in the Large and in the Wild	
Marco Couto, João Saraiva, and João Paulo Fernandes — <i>University of Minho, Portugal; University of Coimbra, Portugal</i>	217
Essential Sentences for Navigating Stack Overflow Answers	
Sarah Nadi and Christoph Treude — <i>University of Alberta, Canada; University of Adelaide, Australia</i>	229
HistoRank: History-Based Ranking of Co-change Candidates	
Manishankar Mondal, Banani Roy, Chanchal K. Roy, and Kevin A. Schneider — <i>University of Saskatchewan, Canada</i>	240
D-Goldilocks: Automatic Redistribution of Remote Functionalities for Performance and Efficiency	
Kijin An and Eli Tilevich — <i>Virginia Tech, USA</i>	251
Detecting Code Clones with Graph Neural Network and Flow-Augmented Abstract Syntax Tree	
Wenhan Wang, Ge Li, Bo Ma, Xin Xia, and Zhi Jin — <i>Peking University, China; Monash University, Australia</i>	261
SAGA: Efficient and Large-Scale Detection of Near-Miss Clones with GPU Acceleration	
Guanhua Li, Yijian Wu, Chanchal K. Roy, Jun Sun, Xin Peng, Nanjie Zhan, Bin Hu, and Jingyi Ma — <i>Fudan University, China; Shanghai Key Laboratory of Data Science, China; University of Saskatchewan, Canada; Singapore Management University, Singapore</i>	272
CORE: Automating Review Recommendation for Code Changes	
Jing Kai Siow, Cuiyun Gao, Lingling Fan, Sen Chen, and Yang Liu — <i>Nanyang Technological University, Singapore</i>	284
Distinguishing Similar Design Pattern Instances through Temporal Behavior Analysis	
Renhao Xiong, David Lo, and Bixin Li — <i>Southeast University, China; Singapore Management University, Singapore</i>	296
Relationship between the Effectiveness of Spectrum-Based Fault Localization and Bug-Fix Types in JavaScript Programs	
Béla Vancsics, Attila Szatmári, and Árpád Beszédes — <i>University of Szeged, Hungary</i>	308
Incremental Map-Reduce on Repository History	
Johannes Härtel and Ralf Lämmel — <i>University of Koblenz-Landau, Germany</i>	320
How EvoStreets Are Observed in Three-Dimensional and Virtual Reality Environments	
Marcel Steinbeck, Rainer Koschke, and Marc O. Rüdell — <i>University of Bremen, Germany</i>	332
Are the Code Snippets What We Are Searching for? A Benchmark and an Empirical Study on Code Search with Natural-Language Queries	
Shuhan Yan, Hang Yu, Yuting Chen, Beijun Shen, and Lingxiao Jiang — <i>Shanghai Jiao Tong University, China; Singapore Management University, Singapore</i>	344
Automatically Learning Patterns for Self-Admitted Technical Debt Removal	
Fiorella Zampetti, Alexander Serebrenik, and Massimiliano Di Penta — <i>University of Sannio, Italy; Eindhoven University of Technology, Netherlands</i>	355
Refactoring Graphs: Assessing Refactoring over Time	
Aline Brito, Andre Hora, and Marco Tulio Valente — <i>Federal University of Minas Gerais, Brazil</i>	367
On Relating Technical, Social Factors, and the Introduction of Bugs	
Filipe Falcão, Caio Barbosa, Balduino Fonseca, Alessandro Garcia, Márcio Ribeiro, and Rohit Gheyi — <i>Federal University of Alagoas, Brazil; PUC-Rio, Brazil; Federal University of Campina Grande, Brazil</i>	378
Characterizing Architectural Drifts of Adaptive Systems	
Daniel San Martín, Bento Siqueira, Valter Camargo, and Fabiano Ferrari — <i>Federal University of São Carlos, Brazil</i>	389
Using Productive Collaboration Bursts to Analyze Open Source Collaboration Effectiveness	
Samridhi Choudhary, Christopher Bogart, Carolyn Rose, and James Herbsleb — <i>Amazon, USA; Carnegie Mellon University, USA</i>	400
Slice-Based Cognitive Complexity Metrics for Defect Prediction	
Basma S. Alqadi and Jonathan I. Maletic — <i>Imam Muhammad ibn Saud Islamic University, Saudi Arabia; Kent State University, USA</i>	411
The Silent Helper: The Impact of Continuous Integration on Code Reviews	
Nathan Cassee, Bogdan Vasilescu, and Alexander Serebrenik — <i>Eindhoven University of Technology, Netherlands; Carnegie Mellon University, USA</i>	423
Heap Memory Snapshot Assisted Program Analysis for Android Permission Specification	
Lannan Luo — <i>University of South Carolina, USA</i>	435
A Code-Description Representation Learning Model Based on Attention	
Qing Huang, An Qiu, Maosheng Zhong, and Yuan Wang — <i>Jiangxi Normal University, China</i>	447

Suggesting Comment Completions for Python using Neural Language Models Adelina Ciurumelea, Sebastian Proksch, and Harald C. Gall — <i>University of Zurich, Switzerland</i>	456
Leveraging Contextual Information from Function Call Chains to Improve Fault Localization Árpád Beszédés, Ferenc Horváth, Massimiliano Di Penta, and Tibor Gyimóthy — <i>University of Szeged, Hungary; University of Sannio, Italy</i>	468
Deep Learning Based Identification of Suspicious Return Statements Guangjie Li, Hui Liu, Jiahao Jin, and Qasim Umer — <i>Beijing Institute of Technology, China</i>	480
Clone Detection in Test Code: An Empirical Evaluation Brent van Bladel and Serge Demeyer — <i>University of Antwerp, Belgium</i>	492
Are SonarQube Rules Inducing Bugs? Valentina Lenarduzzi, Francesco Lomio, Heikki Huttunen, and Davide Taibi — <i>Lappeenranta-Lahti University of Technology, Finland; Tampere University, Finland</i>	501

ERA

Enhancing Source Code Refactoring Detection with Explanations from Commit Messages Rrezarta Krasniqi and Jane Cleland-Huang — <i>University of Notre Dame, USA</i>	512
Unleashing the Potentials of Immersive Augmented Reality for Software Engineering Leonel Merino, Mircea Lungu, and Christoph Seidl — <i>University of Stuttgart, Germany; IT University of Copenhagen, Denmark</i>	517
Reflection on Building Hybrid Access Control by Configuring RBAC and MAC Features Dae-Kyoo Kim, Hua Ming, and Lunjin Lu — <i>Oakland University, USA</i>	522
Is Developer Sentiment Related to Software Bugs: An Exploratory Study on GitHub Commits Syed Fatiul Huq, Ali Zafar Sadiq, and Kazi Sakib — <i>University of Dhaka, Bangladesh</i>	527
The Python/C API: Evolution, Usage Statistics, and Bug Patterns Mingzhe Hu and Yu Zhang — <i>University of Science and Technology of China, China</i>	532
Revisiting the Challenges and Opportunities in Software Plagiarism Detection Xi Xu, Ming Fan, Ang Jia, Yin Wang, Zheng Yan, Qinghua Zheng, and Ting Liu — <i>Xi'an Jiaotong University, China; Xidian University, China; Aalto University, Finland</i>	537
Req2Lib: A Semantic Neural Model for Software Library Recommendation Zhensu Sun, Yan Liu, Ziming Cheng, Chen Yang, and Pengyu Che — <i>Tongji University, China</i>	542
Dependency Solving Is Still Hard, but We Are Getting Better at It Pietro Abate, Roberto Di Cosmo, Georgios Gousios, and Stefano Zacchiroli — <i>Nomadic Labs, France; Inria, France; University Paris Diderot, France; Delft University of Technology, Netherlands</i>	547
A Reflection on An Exploratory Study on Exception Handling Bugs in Java Programs Felipe Ebert, Fernando Castor, and Alexander Serebrenik — <i>Federal University of Pernambuco, Brazil; Eindhoven University of Technology, Netherlands</i>	552
A Preliminary Study on Open-Source Memory Vulnerability Detectors Yu Nong and Haipeng Cai — <i>Washington State University, USA</i>	557
A Reflection on the Predictive Accuracy of Dynamic Impact Analysis Haipeng Cai — <i>Washington State University, USA</i>	562
JavaScript API Deprecation in the Wild: A First Assessment Romulo Nascimento, Aline Brito, Andre Hora, and Eduardo Figueiredo — <i>Federal University of Minas Gerais, Brazil</i>	567
A Semantic-Based Framework for Analyzing App Users Feedback Aman Yadav, Rishab Sharma, and Fatemeh H. Fard — <i>NIT, India; University of British Columbia, Canada</i>	572
MobiLogLeak: A Preliminary Study on Data Leakage Caused by Poor Logging Practices Rui Zhou, Mohammad Hamdaqa, Haipeng Cai, and Abdelwahab Hamou-Lhadj — <i>Concordia University, Canada; Reykjavik University, Iceland; Washington State University, USA</i>	577
Identifying Vulnerable IoT Applications using Deep Learning Hajra Naem and Manar H. Alalfi — <i>Ryerson University, Canada</i>	582
A Mutation Framework for Evaluating Security Analysis Tools in IoT Applications Sajeda Parveen and Manar H. Alalfi — <i>Ryerson University, Canada</i>	587

RENE

Pull Requests or Commits? Which Method Should We Use to Study Contributors Behavior?

Marcus Bertocello, Gustavo Pinto, Igor Scaliante Wiese, and Igor Steinmacher — *State University of Maringá, Brazil; Federal University of Paraná, Brazil; Federal University of Technology Paraná, Brazil; Northern Arizona University, USA* 592

Automated Deprecated-API Usage Update for Android Apps: How Far Are We?

Ferdian Thung, Stefanus A. Haryono, Lucas Serrano, Gilles Muller, Julia Lawall, David Lo, and Lingxiao Jiang — *Singapore Management University, Singapore; Sorbonne University, France; LIP6, France; Inria, France* 602

Industry

Experience Report: How Effective Is Automated Program Repair for Industrial Software?

Kunihiro Noda, Yusuke Nemoto, Keisuke Hotta, Hideo Tanida, and Shinji Kikuchi — *Fujitsu Labs, Japan* 612

Reducing Code Complexity through Code Refactoring and Model-Based Rejuvenation

Arjan J. Mooij, Jeroen Ketema, Steven Klusener, and Mathijs Schuts — *ESI/TNO, Netherlands; Philips, Netherlands* 617

Leveraging Machine Learning for Software Redocumentation

Verena Geist, Michael Moser, Josef Pichler, Stefanie Beyer, and Martin Pinzger — *Software Competence Center Hagenberg, Austria; University of Applied Sciences Upper Austria, Austria; University of Klagenfurt, Austria* 622

Automated Code Transformations: Dealing with the Aftermath

Stefan Strobl, Christina Zoffi, Christoph Haselmann, Mario Bernhart, and Thomas Grechenig — *Vienna University of Technology, Austria* 627

Tool Demonstrations

CryptoExplorer: An Interactive Web Platform Supporting Secure Use of Cryptography APIs

Mohammadreza Hazhirpasand, Mohammad Ghafari, and Oscar Nierstrasz — *University of Bern, Switzerland* 632

AUSearch: Accurate API Usage Search in GitHub Repositories with Type Resolution

Muhammad Hilmi Asyrofi, Ferdian Thung, David Lo, and Lingxiao Jiang — *Singapore Management University, Singapore* 637

Clone Notifier: Developing and Improving the System to Notify Changes of Code Clones

Shogo Tokui, Norihiro Yoshida, Eunjong Choi, and Katsuro Inoue — *Osaka University, Japan; Nagoya University, Japan; Kyoto Institute of Technology, Japan* 642

Mining Version Control Systems and Issue Trackers with LibVCS4j

Marcel Steinbeck — *University of Bremen, Germany* 647

SpojitR: Intelligently Link Development Artifacts

Michael Rath, Mihaela Todorova Tomova, and Patrick Mäder — *DLR, Germany; TU Ilmenau, Germany* 652

ChangeBeadsThreader: An Interactive Environment for Tailoring Automatically Untangled Changes

Satoshi Yamashita, Shinpei Hayashi, and Motoshi Saeki — *Tokyo Institute of Technology, Japan* 657

Late Breaking Ideas

Reinforcement Learning Guided Symbolic Execution

Jie Wu, Chengyu Zhang, and Geguang Pu — *East China Normal University, China* 662

Live Replay of Screen Videos: Automatically Executing Real Applications as Shown in Recordings

Rudolf Ramler, Marko Gattringer, and Josef Pichler — *Software Competence Center Hagenberg, Austria; University of Applied Sciences Upper Austria, Austria* 664

Documentation of Machine Learning Software

Yalda Hashemi, Maleknaz Nayebi, and Giuliano Antoniol — *Polytechnique Montréal, Canada* 666

Building an Inclusive Distributed Ledger System

Cynthia Dookie 668

Author Index 670