April 9–12, 2018
Nice, France

Association for Computing Machinery

Advancing Computing as a Science & Profession

‹Programming› 2018 Companion

Conference Companion of the 2nd International Conference on

Art, Science, and Engineering of Programming

Edited by:
Stefan Marr and Jennifer B. Sartor

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Message from the Chairs

This volume contains the papers presented in the Programming'18 workshops:

- BX: Seventh International Workshop on Bidirectional Transformations
- MoreVMs: Workshop on Modern Language Runtimes, Ecosystems, and VMs
- PASS: Programming Across the System Stack
- PX: Programming Experience
- ProWeb: Programming Technology for the Future Web
- Salon des Refusés

as well as from the ACM Student Research Competition.

The International Conference on the Art, Science, and Engineering of Programming (<Programming> for short) is a new conference focused on programming topics including the experience of programming.

The second edition of this conference was held during April 9-12, 2018 in Nice, France. It consisted of four days of conference, including 6 workshops, 1 compiler coding dojo (CoCoDo), 1 poster session, a student research competition, and 2 keynotes. The first keynote was given by Sukyoung Ryu (KAIST). She presented work on static analysis of Android applications for finding bugs and security vulnerabilities. The second keynote was give by Shriram Krishnamurthi (Brown University). It explored relationships between programming languages, program design, curricula, and how students perceive code structure. The main research track consisted of 15 presentations associated with the 15 papers that appeared in volume 2 of the Programming journal.

I'm grateful to all the people involved in the preparation and organization of <Programming> 2018. In particular I thank all the members of organizing committee: Guido Salvaneschi, Tamara Rezk, Sylvia Grewe, Philipp Haller, Etienne Lozes, Stefan Marr, Minh Ngo, Fabio Niephaus, Tobias Pape, Yves Roudier, and Jennifer B. Sartor. I also thank Agnes Cortell from INRIA that played a fundamental role in organizing the conference. Finally, I thank our organizer and sponsors, INRIA, Oracle, UCA, and AOSA for their administrative and financial support. I also gratefully acknowledge the assistance of the Programming Steering Committee for its help and advice.

Manuel Serrano (Inria, France)
Jennifer B. Sartor (Vrije Universiteit Brussel, Belgium)
Stefan Marr (University of Kent, UK)

7th International Workshop on Bidirectional Transformations (Bx 2018)

Bidirectional transformations (bx) are a mechanism for maintaining the consistency of at least two related sources of information. Such sources can be relational databases, software models and code, or any other document following standard or ad-hoc formats. Bx are an emerging topic in a wide range of research areas, with prominent presence at top conferences in several different fields (namely databases, programming languages, software engineering, and graph transformation), but with results in one field often getting limited exposure in the others. Bx 2018 is a dedicated venue for bx in all relevant fields, and is part of a workshop series that was created in order to promote cross-disciplinary research and awareness in the area. As such, since its beginning in 2012, the workshop has rotated between venues in different fields. In 2018, bx was co-located with <Programming> for the first time in Nice, France. It was previously held at the following locations.

- Bx 2012: Tallinn, Estonia, co-located with ETAPS
- Bx 2013: Rome, Italy, co-located with ETAPS
- Bx 2014: Athens, Italy, co-located with EDBT/ICDT
- Bx 2015: L'Aquila, Italy, co-located with STAF
- Bx 2016: Eindhoven, The Netherlands, co-located with ETAPS
- Bx 2017: Uppsala, Sweden, co-located with ETAPS

The call for papers attracted 13 paper submissions and 4 talk proposals, from which the program committee, after a careful reviewing and discussion process, selected for presentation at the workshop 8 papers (3 full research papers, 1 tool paper, 1 experience report and 3 extended abstracts) and 4 talks.

- Michael Johnson, Perdita Stevens: *Confidentiality in the Process of (Model-Driven) Software Development*
- Patrick Stünkel, Harald König, Yngve Lamo, Adrian Rutle: *Multimodel Correspondence through Inter-Model Constraints*
- Anthony Anjorin, Enes Yigitbas, Hermann Kaindl, Roman Popp: *On the Development of Consistent User Interfaces* (Extended Abstract)
- Michael Johnson, Robert Rosebrugh: *Cospans and Symmetric Lenses*
- Guillaume Bouisseau: *Understanding Profunctor Optics: A Representation Theorem* (Extended Abstract)
- Anthony Anjorin, Hsiang-Shang Ko: *Towards a Visual Editor for Lens Combinators* (Extended Abstract)
- Romina Eramo, Alfonso Pierantonio, Michele Tucci: *Enhancing the JTL Tool for Bidirectional Transformations* (Tool Paper)
- Adrien Duchêne, Hugues Marchal, Zhenjiang Hu, and Pierre-Yves Schobbens: *Lightweight Data Sharing System based on Bidirectional Transformations* (Experience Report)
- Jules Hedges: *Bimorphic Lenses in Compositional Game Theory* (Talk)
- Hsiang-Shang Ko, Zhenjiang Hu: *An Axiomatic Basis for Bidirectional Programming* (Talk)
- Jeremy Gibbons, Guillaume Bouisseau: *Profunctor Optics and the Yoneda Lemma* (Talk)
- Perdita Stevens: *Towards Sound, Flexible and Optimal Build for Megamodels* (Talk)

We would like to thank the Program Committee and the external reviewers for their detailed reviews and careful consideration, and for the overall efficiency that enabled the tight schedule for reviewing. We would also like to thank all the authors and participants for helping us make BX 2018 a success.

Jens Weber and Kazutaka Matsuda
March 2018 PC Chairs of Bx 2018

Program Committee

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Kazutaka Matsuda (Tohoku University, co-chair)
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2nd International Workshop on Modern Language Runtimes, Ecosystems, and VMs (MoreVMs 2018)

Welcome to the proceedings of the second Workshop on Modern Language Runtimes, Ecosystems, and VMs (MoreVMs'18). The workshop is co-located with <Programming>'18 and will take place on April 9th, 2018 in Nice, France.

MoreVMs'18 aims to bring together industrial and academic programmers to discuss the design, implementation, and usage of modern languages and runtimes. This includes aspects such as reuse of language runtimes, modular implementation, language design and compilation strategies.

MoreVMs'18 is the second edition of the workshop. The first was also co-located with <Programming>. This year's workshop continues in the spirit of the first, striving to enable an informal and diverse discussion on how languages and runtimes are currently being utilized, and where they need to improve further.

Presentation proposals were in the form of extended abstracts. Abstracts discussing experiences, work-in-progress, as well as future visions, from either an academic or industrial perspective were welcomed.

Abstracts were reviewed by the members of the program and organising committees. The Program Committee was selected with the intention of having equal parts academic and industrial affiliations. Each reviewer was assigned 3 abstracts. There were 13 submissions in total, of which 8 will appear at the Workshop. Authors were given the option of having their submission appear in the ACM Digital Library (subject to the agreement of the committees on suitability). Of the 8 submissions appearing at the workshop, 7 will appear in the ACM Digital Library.

Whereas the first edition grouped presentations on similar topics into "themed" sessions, for this year's workshop we have opted for mixed-topic sessions. In addition to the accepted submissions, there will also be a 30 minute discussion session entitled "Why do we need Research VMs and what are our Requirements?".

The workshop can be found on the web at:

`https://2018.programming-conference.org/track/MoreVMs-2018/`

The Organising Committee for MoreVMs'18 is:

- Edd Barrett, King's College London, United Kingdom.
- Stefan Marr, University of Kent, United Kingdom.
- Adam Welc, Uber Technologies, United States.

The Program Committee is:

- Clément Bera, Inria Lille Nord Europe, France.
- Maxime Chevalier-Boisvert, University of Montreal, Canada.
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- Maoni Stephens, Microsoft, United States.
- Gaël Thomas, Telecom SudParis, France.
- Mario Wolczko, Oracle Labs, United States.

The Organising Committee would like to thank the authors and members of the Program Committee. Without your contributions MoreVMs'18 would not be possible. We also thank <Programming>'18 for hosting our workshop.

Edd Barrett, Stefan Marr, Adam Welc
March 2018 The Organising Committee

2nd International Workshop on Programming Technology for the Future Web (ProWeb 2018)

It is our distinct pleasure to welcome you to **ProWeb18**.

Full-fledged **web applications** have become ubiquitous on desktop and mobile devices alike. Whereas *"responsive"* web applications already offered a more desktop-like experience, there is an increasing demand for *"rich"* web applications (RIAs) that offer collaborative and even off-line functionality —Google docs being the prototypical example. Long gone are the days that web servers merely had to answer incoming HTTP request with a block of static HTML. Today's servers react to a continuous stream of *events coming from JavaScript applications that have been pushed to clients*. As a result, **application logic and data** are increasingly **distributed**. Traditional dichotomies such as *"client vs. server"* and *"offline vs. online"* are fading.

The *2nd International Workshop on Programming Technology for the Future Web*, or **ProWeb18**, is a forum for *researchers* and *practitioners* to share and discuss new technology for programming these and future evolutions of the web.

ProWeb18 received a total of 11 submissions. Out of these, 4 had to be desk rejected because they were out of the scope of the workshop. The 7 remaining submissions went through a rigorous reviewing process. Every submission received at least three reviews by the PC members, and was carefully discussed until a consensus was reached. All decisions were based solely on the quality of the submission and on the outcome of the discussion. We did not target any minimum nor maximum number of papers to be accepted. The program committee accepted the 2 technical papers included in these proceedings, and the 2 presentation abstracts available on the website of the workshop. We hope that the authors of submissions that did not make it to the program will be able to benefit from the reviewers' feedback. A keynote by Manuel Serrano from INRIA Sophia-Antipolis on multi-tier programming of web applications completes this year's program.

We would like to thank all authors for submitting a set of high-quality submissions, and the program committee for their careful review and discussion of every submission. Enjoy the workshop!

Coen De Roover **Tom Van Cutsem**

Workshop Co-Organizers

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Mario Südholt	École des Mines de Nantes	France
Peter Thiemann	University of Freiburg	Germany
Erik Wittern	IBM Research	United States of America

Keynote "Hop.js: JavaScript Multi-Tier Programming"

Manuel Serrano
INRIA Sophia-Antipolis

Hop.js is a multitier programming environment for JavaScript. It allows a single JavaScript program to describe the client-side and the server-side components of a web application. Its runtime environment ensures consistent executions of the application on the server and on the client. In this presentation we will overview the language design and its implementation. We will show that the concept of "programs generating programs" is ubiquitous in the system and we will show how it makes it possible to conceive web applications globally.

2nd Workshop on Programming Across the System Stack (PASS 2018)

The landscape of computation platforms has changed dramatically in recent years. Emerging systems—such as wearable devices, smartphones, unmanned aerial vehicles, Internet of things, cloud computing servers, heterogeneous clusters, and data centers—pose a distinct set of system-oriented challenges ranging from data throughput, energy efficiency, security, real-time guarantees, to high performance. In the meantime, code quality, such as modularity or extensibility, remains a cornerstone in modern software engineering, bringing in crucial benefits such as modular reasoning, program understanding, and collaborative software development. Current methodologies and software development technologies should be revised in order to produce software to meet system-oriented goals, while preserving high internal code quality.

This workshop is driven by one fundamental question: *How does internal code quality interact with system-oriented goals?* We welcome both positive and negative responses to this question. An example of the former would be modular reasoning systems specifically designed to promote system-oriented goals, whereas an example of the latter would be anti-patterns against system-oriented goals during software development. Areas of interest include but are not limited to:

- Energy-aware software engineering (e.g. energy efficiency models, energy efficiency as a quality attribute)
- Modularity support (e.g., programming language design, development tools or verification) for applications in resource-constrained or real-time systems
- Emerging platforms (e.g., Internet of Things and wearable devices)
- Security support (e.g., compositional information flow, compositional program analysis)
- Software architecture for reusability and adaptability in systems and their interactions with applications

- Empirical studies (patterns and anti-patterns) on the relationship between internal code quality and system-oriented goals
- Software engineering techniques to balance the trade-off between internal code quality and efficiency
- Memory bloats and long-tail performance problems across modular boundaries
- Program optimization across modular boundaries
- Internal code quality in systems software
- Reasoning across applications, compilers, and virtual machines

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- Felix Rieger, University of Marburg, Germany

Programming Experience 2018 (PX/18) Workshop

April 10, 2018, Nice, France
Co-located with <Programming> 2018
http://programming-experience.org/px18/

Imagine a software development task: some sort of requirements, specification, or goal including performance constraints and perhaps a platform and programming language. A group of developers head into a vast workroom. In that room they design and code—and sometimes they discover they need to explore the domain outside the room and the nature of potential solutions.

The Programming Experience (PX) Workshop is about what happens in that room when one or a couple of programmers sit down in front of computers and produce code. Do they create text that is transformed into running behavior (the old way), or do they operate on behavior directly ("liveness"); are they exploring the live domain to understand the true nature of the requirements; are they like authors creating new worlds; does visualization matter; is the experience immediate, immersive, vivid and continuous; do fluency, literacy, and learning matter; do they build tools, meta-tools; are they creating languages to express new concepts quickly and easily; and curiously, is joy relevant to the experience?

The focus of the workshop is charactering the experience of programming and considering how to improve and evolve it.

During PX/18 we discussed a range of topics including the following: creating programs, liveness, domain-specific languages, psychology of programming, user studies, visual, auditory, tactile, and other non-textual languages, text and more than text, program understanding, error tolerance, non-standard tools, experience of programming and exploratory programming.

PX/18 was the 4th edition of the PX workshop. It followed the Writers' Workshop format, was well attended, and left all participants with lively discussions that extended beyond the end of the workshop. Our post-workshop proceedings allowed authors to reflect on the feedback they got from the program committee and the workshop participants, and improve their submission.

We would like to thank our program committee, all workshop attendees, and most importantly our authors for their contributions, constructive criticism, hard work, and willingness to share their ideas.

Luke Church, Richard P. Gabriel, Robert Hirschfeld, and Hidehiko Masuhara

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Program

A Non-Tabular Spreadsheet with Broad Applicability
by Pavel Bažant and Michaela Maršálková

ACID for Programmers!
by Friedrich Steimann

An API and Visual Environment to use Neural Network To Reason About Source Code
by Alexandre Bergel, Paulin Melatagia, and Serge Stinckwich

Attention Patterns for Code Animations: Using Eye Trackers to Evaluate Dynamic Code Presentation Techniques
by Louis Spinelli, Maulishree Pandey, and Stephen Oney

Collectors
by Steven Costiou, Mickael Kerboeuf, Alain Plantec, and Marcus Denker

Do Java Programmers Write Better Python? – Studying Off-Language Code Quality on GitHub
by Siegfried Horschig, Toni Mattis, and Robert Hirschfeld

Few Versatile vs. Many Specialized Collections
by Stefan Marr and Benoit Daloze

Live Programming of Internet of Things in PalCom
by Alfred Åkesson, Mattias Nordahl, Görel Hedin, and Boris Magnusson

Reactive Programming Experience with REScala
by Ragnar Mogk, Guido Salvaneschi, and Mira Mezini

The Exploration Workspace: Interleaving the Implementation and Usage of Plain Objects
by Patrick Rein, and Robert Hirschfeld

The Fun of Being Wrong, or: The Game of Programmer vs. IDE
by Friedrich Steimann

Word Expansion Supports POSIX Shell Interactivity
by Michael Greenberg

Salon des Refusés
Dialectics for new computer science

Salon des Refusés ("exhibition of rejects") was an 1863 exhibition of artworks rejected from the official Paris Salon. It displayed works by later famous modernists such as Édouard Manet, whose paintings were rejected by the jury of the Paris Salon because they did not follow the strict rules of academic art. Many interesting ideas about programming struggle to find space in the modern programming language research community, often because they are difficult to evaluate using strict academic rules. Inspired by the Salon des Refusés, we aim to provide a space where new programming paradigms can appear.

Salon des Refusés in 1863 was an exhibition of all rejected works. Most of those were unsuccessful attempts to produce normal academic pictures. We use a peer review model to find high quality papers, but we use peer review in a new way. As noted by Michael Polanyi, scientific method relies on informal commitments known as *personal knowledge*. Those take the form of tacit unwritten knowledge. The peer review process is often seen as a mechanical process of checking proofs, methodology or citations, but as Polanyi explains, it has an informal tacit aspect. In the Salon des Refusés workshop, we acknowledge such personal knowledge and we allude to it by publishing each paper with a public attributed critique.

The critique can present the paper from a new perspective, review debate about the paper among the programme committee or argue vigorously against the points made by the paper authors. This allows reader to see why the paper is worthwhile. The critique forms an inseparable part of the work and so the proceedings include both papers and critiques. The second Salon des Refusés workshop was held in Nice, France on April 9, 2018 and was co-located with the Second International Conference on the Art, Science, and Engineering of Programming. It featured three original research papers that are presented here jointly with four critiques.

London
May 2018

Luke Church, Tomas Petricek
Salon des Refusés PC Chairs

2018 Student Research Competition

I am delighted to present the extended abstracts accepted to the ACM Student Research Competition held at the second International Conference on the Art, Science and Engineering of Programming (Programming '18).

Of the 14 submitted extended abstracts, 6 were submitted in the undergraduate category and 8 in the graduate category. Each submission was reviewed by at least 3 members of the program committee. Following the electronic discussions of the program committee, 13 submissions were accepted for participation in the on-site research competition, as well as for publication in these companion proceedings. Upon request, one of the accepted extended abstracts was withdrawn from publication; thus, 12 extended abstracts are published. The program committee who reviewed the submitted extended abstracts consisted of Maria Christakis, Philipp Haller, Yu David Liu, and Ana Milanova.

In the on-site competition participated 5 students in the undergraduate category and 8 students in the graduate category. The jury for the on-site competition consisted of James Cheney, Coen De Roover, Yu David Liu, Hidehiko Masuhara, Luca Padovani, Tamara Rezk, and Yves Roudier. The winners are as follows.

Graduate category:

1. place: Manuel Rigger (Johannes Kepler University Linz, Austria)
2. place: Adilla Susungi (MINES ParisTech, France)
3. place: Toni Mattis (University of Potsdam, Germany)

Undergraduate category:

1. place: Franklin Schrans (Imperial College London, UK)
2. place: Ezra Zigmond (Harvard University, USA)
3. place: Daniel Slocombe (Imperial College London, UK)

I would like to thank the members of the program committee for evaluating the submitted extended abstracts, and the members of the jury for their time and effort evaluating the presentations at the on-site competition. I am grateful to Jennifer Sartor who generously shared her experience organizing previous student research competitions. I would like to thank Tobias Pape for his support managing the web presence, ensuring up-to-date information for both participants and attendees of the competition. Nanette Hernández provided excellent administrative support on the side of ACM. Last but not least, I am grateful to Manuel Serrano and Guido Salvaneschi for their organizational support and the invitation to organize the student research competition.

Philipp Haller
May 2018
Chair, ACM Student Research Competition at Programming '18

Thanks to our generous sponsors and partners for making this event possible!

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