

Contact information

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Research interests

- Design and implementation of programming languages;
- Applied logic for program verification (especially for concurrency and distributed systems);
- Static program analysis (especially in application to higher-order and concurrent programs).

1 Education and Qualifications

- Ph.D. in Computer Science, **KU Leuven**, Leuven, Belgium. November 2008–November 2012.
Thesis: *Operational Aspects of Type Systems*, Advisor: Dave Clarke
- M.Sc. in Mathematics and Computer Science, GPA 5.0/5.0, **Saint Petersburg State University**, Saint Petersburg, Russia. 2003–2008.
Thesis: *Extraction of musical notation from a musical signal*, Advisor: Andrey E. Barabanov

2 Employment History

- **Yale-NUS College** (joint appointment with NUS School of Computing), Singapore
Associate Professor (Tenure Track). November 2018–present.
- **University College London**, Department of Computer Science. London, UK
 - *Associate Professor*. Effective 1 October 2018, honorary position since 1 November 2018.
 - *Lecturer (Assistant Professor)*. November 2015–September 2018.
- **Facebook, Inc.**, Static Analysis Tools. London, UK
Research Scientist (Part-Time Contingent Worker). November 2017–July 2018
- **IMDEA Software Institute**, Madrid, Spain
Post-doctoral Researcher. February 2013–October 2015.
- **Microsoft Research**, Cambridge, UK
Research Intern. Programming Principles and Tools group. July–September 2012.
- **JetBrains Inc.**, Saint Petersburg, Russia
Software Engineer. IntelliJ IDEA. September 2006–November 2008.
- **OpenWay**, Saint Petersburg, Russia
Summer School Intern. June 2006–September 2006
- **Informational Systems for Business**, Saint Petersburg, Russia
Software Engineer. August 2005–June 2006.

3 Advisory Appointments and Knowledge Transfer

- **Zilliqa Inc**, Singapore.
Research Advisor and Lead Language Designer. Started in March 2018.

4 Selected Publications and Manuscripts

4.1 Journal articles

- J3 **Modular, Higher-Order Cardinality Analysis in Theory and Practice**
Ilya Sergey, Dimitrios Vytiniotis, Joachim Breitner and Simon Peyton Jones
Journal of Functional Programming, volume 27, e11, January 2017.

J2 **Pushdown Flow Analysis with Abstract Garbage Collection**

J. Ian Johnson, Ilya Sergey, Christopher Earl, Matthew Might and David Van Horn
Journal of Functional Programming, volume 24, issue 2-3, pages 218–283, May 2014.

J1 **A correspondence between type checking via reduction and type checking via evaluation**

Ilya Sergey and Dave Clarke
Information Processing Letters, volume 112, issue 1-2, pages 13–20, January 2012.

4.2 **Articles in international conference proceedings**

C21 **Structuring the Synthesis of Heap-Manipulating Programs**

Nadia Polikarpova and Ilya Sergey. In **POPL 2019** (A*), 77/269 \approx 29% accepted.

C20 **A True Positives Theorem for a Static Race Detector**

Nikos Gorogiannis, Peter O’Hearn, and Ilya Sergey. In **POPL 2019** (A*), 77/269 \approx 29% accepted.

C19 **Distributed Protocol Combinators**

Kristoffer Just Arndal Andersen and Ilya Sergey. In **PADL 2019** (B).

C18 **Finding the Greedy, Prodigal, and Suicidal Contracts at Scale**

Ivica Nikolić, Aashish Kolluri, Ilya Sergey, Prateek Saxena, and Aquinas Hobor.
In **ACSAC 2018** (A), 60/299 \approx 20% accepted.

C17 **RacerD: Compositional Static Race Detection**

Sam Blackshear, Nikos Gorogiannis, Peter O’Hearn, and Ilya Sergey.
In **OOPSLA 2018** (A*), 60/216 \approx 28% accepted.

C16 **ETHIR: A Framework for High-Level Analysis of Ethereum Bytecode**

Elvira Albert, Pablo Gordillo, Benjamin Livshits, Albert Rubio, and Ilya Sergey.
In **ATVA 2018** (A), 33/82 \approx 40% accepted.

C15 **Paxos Consensus, Deconstructed and Abstracted**

Álvaro García Pérez, Alexey Gotsman, Yuri Meshman and Ilya Sergey.
In **ESOP 2018** (A), 36/114 \approx 32% accepted.

C14 **Mechanising Blockchain Consensus**

George Pirlea and Ilya Sergey. In **CPP 2018**, 22/51 \approx 43% accepted.

C13 **Programming and Proving with Distributed Protocols**

Ilya Sergey, James R. Wilcox, and Zachary Tatlock. In **POPL 2018** (A*), 66/271 \approx 24% accepted.
This paper was featured in **The Morning Paper** on 22 January 2018:
<https://blog.acolyer.org/2018/01/22/programming-and-proving-with-distributed-protocols/>

C12 **Concurrent Data Structures Linked in Time**

Germán Andrés Delbianco, Ilya Sergey, Aleksandar Nanevski and Anindya Banerjee.
In **ECOOP 2017** (A), 27/81 \approx 33% accepted.

C11 **Programming Language Abstractions for Modularly Verified Distributed Systems**

James R. Wilcox, Ilya Sergey and Zachary Tatlock. In **SNAPL 2017**.

C10 **Hoare-style Specifications as Correctness Conditions for Non-linearizable Concurrent Objects**

Ilya Sergey, Aleksandar Nanevski, Anindya Banerjee and Germán Andrés Delbianco.
In **OOPSLA 2016** (A*), 52/203 \approx 26% accepted.

C9 **Experience Report: Growing and Shrinking Polygons for Random Testing of Computational Geometry Algorithms**

Ilya Sergey. In **ICFP 2016** (A*), 37/118 \approx 31% accepted.

C8 **Mechanized Verification of Fine-grained Concurrent Programs**

Ilya Sergey, Aleksandar Nanevski and Anindya Banerjee. In **PLDI 2015** (A*), 58/303 \approx 19% accepted.

C7 **Specifying and Verifying Concurrent Algorithms with Histories and Subjectivity**

Ilya Sergey, Aleksandar Nanevski and Anindya Banerjee. In **ESOP 2015** (A), 33/115 \approx 29% accepted.

C6 **Communicating State Transition Systems for Fine-Grained Concurrent Resources**

Aleksandar Nanevski, Ruy Ley-Wild, Ilya Sergey and Germán Andrés Delbianco.
In **ESOP 2014** (A), 27/109 \approx 25% accepted.

- C5 **Modular, Higher-Order Cardinality Analysis in Theory and Practice**
Ilya Sergey, Dimitrios Vytiniotis and Simon Peyton Jones. In **POPL 2014 (A*)**, 51/220 \approx 23% accepted.
- C4 **Monadic Abstract Interpreters**
Ilya Sergey, Dominique Devriese, Matthew Might, Jan Midtgaard, David Darais, Dave Clarke and Frank Piessens. In **PLDI 2013 (A*)**, 46/267 \approx 17% accepted.
- C3 **Introspective Pushdown Analysis of Higher-Order Programs**
Christopher Earl, Ilya Sergey, Matthew Might and David Van Horn.
In **ICFP 2012 (A*)**, 32/88 \approx 36% accepted.
- C2 **Calculating Graph Algorithms for Dominance and Shortest Path**
Ilya Sergey, Jan Midtgaard and Dave Clarke. In **MPC 2012 (B)**, 13/27 \approx 48% accepted.
- C1 **Gradual Ownership Types**
Ilya Sergey and Dave Clarke. In **ESOP 2012 (A)**, 28/88 \approx 32% accepted.

4.3 Peer-reviewed articles in international workshop proceedings

- W8 **Towards Mechanising Probabilistic Properties of a Blockchain**
Kiran Gopinathan and Ilya Sergey. In **CoqPL 2019**.
- W7 **A Concurrent Perspective on Smart Contracts**
Ilya Sergey and Aquinas Hobor. *1st Workshop on Trusted Smart Contracts (WTSC 2017)*
This paper was featured in **The Morning Paper** on 30 August 2017:
<https://blog.acolyer.org/2017/08/30/a-concurrent-perspective-on-smart-contracts>
- W6 **Deriving Interpretations of the Gradually-Typed Lambda Calculus**
Álvaro García Pérez, Pablo Nogueira and Ilya Sergey. In **PEPM 2014**.
- W5 **Fixing Idioms – A recursion primitive for applicative DSLs**
Dominique Devriese, Ilya Sergey, Dave Clarke and Frank Piessens. In **PEPM 2013**.
- W4 **Towards Gradual Ownership Types**
Ilya Sergey and Dave Clarke. In **IWACO 2011**.
- W3 **From type checking by recursive descent to type checking with an abstract machine**
Ilya Sergey and Dave Clarke. In **LDTA 2011**.
- W2 **Automatic refactorings for Scala programs**
Ilya Sergey, Dave Clarke and Alexander Podkhalyuzin
The First Scala Workshop — Scala Days 2010
- W1 **A semantics for context-oriented programming with layers**
Dave Clarke and Ilya Sergey. In **COP 2009**.

4.4 Invited articles

- I1 **Temporal Properties of Smart Contracts**
Ilya Sergey, Amrit Kumar and Aquinas Hobor.
In **ISOLA 2018**, *Reliable Smart Contracts: State-of-the-art, Applications, Challenges and Future Directions*.

4.5 Technical Reports and Software Specifications

- T1 **SCILLA: a Smart Contract Intermediate-Level Language**
Ilya Sergey, Amrit Kumar and Aquinas Hobor.
Featured in **The Bitcoin Exchange Guide**: <https://bitcoinexchangeguide.com/scilla/>

4.6 Monographs

- M1 **Programs and Proofs: Mechanizing Mathematics with Dependent Types**
Ilya Sergey. *Lecture notes with exercises*, available at <http://ilyasergey.net/npn>.

4.7 Book chapters

B1 Ownership Types: A Survey

Dave Clarke, Johan Östlund, Ilya Sergey and Tobias Wrigstad.

Aliasing in Object-Oriented Programming: Types, Analysis and Verification, Springer, 2013.

5 External Research Funding

1. Grant of NUS Crystal Centre (Co-PI). **50,000 SGD**. November 2018.
2. Google Faculty Research Award 2017. **59,925 USD**. February 2018, 152/1033 \approx 15% acceptance rate. One-year project on the topic *Distributed System Optimizations as Network Semantics Transformations*.
3. Grant of Research Institute in Verified Trustworthy Software Systems (VeTSS). **55,561 GBP**. August 2017. 8-month project on the topic *Automated Reasoning with Fine-Grained Concurrent Collections*.
4. EPSRC First Grant. **101,009 GBP**. September 2016. 18-month project on the topic *Program Logics for Compositional Specification and Verification of Distributed Systems*.

6 Academic Supervision

PhD students

- **Maria A Schett**, PhD student, UCL. Started in November 2017.

Postdocs

- **Thomas Sibut-Pinote**, Research Associate, UCL. November 2017–August 2018.

Undergraduate and MSc students

- **Daniel Lok Yu-Kin**, Capstone project student at Yale-NUS, 2018/19 Academic Year.
- **Jake (Si Yuan) Goh**, Capstone project student at Yale-NUS, 2018/19 Academic Year.
- **Anirudh Pillai**, BSc student at UCL, 2017/18 Academic Year.
Final Year Thesis: *Mechanised Verification of Paxos-like Consensus Protocols*.
- **Jorge Botelho Dias De Ayala Botto**, MSc student at UCL, 2016/17 Academic Year.
Worked on formal verification of LLVM optimisations.

Interns and Research Visitors

- **Kristoffer Just Arndal Andersen** (Aarhus U.), Visiting PhD Researcher at UCL, January–June 2018.
Topic: Practical programming with distributed protocols; conference paper: **C19**.
- **Kiran Gopinathan**, Intern at UCL, Summer 2018.
Topic: Probabilistic reasoning about blockchain protocols; workshop paper: **W8**.
- **Oscar King**, Intern at UCL, Summer 2018.
Topic: Extraction for verified blockchain protocols.
- **George Pirlea**, Intern at UCL, Summer 2017.
Topic: Verification of blockchain consensus protocols in Coq; conference paper: **C14**.
- **Benedict Loh**, Intern at UCL, Summer 2017.
Topic: Implementing a program synthesis engine, based on Separation Logic.
- **Georgi Georgiev**, Intern at UCL, Summer 2016.
Topic: Verification of a concurrent garbage collector in the Coq proof assistant.
- **Anton Podkopaev**, Intern at IMDEA Software Institute (main supervisor: Aleks Nanevski), 2015.
Topic: Operational semantics for C/C++11 concurrency.

7 Academic Service

7.1 PhD Examiner

- Marco Vassena. Chalmers University of Technology, Sweden, February 2019.
- Morten Krogh-Jespersen. Aarhus University, Denmark, December 2018
Thesis: *Towards Modular Reasoning for Stateful and Concurrent Programs*.

7.2 Conference Chair/Organiser

- The Fifth International Workshop on Coq for Programming Languages (CoqPL 2019), January 2019, Lisbon, Portugal. *Co-chair (with Robbert Krebbers)*
- The Fourth International Workshop on Coq for Programming Languages (CoqPL 2018), January 2018, Los Angeles, CA, USA. *Co-chair (with Yves Bertot)*
- ICFP 2017, September 2017, Oxford, UK. *Student Research Competition Chair*
- 6th South of England Regional Programming Language Seminar (S-REPLS 6), May 2017, London, UK. *Organiser*. Event web page: <http://srepls6.cs.ucl.ac.uk>.
The meeting has attracted speakers from 10 institutions from France, New Zealand, Singapore, UK, USA, and has been attended by approximately 90 researchers, students, and industry practitioners.

7.3 Member of Editorial Boards

- The Journal of Financial Technology, May 2018 – present.

7.4 Programme Committee Member for International Conferences

- ESOP 2020: *29th European Symposium on Programming*
- OOPSLA 2019: *34th ACM Conf. on Object-Oriented Programming, Systems, Languages, and Applications*
- PLDI 2019: *40th ACM SIGPLAN Conference on Programming Language Design and Implementation*
- ECOOP 2019: *33rd European Conference on Object-Oriented Programming*
- POPL 2019: *46th ACM SIGPLAN Symposium on Principles of Programming Languages*
- APLAS 2018: *16th Asian Symposium on Programming Languages and Systems*
- ICFP 2018: *23rd ACM SIGPLAN International Conference on Functional Programming*
- APLAS 2017: *15th Asian Symposium on Programming Languages and Systems*
- Scala 2017: *Scala Symposium 2017*
- SAS 2017: *24th Static Analysis Symposium*
- POPL 2017: *44th ACM SIGPLAN Symposium on Principles of Programming Languages*
- TMPA 2017: *4th International Conference on Tools And Methods of Program Analysis*
- Scala 2016: *Scala Symposium 2016*
- SEIM 2016: *1st Russian Conference on Software Engineering and Information Management*
- ESOP 2016: *25th European Symposium on Programming*
- PPDP 2014: *16th International Symposium on Principles and Practice of Declarative Programming*

7.5 PC Member for International Workshops

- PEPM 2019: *ACM SIGPLAN 2019 Workshop on Partial Evaluation and Program Manipulation*
- HOPE 2018: *The 6th ACM SIGPLAN Workshop on Higher-Order Programming with Effects*
- WTSC 2018: *2nd Workshop on Trusted Smart Contracts*
- WTSC 2017: *1st Workshop on Trusted Smart Contracts*
- PEPM 2017: *ACM SIGPLAN 2017 Workshop on Partial Evaluation and Program Manipulation*
- TAPAS 2016: *The Seventh Workshop on Tools for Automatic Program Analysis*
- STOP 2015: *International Workshop on Scripts to Programs*
- Scala 2014: *The Fifth Annual Scala Workshop*

7.6 Reviewing for Journals

- Journal of Automated Reasoning (JAR) (2017)
- ACM Transactions on Programming Languages and Systems (TOPLAS) (2014, 2015 × 2, 2016, 2017)
- Philosophical Transactions of the Royal Society of London (2017),
- Journal of Functional Programming (JFP) (2015)
- Formal Aspects of Computing (2015).

7.7 Additional Conference and Workshop Refereeing

CONCUR 2018, ECOOP 2018, ICALP 2018, PLDI 2018, S&P (Oakland) 2018, TYPES 2017 (Post-proceedings), PLDI 2017, TACAS 2017, ESOP 2017, ATVA 2016, CONCUR 2016, DISC 2015, ECOOP 2015, ESOP 2015, POPL 2015, GPCE 2014, ICFP 2014, CSF 2014, PROLE 2013, SAIRP 2013, CC 2013, ESOP 2013, POPL 2013, CPP 2012, ECOOP 2012, NFM 2012, ESOP 2012, DSL 2011, IWACO 2011, Coordination 2010, Coordination 2009.

7.8 Other Service

- SPLASH 2017 Workshops, *Workshop Program Committee member*
- ICFP 2016, Student Research Competition, *Selection Committee member*
- ECOOP 2014, *Artifact Evaluation Committee member*

8 Awards and Fellowships

- Google Faculty Research Award recipient (2017). Google Inc.
- Fellow of the UK Higher Education Academy (2017).
- Vladimir Potanin Fund Scholarship recipient (2004, 2005, 2007). The Vladimir Potanin Foundation.

9 Teaching

9.1 Teaching at summer schools and seminars

- **SIGPL Summer School 2018**, August 2018, Dongguk University, Seoul, Korea.
Summer School Lecturer (3 one-hour lectures).
- **Programs and Proofs: Mechanizing Mathematics with Dependent Types**, August 2014, Saint Petersburg State University, Saint Petersburg, Russia.
Course Designer, Summer School Lecturer (5-day course).

9.2 Teaching at UCL

- Spring 2018: ENGS102P – Design and Professional Skills (147 students), *Scenario Project Organiser*
- Spring 2018: COMP104P – Theory 2, Analysis of Algorithms (172 students), *Lecturer*
- Autumn 2017: COMP214P – Systems Engineering (116 students), *Scenario Project Designer*
- Spring 2017: COMP104P – Theory 2, Analysis of Algorithms (142 students), *Lecturer*
- Spring 2017: COMP203P – Software Engineering and HCI (124 students), *Scenario Project Designer*
- Spring 2016: COMP104P – Theory 2, Analysis of Algorithms (155 students), *Lecturer*
- Spring 2016: COMP203P – Software Engineering and HCI (94 students), *Scenario Week Designer*
- Spring 2016: COMP2012 – Directed Reading (11 students), *Second Examiner* (with James Brotherston)

9.3 Teaching at KU Leuven

- Fall 2011: B-KUL-H04L5A – Comparative Programming Languages, *Teaching Assistant*
- Fall 2010: B-KUL-H04H8B – Formal systems and their applications, *Teaching Assistant, 2nd Lecturer*
- Fall 2009: B-KUL-H04H8B – Formal systems and their applications, *Teaching Assistant, 2nd Lecturer*

10 Appearances in Press

10.1 Online media

- **Scilla – A Formal Verification Oriented Contract Language**
Epicenter, video interview. 6 June 2018.
<https://epicenter.tv/episode/238/>
- **Ethereum’s smart contracts are full of holes**
MIT Technology Review. By Mike Orcutt, 1 March 2018.
<https://www.technologyreview.com/s/610392/ethereums-smart-contracts-are-full-of-holes/>
- **Millions of Dollars In Ethereum Are Vulnerable to Hackers Right Now**
Motherboard, Vice. By Jordan Pearson, 22 February 2018. <https://goo.gl/Z68sbr>

11 Invited Keynote Talks

1. April 2017. Keynote speaker at *Russian National Conference on Programming Languages and Compilers* Rostov-on-Don, Russia. <http://plc.sfedu.ru>
Talk title: *Dependent Types for Verification of Real-World Programs*
2. September 2013. Keynote speaker at *15th International Symposium on Principles and Practice of Declarative Programming (PPDP 2013)*, Madrid, Spain.
Talk title: *Monadic Abstract Interpreters*

12 Selected Projects and Software Contributions

12.1 Contributions to large open source projects

- **Scilla – A Smart Contract Intermediate Level Language**, <https://scilla-lang.org>.
Lead language designer and principal developer. Related paper: **I1, T1**.
- **Facebook Infer static analyzer**, <http://fbinfer.com>.
Contributor to the RACERD concurrency analyser. Related papers: **C17, C20**.
- **Glasgow Haskell Compiler (GHC)**, <https://github.com/ghc/ghc>.
Contributor to the demand analyser. Related paper: **C5**.

12.2 Research-related and personal projects

- **TOYCHAIN**, a minimalistic blockchain consensus implemented and verified in Coq.
Related paper: **C14**. Sources available at <https://github.com/certichain/toychain>.
- **DISEL: Distributed Separation Logic**, a mechanized framework for compositional verification of distributed systems, *primary contributor*. Related papers: **C11, C13**.
Sources available at <https://github.com/DistributedComponents/disel>.
- **FCSL: Fine-grained Concurrent Separation Logic**, a verification tool for fine-grained concurrent programs, *primary contributor*. Related papers: **C6, C7, C8, C10, C12**.
Project site: <http://software.imdea.org/fcsl>.
- **Geometry Testing**, a QuickCheck-style framework for randomized testing of geometric algorithms, *sole implementer*. Related paper: **C9**. Available at <https://github.com/ilyasergey/geometry-testing>.
- **Pushdown k-CFA**, a pushdown context-sensitive control-flow analysis with optional Abstract Garbage Collection for LambdaJS and a subset of Scheme programming language, *sole implementer*. Related papers: **C3, J2**. Available at <https://github.com/ilyasergey/reachability>.
- **La Clojure** plugin for IntelliJ IDEA, *founder and maintainer* (discontinued).
Sources available at <http://github.com/JetBrains/la-clojure>.

12.3 More software on GitHub

- <http://github.com/ilyasergey>
- <http://github.com/certichain>

13 Selected Invited Seminar Presentations and Technical Talks

- **What We Talk about When We Talk about Formally Verified Systems**
Blockchain and Cybersecurity Workshop at NUS (November 2018).
- **Deductive Synthesis of Programs that Alter Data Structures**
National University of Singapore (November 2018); Imperial College London, UK (October 2018); KU Leuven, Belgium (September 2018); Inria Paris, France (September 2018); KAIST, Daejeon, Korea (August 2018).
- **Scilla: Foundations for Verifiable Decentralised Computations on a Blockchain**
The Blockchain Connector, London Blockchain Developer Meetup, London, UK (May 2018); PLEMM 2018: Programming Language Enthusiasts Mind Melt, Bellevue, WA, US (May 2018); University of California San Diego, CA, US (May 2018).
- **Mechanising Blockchain Consensus**
University of Utah, UT, US (May 2018).
- **Programming and Proving with Distributed Protocols**
University Paris Diderot – Paris 7, France (April 2018); Microsoft Research, Cambridge, UK (November 2017); National University of Singapore (October 2017); Heriot-Watt University, UK (July 2017); IMDEA Software Institute, Spain (June 2017); Aarhus University, Denmark (May 2017); University of California San Diego, CA, US (May 2017); Imperial College London, UK (November 2016).
- **Guarding a Gallery with Sleepy Robots**
Yale-NUS College, Singapore (October 2017).
- **Programming and Proving with Concurrent Resources**
University of York, UK (October 2016); University of Cambridge, UK (June 2016); Aarhus University, Denmark (June 2016); MPI-SWS, Germany (May 2016); Imperial College London, UK (May 2016); Middlesex University, UK (May 2016); University of Birmingham, UK (January 2016); Queen Mary University of London, UK (December 2015); University College London, UK (April 2015); Microsoft Research, Cambridge, UK (March 2015).
- **Reasoning about non-linearizable concurrent objects**
Dagstuhl Seminar 16201, Germany (May 2016); University of Kent, UK (April 2016).
- **Anatomy of mechanized reasoning about fine-grained concurrency**
Dagstuhl Seminar 15191, Germany (May 2015).
- **Programming with Proofs**
Google, London, UK (April 2015); Russian Academy of Sciences, St Petersburg, Russia (August 2014).
- **Communicating State Transition Systems for Fine-Grained Concurrent Resources**
IMDEA Software Institute, Spain (April 2014); Concurrency Yak, San Diego, US (January 2014); HOPE 2013 Workshop, Boston, US (September 2013).
- **Static Analysis and Code Optimizations in Glasgow Haskell Compiler**
St Petersburg Functional Programming meetup, Russia (December 2012)
- **Gradual Ownership Types**
IMDEA Software Institute, Spain (July 2012); Aarhus University, Denmark (December 2011).
- **Scripting an IDE for DSL awareness**
Devoxx 2009, Antwerp, Belgium (November 2009)
- **Clojure support in IntelliJ IDEA**
The Bay Area Clojure User Group meetup, San Francisco, US (June 2009).
- **Cross-Language Development in IntelliJ IDEA**
JAX 2009, Mainz, Germany (April 2009); Devoxx 2008, Antwerp, Belgium (December 2008).