

Alexander J. Summers (CV) — 12th December 2019

CONTACT INFORMATION ETH Zurich
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RESEARCH INTERESTS I'm motivated by the general question of how to bring formal techniques for reasoning about rich program behaviours to tools which can directly benefit programmers. I work both on proof techniques to capture succinct and natural correctness arguments for particular programming domains, and on bringing such reasoning to practice via automatic verification tools and encodings to SMT solvers. I enjoy relating and combining alternative methodologies (program logics, static analyses, type systems), and developing reusable verification tool stacks.

EDUCATION **Imperial College London**, London, UK

Ph.D. Computer Science, awarded July 2009 (examined November 2008)

- Thesis title: *Curry-Howard Term Calculi for Gentzen-Style Classical Logics*
- Supervisor: Steffen van Bakel Second Supervisor: Luca Cardelli
- Examiners: Gavin Bierman and Hugo Herbelin

MSci Joint Mathematics and Computer Science, awarded July 2004 (First class honours)

EMPLOYMENT HISTORY *Senior Researcher, ETH Zurich* **October 2015 – December 2019**

Further to the responsibilities of my previous position (below): supervision of new Ph.D. students, writing and managing grant proposals, coordination of the *Viper* project, interaction with funding agencies, interviewing Ph.D., postdoc and department faculty candidates, and development of and teaching a new Master's course on building software verification tools.

Postdoctoral Researcher, ETH Zurich **October 2009 – September 2015**

Working in the Programming Methodology group, in the area of concurrent software verification, using permission-based verification logics. This position has included teaching and supervision responsibilities, as well as tool development and collaborations both within the group and outside (Microsoft Research Redmond and Cambridge, Imperial College London).

Research Associate, Imperial College London **October 2007 – August 2009**

Working with Sophia Drossopoulou on the Möbius (EU FP6) project, developing static type systems and invariant methodologies for the verification of object-oriented languages.

Ph.D. Student, Imperial College London **October 2004 – November 2008 (viva date)**

Ph.D. on the relationship between classical logics and programming languages, via the Curry-Howard Correspondence. Ph.D. degree awarded on 30th June 2009.

Year in Industry student, STMicroelectronics, Bristol, UK **September 1999 – July 2000, Summer 2001 & 2002**

Internship at a global semiconductor company, involving verification of new chip designs and automatic generation of test harnesses. Sponsorship and further placements obtained.

PRIZES AND
ESTEEM
INDICATORS

- 2015 Dahl-Nygaard Junior Prize, awarded by AITO (aito.org) for my research work on the verification of object-oriented programs and type systems. This prize is given annually to one senior and one junior researcher, and came with a cash award and an invited keynote talk at the ECOOP 2015 conference in Prague.
- Member (by invitation) of IFIP Working Group 1.9/2.15 on Verified Software (<https://www.lri.fr/~filliatr/1.9/>)
- OOPSLA 2019 Distinguished Artifact Award, for the open-source implementation and experiments for the paper: *Leveraging Rust Types for Modular Specification and Verification*. The award is for exceptionally clear and impressive artifacts accompanying accepted papers at the conference.
- VerifyThis 2019 Competition prize for *Tool Used by Most Teams*, awarded for the software (Viper) used by the most participating teams in that year's competition.
- TACAS 2018 Distinguished Artifact Award, for the open-source implementation and experiments for the paper: *Automating Deductive Verification for Weak-Memory Programs*. The award is for exceptionally clear and impressive artifacts accompanying accepted papers at the conference. The same paper was nominated for a Best Paper Award.
- Invited speaker at Tools for Automatic Program Analysis (TAPAS) 2017
- VerifyThis 2016 Competition prize for *Distinguished User Assistance Feature*, awarded for a particularly powerful or useful feature available in the competitors' tools (here, Viper).
- Invited speaker at the British Logic Colloquium 2009, based on Ph.D. research outcomes
- Donald Davies Memorial Prize 2004 (best final year MSci project), Imperial College London
- David Howarth Group Project Prize 2003 for best undergraduate group project
- First place in the regional final of the Young Engineers for Britain competition 2000, for project work during an 11 month placement at STMicroelectronics (Bristol)

RESEARCH
PROJECTS AND
GRANTS

From Type Capabilities to Permissions for Program Verification (and back again)

Principal investigator: Alexander J. Summers.

3 year project funded by Swiss National Science Foundation: Jan 2017 – Dec 2019. Funding: \$454,590.

Verification Infrastructure for Permission-based Reasoning

Principal investigator: Peter Müller.

I contributed to the research proposal and am coordinating the Viper project (partially funded by this grant). 3 year project funded by Swiss National Science Foundation: Oct 2014 – Sep 2017. Funding: \$450,785.

Automatic Verification of Concurrent Programs with Tamed Mutable State

Principal investigator: Peter Müller.

I wrote the majority of the proposal and was the research lead for the project throughout. I wrote annual reports for the funding body, who judged the project a success on completion. 3 year project funded by Hasler Foundation: May 2011 – Apr 2014. Funding: \$398,810.

PUBLICATIONS

In my field, the most common and prestigious publications are typically at selective *conferences*, which are often of substantial length; in rarer cases, longer journal papers are also published. I list conference papers first, then journal, then workshop and finally teaching-related papers.

The default author-ordering for most publications is alphabetical order by surname. In cases

where an author made a significantly larger contribution, this order was changed; author(s) who were explicitly given prominence in this way are underlined below. Co-authors whom I supervised are highlighted in **bold**. Unless marked “invited” all publications are refereed.

CONFERENCE
PUBLICATIONS

Vytautas Astrauskas and Peter Müller and **Federico Poli** and Alexander J. Summers. *Leveraging Rust Types for Modular Specification and Verification*. Object-Oriented Programming, Systems, Languages and Applications (OOPSLA) 2019. (acceptance rate: 36.3%) *Distinguished Artifact Award*.

Arshavir Ter-Gabrielyan and Alexander J. Summers and Peter Müller. *Modular Verification of Heap Reachability Properties in Separation Logic*. Object-Oriented Programming, Systems, Languages and Applications (OOPSLA) 2019. (acceptance rate: 36.3%)

Nils Becker and Peter Müller and Alexander J. Summers. *The Axiom Profiler: Understanding and Debugging SMT Quantifier Instantiations*. Tools and Algorithms for the Construction and Analysis of Systems (TACAS) 2019. (acceptance rate: 30.4%)

Jérôme Dohrau, Alexander J. Summers, Caterina Urban, **Severin Münger**, and Peter Müller. *Permission Inference for Array Programs*. Computer Aided Verification (CAV) 2018. (acceptance rate: 30.2%)

Alexander J. Summers and Peter Müller. *Automating Deductive Verification for Weak-Memory Programs*. Tools and Algorithms for the Construction and Analysis of Systems (TACAS) 2018. (acceptance rate: 29.2%) *Distinguished Artifact Award*. *Nominated for Best Paper Award*.

Peter Müller, **Malte Schwerhoff** and Alexander J. Summers. *Automatic Verification of Iterated Separating Conjunctions using Symbolic Execution*. Computer Aided Verification (CAV) 2016. (acceptance rate: 29.7%)

Alexander J. Summers and Peter Müller. *Actor Services - Modular Verification of Message Passing Programs*. European Symposium on Programming (ESOP) 2016. (acceptance rate: 32.6%)

Peter Müller, **Malte Schwerhoff** and Alexander J. Summers. *Viper - A Verification Infrastructure for Permission-Based Reasoning*. Verification, Model Checking, and Abstract Interpretation (VMCAI) 2016. (*invited paper*)

Malte Schwerhoff and Alexander J. Summers. *Lightweight Support for Magic Wands in an Automatic Verifier*. European Conference on Object-Oriented Programming (ECOOP) 2015. (acceptance rate: 22.8%)

Alexander J. Summers and Sophia Drossopoulou. *A Formal Semantics for Isorecursive and Equirecursive State Abstractions*. European Conference on Object-Oriented Programming (ECOOP) 2013. LNCS Vol. 7920, pages 129–153. (acceptance rate: 25%)

Stefan Heule, Ioannis T. Kassios, Peter Müller and Alexander J. Summers. *Verification Condition Generation for Permission Logics with Abstract Predicates and Abstraction Functions*. European Conference on Object-Oriented Programming (ECOOP) 2013. LNCS Vol. 7920, pages 451–476. (acceptance rate: 25%)

Daniel Jost and Alexander J. Summers. *An automatic encoding from VeriFast Predicates into Implicit Dynamic Frames*. Verified Software: Theories, Tools and Experiments (VSTTE) 2013. LNCS Vol. 8164, pages 202–221. (acceptance rate: 48.6%)

Stefan Heule, Rustan Leino, Peter Müller and Alexander J. Summers. *Abstract Read Permissions: Fractional Permissions without the Fractions*. Verification, Model Checking and Abstract Interpretation (VMCAI) 2013. LNCS Vol. 7737, pages 315–334. (acceptance rate: 37.5%)

Alexander J. Summers and Peter Müller. *Freedom Before Commitment - A Lightweight Type System for Object Initialisation*. Object-Oriented Programming, Systems, Languages and Applications (OOPSLA) 2011. ACM, pages 1013–1032. (acceptance rate: 36.7%)

Matthew J. Parkinson and Alexander J. Summers. *The Relationship Between Separation Logic and Implicit Dynamic Frames*. European Symposium on Programming (ESOP) 2011. LNCS Vol. 6602, pages 439–458. (acceptance rate: 26.1%)

Alexander J. Summers and Sophia Drossopoulou. *Considerate Reasoning and the Composite Design Pattern*. Verification, Model Checking, and Abstract Interpretation (VMCAI) 2010. LNCS Vol. 5944, pages 328–344. (acceptance rate: 36.8%)

Sophia Drossopoulou, Adrian Francalanza, Peter Müller and Alexander J. Summers. *A Unified Framework for Verification Techniques for Object Invariants*. European Conference on Object-Oriented Programming (ECOOP) 2008. LNCS Vol. 5142, pages 412–437. (acceptance rate: 19.6%)

Dave Cunningham, Werner Dietl, Sophia Drossopoulou, Adrian Francalanza, Peter Müller and Alexander J. Summers. *Universe Types for Topology and Encapsulation*. Extended paper in LNCS special issue for Post-proceedings of Formal Methods for Components and Objects (FMCO) 2007.

Alexander J. Summers and Steffen van Bakel. *Approaches to Polymorphism in Classical Sequent Calculus*. European Symposium on Programming (ESOP) 2006. LNCS Vol. 3924, pages 84–99. (acceptance rate: 24.1%)

JOURNAL
PUBLICATIONS

Matthew J. Parkinson and Alexander J. Summers. *The Relationship Between Separation Logic and Implicit Dynamic Frames*. Published in Logical Methods in Computer Science (2012), Vol. 8, No. 3, pages 1–54.

Alexander J. Summers. *Soundness and Principal Contexts for a Shallow Polymorphic Type System based on Classical Logic*. Published in Logic Journal of IGPL (2011), special issue on Unification, Vol. 19, No. 6, pages 848–896.

Alexander J. Summers, Sophia Drossopoulou and Peter Müller. *Universe-Type-Based Verification Techniques for Mutable Static Fields and Methods*. Published in Journal of Object Technology (2009) special issue for invited FTfJP 2008 papers. Vol. 8, No. 4, pages 85–125.

WORKSHOP
PUBLICATIONS

John Tang Boyland, Peter Müller, **Malte Schwerhoff** and Alexander J. Summers. *Constraint Semantics for Abstract Read Permissions*. Formal Techniques for Java-Like Programs (FTfJP) 2014. Published by ACM, article 2.

Stefan Heule, Rustan Leino, Peter Müller and Alexander J. Summers. *Fractional Permissions Without the Fractions*. Formal Techniques for Java-Like Programs (FTfJP) 2011. Published by ACM, article 1.

Alexander J. Summers, Nicholas Cameron, Mariangiola Dezani and Sophia Drossopoulou. *Towards a Semantic Model for Java Wildcards*. Formal Techniques for Java-like Programs (FTfJP) 2010. Published by ACM, article 2.

Clément Hurlin, François Bobot, Alexander J. Summers. *Size Does Matter: Two Certified Abstractions to Disprove Entailment in Intuitionistic and Classical Separation Logic*. International Workshop on Aliasing, Confinement and Ownership (IWACO) 2009. Published by ACM, article 5.

Alexander J. Summers, Sophia Drossopoulou and Peter Müller. *The Need for Flexible Object Invariants*. International Workshop on Aliasing, Confinement and Ownership (IWACO) 2009. Published by ACM, article 6.

Alexander J. Summers. *Modelling Java Requires State*. Proceedings of the 11th Workshop on Formal Techniques for Java-like Programs (FTfJP) 2009. Published by ACM, article 10.

Alexander J. Summers, Sophia Drossopoulou and Peter Müller. *A Universe-Type-Based Verification Technique for Mutable Static Fields and Methods*. Formal Techniques for Java-like Programs (FTfJP) 2008.

Jayshan Raghunandan and Alexander J. Summers. *On the Computational Representation of Classical Logical Connectives*. Developments in Computational Models (DCM) 2006. Published by ENTCS, Vol. 171, Issue 3, Pages 85–109

TEACHING-
RELATED
PUBLICATIONS

Kryisia Broda, Jiefei Ma, Gabrielle Sinnadurai and Alexander Summers. *Pandora: A Reasoning Toolbox using Natural Deduction Style*. Special issue of Logic Journal of the IGPL 2007 on Tools for Teaching Logic. Vol. 15, No. 4, pages 293–304.

Kryisia Broda, Jiefei Ma, Gabrielle Sinnadurai and Alexander Summers. *Pandora - Natural Deduction made Easy*. International Congress on Tools for Teaching Logic (ICTTL) 2006, pages 11–14.

Kryisia Broda, Jiefei Ma, Gabrielle Sinnadurai and Alexander Summers. *Friendly e-tutor for Natural Deduction*. Teaching Formal Methods (TFM) 2006: practice and experience. Published by BCS-FACS, 2006. pages 1–6.

SERVICE

- External Ph.D. Examiner for Awanish Pandey (IIT Kanpur, June 2019)
- Examiner on the Ph.D. Thesis Committee for Stephanie Balzer (ETH Zurich, July 2011)
- Programme Committee for *European Symposium on Programming (ESOP) 2021*
- Programme Committee for *Verification, Model Checking, and Abstract Interpretation (VMCAI) 2020*
- Programme Committee for *Symbolic and Numeric Algorithms for Scientific Computing (SYNASC) 2019*
- Programme Committee for *Formal Techniques for Distributed Objects, Components, and Systems (FORTE) 2019*

- External Review Committee for *European Conference on Object-Oriented Programming (ECOOP) 2019*
- Program Chair for *Formal Techniques for Java-like Programs (FTfJP) 2018*
- Programme Committee for *Asian Symposium on Programming Languages and Systems (APLAS) 2018*
- Programme Committee for *Static Analysis Symposium (SAS) 2018*
- Programme Committee for *PLDI Student Research Competition Committee 2018*
- External Programme Committee for *Object-Oriented Programming, Systems, Languages and Applications (OOPSLA) 2017*
- Programme Committee for *Systems, Programming, Languages and Applications: Software for Humanity (SPLASH) 2017 Workshops*
- Programme Committee for *European Symposium on Programming (ESOP) 2017*
- Programme Committee for *Aliasing, Capabilities, and Ownership (IWACO) 2016*
- Programme Committee for *Verified Software: Theories, Tools, and Experiments (VSTTE) 2015*
- Programme Committee for *Formal Techniques for Java-Like Programs (FTfJP) 2015*
- Programme Committee for *Programming Language Evolution (PLE) 2014*
- Programme Committee for *Aliasing, Capabilities, and Ownership (IWACO) 2014*
- Programme Committee for *Formal Techniques for Java-Like Programs (FTfJP) 2014*
- External Review Committee for *European Conference on Object-Oriented Programming (ECOOP) 2014*
- Programme Committee for *ACM SIGPLAN Workshop on Programming Languages Meets Program Verification (PLPV) 2014*
- Programme Committee for *Object-Oriented Programming, Systems, Languages and Applications (OOPSLA) 2013*
- Programme Committee for *Intermediate Verification Languages (BOOGIE) 2011*
- Programme Committee for *Formal Techniques for Java-Like Programs (FTfJP) 2009*

OTHER

REVIEWING WORK

- Fundamental Approaches to Software Engineering (FASE) 2020
- Object-Oriented Programming, Systems, Languages and Applications (OOPSLA) 2019
- Tools and Algorithms for the Construction and Analysis of Systems (TACAS) 2018
- TOPLAS journal, 2018
- Principles of Programming Languages (POPL) 2018
- TOPLAS journal, 2017
- Principles of Programming Languages (POPL) 2017
- Formal Methods Symposium (FM) 2016
- Automated Technology for Verification and Analysis (ATVA) 2016
- Logical and Algebraic Methods in Programming journal, 2016
- Verification, Model Checking, and Abstract Interpretation (VMCAI) 2016
- Integrated Formal Methods (iFM) 2016
- TOPLAS journal, 2016
- Concurrency Theory (CONCUR) 2015
- Science of Computer Programming journal, 2015
- Formal Methods Symposium (FM) 2015
- Computer Languages, Systems and Structures journal, 2015
- Verification, Model Checking, and Abstract Interpretation (VMCAI) 2015
- Verified Software: Theories, Tools and Experiments (VSTTE) 2014

- Joint International Conference on Rewriting Techniques and Applications and International Conference on Typed Lambda Calculi and Applications (RTATLCA) 2014
- Verification, Model Checking, and Abstract Interpretation (VMCAI) 2014
- International Journal on Software Tools for Technology Transfer (STTT) (2013)
- European Conference on Object-Oriented Programming (ECOOP) 2012
- Formal Techniques for Distributed Systems (FMOODS-FORTE) 2012
- Journal of Information and Computation, 2012
- Journal of Logic and Computation, 2012
- Workshop on Developing Tools as Plug-Ins (TOPI) 2011
- Annals of Pure and Applied Logic journal, 2010
- Verified Software: Theories, Tools and Experiments (VSTTE) 2010
- Theoretical Computer Science journal, 2010
- Objects, Models, Components, Patterns (TOOLS EUROPE) 2010
- European Conference on Object-Oriented Programming (ECOOP) 2009
- Object-Oriented Programming, Systems, Languages and Applications (OOPSLA) 2009
- Annals of Pure and Applied Logic journal, 2008

PRESENTATIONS
AND TALKS

In the list below, * marks talks I was invited to give; ** marks those invited talks for which paid expenses were also part of the invitation.

*Prusti: Deductive Verification for Rust***. Max Planck Institute for Software Systems (MPI-SWS), Kaiserslauten, Germany. 3rd December 2019.

*Prusti: Deductive Verification for Rust**. ETH Workshop on Dependable and Secure Software Systems. ETH Zurich, Switzerland. 18th October 2019.

*Viper: A Tool Stack for Concurrency Verification***. University of Twente, The Netherlands. 18th May 2018.

*Viper: A Tool Stack for Concurrency Verification***. Max Planck Institute for Software Systems (MPI-SWS), Saarbrücken, Germany. 22nd February 2018.

*Viper: A Tool Stack for Concurrency Verification**. Facebook Concurrency Reasoning Workshop, London, UK. 18th January 2018.

*Hybrid Program Analyses for Pointwise Permission Inference**. NII Shonan Meeting on Analysis and Verification of Pointer Programs, Hayama, Japan. 4th October 2017.

*A Hybrid Pointwise Permission Analysis for Array Programs**. KAIST, South Korea. 29th September 2017.

*Hybrid Program Analyses for Pointwise Permission Inference**. Invited Talk, Workshop on Tools for Automatic Program Analysis, New York, USA. 29th August 2017.

*Automatic Deductive Verification for Weak-Memory Programs**. Meeting of IFIP Working Group 1.9/2.15 (Verified Software), Leuven, Belgium. 12th May 2017.

*Quantified Permissions — Verification for Point-wise Specifications**. ESOP 2017 PC Workshop, Oxford, UK. 17th December 2016.

*Viper: A Verification Infrastructure for Permission-based Reasoning***. Aarhus University, Denmark. 19th November 2016.

*Quantified Permissions — Verification for Point-wise Specifications**. Meeting of IFIP Working Group 1.9/2.15 (Verified Software), Montauban/Villebrumier, France. 4th October 2016.

*An Improved Axiom Profiler for Z3**. Microsoft Research, Redmond, USA. 2nd August 2016.

*Viper: A Verification Infrastructure for Permission-Based Reasoning**. University of Waterloo, Canada. 26th July 2016.

*Actor Services - Modular Verification of Message Passing Programs**. Dagstuhl Seminar 16201, Dagstuhl, Germany. 20th May 2016.

*Deductive Verification Tools**. Invited Tutorial for Dagstuhl Seminar 16201, Dagstuhl, Germany. 18th May 2016.

Actor Services - Modular Verification of Message Passing Programs. European Symposium on Programming, Eindhoven, Netherlands. 6th April 2016.

*Actor Services - Modular Verification of Message Passing Programs**. Meeting of IFIP Working Group 1.9/2.15 (Verified Software), St. Petersburg, Florida, USA. 16th January 2016.

*Viper: A Verification Infrastructure for Permission-Based Reasoning**. Northeastern University, Boston, USA. 11th August 2015.

*Viper: A Verification Infrastructure for Permission-Based Reasoning**. Massachusetts Institute of Technology, Boston, USA. 10th August 2015.

*Viper: A Verification Infrastructure for Permission-Based Reasoning**. Yale University, New Haven, USA. 7th August 2015.

*Viper: A Verification Infrastructure for Permission-Based Reasoning**. New York University, New York, USA. 6th August 2015.

*Viper: A Verification Infrastructure for Permission-Based Reasoning**. Microsoft Research, Redmond, USA. 4th August 2015.

*Viper: A Verification Infrastructure for Permission-Based Reasoning**. Galois Inc., Portland, Oregon, USA. 31st July 2015.

*Viper: A Verification Infrastructure for Permission-Based Reasoning**. University of California, San Diego, USA. 27th July 2015.

*Viper: A Verification Infrastructure for Permission-Based Reasoning**. Invited Talk, Imperial Concurrency Workshop 2015, Imperial College London, London, UK. 16th July 2015.

*Software Verification “Across the Stack”**. Invited Talk, European Conference on Object-Oriented Programming, Prague, Czech Republic. 10th July 2015.

*Viper: A Verification Infrastructure for Permission-Based Reasoning**. Invited Talk, Workshop on Reliability of Concurrent and Distributed Software, Leiden, Netherlands. 6th May 2014.

*The Relationship Between Separation Logic and Implicit Dynamic Frames**. Invited Talk, Microsoft Research, Cambridge, UK. 21st August 2013.

Verification Condition Generation for Permission Logics with Abstract Predicates and Abstraction Functions. European Conference on Object-Oriented Programming, Montpellier, France. 4th July 2013.

A Formal Semantics for Isorecursive and Equirecursive State Abstractions. European Conference on Object-Oriented Programming, Montpellier, France. 3rd July 2013.

An automatic encoding from VeriFast Predicates into Implicit Dynamic Frames. Verified Software: Theories, Tools and Experiments, Atherton, California, USA. 18th May 2013.

Abstract Read Permissions: Fractional Permissions without the Fractions. Verification, Model Checking, and Abstract Interpretation, Rome, Italy. 21st January 2013.

The Relationship Between Separation Logic and Implicit Dynamic Frames.* Invited Talk, Imperial College London, UK. May 25th 2012.

Freedom Before Commitment - A Lightweight Type System for Object Initialisation. International Conference on Object-Oriented Programming, Systems, Languages and Applications, Portland, Oregon, USA. 27th October 2011.

The Relationship Between Separation Logic and Implicit Dynamic Frames. European Symposium on Programming, Saarbrücken, Germany. 31st March 2011.

Considerate Reasoning and Event-Based Programming.* 50th meeting of IFIP Working Group 2.3, Lachen, Switzerland. 2nd March 2010.

Considerate Reasoning and the Composite Design Pattern. Verification, Model Checking, and Abstract Interpretation, Madrid, Spain. 18th January 2010.

*Natural Delimited Control: A Curry-Howard Correspondence for a Canonical Classical Natural Deduction**.* Invited Talk, British Logic Colloquium. Swansea, Wales, 5th September 2009.

A Considerate Specification of the Composite Pattern.* 3rd Meeting of COST Action IC0701 on Formal Verification of Object-Oriented Software, Lisbon, Portugal. 11th June 2009.

A Case Study on Verification with Cyclic Structures.* Invited talk at UCD Dublin, Dublin, Ireland. 26th February 2009.

A Case Study on Verification with Cyclic Structures.* 2nd Meeting of COST Action IC0701 on Formal Verification of Object-Oriented Software, Madrid, Spain. 2nd December 2008.

A Curry-Howard Correspondence for a Canonical Classical Natural Deduction. International Workshop on Classical Logic and Computation, Reykjavik, Iceland. July 13th 2008.

A Unified Framework for Verification Techniques for Object Invariants. European Conference on Object-Oriented Programming, Paphos, Cyprus. July 10th 2008.

A Universe-Type-Based Verification Technique for Mutable Static Fields and Methods. Workshop on Formal Techniques for Java-like Programs, Paphos, Cyprus. July 8th 2008.

$\nu\lambda\mu$: The Computational Content of Classical Natural Deduction.* London Theory Day, London, UK. April 11th 2008.

On the Computational Representation of Classical Logical Connectives. International Workshop on Developments in Computational Models, Venice, Italy. 16th July 2006.

Approaches to Polymorphism in Classical Sequent Calculus. European Symposium on Programming, Vienna, Austria. 27th March 2006.

- RESEARCH VISITS 2nd-3rd December 2019: Max Planck Institute for Software Systems (MPI-SWS), Kaiserlauten and Saarbrücken, Germany. Invited by Derek Dreyer.
- 7th June 2019: University of Twente, The Netherlands. Invited by Marieke Huisman.
- 17th-18th July 2018: University of Twente, The Netherlands. Invited by Marieke Huisman.
- 13th-14th July 2018: IFIP Working Group 1.9/2.15 (Verified Software), Oxford, UK.
- 17th-18th May 2018: University of Twente, The Netherlands. Invited by Marieke Huisman.
- 22nd-23rd February 2018: Max Planck Institute for Software Systems (MPI-SWS), Saarbrücken, Germany. Invited by Derek Dreyer.
- 18th-19th January 2018: Facebook Concurrency Reasoning Workshop and follow-up meeting. London, UK. Invited by Peter O’Hearn.
- 2nd-5th October 2017: NII Shonan Meeting on Analysis and Verification of Pointer Programs, Hayama, Japan. Invited by Marieke Huisman, Thomas Noll, Makoto Tatsuta
- 29th September 2017: KAIST, South Korea. Invited by Sukyoung Ryu.
- 11th-12th May 2017: IFIP Working Group 1.9/2.15 (Verified Software), Leuven, Belgium.
- 26th-28th October 2016: Aarhus University, Denmark. Invited by Anders Möller, Lars Birkedal.
- 1st-5th October 2016: IFIP Working Group 1.9/2.15 (Verified Software), Montauban/Villebrumier, France. Invited by Jean-Christophe Filliâtre.
- 16th-20th May 2016: Synergies among Testing, Verification, and Repair for Concurrent Programs (Dagstuhl Seminar 16201), Dagstuhl, Germany. Invited by Julian Dolby, Orna Grumberg, Peter Müller, Omer Tripp.
- 16th-17th January 2016: IFIP Working Group 1.9/2.15 (Verified Software), St. Petersburg, Florida, USA. Invited by Gary Leavens.
- 21st-25th September 2015: NII Shonan Meeting on Semantics and Verification of Object-Oriented Languages, Hayama, Japan. Invited by Atsushi Igarashi, Andrzej Murawski, Nikos Tzevelekos
- 14th-18th September 2015: Lorentz Centre Workshop on Verification of Concurrent and Distributed Software, Leiden, Netherlands. Invited by Dilian Gurov, Marieke Huisman, James J. Hunt, Arnd Poetsch-Heffter.
- 3rd-4th August 2015: Microsoft Research, Redmond, USA. Invited by Rustan Leino.
- 6th-9th May 2014: Lorentz Centre Workshop on Reliability of Concurrent and Distributed Software, Leiden, Netherlands. Invited by Marieke Huisman, Einar Broch Johnsen.
- 16th-21st August 2013: Microsoft Research, Cambridge, UK. Invited by Matthew J. Parkinson.
- 24th-25th May 2012: Imperial College London, UK. Invited by Philippa Gardner.

Between 6th May 2010 and 13th December 2013: 12 visits (each 1-2 days) to Imperial College London, UK. Invited by Sophia Drossopoulou.

11th-13th June 2009: 3rd MC and WG Meeting of COST Action IC0701 on Formal Verification of Object-Oriented Software, Lisbon, Portugal. Funded as expert participant.

23rd-26th February 2009: UCD Dublin, Ireland. Invited by Joseph R. Kiniry.

19th-23rd January 2009: ETH Zurich, Switzerland. Invited by Peter Müller.

1st-3rd December 2008: 2nd MC and WG Meeting of COST Action IC0701 on Formal Verification of Object-Oriented Software, Madrid, Spain. Funded as expert participant.

MANAGEMENT
AND OTHER
SERVICE
ACTIVITIES

- Running the *Prusti* project, including supervision of two Ph.D. students funded by my grant, technical direction and outreach to potential industrial collaborators and users.
- Coordination of the *Viper Project*, involving 12 members of our research group, plus undergraduate students. The project is the largest in our group, and has produced a number of software tools which are in use by other groups at ETH Zurich and at universities abroad.
- Coordination of and writing grant proposal material for five research groups at ETH Zurich (for an EU Horizon 2020 proposal).
- Representing the department as part of its external evaluation; gave a short presentation of the Viper project as an example of a successful and substantial research direction.
- Interviewing faculty candidates for Assistant Professor positions at ETH Zurich. I interviewed Software Engineering candidates and provided feedback to the hiring committee.
- Interviewing potential Ph.D., postdoc and internship candidates, both for Professor Peter Müller's group, and for the group of Professor Martin Vechev. This has included phone/Skype interviews and personal one-on-one meetings. The majority of the current Ph.D. students in our group were interviewed by me.
- Hiring student teaching assistants. I have organised interviews to select suitable teaching assistants, and managed their subsequent supervision. This included devoting time to explaining the challenging aspects of teaching the particular course to the new assistants.
- Chairing project meetings. For both past and current research proposals I have organised project meetings, steered the direction of the research agenda, and supervised the activities of the funded Ph.D. students.
- Reporting to Hasler Foundation (research council). I wrote annual reports to our funding body describing the progress and results so far, current goals and timeline for remaining project objectives. The reports were each accepted and the outcomes judged a success.

STUDENT
SUPERVISION

In the following list, where Ph.D. "day-to-day" supervision is mentioned, this indicates a major research supervision role, including regular technical and strategic discussions; for Vytautas Astrauskas and Federico Poli, I act as primary supervisor. These roles are unofficial, since only faculty may officially supervise Ph.D. students.

- Day-to-day supervision for two current Ph.D. students (Vytautas Astrauskas and Federico Poli), working on the *Prusti* project funded by my research grant *From Type Capabilities to Permissions for Program Verification (and back again)*.
- Day-to-day supervision for a prior Ph.D. student (Malte Schwerhoff); he successfully defended his thesis in November 2016. I subsequently supervised him as a research programmer. Overall supervision from May 2011 to September 2017. Malte is now a Senior Scientist with a Focus on Teaching (teaching faculty) at ETH Zurich.

- Supervision of a research programmer (Fábio Pakk Selmi-Dei), for the Viper project; July 2018 onwards (ongoing).
- Supervision of a research intern (G Rahul Kranti Kiran), who worked on developing extensible grammar support for a Viper plugin infrastructure; May 2017–July 2019.
- Supervision of a research intern (Nils Becker), who worked on developing the theory and implementation of the Axiom Profiler tool; September 2017–January 2019.
- *Verifying weak memory programs in the Viper ecosystem*. Anouk Paradis, Research in Computer Science Thesis, ETH Zurich. Autumn Semester 2019.
- *Semantic Heap Snapshots for a Symbolic-execution-based Verifier*. Mauro Bringolf, Bachelor's Thesis, ETH Zurich. Autumn Semester 2019.
- *Deductive Verification of Real-World C++ Weak-Memory Programs*. Pascal Wiesmann, Master's Thesis, ETH Zurich. Autumn Semester 2018. Pascal is now a Software Engineer at Zühike Engineering AG.
- *SMT Models for Verification Debugging*. Cédric Stoll, Master's Thesis, ETH Zurich. Autumn Semester 2018. Cédric is now a Software Engineer at Zühike Engineering AG.
- *Optimisation of a Deductive Program Verifier*. Philippe Voinov, Bachelor's Thesis, ETH Zurich. Autumn Semester 2018.
- *Adding Generalized Magic Wand Support to a Verification-Condition-Generation-Based Verifier*. Ahmed Gamal Khedr, Bachelor's Thesis, ETH Zurich. Spring Semester 2018. Ahmed is now a Software Engineer at Google Warsaw.
- *Modular Verification of Message Passing Programs*. Gaurav Parthasarathy, Master's Thesis, ETH Zurich. Spring Semester 2018. *Awarded the ETH Medal, given to the best Master's theses across the university each year*. Gaurav is now a Ph.D. student at ETH Zurich.
- *Specification and Automated Reasoning for Datastructure Comprehensions*. Thierry Hörmann, Bachelor's Thesis, ETH Zurich. Spring Semester 2018.
- *Applying and Extending the Weak-Memory Logic FSL++*. Gaurav Parthasarathy, Research in Computer Science Project, ETH Zurich. Spring Semester 2017.
- *A Prototype Verifier for Weak Memory Reasoning*. Christiane Goltz, Bachelor's Thesis, ETH Zurich. Spring Semester 2017.
- *Inference of Pointwise Specifications for Heap Manipulating Programs*. Severin Münger, Master's Thesis, ETH Zurich. Spring Semester 2017. Severin is now a Software Engineer at Google Zurich.
- *A Formal Semantics for Viper*. Cyrill Gössi, Master's Thesis, ETH Zurich. Autumn semester 2016. Cyrill is now a Cybersecurity Research Assistant at Lucerne University of Applied Sciences (HSLU).
- *Generalised Verification for Quantified Permissions*. Nadja Müller, Master's Thesis, ETH Zurich. Spring semester 2016.
- *From Viper to Grasshopper*. Andrea Helfenstein, Master's Thesis, ETH Zurich. Spring semester 2016.
- *Automatic Inference of Quantified Permissions by Abstract Interpretation*. Seraiah Walter, Master's Thesis, ETH Zurich. Spring semester 2016. Seraiah is now a Software Engineer at Bloomberg L.P. New York.
- *Rust2Viper: Building a static verifier for Rust*. Florian Hahn, Master's Thesis, ETH Zurich. Autumn semester 2015. Florian is now a Compiler Engineer at Apple.
- *Integration and Analysis of Alternative SMT Solvers for Software Verification*. Frederik Rothenberger, Master's Thesis, ETH Zurich. Autumn semester 2015. Frederik is now a Security Software Engineer at Ergon Informatik AG.

- *Automated Support for Mathematical Datatypes via Trigger-based Axiomatization*. Prasoon Dadhich, External Master's Thesis / Internship, Master Parisien de Recherche en Informatique (MPRI). Summer 2015.
- *Adding Magic Wand Support to Carbon*. Gaurav Parthasarathy, Bachelor's Thesis, ETH Zurich. Spring Semester 2015.
- *Integrating the Abstract Interpreter Sample with the Symbolic-Execution-Based Verifier Silicon*. Severin Heiniger, Master's Thesis, ETH Zurich. Spring semester 2014. *Awarded the ETH Medal, given to the best Master's theses across the university each year*. Severin is now a Senior Software Engineer at Google Zurich.
- *Quantified Permissions for Random Access Data Structures*. Korbinian Breu, Master's Thesis, ETH Zurich. Spring semester 2014.
- *Verification Condition Generation for the Intermediate Verification Language SIL*. Stefan Heule, Master's Thesis, ETH Zurich. Spring semester 2013. Stefan completed a Ph.D. at Stanford University, and now works as a Software Engineer at Google Mountain View.
- *Runtime Checking for Chalice*. Heinz Hegi, Bachelor's Thesis, ETH Zurich. Spring semester 2013.
- *Verifying Separation Logic Contracts in Chalice*. Daniel Jost, Bachelor's Thesis, ETH Zurich. Spring semester 2013. Daniel is now a Ph.D. student at ETH Zurich.
- *Translating Chalice into SIL*. Christian Klauser, Bachelor's Thesis, ETH Zurich. Autumn semester 2012.
- Supervision of a research intern (Stefan Heule), working on reasoning features (predicates and functions) in what would later become Viper. September 2012 – January 2012.
- Research supervision assistance (roughly 9 months) and examination committee member for Stephanie Balzer's Ph.D. defence. Stephanie is now a Systems Scientist (research faculty) at Carnegie Mellon University.
- *Improving Permission-Based Verification of Concurrent Programs with Chalice*. Stefan Heule, Bachelor's Thesis, ETH Zurich. Autumn semester 2010.
- *Automatic Verification of Concurrent Programs*. Filip Wieladek, Master's Thesis, ETH Zurich. Spring semester 2010.

TEACHING EXPERIENCE

- Sole course developer and Lecturer / Examiner for the Master's level course: *Program Verification*, ETH Zurich, spring semesters: 2017, 2018, 2019. Average score for relevant student evaluation questions: (4.2, 4.2, 4.3 in respective years) out of 5.
- Successfully completed the faculty development programme *Teaching at ETH: Committed and skilled* (7 days during 2018); on the development and delivery of courses at ETH Zurich.
- Lecturer / Examiner for the second year core Bachelor's course: *Formal Methods and Functional Programming*, ETH Zurich, spring semester 2013 (153 students). Included writing additional and modified lecture material for the course. Positive student evaluation (average score for questions relevant to my responsibilities / half of the course: 3.9 out of 5).
- Teaching assistant for the Master's course *Concepts of Object-Oriented Programming*, ETH Zurich, 2009–2011. Preparing course material, teaching exercise classes and preparing and grading exam. Average score for relevant student evaluation questions: 4.6 out of 5.
- Coordinator of the teaching assistants, exercise and examination material for the *Formal Methods and Functional Programming* course, Department of Computer Science, ETH Zurich, spring semesters 2010-2012, 2014-2016. Hiring and supervising additional assistants, preparation of course material, teaching exercise classes and preparing and grading the exam. Average score for relevant student evaluation questions: 4.6 out of 5.

- Substitute Lecturer (replacing Peter Müller) for two lectures (4 hours) of the second year core Bachelor's course: *Formal Methods and Functional Programming*, Department of Computer Science, ETH Zurich, spring semester 2010 (similarly one lecture (2 hours) in 2015).
- Course Support Leader for the first year Bachelor's course: *Reasoning about Programs*, Department of Computing, Imperial College London (September 2008 - February 2009). Working with Sophia Drossopoulou on a substantial redesign of the teaching material and formal presentation. Very positive feedback from course tutors.
- Substitute lecturer for 8 hours of lectures for the first year Bachelor's course: *Reasoning about Programs*, Department of Computing, Imperial College London, Spring 2007.
- Personal Maths Tutor to four groups of (six to eight) first year students, Department of Computing, Imperial College London, 2006-2008.
- Teaching assistant for the first year Bachelor's course: *Mathematical Methods*, Department of Computing, Imperial College London, 2005.
- Teaching assistant for first year Bachelor's course: *Logic*, Department of Computing, Imperial College London, 2003 (as an undergraduate, with special permission), 2004, 2005. Also developed the *Pandora* tool, which was then used in first year teaching and examinations.

SOFTWARE
DEVELOPED

- *Carbon*. (2013-ongoing) Lead developer for an automatic verifier for the Viper project, which I also coordinate. The software is open-source, and is in use at other universities. Written in Scala. Full sources available at <https://bitbucket.org/viperproject/carbon>
- *Viper Intermediate Verification Language (Silver)*. (2011-ongoing) An (in-house) intermediate verification language, used for several projects within the research group and externally. Written in Scala. Full sources available at <https://bitbucket.org/viperproject/silver>
- *Chalice*. (2011-2013) Adding features and redesigning several aspects of the Chalice verifier's encoding into the Boogie verification language. Written in Scala. Full sources available at <http://chalice.codeplex.com>
- *Pandora*. (2002-2005) A teaching tool for Natural Deduction proofs; originally a 5-person group project, which I was hired to develop further for teaching and practical examinations. Still in use for first-year teaching at Imperial College London. Written in Java.

LANGUAGES
SPOKEN

- English (native speaker)
- German (intermediate - approximately Goethe-Institut B2 level; B1 certificate held)
- French, Italian (basic - GCSE level before university)

OTHER INTERESTS
AND ACTIVITIES

- I was a pianist in the Imperial College Big Band for 7.5 years, and was involved via various committee roles with the organisation of the band and musical direction. During this time we won two national awards, and I was invited back to perform with the band at the World EXPO 2010 in Shanghai.
- I was a member of Imperial College Hockey Club for 9 years and held several committee positions (including one team captaincy). I subsequently joined Red Sox Hockey Club Zürich, where (as well as playing) I have provided training for the junior goalkeepers.
- I was the President and co-founder of Imperial College Tea Society, a successful social society (attracting over 75 members in its first year) newly formed in 2008 by myself and colleagues.