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# ALEKSANDAR PROKOPEC

## Personal Information

Birth date: 6. August 1985.
Slovenian, married
Swiss Permit B (2014 – 2019)

## Summary

I am a computer science researcher with 7 years of academic and industrial experience. I published 12 peer-reviewed research publications, and led multiple software projects, supervised EPFL-hosted open source projects with external funding from Google, and organized a highly successful Coursera massive open online course on reactive programming. In 2016, I created the Parallel Programming course at Coursera, where I was the main lecturer. The Parallel Programming course was one of the three parts of Coursera's Scala specialization program for the Scala programming language, which in total earned more than one million dollars. I have participated in several international collaborations with top universities and industrial partners. I participated on industrial and research conferences and meetups, held 9 invited talks, and authored a textbook on concurrent programming in Scala. Between 2014 and 2016, I worked at Google on systems for Big Data analytics. Since 2016, I work at Oracle Labs on Graal language infrastructure project.

## Education

École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland 2009 – 2014
Ph.D. in Computer Science
Advisor: Martin Odersky
Committee: Douglas Lea, Erik Meijer, Viktor Kuncak, Ola Svensson

Faculty of Electrical Engineering and Computing, Zagreb, Croatia 2004 – 2009
M.A. in Computer Science
Advisor: Marin Golub

## Professional Experience

Principal Researcher, Oracle Labs, Zürich, Switzerland 2016 –

- Working on the Graal language infrastructure project, the next generation runtime for modern programming languages.

Software Engineer, Google Inc., Zürich, Switzerland 2014 – 2016
Product area: Geo

- Maintaining a distributed logging infrastructure for Google Maps products.
- Working on a massively distributed system used to analyze Geo product usage.
- Led the implementation of a real-time distributed pipeline for spam detection. Awarded a Google Spot Bonus for this effort.
- Designed and implemented a test automation suite for product documentation.

- Main organizer of the team-internal monthly Hackathon events. Awarded a Google Peer Bonus for this effort.

Scala Open Source Developer, Scala Team, Lausanne, Switzerland 2009 – 2016

- Designed and implemented Scala Coroutines – language extension for first-class coroutines, used to facilitate asynchronous programming.
- Designed and implemented Parallel Collections – support for data-parallel programming (part of the Scala programming language since 2011).
- Core part of the Futures and Promises working group, aimed to design the support for asynchronous programming (part of Scala programming language since 2012).
- Maintained and improved the Scala compiler and the Scala standard library.
- Engaged in various open-source activities: ScalaDays conference organization, Scala Workshop program committee member, Scala Improvement Proposal process, online education (MOOCs) and documentation, etc.

## Collaborations

FORTH Institute of Computer Science (Greece), 2015 – now
Computer Architecture and VLSI Systems Laboratory
Research collaboration aimed at developing a novel high-performance concurrent data structures for traditional embedded systems.

Typesafe (USA), 2011 – now
Collaborating on maintenance, development, technology and innovation exchange related to the Scala project (~30 Scala developers).

Akka team (Sweden), 2011 – 2012
Member of the working group (~10 people) that developed a unifying asynchronous programming framework for Scala.

Stanford University (USA), 2011 – 2013
Pervasive Parallelism Laboratory
Collaborated on the LMS and Delite compiler frameworks and runtimes for parallel embedded domain-specific languages (~10 people). Designed high-performance data structures and collections frontends.

## Teaching Experience

Lecturer, Organizer, Parallel Programming 2016
Coursera MOOC on Parallel Programming.

External Lecturer, Co-Organizer, Reactive Programming and Parallelism 2015
Co-organized, prepared materials and exercises, led teaching staff (~7 people) on the undergraduate course on parallel, distributed, and asynchronous programming at EPFL, ~90 students.

Lead Organizer, Principles of Reactive Programming 2013
Coursera MOOC on reactive programming in Scala, with 2 iterations and >60,000 participants so far.

- Coordinated a team of three lecturers during recording and lecture material production.

- Led graduate student teaching staff (~8 people), directed content production, designed and implemented exercise materials, managed the production of lecture videos, organized community TAs on Coursera.
- Received the EPFL IC Teaching Award for this effort.

Teaching Assistant, Functional Programming in Scala 2010-2013
Required EPFL undergraduate course on functional programming (~160 students).

## Research Interests

My focus is design and implementation of frameworks, programming languages, and runtime support for concurrent, parallel and distributed software development. I proposed and implemented novel persistent, concurrent and incremental data structures that support these programming paradigms. I use the Scala programming language as both the underlying development platform and research vehicle.

## Thesis

Data Structures and Algorithms for Data-Parallel Computing in a Managed Runtime — EPFL 2014
Aleksandar Prokopec

## Books

Learning Concurrent Programming in Scala — Packt Publishing 2014
Aleksandar Prokopec

## Publications

Authored 13 international research publications and several technical reports.

Pluggable Scheduling for the Reactor Programming Model — AGERE 2016
Aleksandar Prokopec
AGERE 2016, co-located with SPLASH

Isolates, Channels and Event Streams for Composable Distributed Programming — Onward! 2015
Aleksandar Prokopec, Martin Odersky
Onward! 2015

Conc-Trees for Functional and Parallel Programming — LCPC 2015
Aleksandar Prokopec, Martin Odersky
Languages and Compilers for Parallel Computing 2015

SnapQueue: Lock-Free Queue with Constant Time Snapshots — SCALA 2015
Aleksandar Prokopec
Scala Symposium 2015, co-located with PLDI

Efficient Lock-Free Work-stealing Iterators for Data-Parallel Collections — PDP 2015
Aleksandar Prokopec, Dmitry Petrashko, Martin Odersky
Parallel, Distributed and Network-Based Processing 2015

Containers and Aggregates, Mutators and Isolates for Reactive Programming — SCALA 2014
Aleksandar Prokopec, Philipp Haller, Martin Odersky
Annual Scala Workshop 2014, co-located with ECOOP

Near Optimal Work-Stealing Tree Scheduler for Highly Irregular Data-Parallel Workloads — LCPC 2013
Aleksandar Prokopec, Martin Odersky
Languages and Compilers for Parallel Computing 2013

Composition and Reuse with Compiled Domain-Specific Languages — ECOOP 2013
Arvind K. Sujeeth, Tiark Rompf, Kevin J. Brown,
HyoukJoong Lee, Hassan Chafi, Victoria Popic, Michael Wu,
Aleksandar Prokopec, Vojin Jovanovic, Martin Odersky, Kunle Olukotun
European Conference on Object-Oriented Programming 2013

FlowPools: A Lock-Free Deterministic Concurrent Dataflow Abstraction — LCPC 2012
Aleksandar Prokopec, Heather Miller, Tobias Schlatter
Philipp Haller, Martin Odersky
Languages and Compilers for Parallel Computing 2012

Concurrent Tries with Efficient Non-blocking Snapshots — PPOPP 2012
Aleksandar Prokopec, Nathan Bronson, Phil Bagwell, Martin Odersky
Symposium on Principles and Practice of Parallel Programming 2012

Lock-Free Resizeable Concurrent Tries — LCPC 2011
Aleksandar Prokopec, Phil Bagwell, Martin Odersky
Languages and Compilers for Parallel Computing 2011

A Generic Parallel Collection Framework — Euro-Par 2011
Aleksandar Prokopec, Phil Bagwell, Tiark Rompf, Martin Odersky
Euro-Par 2011

Adaptive Mutation Operator Cycling — ICADIWT 2009
Aleksandar Prokopec, Marin Golub
International Conference on the Applications
of Digital Information and Web Technologies 2009

## Selected Tech Reports

Achieving Efficient Work-Stealing for Data-Parallel Collections — April 2013
Aleksandar Prokopec, Martin Odersky

Multi-Lane FlowPools: A Detailed Look — September 2012
Tobias Schlatter, Aleksandar Prokopec, Heather Miller, Philipp Haller, Martin Odersky

FlowPools: A Lock-Free Deterministic Concurrent Dataflow Abstraction – Proofs — June 2012
Aleksandar Prokopec, Heather Miller, Philipp Haller

Cache-Aware Lock-Free Concurrent Hash Tries — June 2011
Aleksandar Prokopec, Phil Bagwell, Martin Odersky

## Open Source

Scala Programming Language, Scala team member — 2009 – now

- Scala Coroutines, lead
  Scala language extension for first-class coroutines, used for easier asynchronous programming.
- Reactors Framework for Distributed Programming, lead
  Programming framework aimed at building asynchronous, composable, distributed systems.
- Scala-Blitz – High-Performance Data-Parallelism Framework, lead
  Scala module for highly efficient data-parallel programming.
- ScalaMeter Benchmarking Framework, lead
  Microbenchmarking and performance regression testing framework for Scala and JVM, adopted in various open source projects.
- Scala Futures & Promises (Scala Improvement Proposal 14), team member
  Asynchronous programming framework for Scala, used as a basic building block for other concurrency frameworks within the Scala ecosystem (part of standard Scala distribution since 2012).
- Parallel Collections Framework, lead
  Scala standard library module for data-parallel programming (part of the standard Scala distribution in 2011).

Java Group at Faculty of Electrical Engineering and Computing, Zagreb, — 2006 – 2008

- VHDLLab, team member
  Award-winning online educational VHDL editor for modeling and simulation of digital circuits (used as part of the computer science curriculum at the Faculty of Electrical Engineering and Computing in Zagreb since 2007).

## Honors and Awards

| | |
|---|---|
| Google Spot Bonus for the Distributed Real-Time Spam Detection Project | 2015 |
| Google Peer Bonus for the Team Hackathon Initiative | 2015 |
| Nominated for the Patrick Denantes Doctoral Thesis Award | 2014 |
| EPFL Outstanding Teaching Assistant Award | 2013 |
| LCPC Best Paper Presentation Award | 2011 |

| | |
|---|---|
| EPFL Computer Science Fellowship | 2009 – 2010 |
| University of Zagreb Rector Award for Best Project (VHDLLab) | 2008 |
| Faculty of Electrical Engineering and Computing Josip Loncar Award | 2007 |
| Faculty of Electrical Engineering and Computing Josip Loncar Award | 2006 |
| Participation in the International Physics Olympiad (IPhO) | 2004 |
| 1st Place in the Croatian National Physics Competition (Finals) | 2004 |
| Participation in the Croatian National Physics Competition (Finals) | 2002 |
| Participation in the Croatian National Physics Competition (Finals) | 2001 |

## Selected Talks

Gave over 20 academic and industrial talks, 8 as an invited speaker.

Pluggable Scheduling for the Reactor Programming Model — AGERE 2016
Academic Conference Talk
Amsterdam, Netherlands, October 30, 2016

First-Class Coroutines for the Scala Programming Language — Scala World 2016
Developer Conference Talk
Lake District, UK, September 12, 2016

Reactors - Road to Composable Distributed Computing — ScalaDays 2016
Developer Conference Talk
Berlin, Germany, June, 2016

Reactor Model for Composable Distributed Computing — Voxxed Days Zurich 2016
Developer Conference Talk
Zurich, Switzerland, March 3, 2016

Isolates, Channels and Event Streams for Composable Distributed Programming — Onward! 2015
Academic Conference Talk
Pittsburgh, Pennsylvania, USA, October 29, 2015

Scala – The Learning Curve — Jazoon 2015
Developer Conference Talk
Zurich, Switzerland, October 23, 2015

Conc-Tree Data Structure for Functional and Parallel Programming — LCPC 2015
Academic Conference Talk
Raleigh, North Carolina, USA, September 10, 2015

SnapQueue: Lock-Free Queue with Constant Time Snapshots — SCALA 2015
Academic Conference Talk
Portland, Oregon, USA, June 13, 2015

ScalaMeter – Performance Regression Testing Framework — Oracle VM Meetup 2014
Academic Meetup Talk
ETH, Zürich, Switzerland, September 11, 2014

Containers and Aggregates, Mutators and Isolates for Reactive Programming — SCALA 2014

Academic Conference Talk
Uppsala, Sweden, July 28, 2014

Reactive Collections and 3D Engine Design — ScalaDays 2014
Industrial Conference Talk (800 attendees)
Berlin, Germany, June 24, 2014

Macro-based Scala Parallel Collections — Scala eXchange 2013
Industrial Conference Talk (350 attendees, invited talk)
London, UK, December 2, 2013

Work-Stealing Tree Scheduling — LCPC 2013
Academic Conference Talk
San Jose, CA, USA, September 26, 2013

Scala as a Research Tool — ECOOP 2013
ECOOP Tutorial (w/ Heather Miller and Philipp Haller)
Montpellier, France, July 1, 2013

Scala Performance Regression Testing — Scala eXchange 2012
Industrial Conference Talk (invited talk)
London, UK, November 19, 2012

Parallel Concurrent Hash Tries — ScalaDays 2012
Industrial Conference Talk (400 attendees)
London, UK, April 18, 2012

Concurrent Hash Tries in Scala — Croatian IEEE Chapter Meetup
Academic Meetup Talk (invited talk)
Zagreb, Croatia, April 11, 2012

Concurrent Tries with Efficient Non-Blocking Snapshots — PPOPP 2012
Academic Conference Talk
New Orleans, Louisiana, USA, February 29, 2012

Lock-Free Resizeable Concurrent Tries — LCPC 2011
Academic Conference Talk
Fort Collins, CO, USA, September 9, 2011

Generic Parallel Collection Framework — Euro-Par 2011
Academic Conference Talk
Bordeaux, France, September 2, 2011

Parallel Collections — Scala eXchange 2011
Industrial Conference Talk (280 attendees, invited talk)
London, UK, June 15, 2011

Scala Parallel Collections — ScalaDays 2011
Industrial Conference Talk
Palo Alto, CA, USA, June 3, 2011

Introduction to Scala — JUG Meetup 2011
Industrial Talk, Java User Group Grenoble (invited talk)
Grenoble, France, March, 2011

Parallel Collections — ScalaDays 2010
Industrial Conference Talk (150 attendees, invited talk)
Lausanne, Switzerland, April 15, 2010

## External Service

Reviewer or program committee member on various scientific conferences and journals.

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|---|---|
| Parallel Processing Letters 2016, external reviewing | 2016 |
| AGERE! 2016, program committee | 2016 |
| ICPADS 2016, program committee | 2016 |
| HLPP 2016, program committee | 2016 |
| On Principles of Distributed Systems (OPODIS 2015), external reviewer | 2015 |
| Transactions on Computers 2015, journal submission reviewer | 2015 |
| Scala Workshop 2014, program committee | 7/2014 |
| High-Level Parallel Programming and Applications 2014, external reviewer | 4/2014 |
| ECOOP 2013, external reviewer | 7/2013 |
| Scala Workshop 2013, program committee (co-chair) | 7/2013 |
| ScalaDays 2010, external reviewer | 6/2010 |
| ICADIWT 2009, external reviewer | 8/2009 |

## Supervised Projects[1]

Supervised 14 bachelor and master student projects.

Joël Rossier, MacroGL Scala.JS Backend — 2/2014 – 6/2014
B.Sc. level

Sven Reber, MacroGL API Extensions — 2/2014 – 6/2014
B.Sc. level

Gwangbae Choi, ScalaMeter Inline Benchmarking — 2/2014 – 6/2014
B.Sc. level

Kristof Szabo, ScalaMeter Java API — 2/2014 – 6/2014
B.Sc. level

Nicolas Stucki, Scala Multiset Collection — 9/2013 – 1/2014
M.Sc. level

Timo Babst, Data-Parallel Raytracer — 9/2013 – 1/2014
B.Sc. level

Clément Moutet, Data-Parallel Flocking Algorithm — 9/2013 – 1/2014
B.Sc. level

Roman Zoller, ScalaMeter D3js Frontend — 2/2013 – 6/2013
M.Sc. level

[1] EPFL research labs prepare projects for B.Sc./M.Sc. students to complete for credits. These projects are designed and supervised by EPFL doctoral assistants.

Tobias Schlatter, FlowSeqs: Barrier-Free ParSeqs — 9/2012 – 1/2013
M.Sc. level, co-supervision w/ Philipp Haller & Heather Miller

Roger Vion, Improvements to ScalaMeter — 9/2012 – 1/2013
B.Sc. level

Tobias Schlatter, Multi-Lane FlowPools — 2/2012 – 6/2012
M.Sc. level, co-supervision w/ Philipp Haller & Heather Miller

Bruno Studer, A Non-Blocking Concurrent Queue Algorithm — 2/2012 – 6/2012
B.Sc. level

Ngoc Duy Pham, Scala Benchmarking Suite – Performance Regression Pinpointing — 8/2011 – 1/2012
M.Sc. level

Pamela Delgado, Scala Invariant Verifier — 8/2011 – 1/2012
M.Sc. level

## GSoC Projects[2]

Supervised 4 Google Summer of Code projects.

Krzysztof Janosz, ScalaMeter –- Binary Compatible Serialization Format and Invocation Measurers — 5/2015 – 9/2015

Dmitry Petrashko, Specializing Parallel Collections with Scala Macros — 5/2013 – 9/2013

Ivan Oreskovic, Porting Scala Parallel Collections to the Android Platform — 5/2012 – 9/2012

Heather Miller, Parallel Collections Extensions — 5/2011 – 9/2011

[2] The Scala Team is a regular host of Google Summer of Code Projects. These are 3-month paid projects offered to students all over the world, sponsored by Google and supervised by members of various open-source organizations.

## References

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