



## Eugene Burmako

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### EXPERTISE

Programming languages,  
Compilers,  
Developer tools.

### HIGHLIGHTS

Created Rsc, an experimental Scala compiler focused on compilation speed. Through outlining - really quick computation of type signatures - we've been able to extract additional parallelism from Scala builds and obtain significant compilation speedups. On Twitter Util, one of the foundational libraries of the Twitter stack, our compilation pipeline is  $\sim 2.7$  times faster than the traditional compilation pipeline on powerful hardware.

Cofounded and spearheaded Scalameta, an opensource toolchain that raises the bar of what is possible for effective Scala development environment. Together with Denys Shabalin and Ólafur Páll Geirsson, we turned Scalameta into a strategically important community initiative, which nowadays encompasses more than 10 projects that add up to more than 13000 commits made by more than 200 contributors.

Designed and implemented reflection and macros for Scala together with Martin Odersky, enabling a number of new patterns used in popular community libraries: Akka, Play, Sbt, Scala.js, ScalaTest, Shapeless, Slick, Spark, Spire and others.

Bootstrapped the Scala macros community from zero to self-sustaining, gave more than 20 talks about metaprogramming, managed more than 10 successful student projects, supervised the work of more than 40 contributors, provided help with more than 30 opensource projects.

Contributed  $\sim 750$  commits,  $\sim 750$  tests and  $\sim 150k$  lines of code to the Scala compiler, fixed  $\sim 350$  issues, being the 2nd top contributor to the Scala 2.10 release and the 3rd top contributor to the Scala 2.11 release.

### PROJECTS

**Rsc.** In Aug 2017, I started developing Rsc, an experimental Scala compiler focused on compilation speed. Shortly after its inception, the project got internal funding at Twitter. At the moment, Rsc is focused on outlining - really quick computation of type signatures for an almost full subset of Scala. Once outlines are computed, it becomes possible to compile all files of the program in parallel, which leads to significant speedups on powerful hardware.

- Owned internal and external roadmaps of Rsc, ensuring continuous delivery on commitments in the face of significant uncertainty.
- Worked together with partners within Advanced Scala Tools and Build teams towards seamless integration of Rsc into the Twitter toolchain and developer workflow.
- Co-designed and implemented Rsc outlining, achieving significant coverage of Twitter internal codebase.
- Co-designed and prototyped RscCompat, an automated code rewrite that transforms Scala code into a subset of Scala supported by Rsc.
- Put together Warp - a simplistic build tool specialized for experiments with Rsc-based toolchains.

**Scalameta.** Based on the success of `scala.reflect` and learning from user feedback, in Oct 2013 I set out to build a new metaprogramming platform for Scala. Together with my colleague Denys Shabalin, we've laid out the axioms: 1) user convenience comes first, 2) never lose a token or irreversibly desugar a tree, 3) always save typed ASTs into the resulting bytecode. After my colleague Ólafur Páll Geirsson joined the project, we shifted focus to developer tools which significantly increased the popularity of Scalameta.

- Co-designed and implemented lexical, syntactic and semantic models for the Scala programming language, tested them out in practice using the experience of working on the Scala compiler.
- Co-designed and prototyped other aspects of the Scalameta vision (lightweight and portable reflection API, quasiquoting and hygiene, AST interpreter, AST persistence, integration with build tools, IDEs, etc).
- Worked together with tool developers from the community to make sure that the new metaprogramming platform adequately addresses their needs.
- Evangelized and applied the research behind Scalameta in an industrial setting by designing and building next-generation developer tools at Twitter.
- Planned and managed the timeline of the project, organized opensource contributors and their contributions.

**Scala** is a statically-typed object-functional programming language. Since Sep 2011, I'm a committer to `scalac`, the official Scala compiler. During my first two years, I was a very active contributor to the compiler before moving my research into separate repositories.

- Contributed and maintained a novel language feature: `def macros`, along with the underlying metaprogramming API.
- Implemented Macro Paradise, a popular compiler plugin with additional macro flavors, which was clocking 20k+ monthly downloads and ultimately got merged into the official Scala compiler.
- Discovered and codified new tricks and idioms on the intersection of macros and vanilla Scala features together with prominent community members.
- Worked together with tool developers to enable support for the newly introduced language features and patterns.
- Fixed hundreds of issues in `scalac`, patching various subsystems of the compiler including the parser and the typechecker.

**Scala Macros.** After joining the PhD program at EPFL in Sep 2011, I've come up with an idea to implement macros in Scala. I realized the initial vision in the official Scala compiler under the supervision of Martin Odersky and then proceeded to

research and preach new flavors of macros, gradually gaining support in the community. Very soon, macros spread like wildfire, and now they are used in many popular libraries, including major components of the Lightbend platform.

- Co-designed and implemented `scala.reflect`, the library that has become the foundation for compile-time and runtime metaprogramming in Scala 2.10.
- Co-designed and implemented `def` macros for Scala 2.10.
- Designed and realized a number of other macro flavors (dynamic macros, interpolation macros, implicit macros, fundep materializers, type macros, type providers and macro annotations).
- Promoted, documented and maintained Scala macros, communicating with the adopters and contributors from the Scala community.
- Provided consulting and support for a number of production and research users, ramping up adoption of the new technologies.

**Pickling** is an experimental persistence library for Scala that uses implicits and macros to derive extremely fast and customizable serializers, matching and surpassing the performance of similar Java libraries. Pickling has gained popularity and was eventually included in `sbt`, the most popular build tool for Scala.

- Co-designed object-oriented pickler combinators.
- Implemented and optimized the initial version of compile-time pickler generation facilities that stood the test of time for more than two years.

**Conflux** is an experimental parallel programming platform for C# that I developed in 2010-2011. Conflux features a domain-specific language and a high-level programming model that transparently distributes computational algorithms to GPUs both in single-machine and cluster environments:

- Designed and developed a high-level programming model in the form of an embedded DSL for C#.
- Implemented a C# frontend: a C# AST and a decompiler library.
- Implemented a CUDA backend: a code generator for the PTX assembler of NVIDIA graphics processors and a JIT compilation library.
- Implemented a CPU backend: a code generator for multicore CPUs.
- Provided integration with the Visual Studio debugger.

**Relinq** is a library for transforming C# expression trees into JavaScript code and vice versa. Relinq can be used to implement such scenarios as: querying LINQ data sources from JavaScript, invoking cross-process LINQ queries and constructing LINQ queries dynamically.

- Designed and developed a JavaScript-based query language.
- Extracted and documented a coherent subset of the C# 3.0 specification.
- Implemented an expression compiler for the aforementioned subset of C# that supports generics, lambdas and local type inference.

**Truesight** is an experimental decompiler for the bytecode of the .NET virtual machine. The library provides intermediate representation for both low-level (bytecode) and high-level (abstract syntax tree) views of code. Truesight supports basic constructs of C# and is capable of decompiling structured control flow: conditionals, loops, and restricted `gotos` (i.e. `returns`, `breaks` and `continues`).

- Implemented a parser for CIL that reifies the bytecode and preserves debug information.
- Designed and documented an intermediate tree-based representation for decompiled C# code.

- Implemented visualization for the IR: graphviz dumps, integration with the Visual Studio debugger.
- Created and implemented an algorithm for decompilation of structured programs.

**Tiller** is a C# software suite for designing and generating WYSIWYG interactive reports. It features a programming language that can be used to specify formulae and to script report generation process. The programming language comes with a JIT compiler that speeds up execution:

- Designed and developed a script language.
- Implemented a JIT compiler for the language.
- Implemented a thread-safe ZIP-based engine for storing report components.

## WORK

### *Google*

Mountain View, CA

Staff Software Engineer

Feb 2019 - present

Activities: Working on Swift for TensorFlow - a new way to develop machine learning models which gives the power of TensorFlow directly integrated into the Swift programming language.

### *Twitter*

San Francisco, CA

Staff Software Engineer, Tech Lead of the Advanced Scala Tools team

Nov 2016 - Feb 2019

Activities: Worked on my opensource Scala projects including Rsc, Scalameta and others to make Scala tooling better - both internally inside the company and publicly in the Scala community.

### *École Polytechnique Fédérale de Lausanne*

Lausanne, Switzerland

Doctoral Assistant

Sep 2011 - Nov 2016

Activities: Did a PhD at EPFL, on the academic side of the Scala programming language team. Along with the opensource work on putting my research in practice into Scala, I was also writing occasional papers and doing teaching for the faculty.

### *ScienceSoft*

Minsk, Belarus

Software Engineer

Nov 2007 - Aug 2011

Activities: Enterprise software development with C# and a little bit of JavaScript, with integration into Microsoft Office and Microsoft SharePoint.

### *Itransition*

Minsk, Belarus

Software Engineer

Oct 2005 - Sep 2007

Activities: Enterprise software development with C#.

### *Omega Software*

Minsk, Belarus

Software Engineer

Oct 2004 - Sep 2005  
Activities: Enterprise software development with C++.

## EDUCATION

*École Polytechnique Fédérale de Lausanne*  
Lausanne, Switzerland  
Sep 2011 - Mar 2017  
Degree: PhD in Computer Science  
Thesis: Unification of Compile-Time and Runtime Metaprogramming in Scala

*United Institute of Informatics Problems*  
Minsk, Belarus  
Nov 2009 - Oct 2012  
Degree: Researcher in Computer Science

*Belarusian State University*  
Minsk, Belarus  
Sep 2003 - Jun 2008  
Degree: Specialist in Computer science

## MEMBERSHIPS

- Scala Center Advisory Board (Mar 2018 - Feb 2019)
- Scala Language Server Protocol Working Group (Feb 2018 - Feb 2019)
- GPCE 2018 Program Committee (Feb 2018 - Oct 2018)
- Scala Symposium 2017 Program Committee (Apr 2017 - Oct 2017)
- GPCE 2017 Program Committee (Dec 2016 - Oct 2017)
- Scala Improvement Process Committee (Aug 2016 - Feb 2019)

## TALKS

1. E. Burmako “Towards Parallelizing Scala Compilations”, Scale by the Bay, San Francisco, November 15, 2018
2. E. Burmako “SemanticDB: a Common Data Model for Scala Developer Tools”, Workshop on Meta-Programming Techniques and Reflection, Boston, November 5, 2018
3. E. Burmako “SemanticDB: a Common Data Model for Scala Developer Tools”, Scala Symposium, September 28, 2018
4. E. Burmako “How We Built Tools That Scale to Millions of Lines of Code”, Scala Days, New York City, June 20, 2018
5. E. Burmako “Reasonable Scala Compiler”, Scale by the Bay, San Francisco, November 16, 2017
6. E. Burmako “Concrete Next Steps for Scala Macros”, SF Scala, San Francisco, June 7, 2017
7. E. Burmako, S. Hood “Semantic Tooling at Twitter”, Scala Days, Copenhagen, June 1, 2017
8. E. Burmako, S. Hood “Semantic Tooling at Twitter”, Scala Days, Chicago, Apr 21, 2017
9. E. Burmako “Scala.Meta Semantic API”, ScalaSphere DevTools Summit, Kraków, Mar 2-3, 2017
10. E. Burmako “A New Macro System for Scala”, Scala eXchange, London, Dec 8, 2016
11. E. Burmako “Scala.Meta: the Past, the Present and the Future”, Scala by the Bay, San Francisco, Nov 12, 2016

12. E. Burmako “To Macros and Beyond!: How macros changed Scala, and what’s coming next”, Curry On, Rome, Jul 19, 2016
13. E. Burmako “Metaprogramming 2.0: No, Macros Are Not Going Away”, Scala Days, Berlin, Jun 17, 2016
14. E. Burmako “Metaprogramming 2.0”, Scala Days, New York City, May 11, 2016
15. E. Burmako “What Did We Learn In Scala Meta?”, ScalaSphere DevTools Summit, Kraków, Feb 11, 2016
16. E. Burmako “State of the Meta, Fall 2015”, fby.by, Minsk, Nov 28, 2015
17. E. Burmako “Hands on Scala.Meta”, Scala World, Lake District, Sep 21, 2015
18. E. Burmako “State of the Meta, Summer 2015”, Scala Days, Amsterdam, Jun 09, 2015
19. E. Burmako “State of the Meta, Spring 2015”, Scala Days, San Francisco, Mar 17, 2015
20. E. Burmako “State of the Meta, Fall 2014”, f(by) - Conference on Functional Programming, Minsk, Nov 22, 2014
21. E. Burmako, D. Shabalin “Easy Metaprogramming For Everyone!”, Scala Days, Berlin, Jun 16-18, 2014
22. E. Burmako, D. Shabalin “Macrology 201”, flatMap, Oslo, May 12-13, 2014
23. E. Burmako, T. Brown “Macro-Based Type Providers in Scala”, Scalar, Warsaw, Apr 5, 2014
24. E. Burmako “Rethinking Scala Macros”, Northeast Scala Symposium, New York, March 1-2, 2014
25. E. Burmako, L. Hupel “Macros vs Types”, NE Scala, New York, March 1-2, 2014
26. E. Burmako “What Are Macros Good For?”, Scala eXchange, London, December 2-3, 2013
27. E. Burmako, D. Shabalin “Scala Macros”, Google PhD Student Summit on Compiler & Programming Technology, Munich, November 25, 2013
28. E. Burmako “Philosophy of Scala Macros”, Strange Loop, St. Louis, September 18-19, 2013
29. E. Burmako “What Are Macros Good For?”, Scalapeño, Tel Aviv, July 17, 2013
30. E. Burmako “Applied Materialization”, Bay Area Scala Enthusiasts, San Francisco, June 13, 2013
31. E. Burmako “Half a Year in Macro Paradise”, Scala Days, New York City, June 10-12, 2013
32. E. Burmako “Macros in Scala”, Codefest, Novosibirsk, March 30-31, 2013
33. E. Burmako “Metaprogramming in Scala 2.10”, Minsk, April 28, 2012
34. E. Burmako, J. C. Vogt “Scala Macros”, Scala Days, London, April 17-18, 2012
35. E. Burmako “Project Kepler: Compile-Time Metaprogramming for Scala”, Lausanne, September 27, 2011
36. E. Burmako “Conflux: GPGPU for .NET”, 1st International Conference, Application Developer Days, Yaroslavl, 2010
37. A. Varanovich, V. Tulchinsky, E. Burmako, V. Falfushinsky, R. Sadykhov “Automated Software Development in Heterogeneous GPU/CPU Environments for Seismic Modeling”, EAGE, Barcelona, 2010

## PAPERS

1. E. Burmako, M. Odersky “Unification of Compile-Time and Runtime Metaprogramming in Scala”, PhD thesis, Lausanne, March, 2017
2. V. Ureche, E. Burmako, M. Odersky “Late Data Layout: Unifying Data Representation Transformations”, Object Oriented Programming Systems Languages & Applications, Portland, October 19-21 2014
3. A. Biboudis, E. Burmako “MorphScala: Safe Class Morphing with Macros”, Scala Workshop, Uppsala, Jul 28-29, 2014

4. H. Miller, P. Haller, E. Burmako, M. Odersky. “Instant Pickles: Generating Object-Oriented Pickler Combinators for Fast and Extensible Serialization”, Object-Oriented Programming, Systems, Languages & Applications, Indianapolis, October 26-31, 2013
5. E. Burmako “Scala Macros: Let Our Powers Combine!”, Scala Workshop, Montpellier, July 2, 2013
6. D. Shabalin, E. Burmako, M. Odersky “Quasiquotes for Scala”, Technical report, Lausanne, March, 2013
7. E. Burmako, M. Odersky “Scala Macros”, Valentin Turchin Workshop on Meta-computation, Pereslavl-Zalessky, July 5-9, 2012
8. E. Burmako, R. Sadykhov “Conflux: Embedding Massively Parallel Semantics in a High-Level Programming Language”, Pattern Recognition and Information Processing, Minsk, 2011
9. E. Burmako, R. Sadykhov “Compilation of high-level programming languages for execution on graphical processor units”, Supercomputer Systems and Applications, Minsk, 2010
10. A. Varanovich, E. Burmako, R. Sadykhov “Implementation of CUDA kernels for execution in multiprocessor systems with the use of dynamic runtime”, Technologies of high-performance computing and computer-aided modeling, St. Petersburg, 2010