Embedding Staged Domain-Specific Languages

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ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

To my son David.

Acknowledgements

Lausanne, Switzerland, October 30th, 2015 V. J.

Abstract

Zusammenfassung

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Bibliography

Curriculum Vitae

Personal Information

Full Name	Vojin Jovanovic
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Date of birth	14th January 1985

Goals and aspirations

I believe that programs can be written abstractly and yet execute as fast as their hand tuned counterparts. To this end, I am making a framework that allows effortless addition of domain-specific optimizations to existing libraries. I am also working on a high-level programming model for dynamic compilation where dynamic information is used to perform domain-specific optimizations at runtime; yet managing assumptions, deoptimization, and code caches is done behind the scenes.

Selected Work Experience

Position and Dates — **PhD Candidate** — October 2010 – present

Employer — Scala Laboratory (LAMP), EPFL, Switzerland

Main activities and responsibilities

Author and maintainer of the Yin-yang framework which is used for seamless embedding of DSLs. Yin-yang is used for generating and reifying queries in the new version of LegoBase.
Co-author and initiator of Scala Records. Scala Records are used for type-safe manipulation of SparkSQL query results.
Co-author of SIP 14 – Futures and Promises
LMS contributor: implemented a loop fusion prototype, added record support, enabled and helped removal of the dependency to Virtualized Scala.
Author of sbt-coursera which is used for automatic grading of Java based projects Coursera.
Co-author of the Actors Migration Kit.
Currently working on the Scala interpreter.

Position and Dates — **Research Intern** — June 2013 – September 2013

Employer — Oracle Labs, Switzerland

Main activities and responsibilities

Implemented the Graal backend for Lightweight Modular Staging with support for vectorization. Performance on all (at the time) supported vectorization features was within 10% of hand-written C.

Position and Dates — **Research Intern** — April 2010 – September 2010

Employer — Network Systems Laboratory (NSL), EPFL, Switzerland

Main activities and responsibilities

Implemented DiCE, a system that makes a snapshot of a network of BGP routers and uses concolic execution to explore the live system state. Exploration ensures that the faulty system states can not be reached. DiCE detects common errors in BGP networks like the cybernuke vulnerability.

Position and Dates — **Software Developer – Team Leader** — March 2008 – September 2009

Employer — Margintech Corporation, Toronto
Working for Taleo inc. on the TBE product

Main activities and responsibilities

Developed software for a large SaaS system that is used daily by over 50.000 customers. Lead a team of 3 people on several enterprise projects. At the same time developed algorithms for cache re-balancing (10x improvement in memory utilization), fixed critical concurrency bugs and integrated a semantic search engine.

Education

School and Dates — School of Electrical Engineering, University of Belgrade, Serbia — October 2008 – April 2010

Title — Engineer of Electrical Engineering and Computer Science – Master — GPA 10.00/10.00
Thesis: Human Computer Interaction Device for Visually Impaired People

School and Dates — School of Electrical Engineering, University of Belgrade, Serbia — October 2003 – October 2008

Title — Engineer of Electrical Engineering — GPA 9.02/10.00
Thesis: Tactile Web Browser Simulator

Selected Publications

V. Jovanovic, D. Shabalin, E. Burmako, and M. Odersky, Annotating the Previous Stage: Succinct Type-Driven Staging at Compile Time, Scala'15 (under submission)

V. Jovanovic, A. Shaikhha, S. Stucki, V. Nikolaev, C. Koch, and M. Odersky, Yin-Yang: Concealing the deep embedding of DSLs, GPCE'14

A. Sujeeth, T. Rompf, K. Brown, H. Lee, H. Chafi, V. Popic, M.Wu, A. Prokopec, V. Jovanovic, M. Odersky, and K. Olukotun, Composition and reuse with compiled domain-specific languages, ECOOP'13

T. Rompf, A. Sujeeth, N. Amin, K. Brown, V. Jovanovic, H. Lee, M. Jonnalagedda, K. Olkotun, and M. Odersky, Optimizing Data Structures in High-Level Programs: New Directions for Extensible Compilers based on Staging, POPL '13

S. Ackermann, V. Jovanovic, T. Rompf, and M. Odersky, Jet: An Embedded DSL for High-Performance Big Data Processing, BigData'12

M. Canini, V. Jovanovic, D. Venzano, D. Novakovic, and D. Kostic, Online Testing of Federated and Heterogeneous Distributed Systems, Computer Communication Review, vol. 41, p. 434-435, 2011.

M. Canini, V. Jovanovic, D. Venzano, B. Spasojevic, and O. Crameri, Toward Online Testing of Federated and Heterogeneous Distributed Systems, USENIX'11

Activities

Selected talks	Programming DSLs Made Simple, ScalaDays 2014 Yin-Yang: Transparent Deep Embedding of DSLs, ScalaCamp 2013 High-Performance DSLs Embedded in Scala, GeeCon 2013
Reviewing	Artefact reviewer for OOPSLA'15 Subreviewer for HLPP'14, GPCE'14, and ICFP'14
Demos	Yin-Yang: Concealing the Deep Embedding of DSLs, ECOOP'15
Organizing	Summer School on Domain Specific Programming Languages, Lausanne, July 2015 Scala Workshop, 2013 PL Seminar at EPFL
Teaching	Reactive Programming and Parallelism (2015) Functional Programming Principles in Scala *(2013, 2014, 2015)* Principles of Reactive Programming *(2013, 2015)* Foundations of Software (2012) Operating Systems (2011)

References

Martin Odersky, Professor of Computer Science at EPFL, martin.odersky@epfl.ch

Christoph Koch, Professor of Computer Science at EPFL, christoph.koch@epfl.ch

Tiark Rompf, Professor of Computer Science at Purdue University, tiark@purdue.edu

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