ORACLE Labs

HPI Hasso Plattner Institut
Digital Engineering · Universität Potsdam

Polyglot Notebooks with Squeak/Smalltalk on the GraalVM

Fabio Niephaus (`@fniephaus`)

Software Architecture Group
Prof. Dr. Robert Hirschfeld
Hasso Plattner Institute
University of Potsdam, Germany

http://www.hpi.uni-potsdam.de/swa/

30 August 2019

HPI

State-of-the-art Programming

- Most applications are written in a single language
- Language decision often based on…
  - Use case
    - E.g.: Statistical computing → R, Android app → Java or Kotlin, Live tools → Squeak/Smalltalk, …
  - Skill sets and personal preferences
  - Management of a company
- Software developers…
  - constrained by language decision
  - limited to libraries, frameworks, and tools of language
  - have duplicated thousands of software artifacts across many programming languages

How to Integrate with Other Languages?

- Foreign Function Interfaces (FFIs)
  - Call out to foreign subroutines
- Inter-process Communication (IPC)
  - Communicate with other processes

How to Integrate with Other Languages?

- Foreign Function Interfaces (FFIs)
  - Call out to foreign subroutines
- Inter-process Communication (IPC)
  - Communicate with other processes

Both break OO paradigm and tooling → Lots of work!

How to Integrate with Other Languages?

- Foreign Function Interfaces (FFIs)
  - Call out to foreign subroutines
- Inter-process Communication (IPC)
  - Communicate with other processes

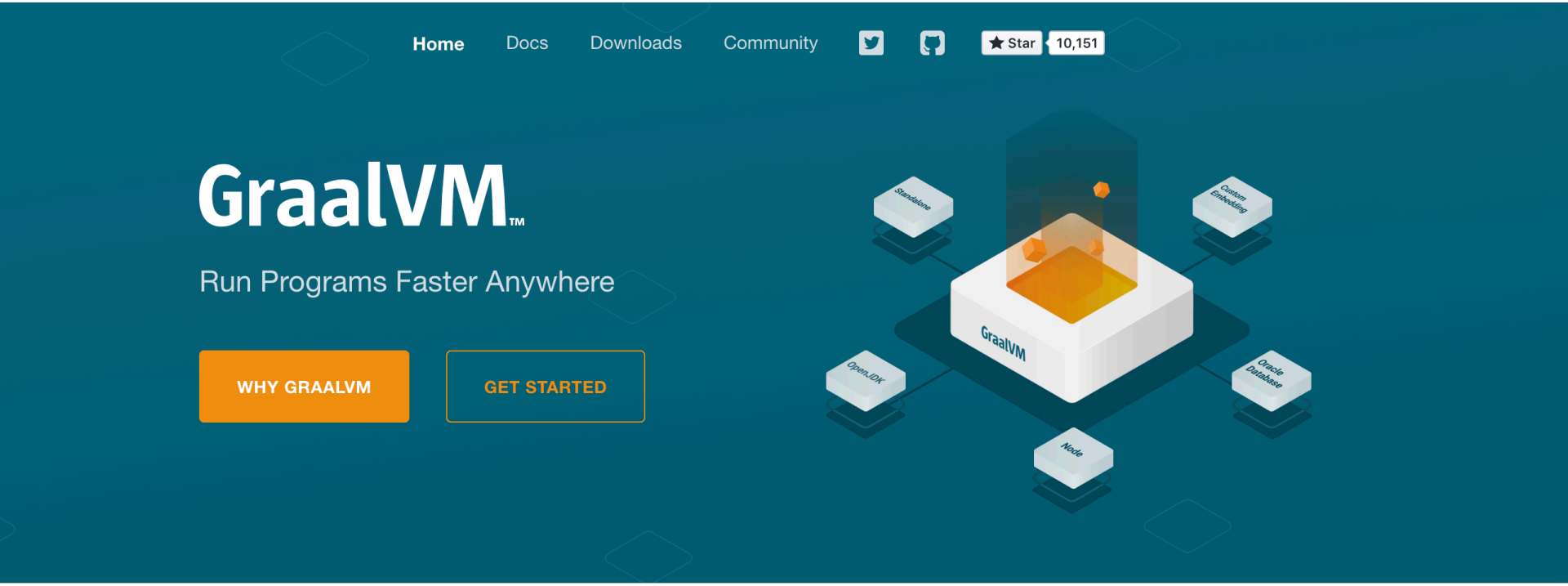
Both break OO paradigm and tooling → Lots of work!

Can we do better?

GraalVM: One VM to Rule Them All*

graalvm.org

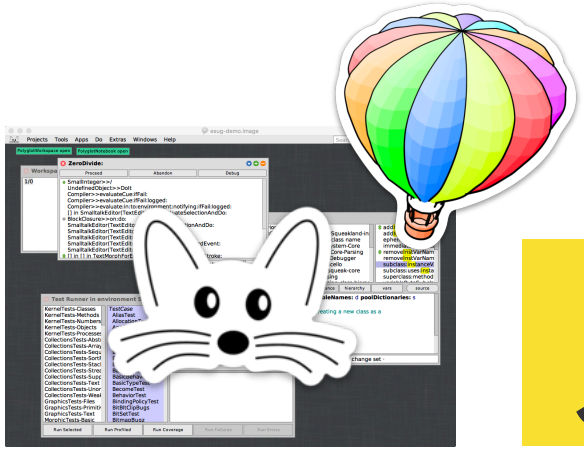
*doi.org/10.1145/3140587.3062381



High-performance polyglot VM

GraalVM is a universal virtual machine for running applications written in JavaScript, Python, Ruby, R, JVM-based languages like Java, Scala, Groovy, Kotlin, Clojure, and LLVM-based languages such as C and C++.

GraalVM Technology Stack



GraalSqueak	Graal.js	GraalPython	TruffleRuby	…

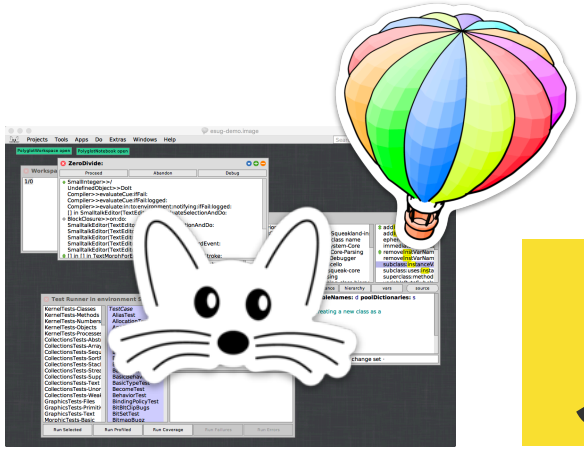
Truffle Language Implementation Framework

Graal Compiler

Java HotSpot VM

Demo

GraalVM Technology Stack



GraalSqueak	Graal.js	GraalPython	TruffleRuby	…

Truffle Language Implementation Framework

Graal Compiler

Java HotSpot VM

Paper at MPLR'19 (SPLASH)

https://conf.researchr.org/home/mplr-2019

GraalSqueak

Toward a Smalltalk-based Tooling Platform for Polyglot Programming

Fabio Niephaus
Hasso Plattner Institute
University of Potsdam
Potsdam, Germany
fabio.niephaus@hpi.uni-potsdam.de

Tim Felgentreff
Oracle Labs
Potsdam, Germany
tim.felgentreff@oracle.com

Robert Hirschfeld
Hasso Plattner Institute
University of Potsdam
Potsdam, Germany
hirschfeld@hpi.uni-potsdam.de

Abstract

Polyglot programming provides software developers with a broader choice in terms of software libraries and frameworks available for building applications. Previous research and engineering activities have focused on language interoperability and the design and implementation of fast polyglot runtimes.

To make polyglot programming more approachable for developers, novel software development tools are needed that help them build polyglot applications. We believe a suitable prototyping platform helps to iterate over and evaluate new ideas for such tools faster.

In this paper we present GraalSqueak, a Squeak/Smalltalk virtual machine implementation for the GraalVM. We report our experience implementing GraalSqueak, evaluate the performance of the language and the programming environment, and discuss how the system can be used as a tooling platform for polyglot programming.

CCS Concepts • **Software and its engineering → Runtime environments**; **Integrated and visual development environments**; *Interpreters*.

Keywords Squeak/Smalltalk, virtual machine, Truffle, GraalVM, polyglot programming, tools, live development

ACM Reference Format:
Fabio Niephaus, Tim Felgentreff, and Robert Hirschfeld. 2018. GraalSqueak: Toward a Smalltalk-based Tooling Platform for Polyglot Programming. In *Woodstock '18: ACM Symposium on Neural Gaze Detection, June 03–05, 2018, Woodstock, NY*. ACM, New York, NY, USA, 13 pages. https://doi.org/10.1145/1122445.1122456

ACM ISBN 978-1-4503-9999-9/18/06…$15.00
https://doi.org/10.1145/1122445.1122456

1 Introduction and Background

Polyglot programming is the practice of writing code in multiple programming languages. Therefore, it gives software engineers a much broader choice in terms of software libraries and frameworks they can use for building applications. The widespread use of mechanisms, such as Foreign Function Interfaces (FFIs) and Inter-process Communication (IPC), demonstrates that it is desirable and sometimes even necessary to be able to call out to software written in other languages.

In the last years, polyglot runtime environments have become more and more popular. The .NET framework [22] and GraalVM [25] are among the most mature systems that support the execution of multiple programming languages including the interaction between them. Moreover, a lot of research has focused on how languages can be combined and executed efficiently. The .NET framework, for example, compiles all languages to its Common Intermediate Language (CIL) [6], which is then executed on its Common Language Runtime (CLR). GraalVM, on the other hand, requires that all languages are implemented in Truffle, its language implementation framework. This framework, in turn, generates the same kinds of Abstract Syntax Trees (ASTs) for all languages as an intermediate representation, which is then executed and optimized by the Graal Just-in-time (JIT) compiler. Hence, languages can be integrated by mixing ASTs of different languages [24].

Nonetheless, the availability of appropriate technologies enabling fast execution of polyglot code is not sufficient to make polyglot programming practical. We believe software development tools supporting developers in writing polyglot code are just as important. Therefore, the goal of our work is to improve the polyglot programming experience. For this, we want a platform that allows fast prototyping of tools for polyglot programming.

Modern Integrated Development Environments (IDEs) provide comprehensive sets of tools for various languages. These tool sets are powerful on the one hand. On the other hand, they are often hard to extend or to adjust and are therefore not a good choice when it comes to prototyping new tooling ideas. Instead, we decided to use a Smalltalk programming system, which has proven to be a great environment for

1

- Implementation Details
- Performance Benchmarks
- Tools for Polyglot Programming
- Technical Limitations
- …

Demo

seaside on GraalSqueak at esug

ORACLE Labs

HPI Hasso Plattner Institut
Digital Engineering · Universität Potsdam

Polyglot Notebooks with Squeak/Smalltalk on the GraalVM

Fabio Niephaus (`@fniephaus`)

Software Architecture Group
Prof. Dr. Robert Hirschfeld
Hasso Plattner Institute
University of Potsdam, Germany

http://www.hpi.uni-potsdam.de/swa/

30 August 2019

ORACLE Labs

HPI Hasso Plattner Institut
Digital Engineering · Universität Potsdam

GraalSqueak

Squeak/Smalltalk on the GraalVM

Fabio Niephaus (`@fniephaus`)

Thanks!

Questions?

esug
EUROPEAN SMALLTALK USER GROUP

30 August 2019