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An Introduction to TruffleRuby

High performance Ruby on GraalVM

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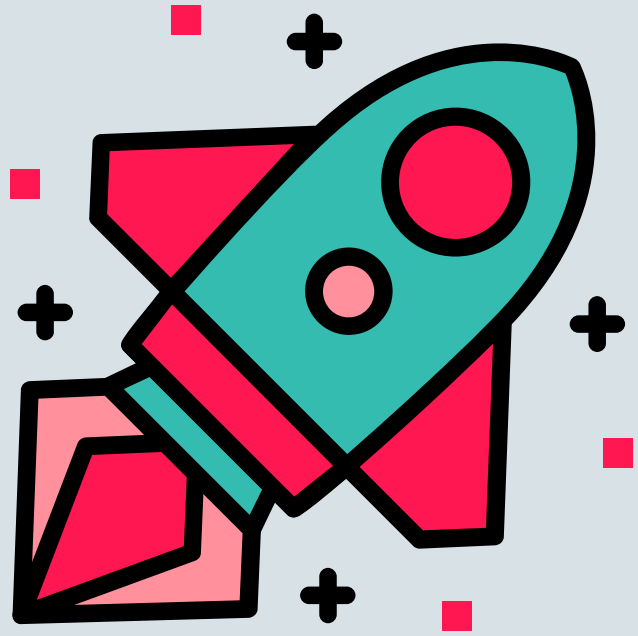
March 2019



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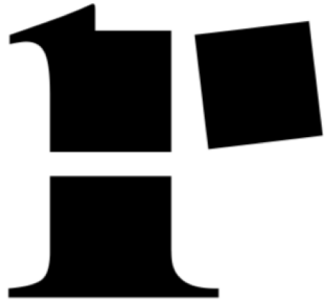
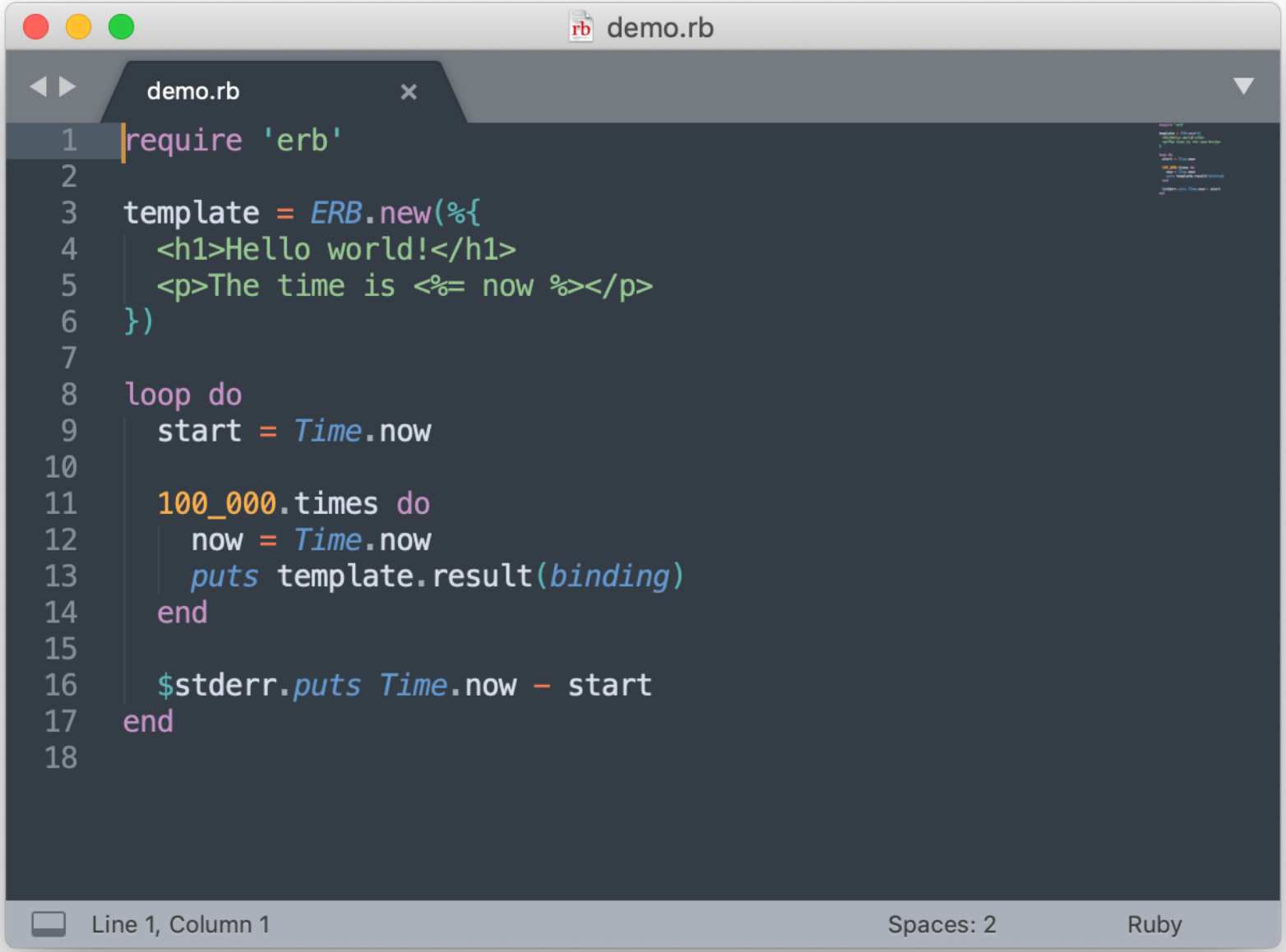
TruffleRuby basics



We wanted to build a Ruby that

- Runs idiomatic Ruby code faster
- Runs Ruby code in parallel
- Boots Ruby applications in less time
- Executes C extensions in a managed environment
- Adds fast and low-overhead interoperability with languages like Java, JavaScript, Python and R
- Provides new tooling such as debuggers and monitoring
- All while maintaining very high compatibility with the standard implementation of Ruby

```
$ rbenv install truffleruby-1.0.0-rc14
$ rbenv shell truffleruby-1.0.0-rc14
$ ruby -v
truffleruby 1.0.0-rc14, like ruby 2.6.2, GraalVM CE Native [x86_64-darwin]
```



TruffleRuby compared to MRI

Like MRI, TruffleRuby

- runs standard Ruby code
- uses RubyGems
- can be distributed as a binary tarball
- runs in Ruby version managers like rbenv, RVM, chruby
- doesn’t need a JVM to run
- starts instantly
- supports C extensions
- is open source

Compared to MRI, TruffleRuby has

- a concurrent, compacting GC
- an optimizing just-in-time native code compiler (a JIT)
- runs that run in parallel
- optimised data structures
- a graphical debugger
- more of the implementation in Ruby rather than C
- support for interop with Java, JavaScript, Python, R, and other languages

TruffleRuby compared to JRuby

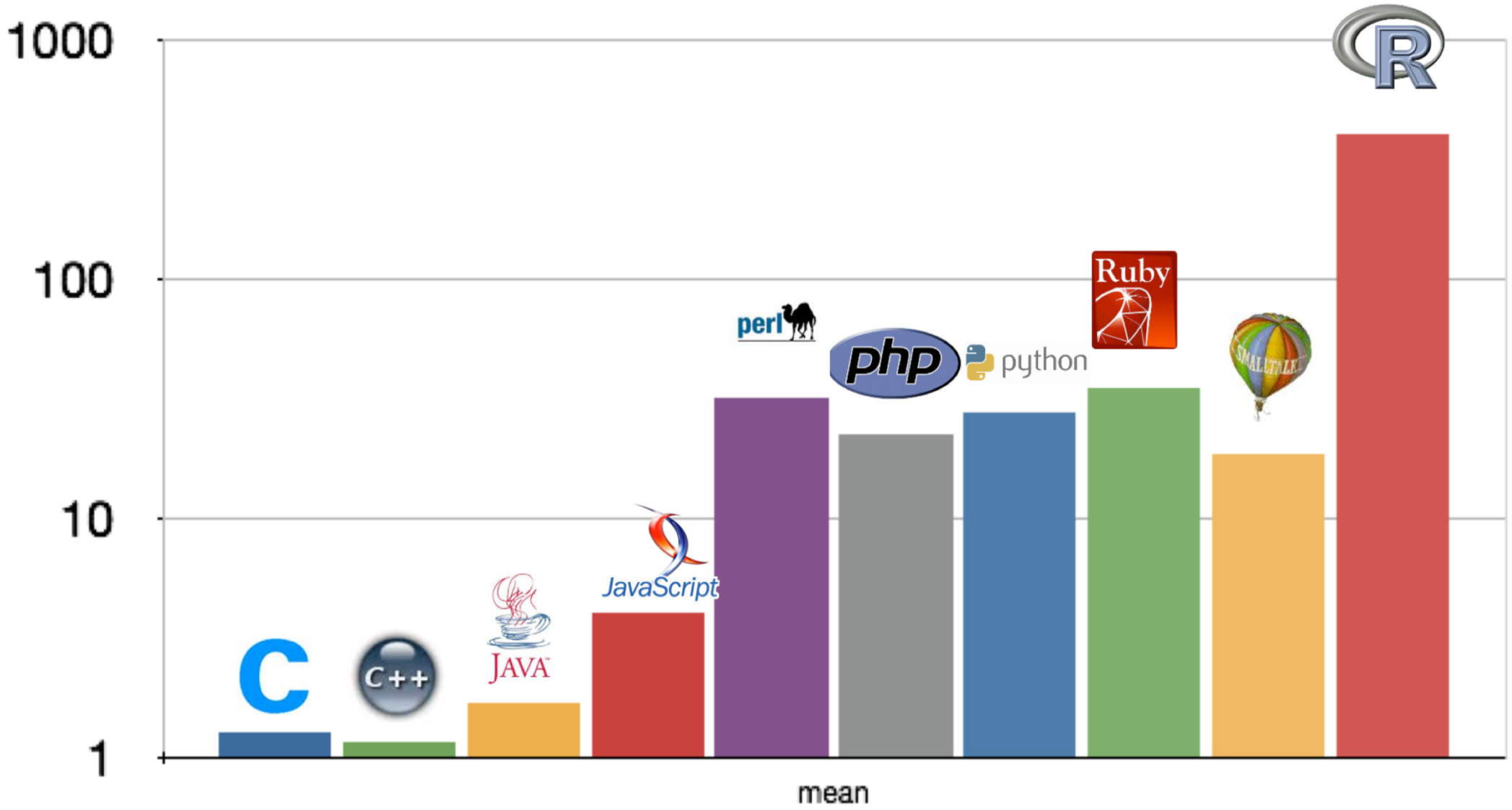
Like JRuby, TruffleRuby

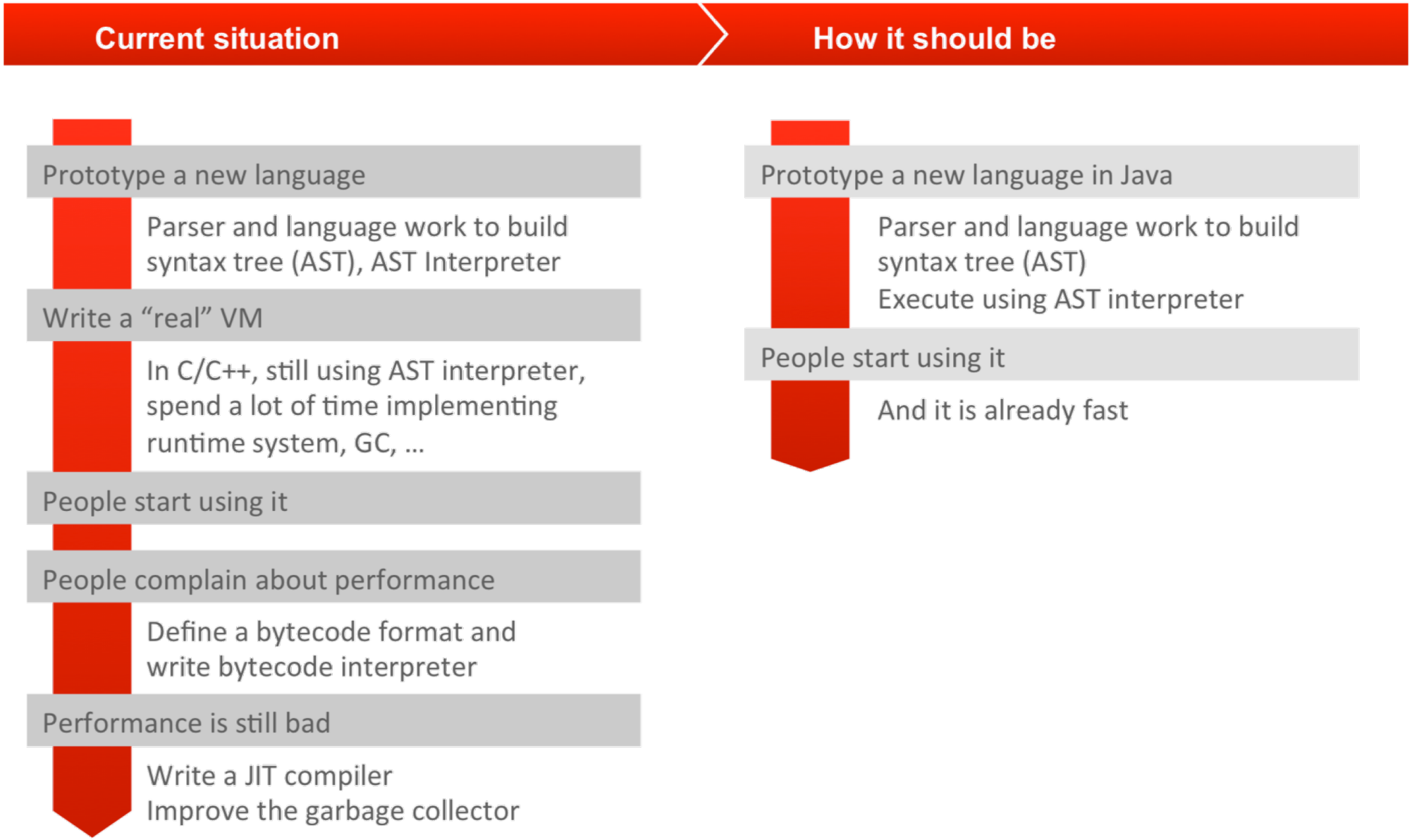
- can run on the JVM
- uses the GC and JIT from the JVM, but in a different way
- runs threads in parallel
- is partially implemented in Java
- can use Java libraries
- is open source

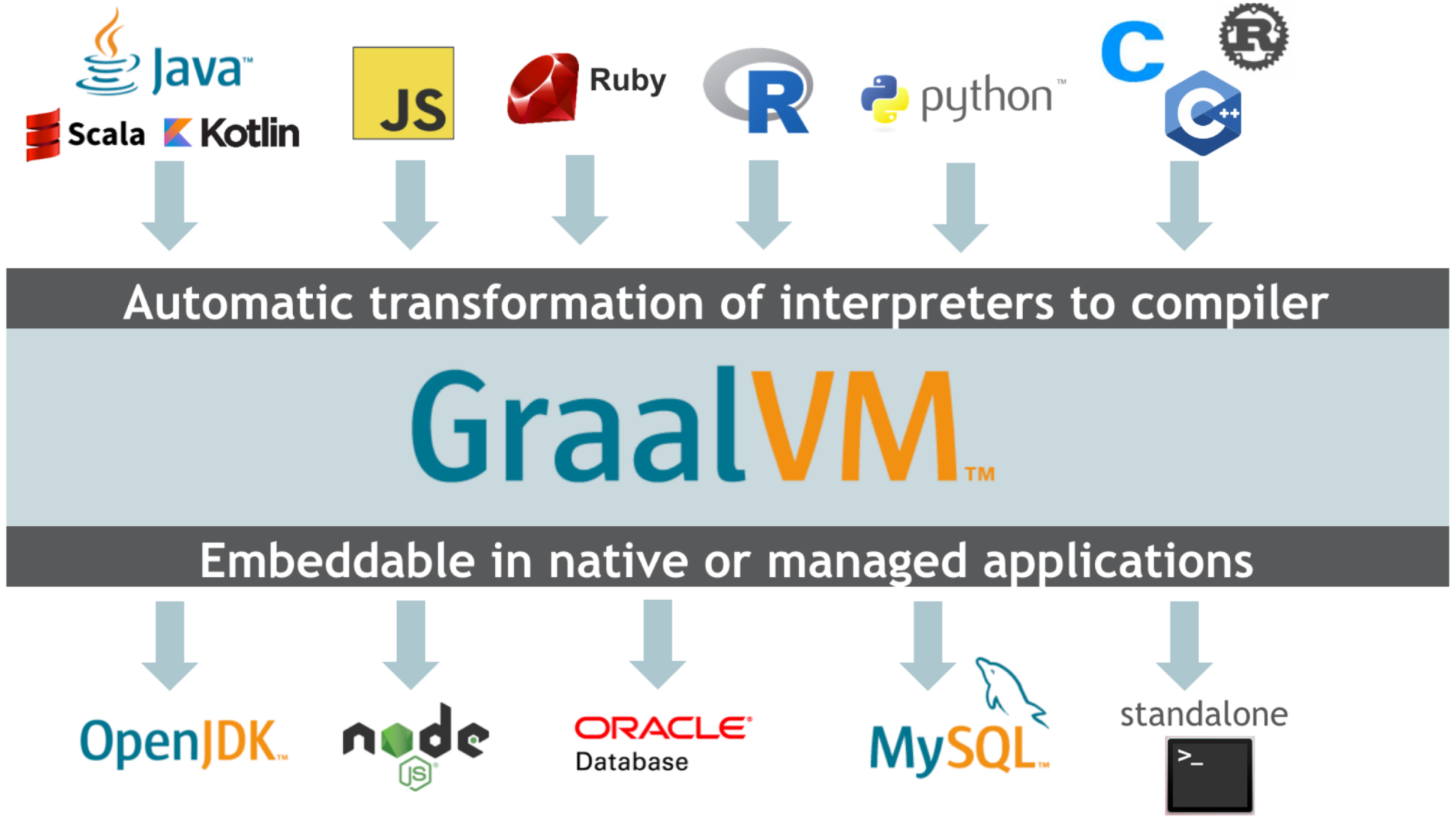
Compared to JRuby, TruffleRuby

- can run without the JVM
- can start instantly
- can be embedded in a native application
- has optimized data structures
- can run C extensions
- has a more powerful JIT
- has more of the implementation in Ruby rather than Java
- supports a standard Ruby stack

The big idea behind TruffleRuby





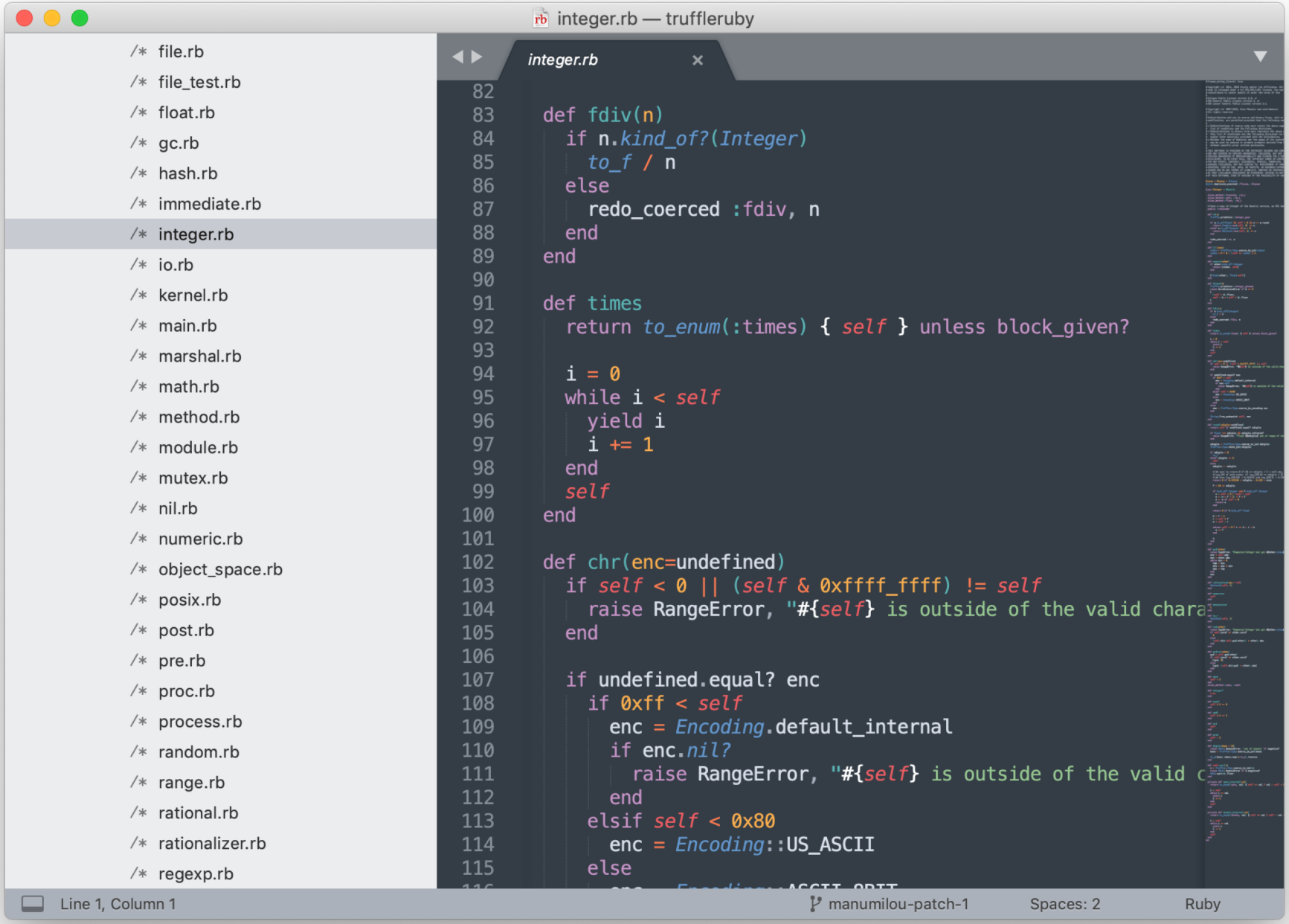


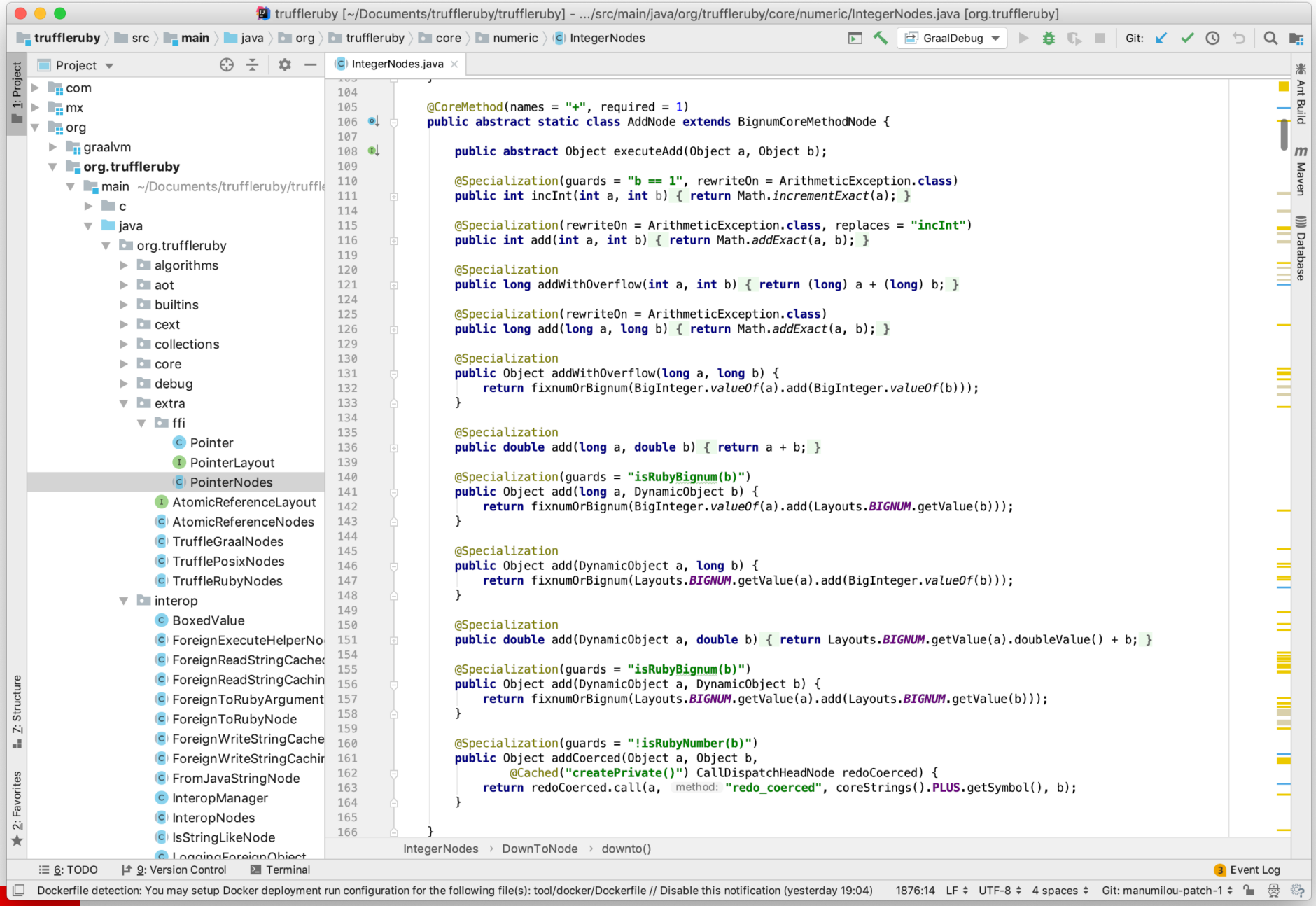
How TruffleRuby works

TruffleRuby is implemented with

- a core in Java providing basic functionality
- a layer on top of that implemented in Ruby for most functionality
- most of the standard library from MRI
- RubyGems, Bundler, etc unmodified

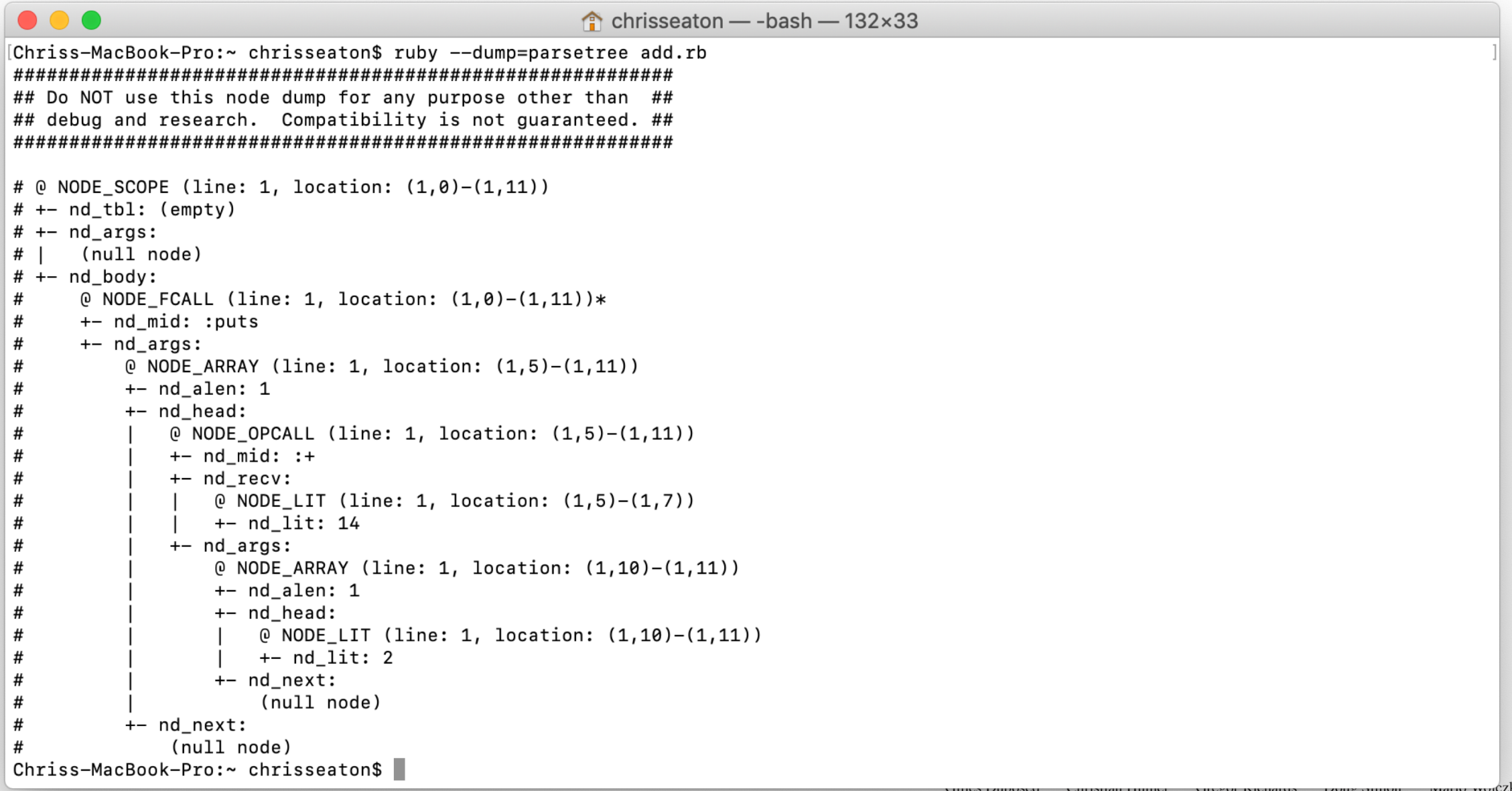
- All similar to the original idea of Rubinius





le Them All

Andreas Wöß† Lukas Stadler†
Gilles Duboscq† Christian Humer† Gregor Richards§ Doug Simon* Mario Wolczko*



Giles Dubosq Christian Hulner Gregor Richards Doug Simon Mario Wolczko*

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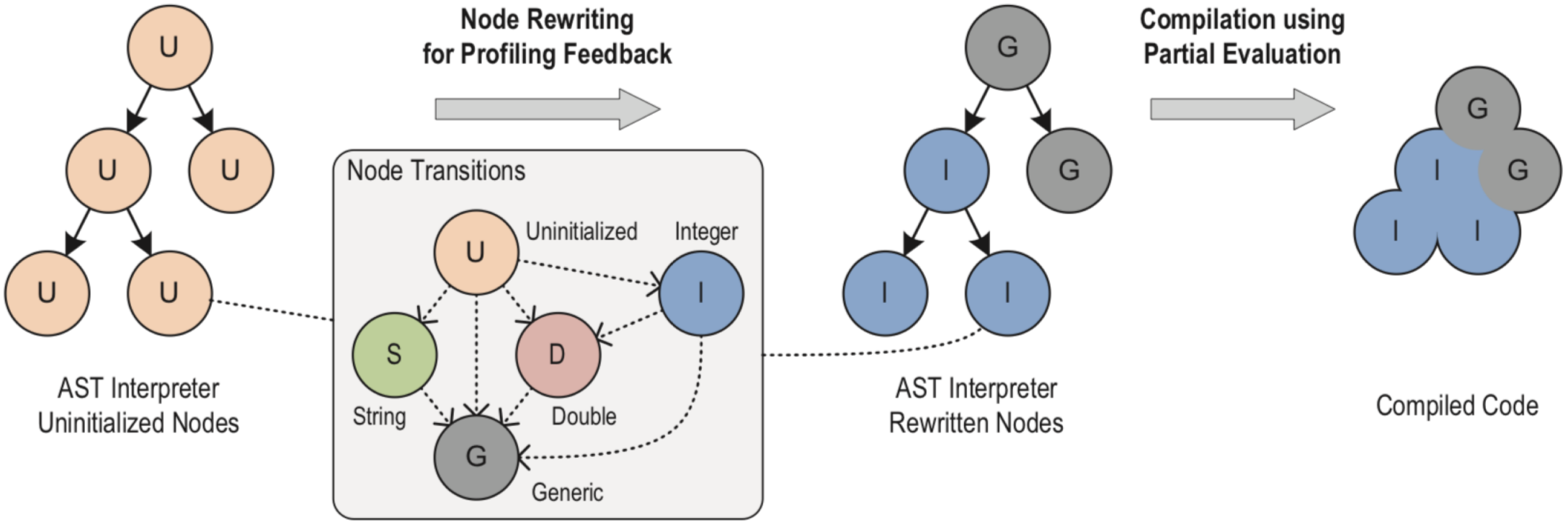

One VM to Rule Them All

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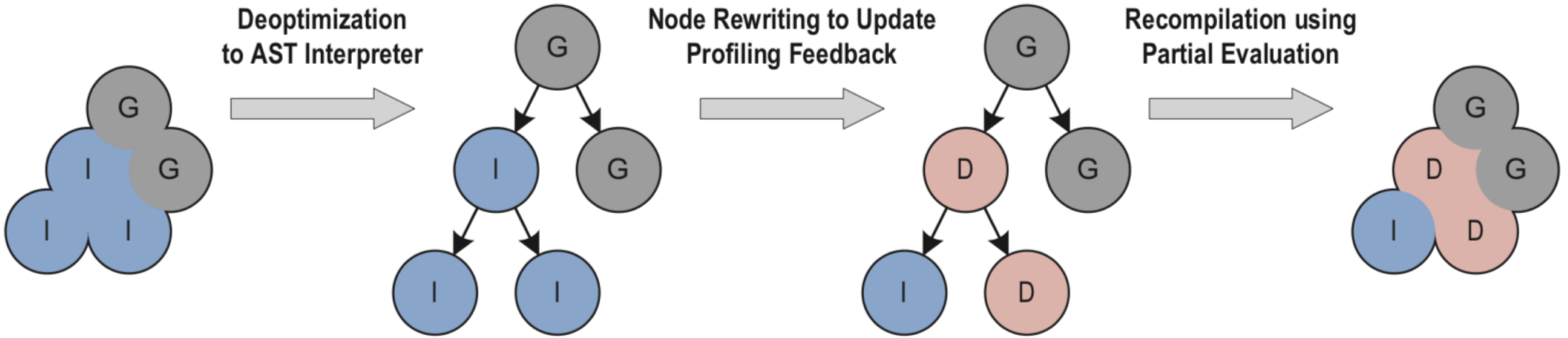
Gilles Duboscq† Christian Humer† Gregor Richards§ Doug Simon* Mario Wolczko*



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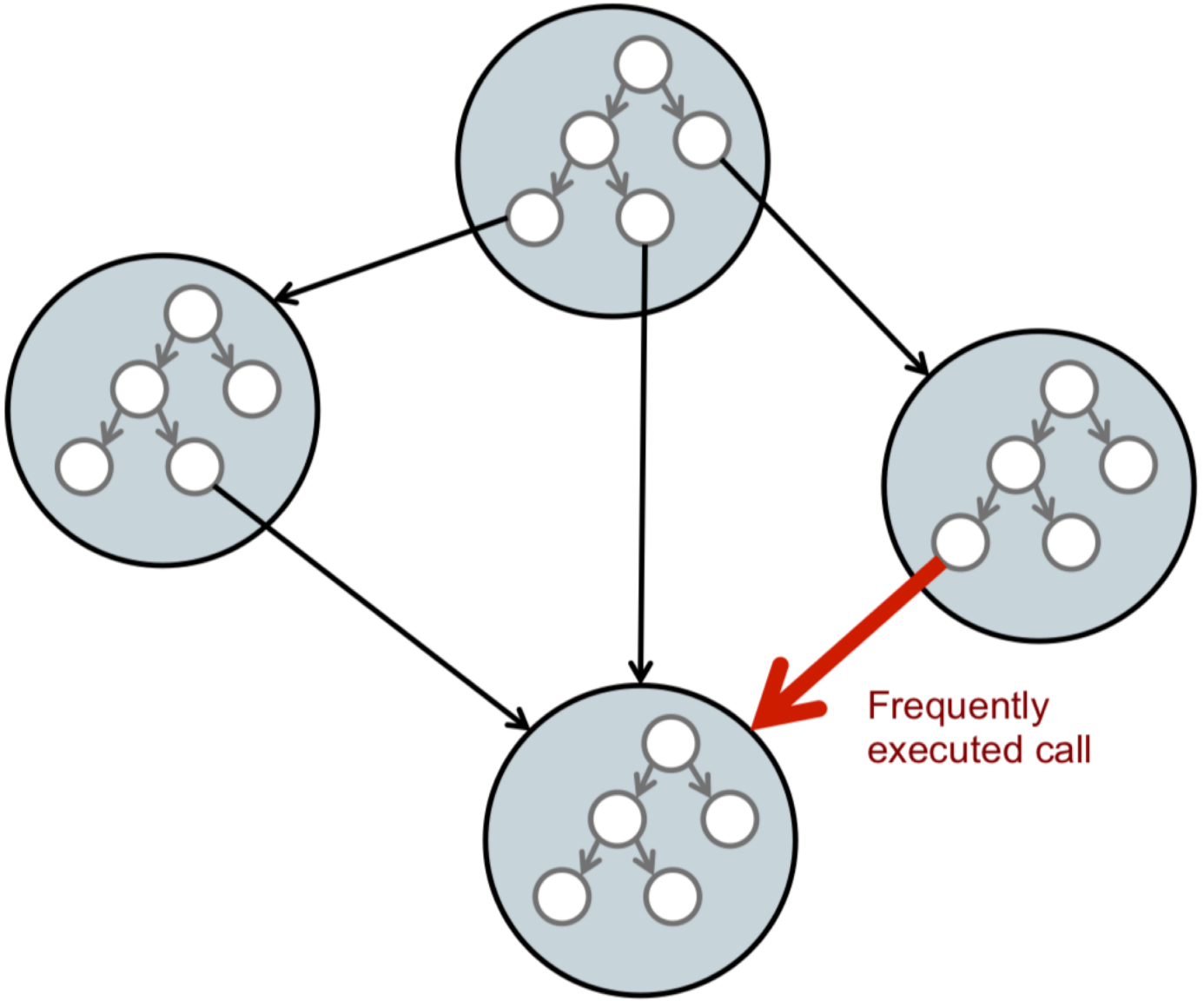
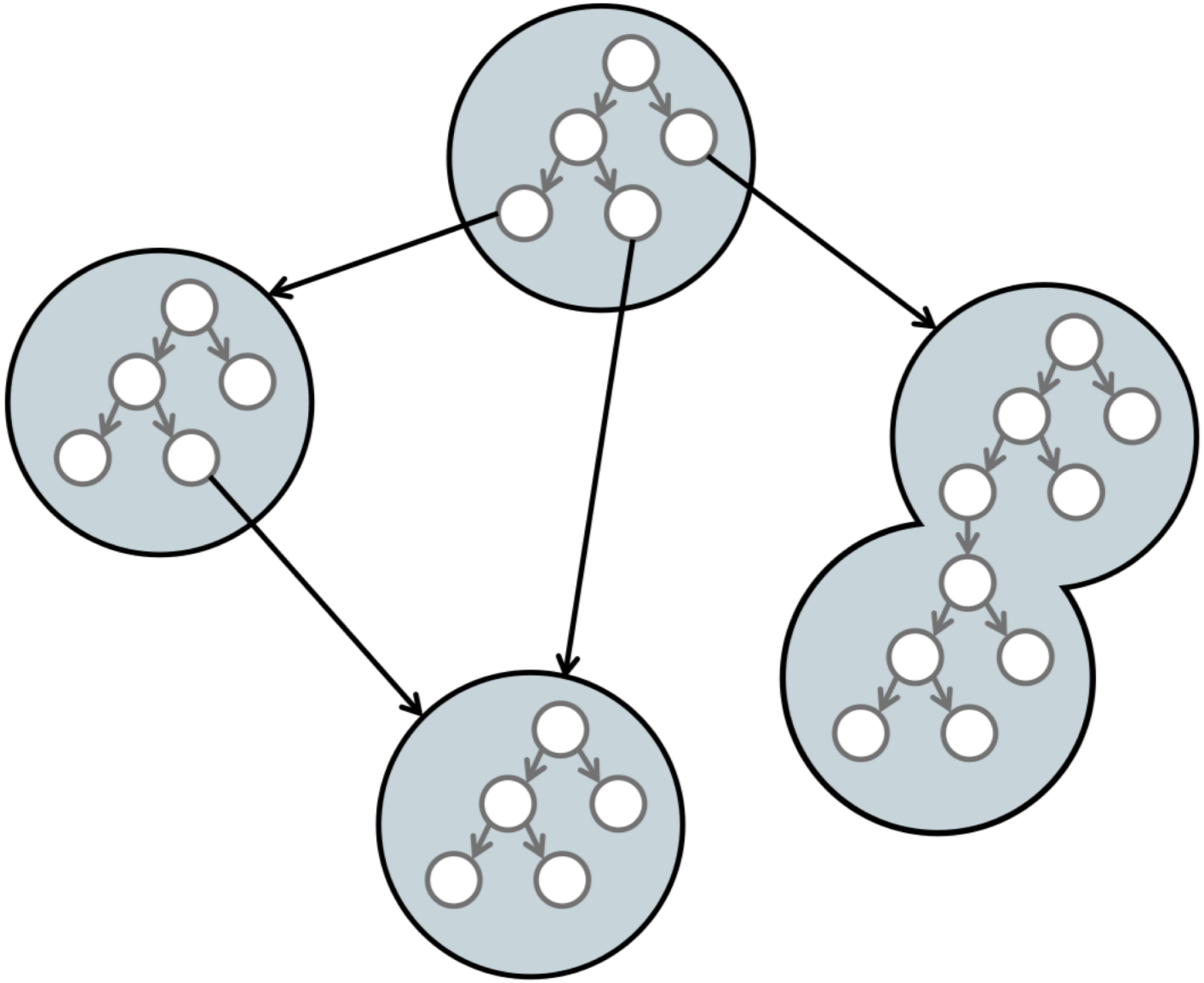
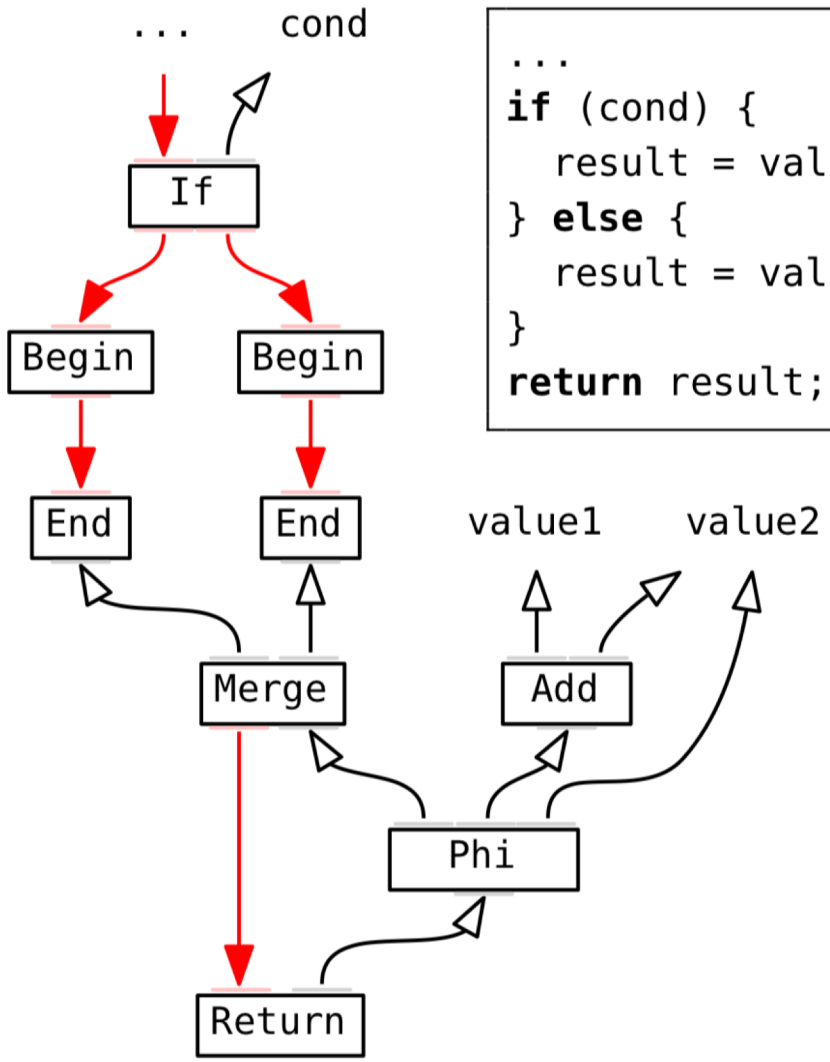




What is Graal?

- A compiler from Java bytecode* to native machine code
  - Not a compiler from Java source code to Java bytecode
  - ‘Java bytecode’ could come from Truffle
- It’s a compiler library rather than being an executable, like GCC
- Some things I didn’t tie Graal down to there:
  - I didn’t say it was specifically a just-in-time compiler
  - I didn’t say the bytecode had to come directly from a program as written

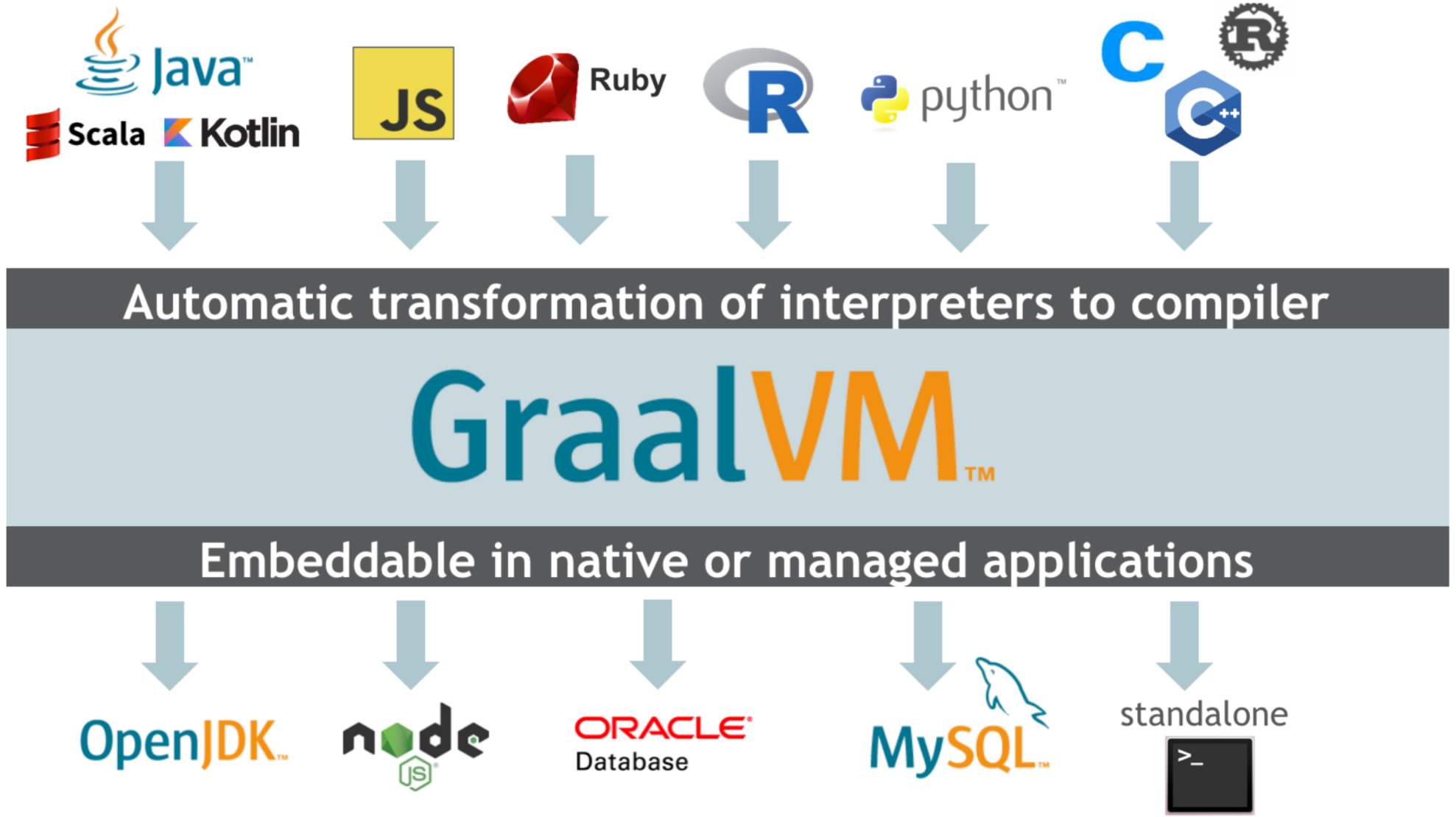


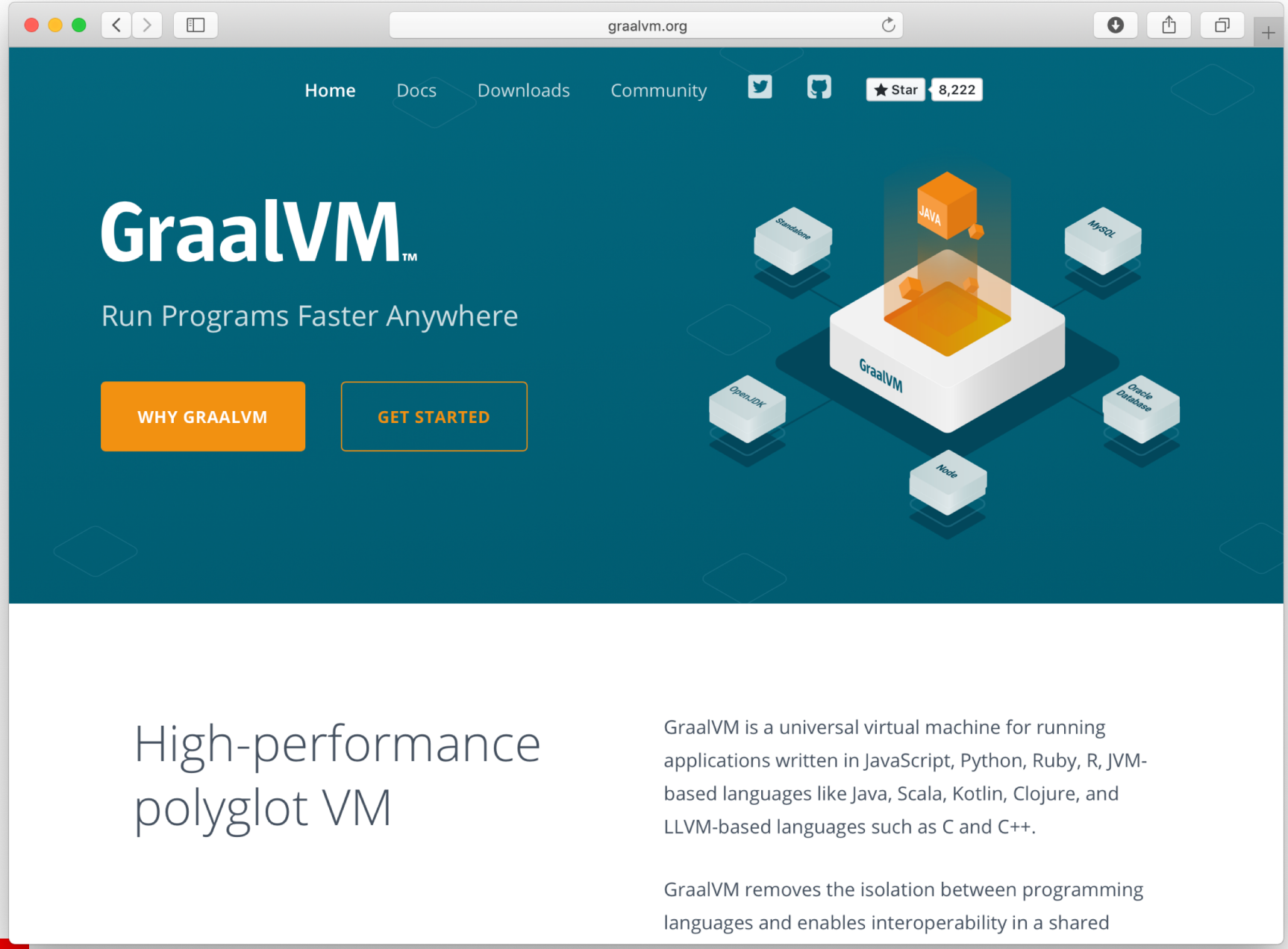

```
...
if (cond) {
  result = value1 + value2;
} else {
  result = value2;
}
return result;
```

Graal IR: An Extensible Declarative Intermediate Representation

Gilles Duboscq* Lukas Stadler* Thomas Würthinger†
Doug Simon† Christian Wimmer† Hanspeter Mössenböck*

Polyglot





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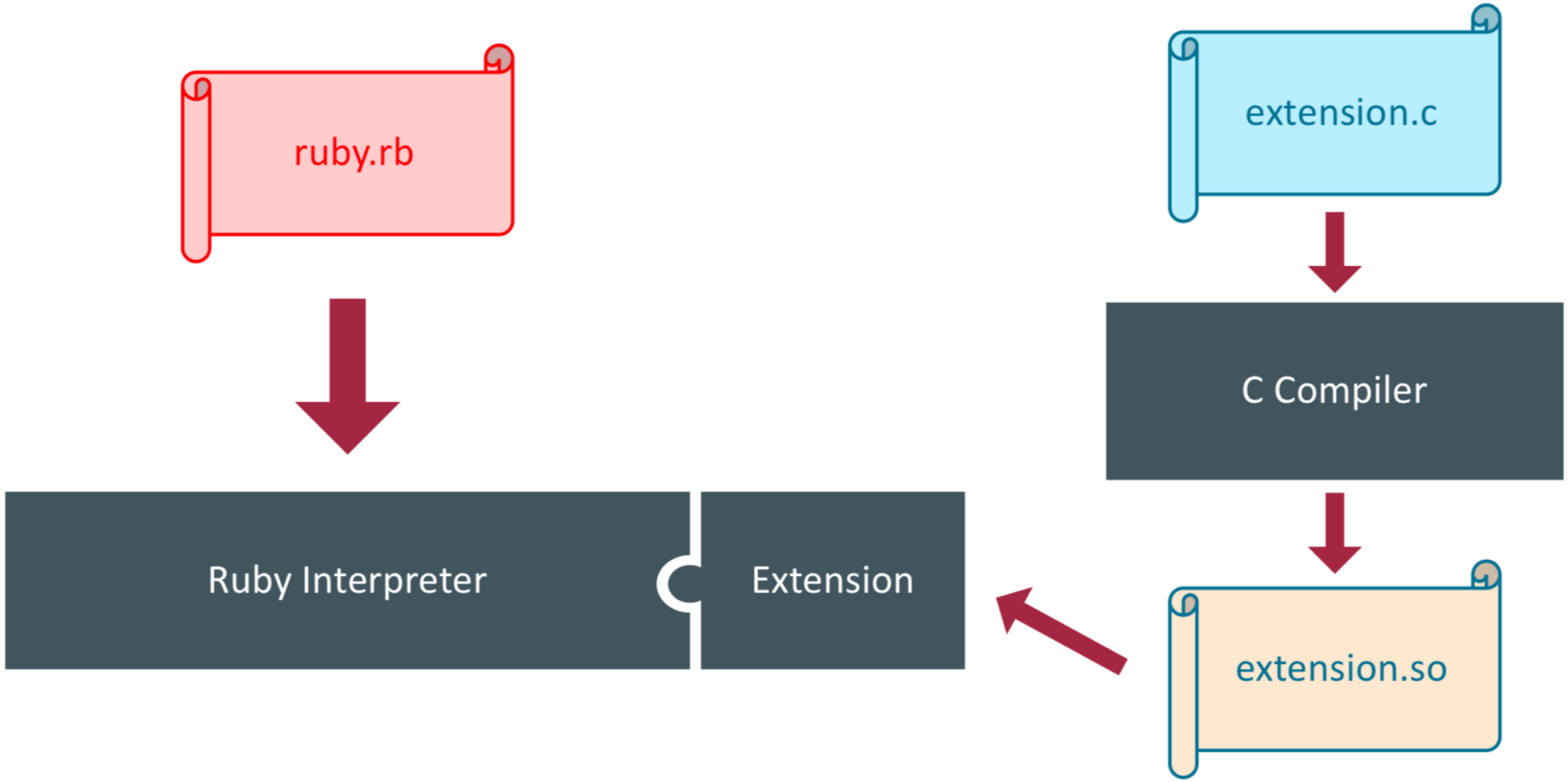
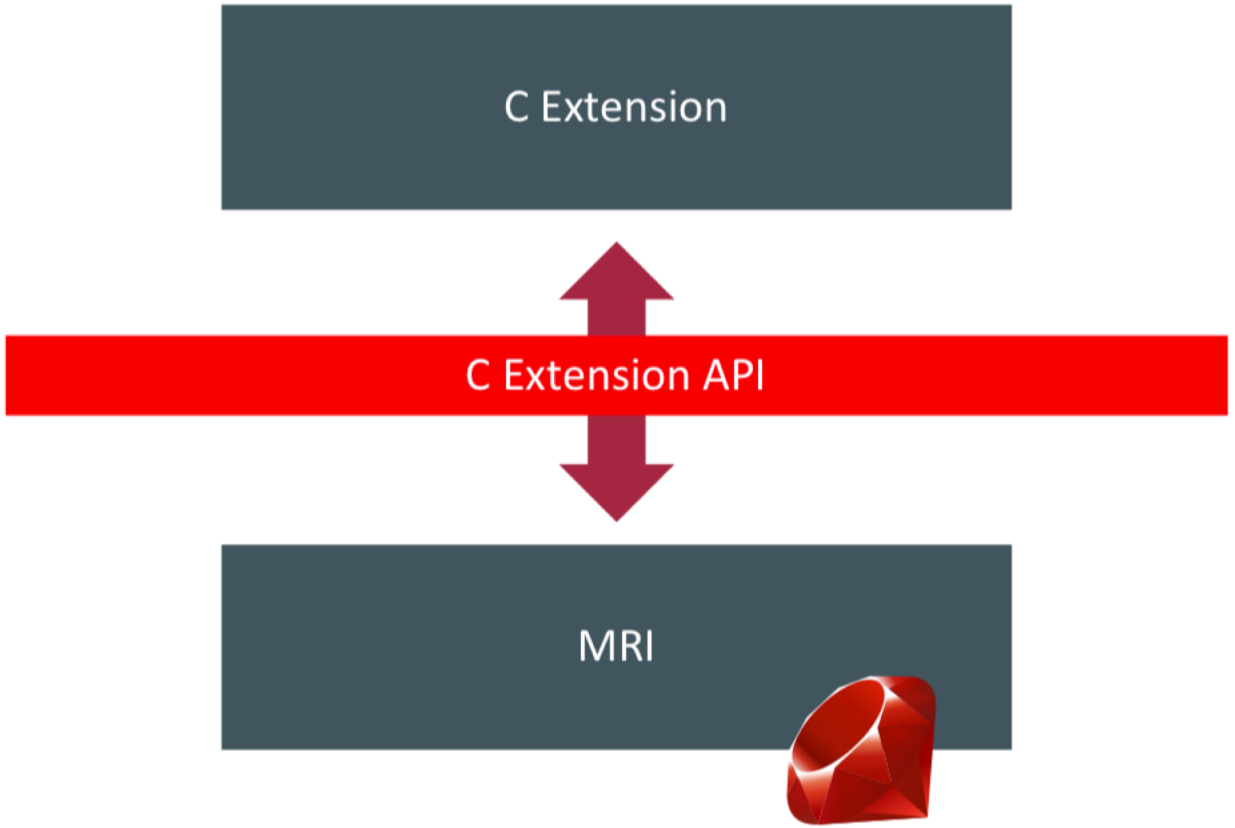
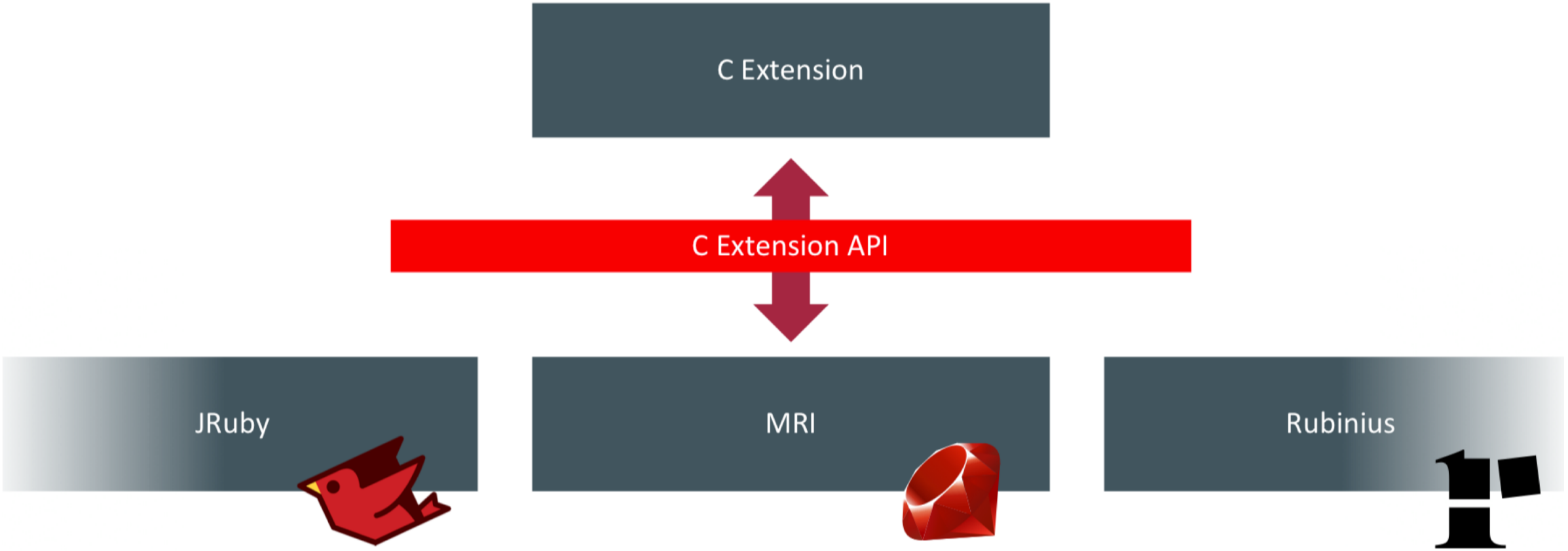
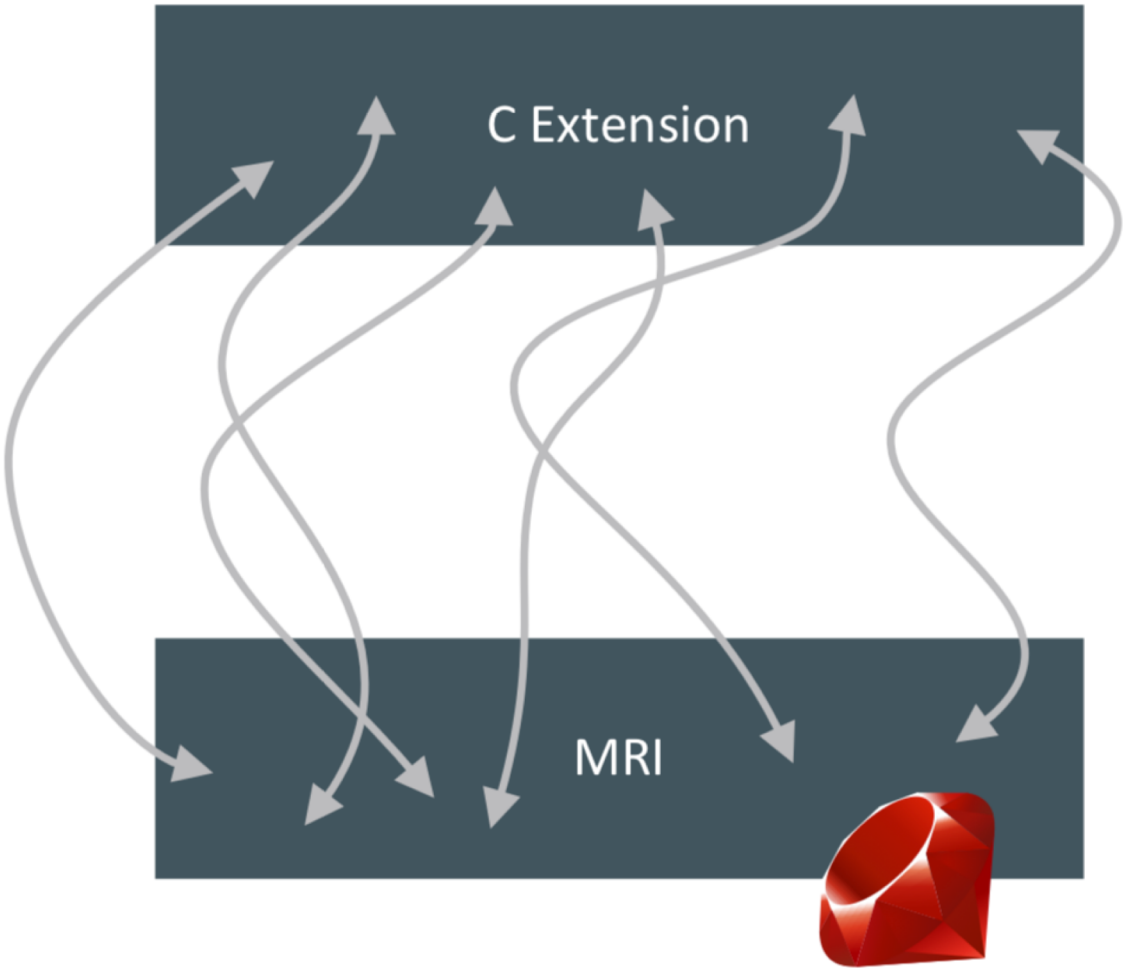
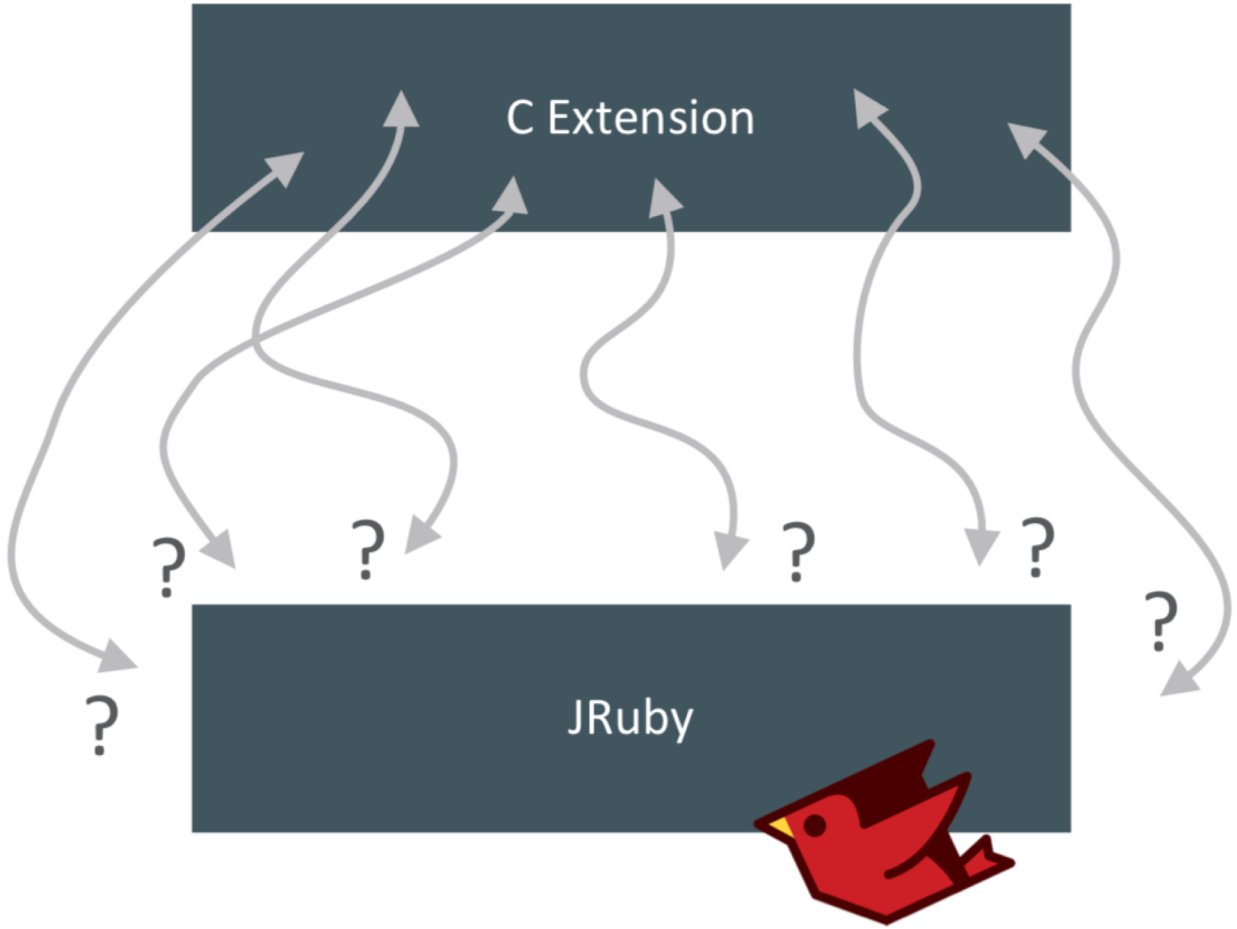
Running C extensions

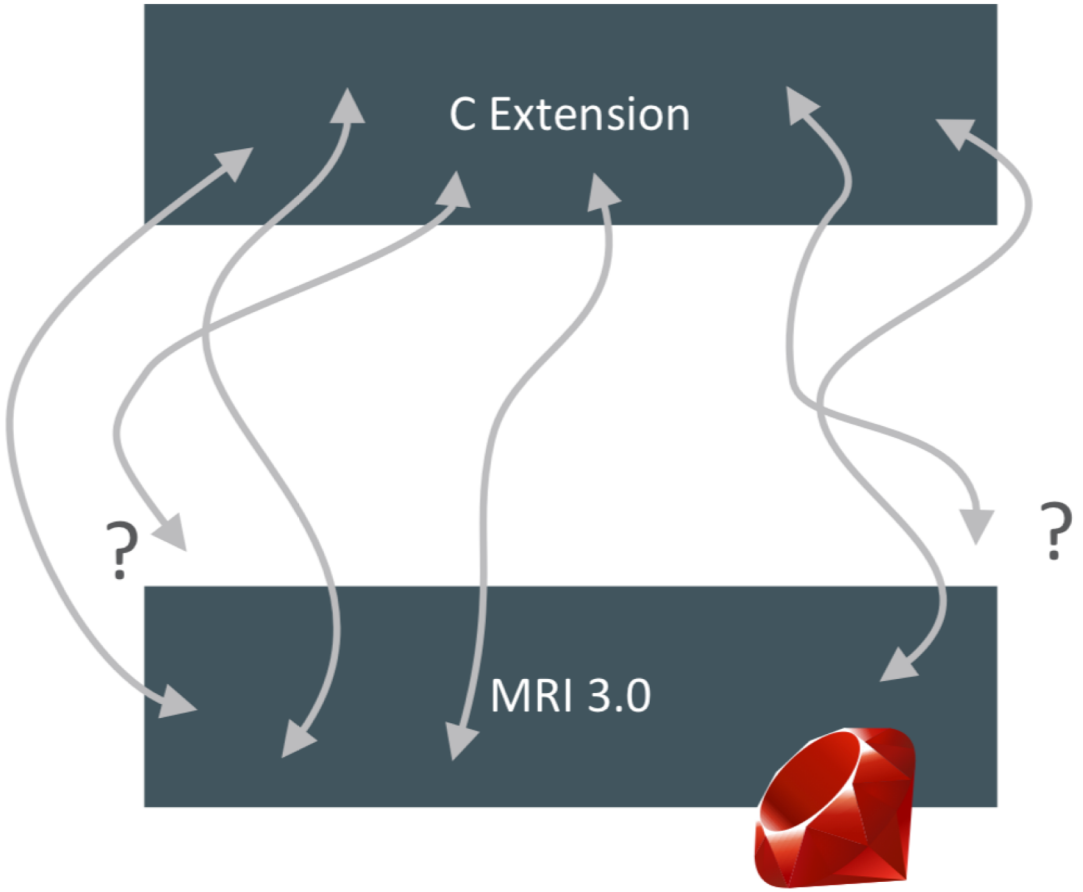


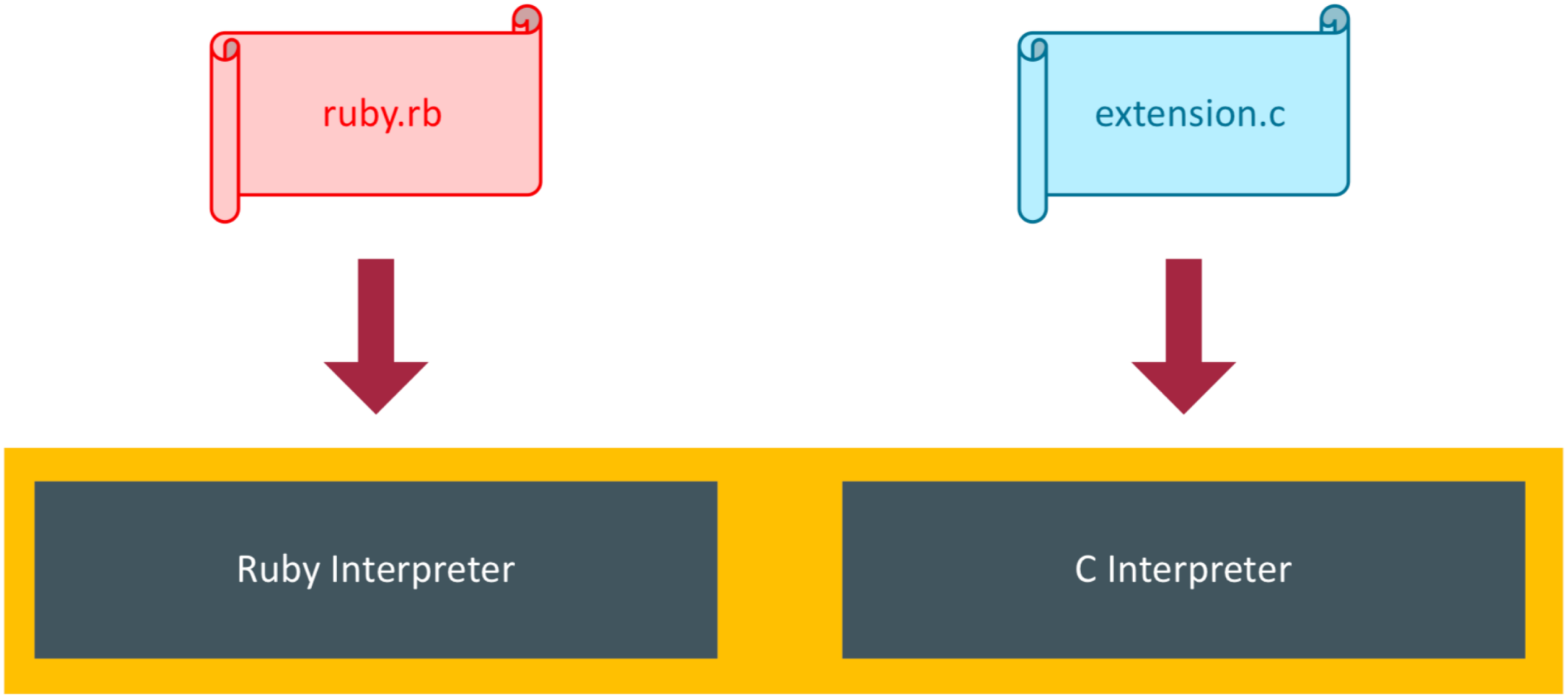


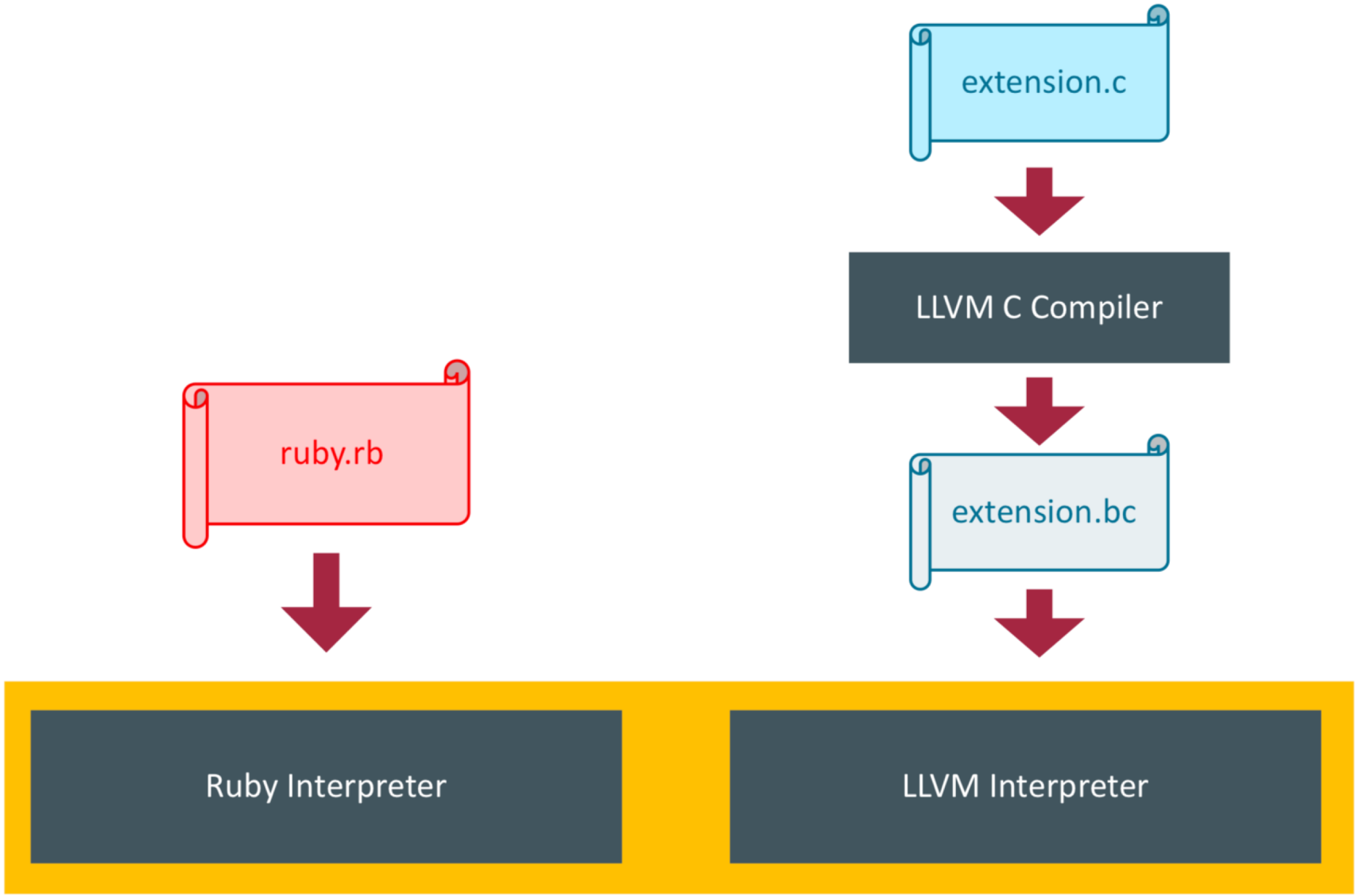


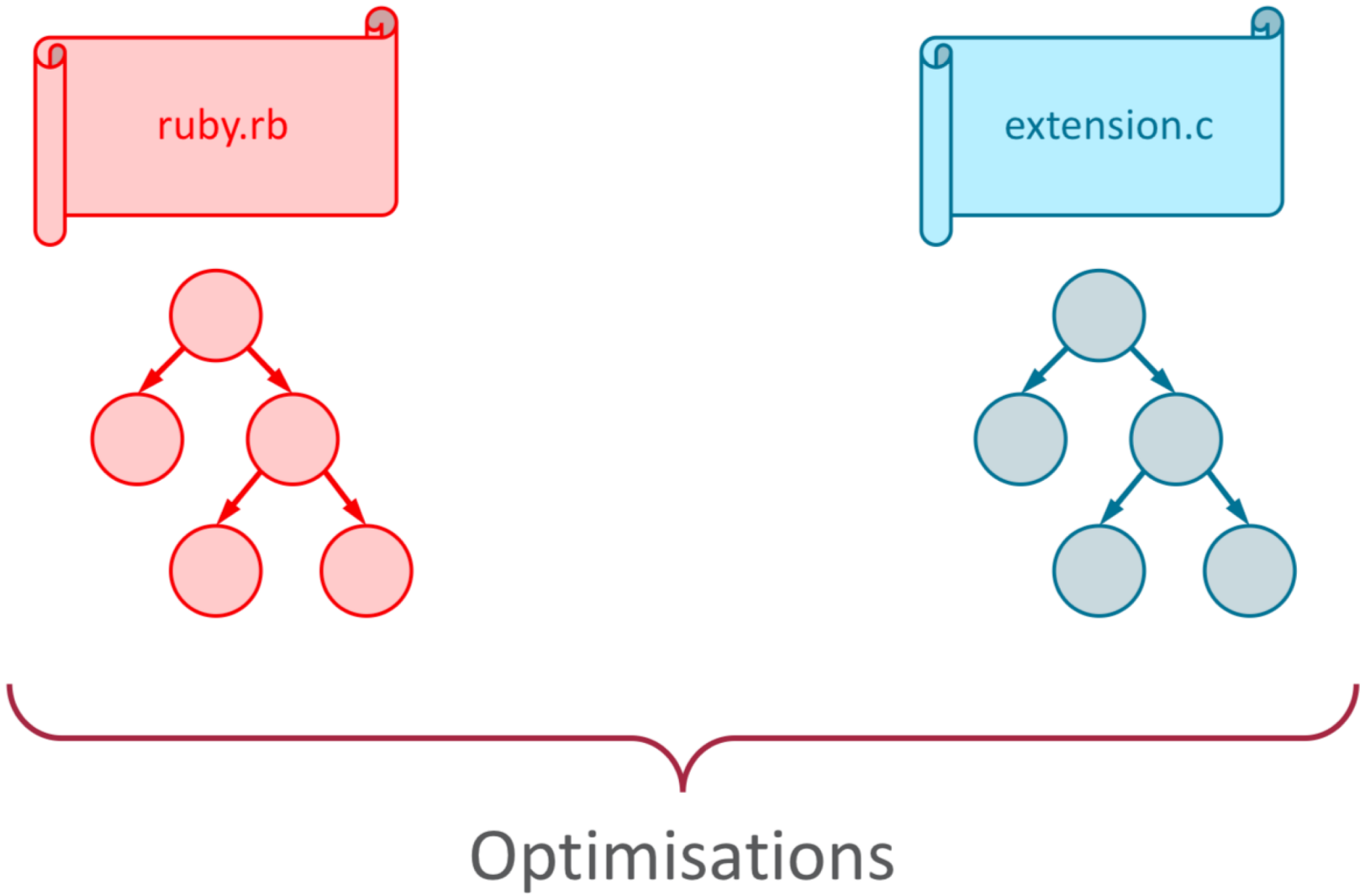


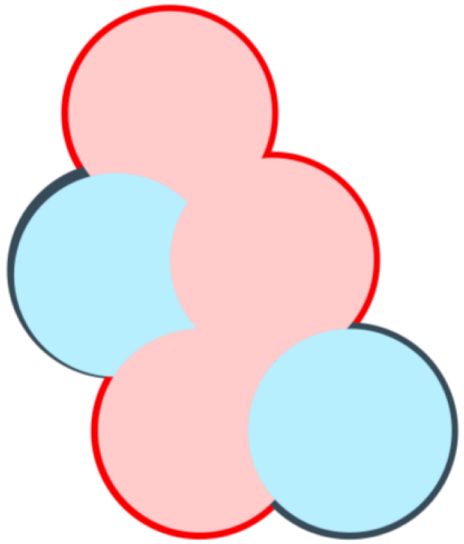












Optimisations

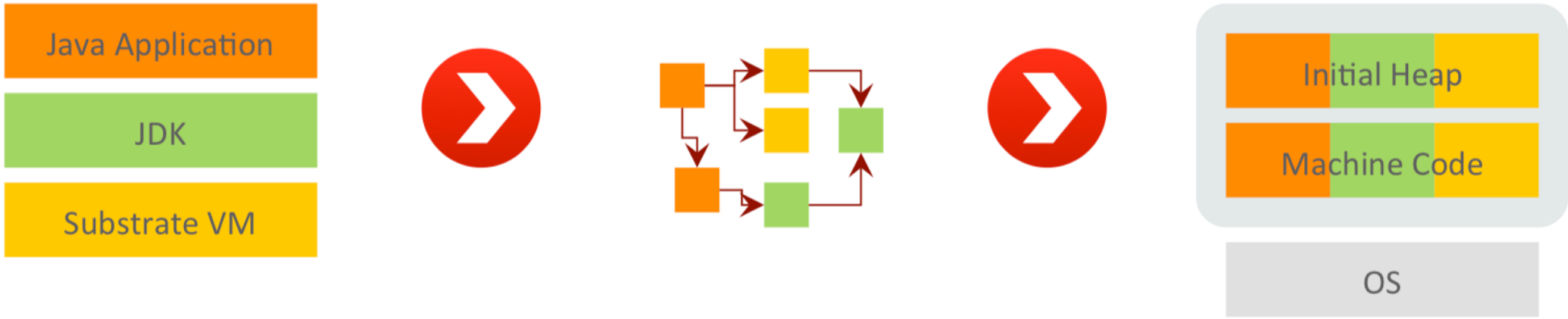
Native compilation

The JVM can be a bit of a burden

- required to run JRuby
- installed separately
- updated separately
- starts relatively slowly
- uses relatively large amount of memory

Static Analysis

Ahead-of-Time Compilation



All Java classes from application, JDK, and Substrate VM

Reachable methods, fields, and classes

Application running without compilation or class loading

Sum up

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