

Clojure and Android

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Sattvik Software & Technology Resources, Ltd. Co.

Clojure/conj 2011

Clojure in Small Places

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Clojure to go

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Overview

Android and the Dalvik VM

Dynamic compilation

Performance

Improving the Clojure/Android experience

Closing thoughts

Android and the Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a running app

What it all means

Dynamic compilation

Performance

Improving the Clojure/Android experience

Closing thoughts

Android and the Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

What is Android?



Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

Android architecture

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

LINUX KERNEL

Display
Driver

Camera Driver

Flash Memory
Driver

Binder (IPC)
Driver

Keypad Driver

WiFi Driver

Audio
Drivers

Power
Management

Android architecture

Clojure and
Android

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Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
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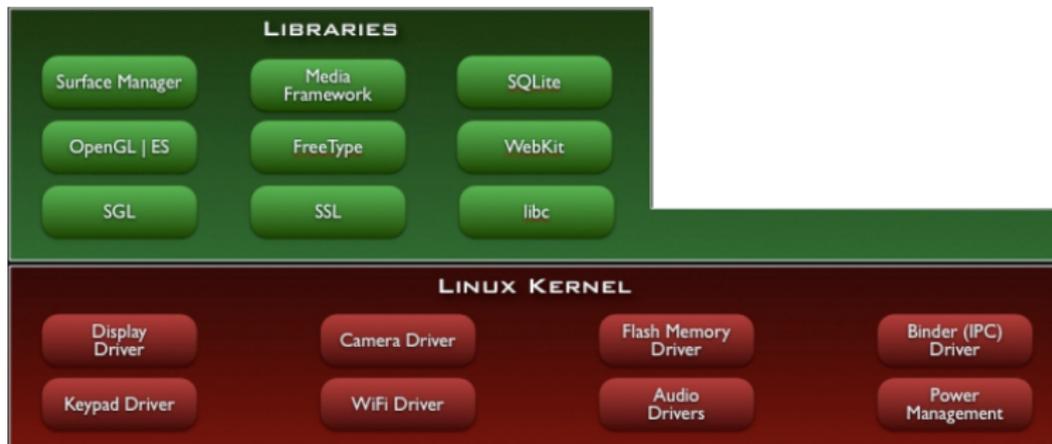
What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts



Android architecture

Clojure and
Android

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Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

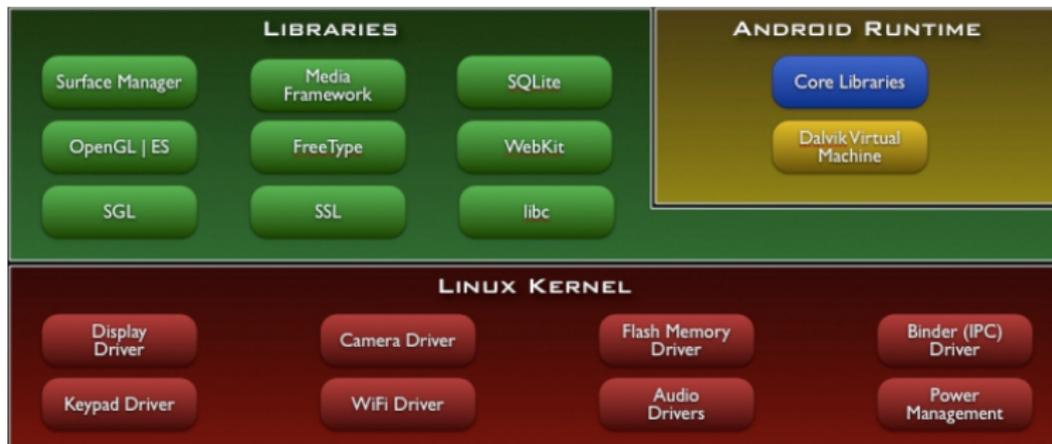
What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts



Android architecture

Clojure and
Android

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Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

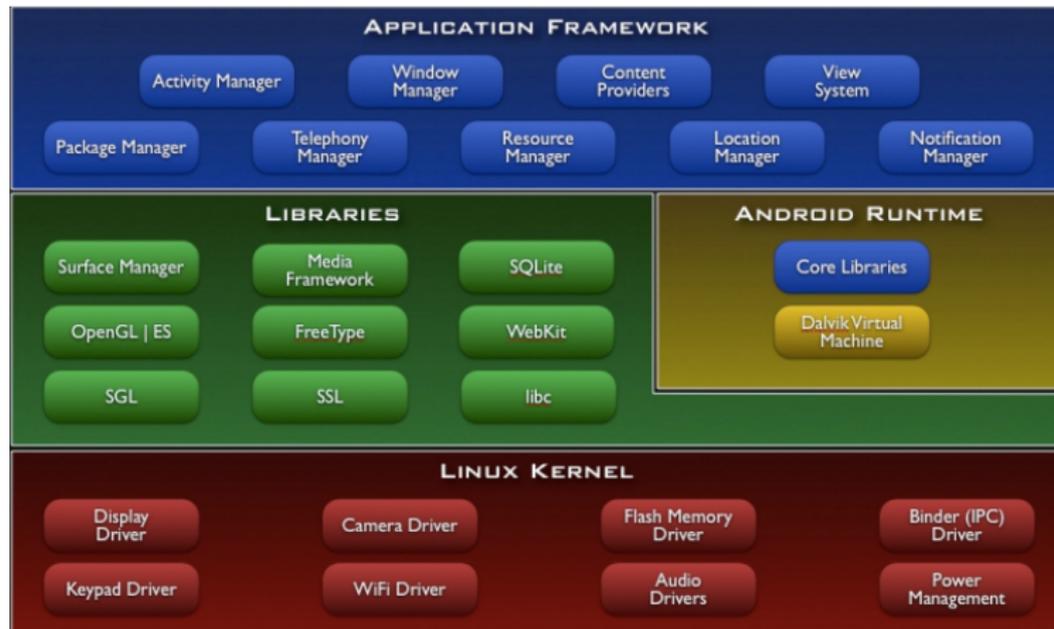
What it all means

Dynamic
compilation

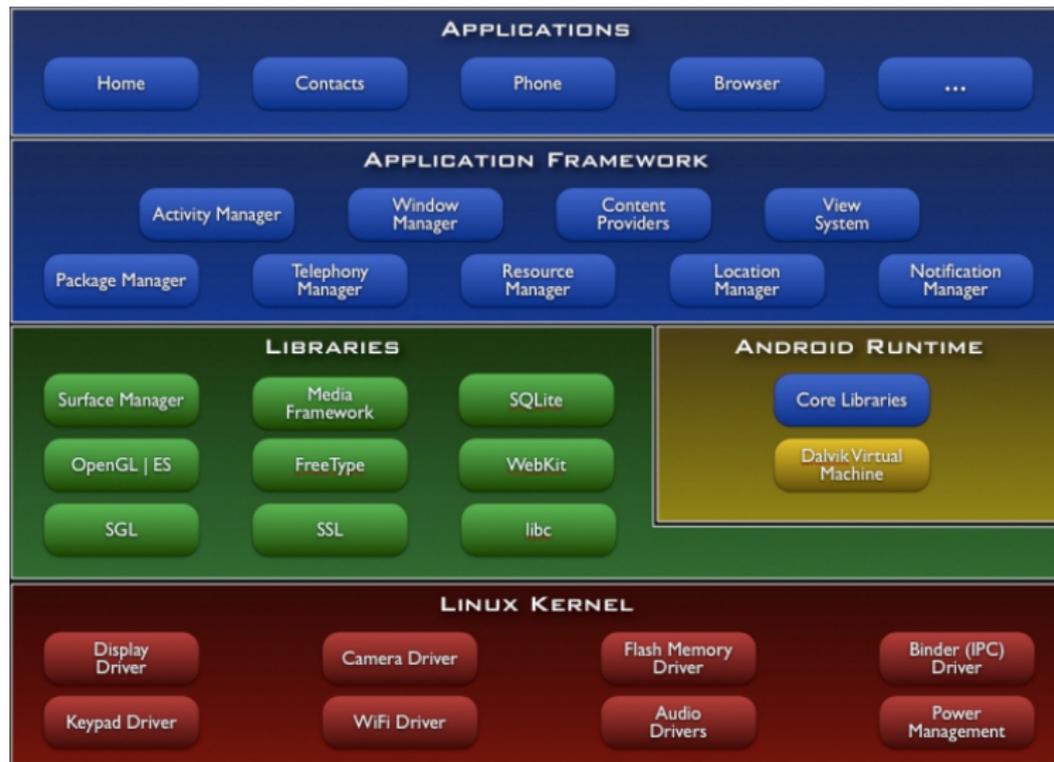
Performance

Improving the
Clojure/Android
experience

Closing thoughts



Android architecture



Clojure and
Android

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Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

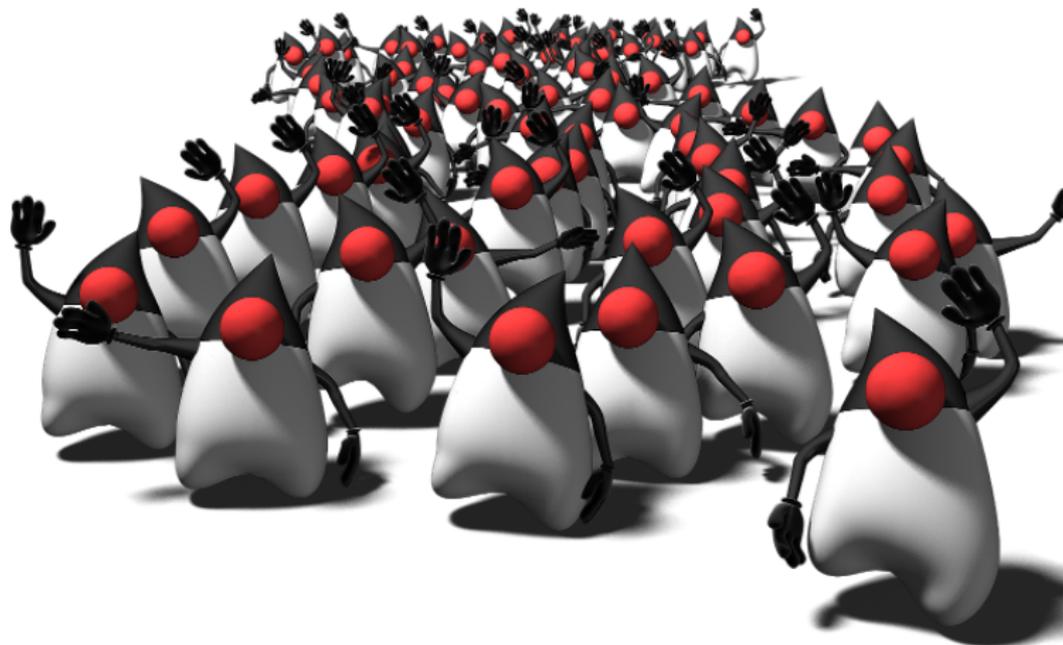
Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

The good news



Clojure and
Android

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Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

The bad news

(= JavaVM DalvikVM)

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

The bad news

(= JVM DalvikVM)

; => *false*

Java VM vs. Dalvik VM

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts



Java VM vs. Dalvik VM

Clojure and
Android

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Gómez

[Android and the
Dalvik VM](#)

[What is Android?](#)

[Java VM vs. Dalvik VM](#)

[From source to a
running app](#)

[What it all means](#)

[Dynamic
compilation](#)

[Performance](#)

[Improving the
Clojure/Android
experience](#)

[Closing thoughts](#)

	Java VM	Dalvik VM
VM type	stack-based	register-based
JIT type	method	trace
Parallel GC?	Yes	Only Android 2.3+

Java VM vs. Dalvik VM

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

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Processing power	Up to 2×1.2GHz	Up to lots
Max heap size	256MiB+	16-48 MiB

Java VM vs. Dalvik VM

Clojure and
Android

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Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

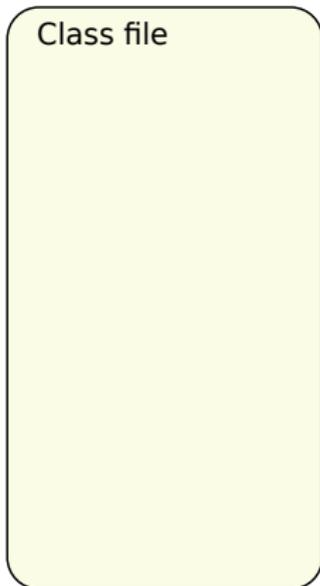
Performance

Improving the
Clojure/Android
experience

Closing thoughts

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APIs	Java SE	Not quite Java SE
Executable format	class	Dalvik EXecutable (DEX)

A class file



Clojure and
Android

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Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

**From source to a
running app**

What it all means

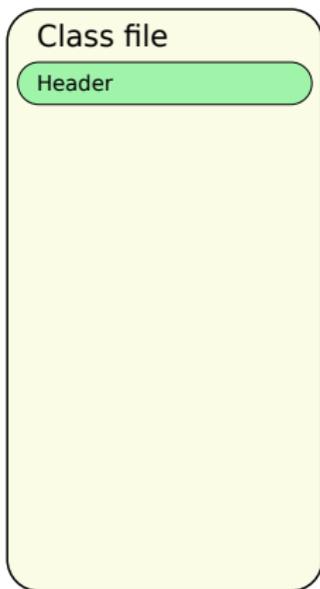
Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

A class file



Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

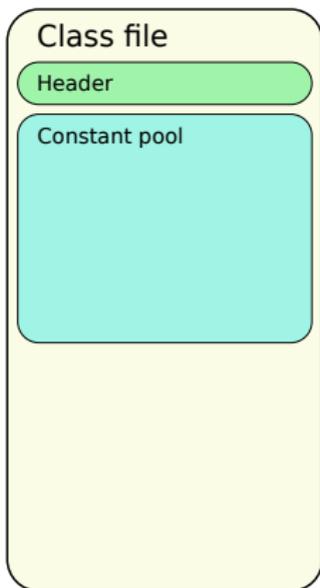
Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

A class file



Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

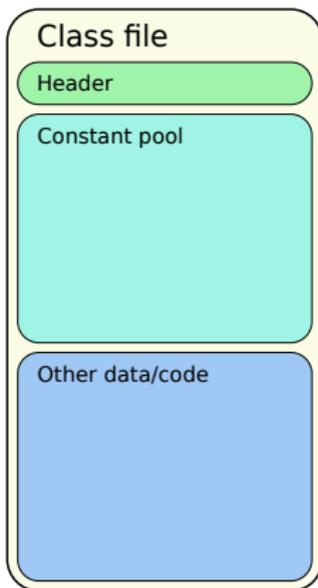
Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

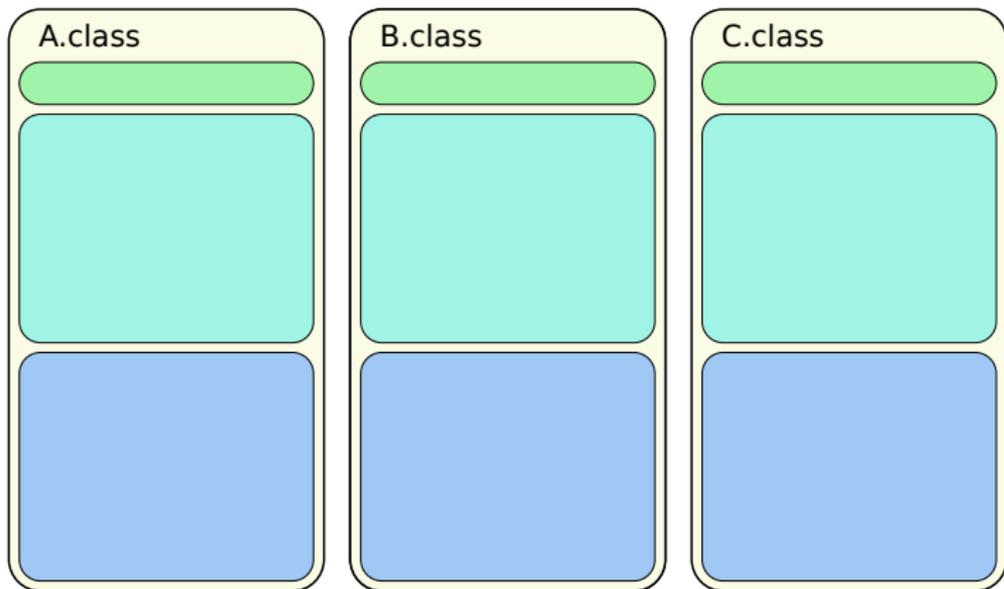
A class file



An application

Clojure and
Android

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Gómez



Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

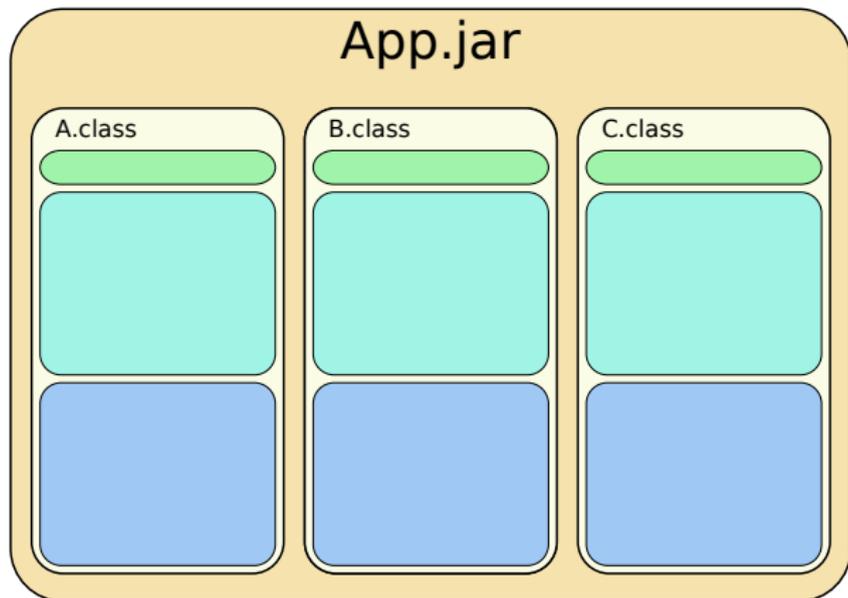
Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

An application



Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

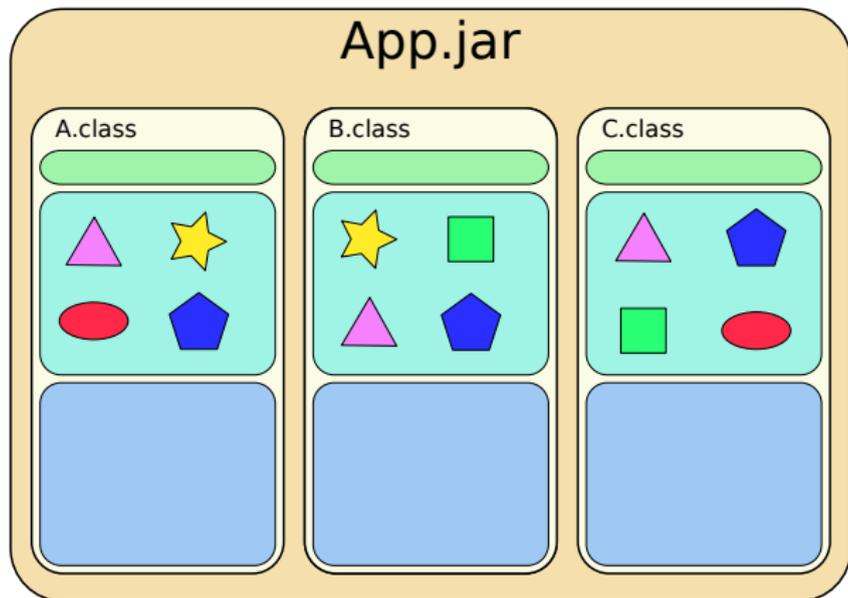
Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

A problem



Creating a DEX

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

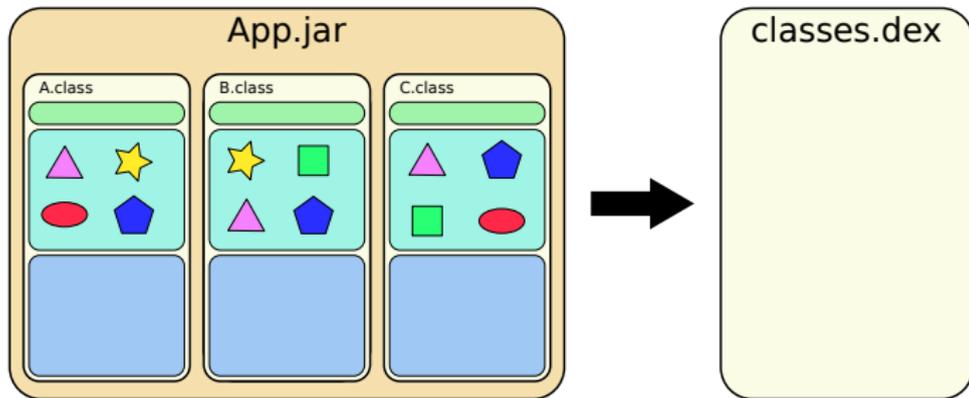
What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts



Creating a DEX

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

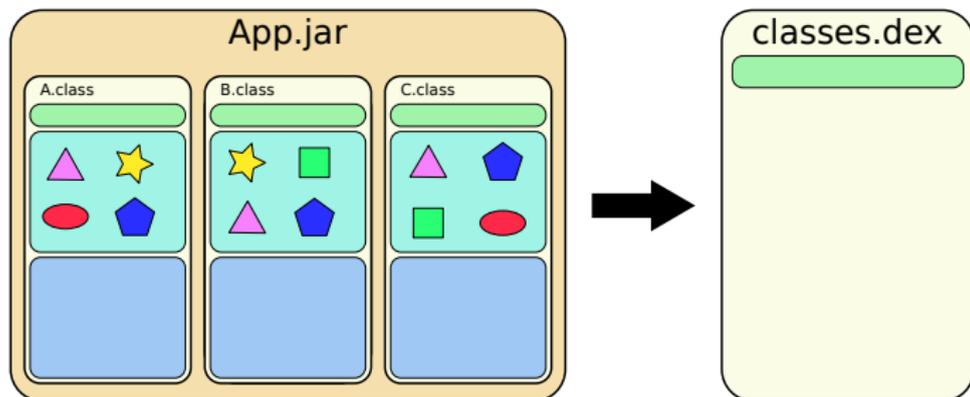
What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts



Creating a DEX

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

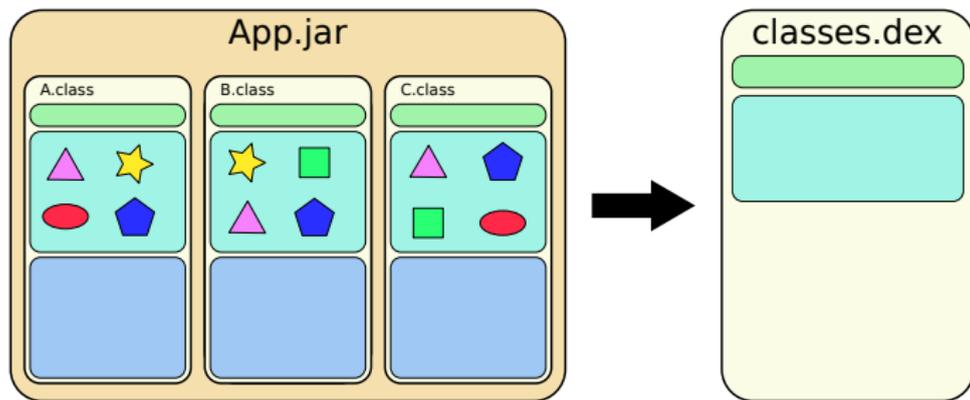
What it all means

Dynamic
compilation

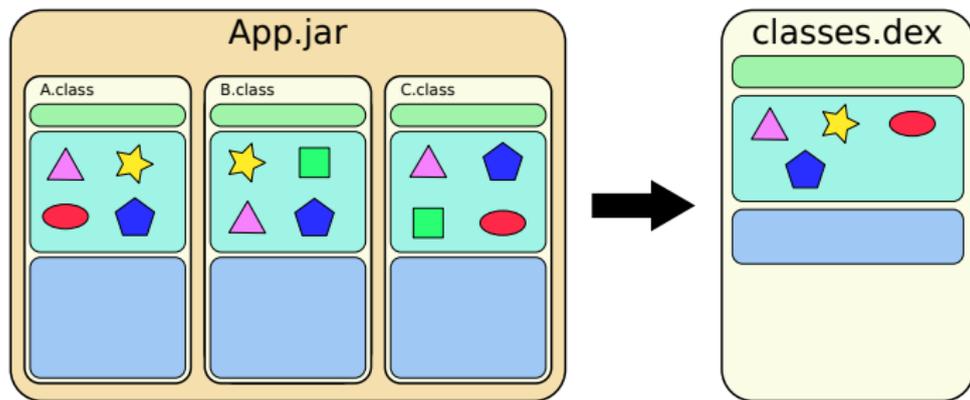
Performance

Improving the
Clojure/Android
experience

Closing thoughts



Creating a DEX



Creating a DEX

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

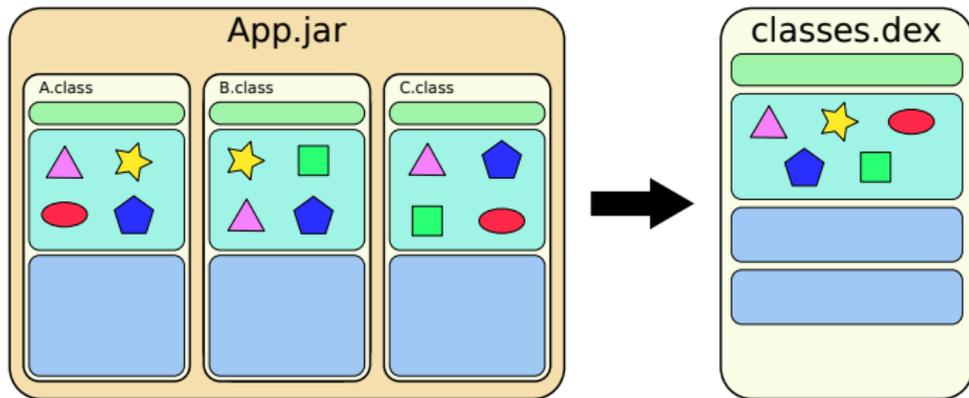
What it all means

Dynamic
compilation

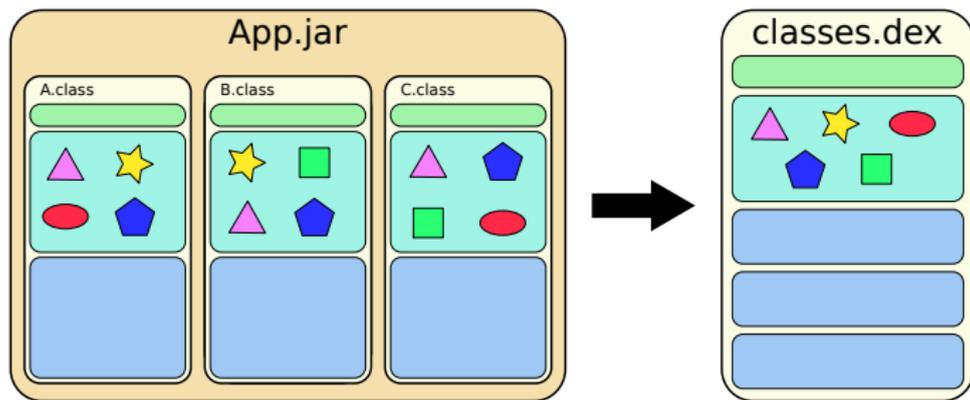
Performance

Improving the
Clojure/Android
experience

Closing thoughts



Creating a DEX



An Android application

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

**From source to a
running app**

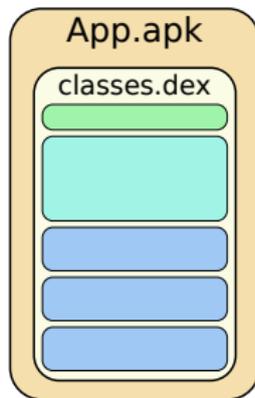
What it all means

Dynamic
compilation

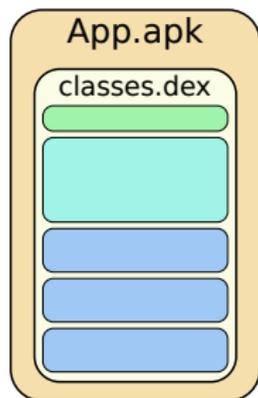
Performance

Improving the
Clojure/Android
experience

Closing thoughts



Installing the application



Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

Installing the application

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

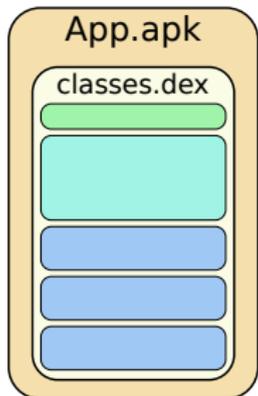
What it all means

Dynamic
compilation

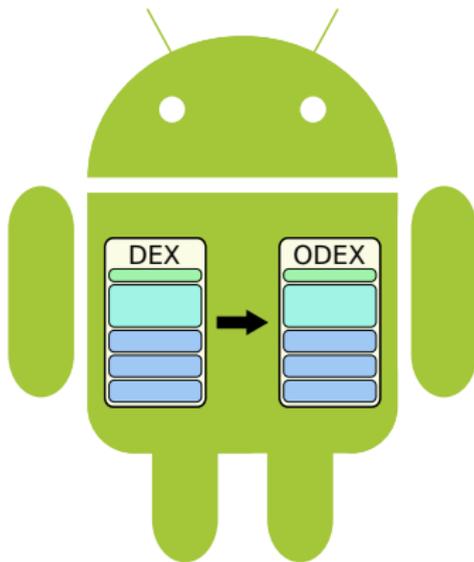
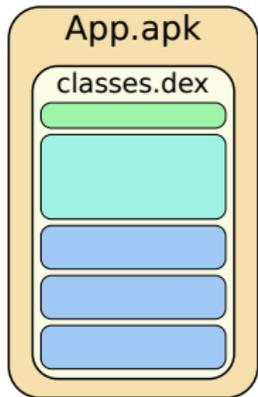
Performance

Improving the
Clojure/Android
experience

Closing thoughts



Installing the application



Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

Installing the application



Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

**From source to a
running app**

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

Consequences

- ▶ Loading bytecode in Android is a heavy-weight process.
- ▶ Dynamically loading bytecode is not currently supported.

Android programming languages

Statically (AOT) compiled



Clojure and
Android

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Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

Android programming languages

Interpreted

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

What is Android?

Java VM vs. Dalvik VM

From source to a
running app

What it all means

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts



Android and the Dalvik VM

Dynamic compilation

Why?

How?

Implementation details

Performance

Improving the Clojure/Android experience

Closing thoughts

Android and the
Dalvik VM

Dynamic
compilation

Why?

How?

Implementation details

Performance

Improving the
Clojure/Android
experience

Closing thoughts

Dynamic compilation on Android

Clojure and Android

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Android and the Dalvik VM

Dynamic compilation

Why?

How?

Implementation details

Performance

Improving the Clojure/Android experience

Closing thoughts

Why?

Benefits of dynamic compilation

- ▶ Make the Clojure REPL possible
- ▶ Make Android development faster and easier

Clojure and
Android

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Android and the
Dalvik VM

Dynamic
compilation

Why?

How?

Implementation details

Performance

Improving the
Clojure/Android
experience

Closing thoughts

A review

```
(defn hello [name]
  (str "Hello, " name \!))
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Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

Dynamic
compilation

Why?

How?

Implementation details

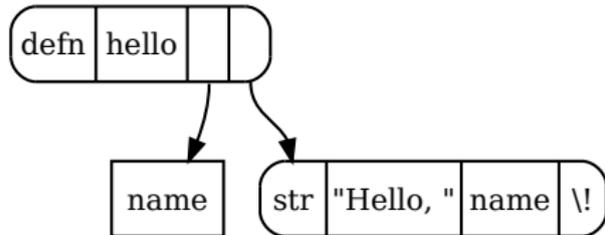
Performance

Improving the
Clojure/Android
experience

Closing thoughts

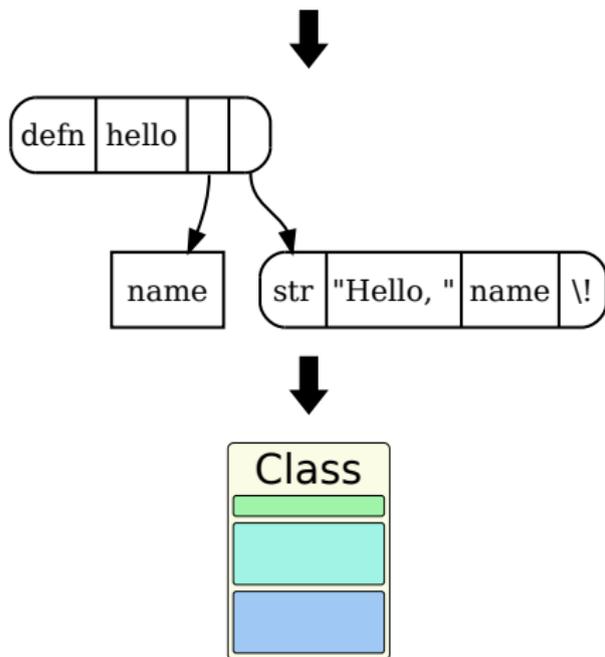
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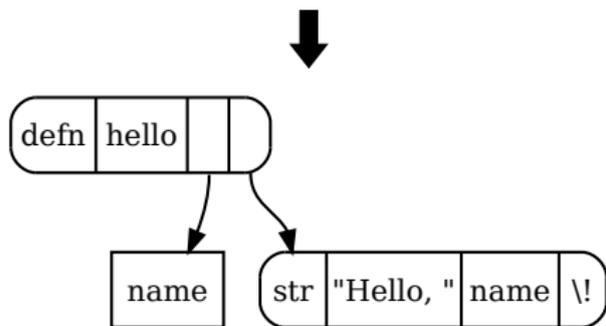
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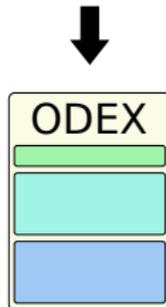
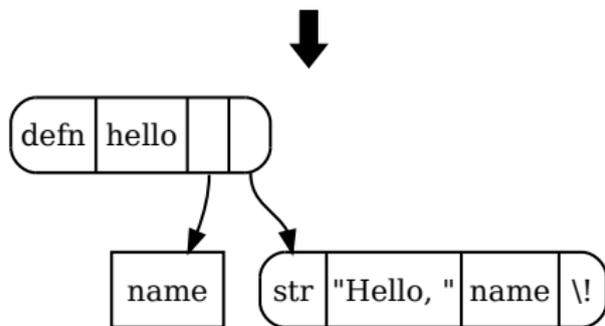
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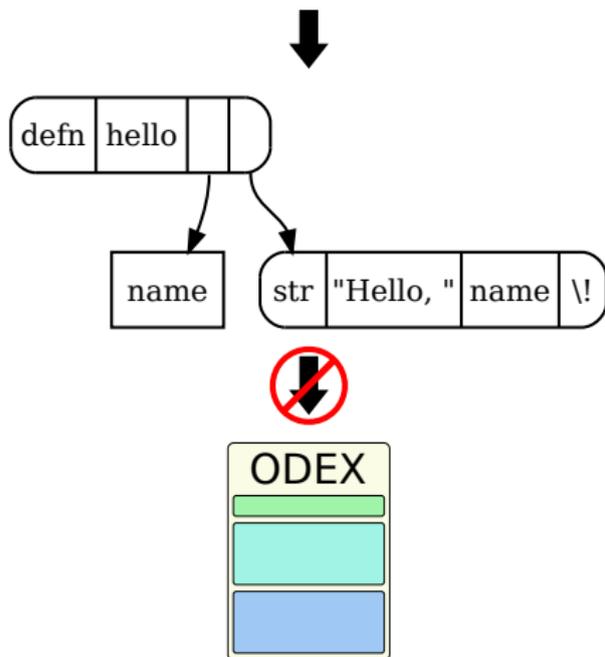
What about Android?

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A new class loader

Clojure and
Android

Daniel Solano
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Android and the
Dalvik VM

Dynamic
compilation

Why?

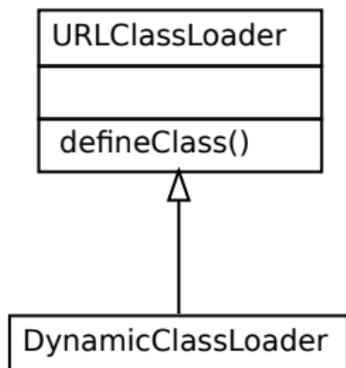
How?

Implementation details

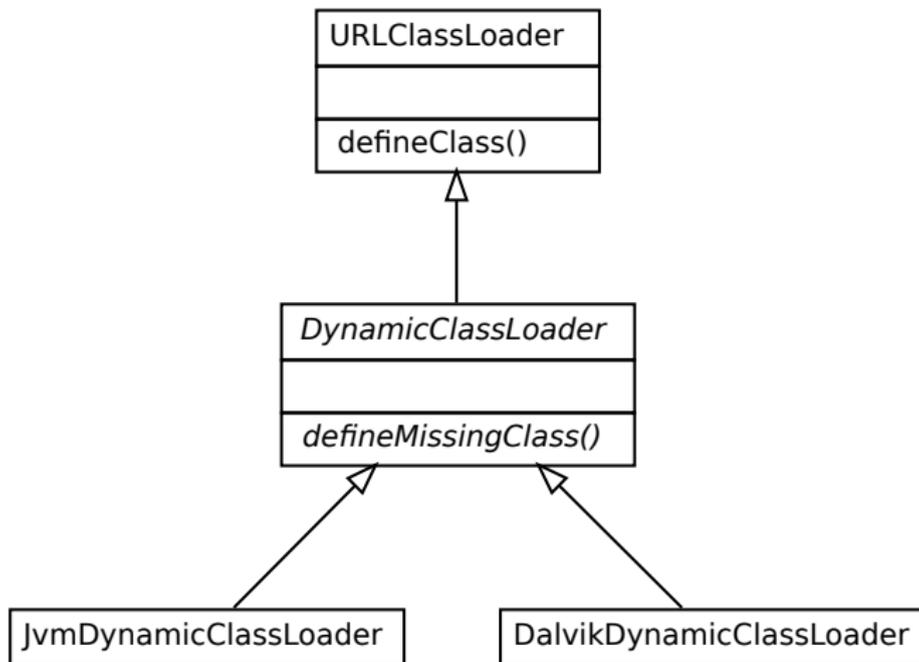
Performance

Improving the
Clojure/Android
experience

Closing thoughts



A new class loader



The Dalvik process

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Clojure and
Android

Daniel Solano
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Android and the
Dalvik VM

Dynamic
compilation

Why?

How?

Implementation details

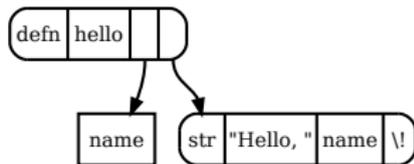
Performance

Improving the
Clojure/Android
experience

Closing thoughts

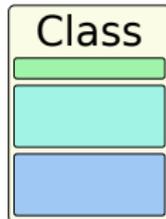
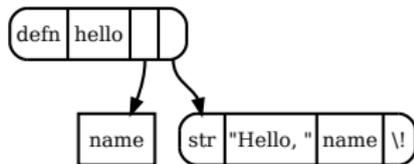
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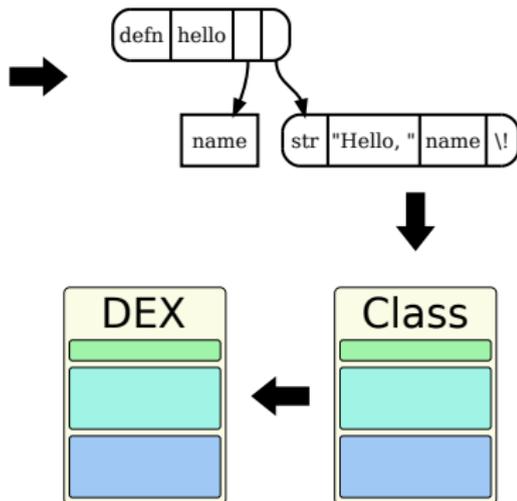


The Dalvik process

Clojure and
Android

Daniel Solano
Gómez

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Android and the
Dalvik VM

Dynamic
compilation

Why?

How?

Implementation details

Performance

Improving the
Clojure/Android
experience

Closing thoughts

The Dalvik process

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

Dynamic
compilation

Why?

How?

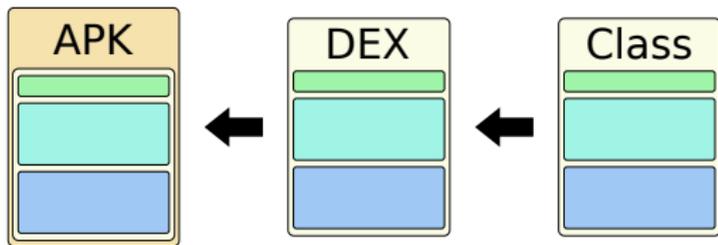
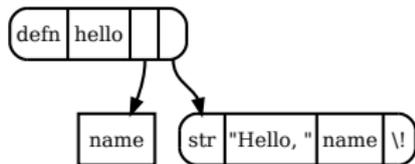
Implementation details

Performance

Improving the
Clojure/Android
experience

Closing thoughts

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The Dalvik process

Clojure and
Android

Daniel Solano
Gómez

Android and the
Dalvik VM

Dynamic
compilation

Why?

How?

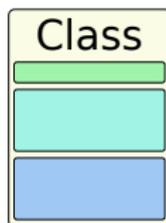
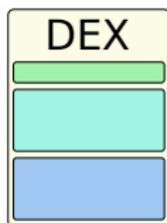
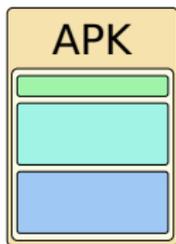
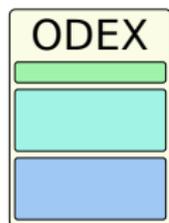
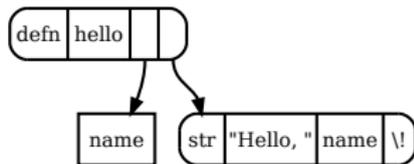
Implementation details

Performance

Improving the
Clojure/Android
experience

Closing thoughts

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Choosing the right ClassLoader

- ▶ New var:
`clojure.core/*vm-type*`
- ▶ May be either `:dalvik-vm` or
`:java-vm`
- ▶ Setting depends on `java.vm.name`
system property
- ▶ Decision takes place in
`RT.makeClassLoader()`

New dependency

- ▶ Relies on code from Android SDK to perform class → DEX transformation
- ▶ Current process extracts code from `dx.jar`
- ▶ A source-based dependency would be better
- ▶ Source available under Apache License 2.0

Android compatibility

Clojure and
Android

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Android and the
Dalvik VM

Dynamic
compilation

Why?

How?

Implementation details

Performance

Improving the
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experience

Closing thoughts

- ▶ Doesn't work on versions earlier than 2.1
- ▶ Contains workaround for bug 5697 (fixed in Android 2.2)

Clojure compatibility

- ▶ All Dalvik-related code is loaded reflectively
- ▶ Some complex macros may not compile due to size limitations
- ▶ `clojure.core/bean` not available due lack of `java.beans` API

Android and the Dalvik VM

Dynamic compilation

Performance

Benchmarks
Analysis

Improving the Clojure/Android experience

Closing thoughts

Android and the
Dalvik VM

Dynamic
compilation

Performance

Benchmarks
Analysis

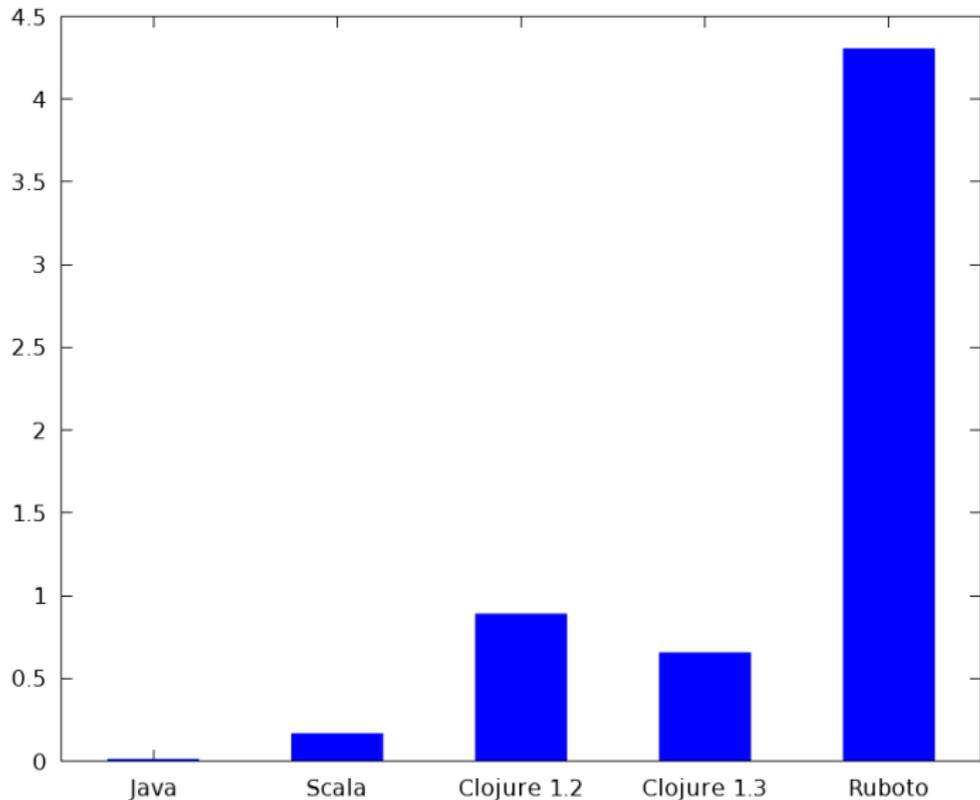
Improving the
Clojure/Android
experience

Closing thoughts

Benchmarking Clojure and the competition

- ▶ Clojure 1.2.1 (Android version)
- ▶ Clojure 1.3 (unmodified)
- ▶ Java
- ▶ Scala (Scala 2.9.1)
- ▶ Ruby (JRuby 1.6.5, ruboto-core-0.5.1)

Package size (MB)



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Dalvik VM

Dynamic
compilation

Performance

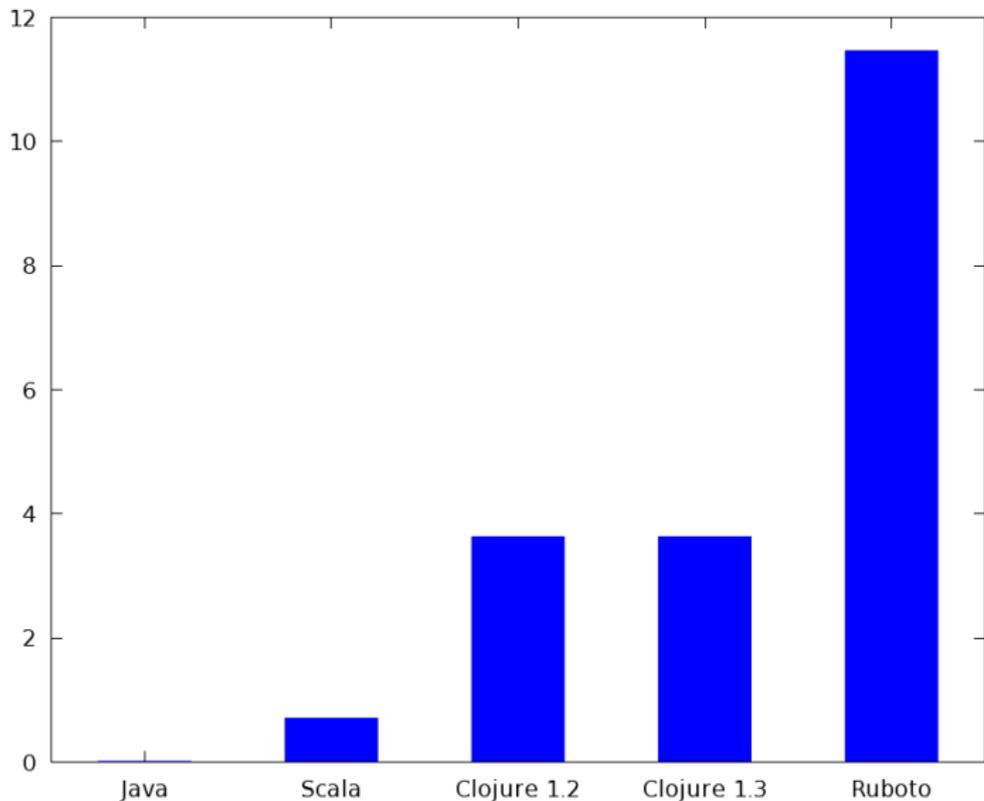
Benchmarks

Analysis

Improving the
Clojure/Android
experience

Closing thoughts

Installed size (MB)



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Dalvik VM

Dynamic
compilation

Performance

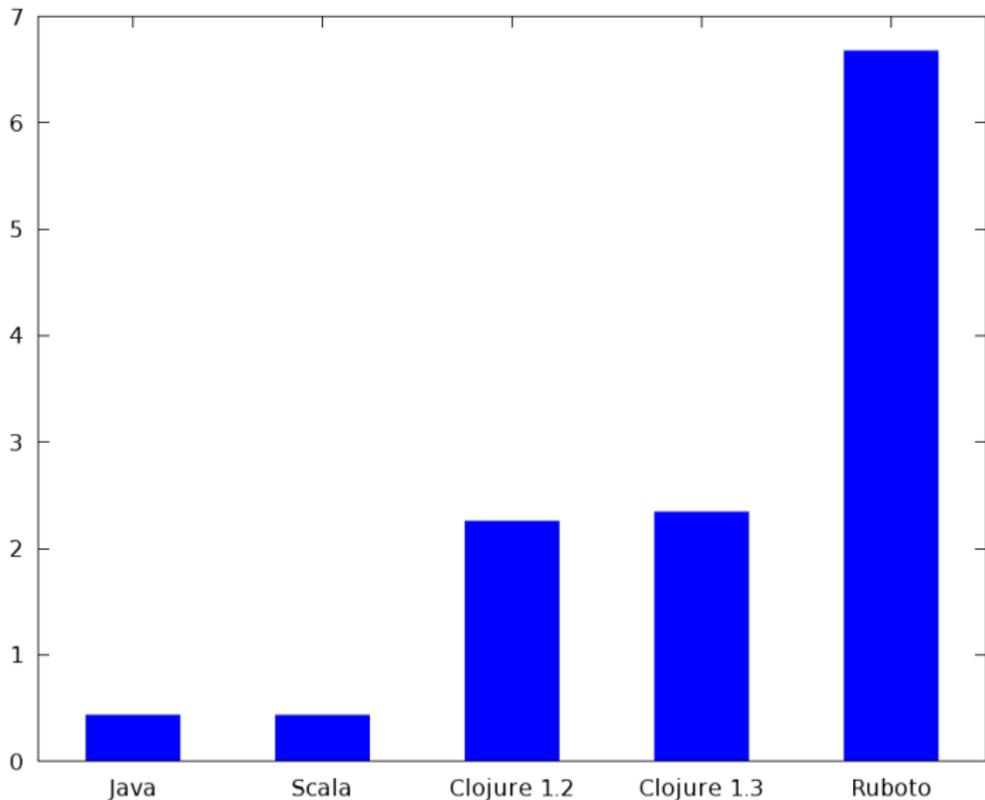
Benchmarks

Analysis

Improving the
Clojure/Android
experience

Closing thoughts

Startup time (s)



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Dalvik VM

Dynamic
compilation

Performance

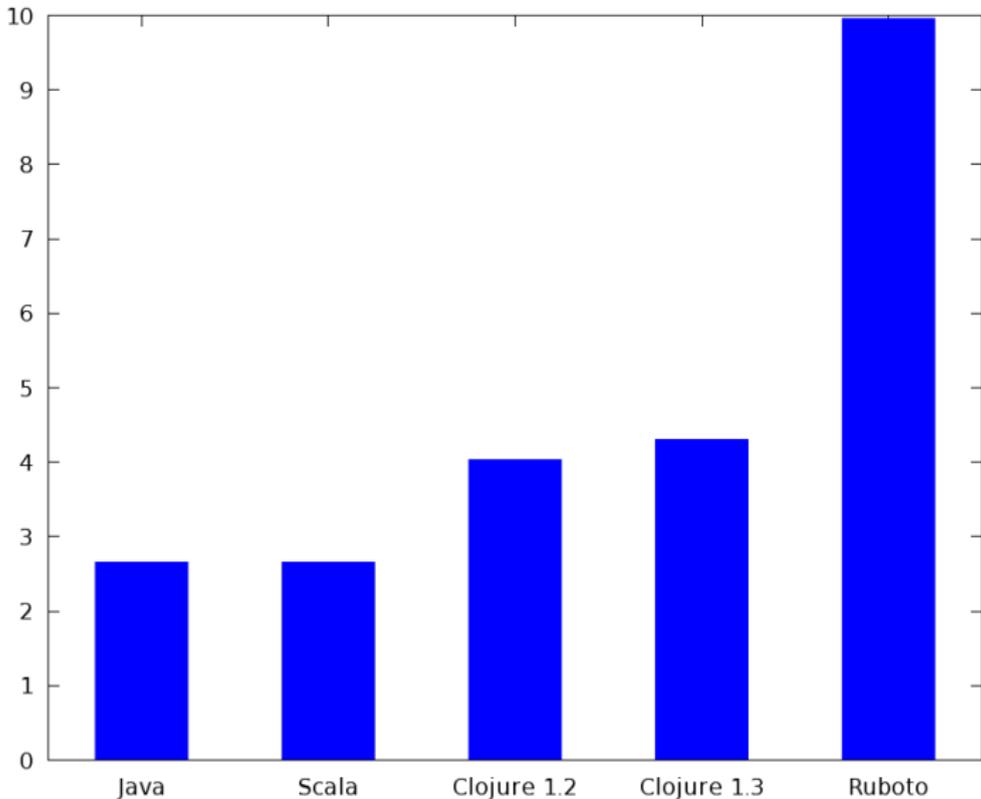
Benchmarks

Analysis

Improving the
Clojure/Android
experience

Closing thoughts

Heap size (MB)



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Android and the
Dalvik VM

Dynamic
compilation

Performance

Benchmarks

Analysis

Improving the
Clojure/Android
experience

Closing thoughts

Question

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Android and the
Dalvik VM

Dynamic
compilation

Performance

Benchmarks
Analysis

Improving the
Clojure/Android
experience

Closing thoughts

Where did all the time and space go?

Answer

clojure.core

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Dalvik VM

Dynamic
compilation

Performance

Benchmarks

Analysis

Improving the
Clojure/Android
experience

Closing thoughts

Top 10 space hogs

By retained heap in bytes

clojure.core/*out*	8,608
Class clojure.java.io.__init	12,784
Class clojure.lang.Compiler	13,152
Class clojure.deftype__init	14,024
clojure.core/*in*	25,056
clojure.core.protocols namespace	25,584
Class clojure.lang.Namespace	26,480
clojure.java.io namespace	31,488
clojure.core namespace	34,992
Class clojure.core__init	203,616

TOTAL	395,784
-------	---------

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Dalvik VM

Dynamic
compilation

Performance

Benchmarks
Analysis

Improving the
Clojure/Android
experience

Closing thoughts

Measuring time, a test

```
// equivalent to (+ 1 2 3)  
RT.var("clojure.core", "+")  
  .invoke(1,2,3);
```

Test results

Times are in milliseconds

Iteration	RT.var()	Var.invoke()	Total
1	0.240	0.397	7,856.773
2	0.299	0.345	0.686

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Dalvik VM

Dynamic
compilation

Performance

Benchmarks
Analysis

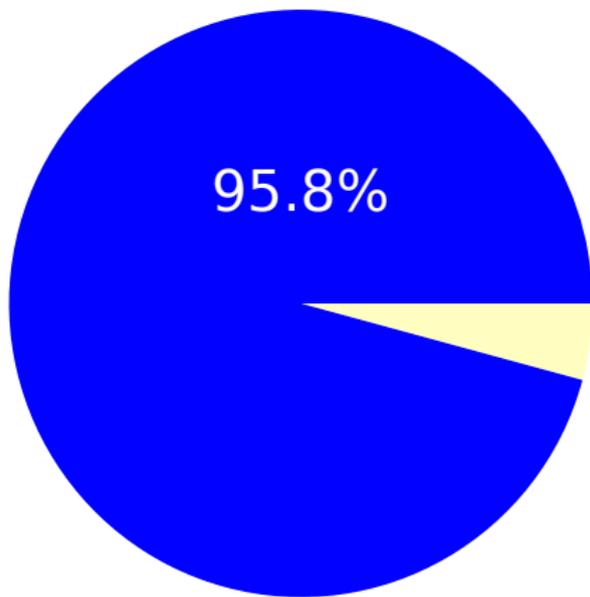
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Closing thoughts

Where did 7.8 seconds go?

CPU time

`clojure.lang.RT.doInit()`



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Dalvik VM

Dynamic
compilation

Performance

Benchmarks

Analysis

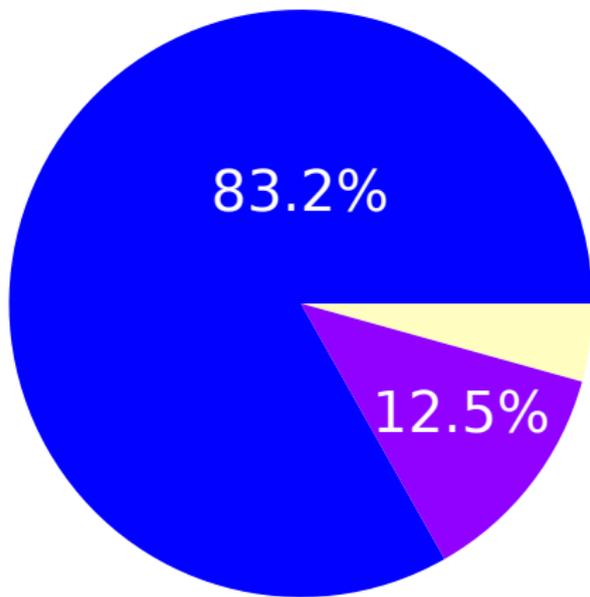
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experience

Closing thoughts

Where did 7.8 seconds go?

CPU time

`RT.load("clojure/core")`



`(in-ns 'user)`

`(refer 'clojure.core)`

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Android and the
Dalvik VM

Dynamic
compilation

Performance

Benchmarks

Analysis

Improving the
Clojure/Android
experience

Closing thoughts

Where did 7.8 seconds go?

Object churn

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Android and the
Dalvik VM

Dynamic
compilation

Performance

Benchmarks
Analysis

Improving the
Clojure/Android
experience

Closing thoughts

	Count	Size (MiB)
Allocated	128,280	4.65
Freed	91,259	3.63
Net	37,021	1.02

Improving performance

- ▶ Remove `user` namespace
- ▶ Remove metadata
- ▶ Transients during initialization
- ▶ Serializable `clojure.core`
- ▶ Source-level tree shaker

Android and the Dalvik VM

Dynamic compilation

Performance

Improving the Clojure/Android experience

Closing thoughts

Android and the
Dalvik VM

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

Making Clojure a first-class language for Android development

- ▶ Improve performance
- ▶ Standard library
- ▶ Development tools

Neko: The Clojure/Android Toolkit

- ▶ Available from `github.com/sattvik/neko`
- ▶ Ease object-oriented/functional impedance mismatch
- ▶ Reduce boilerplate
- ▶ Integrate into Clojure-contrib?

Development tools

- ▶ Android development version of Clojure
- ▶ Build tools
- ▶ REPL/dynamic development tools

Android development version of Clojure

- ▶ Available from `github.com/sattvik/clojure`
- ▶ Needs:
 - ▶ Upgrade to Clojure 1.3
 - ▶ Better handling of dx tool integration
- ▶ Merge upstream?

Build tools

- ▶ Neko provides some helper code for Ant/Android SDK
- ▶ Would be nice to see support from mainstream Clojure tools

REPL/dynamic development tools

- ▶ Requires Android development version of Clojure
- ▶ VimClojure works with some minor modifications
- ▶ Would be good to see tools compatible with nrepl, Emacs, etc.

Android and the Dalvik VM

Dynamic compilation

Performance

Improving the Clojure/Android experience

Closing thoughts

Android and the
Dalvik VM

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

Android and Clojure



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Android and the
Dalvik VM

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

Android and Clojure

Clojure and
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Android and the
Dalvik VM

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

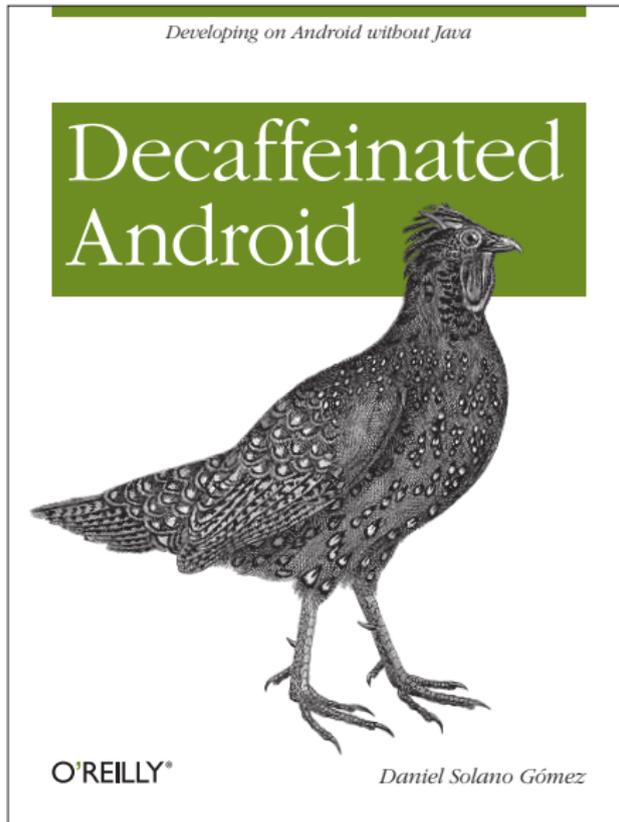
Closing thoughts

- ▶ Clojure has the potential to be a first-class language for Android development.
- ▶ Dynamic development on Android is a killer feature.
- ▶ It needs better tool and community support.

What about ClojureScript?

- ▶ Should work for web apps
- ▶ Might work with mobile development frameworks
- ▶ For native development, constrained by availability of JavaScript engines

Decaffeinated Android



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Android and the
Dalvik VM

Dynamic
compilation

Performance

Improving the
Clojure/Android
experience

Closing thoughts

Questions?

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Group [groups.google.com/group/
clojure-android](https://groups.google.com/group/clojure-android)

Clojure REPL for Android:

