

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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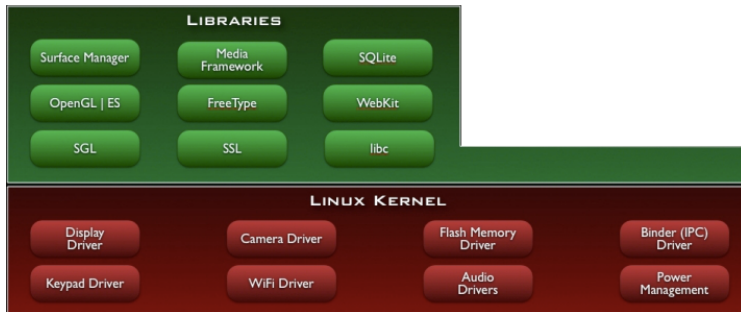
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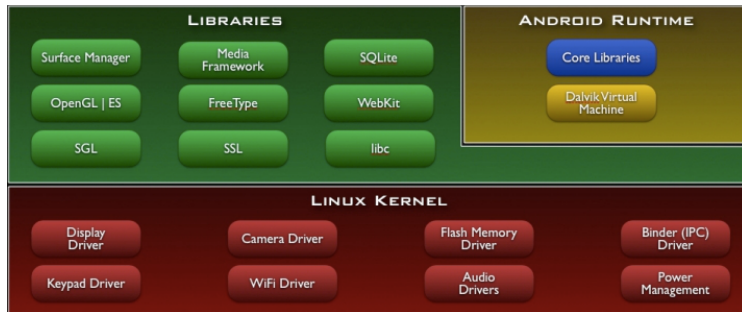
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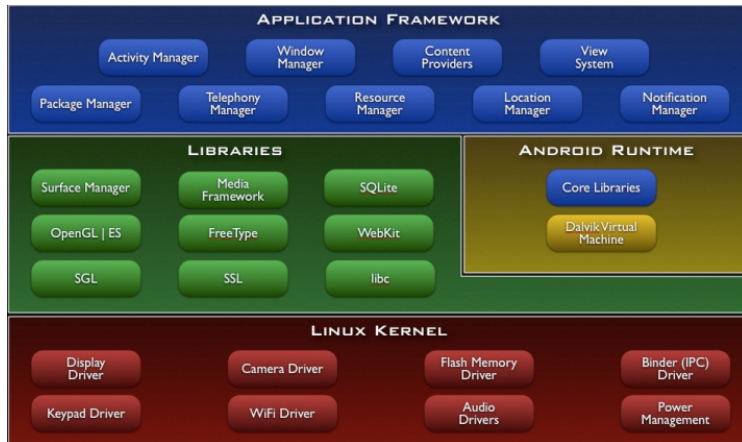
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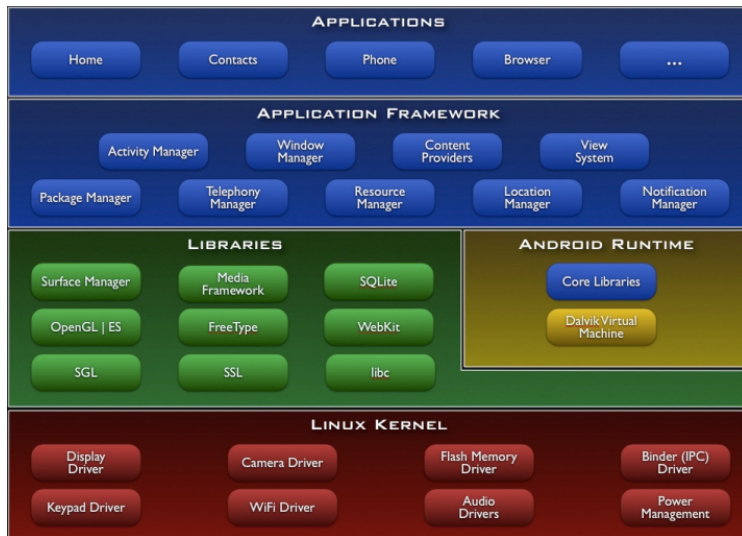
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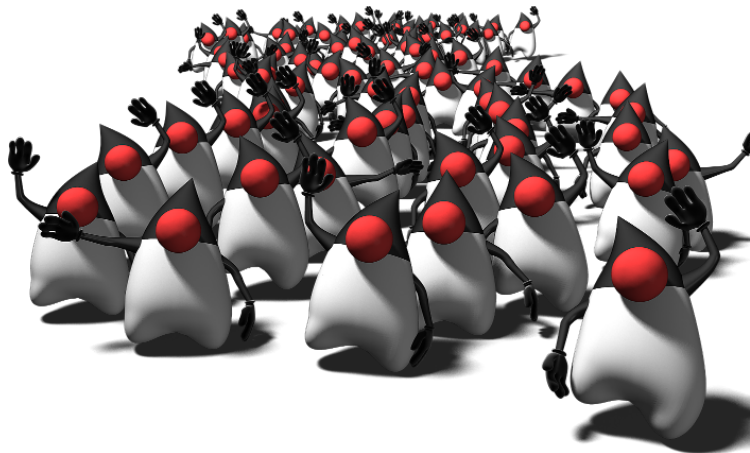
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(= JavaVM DalvikVM)

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(= JavaVM DalvikVM)

; => *false*

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

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

A class file

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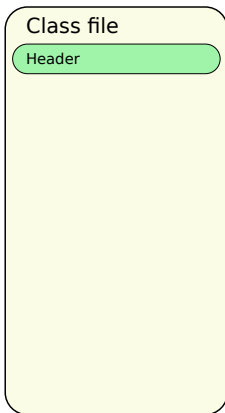
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A class file



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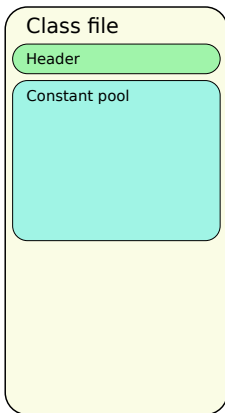
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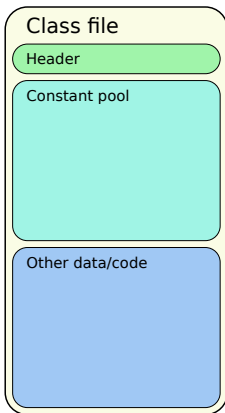
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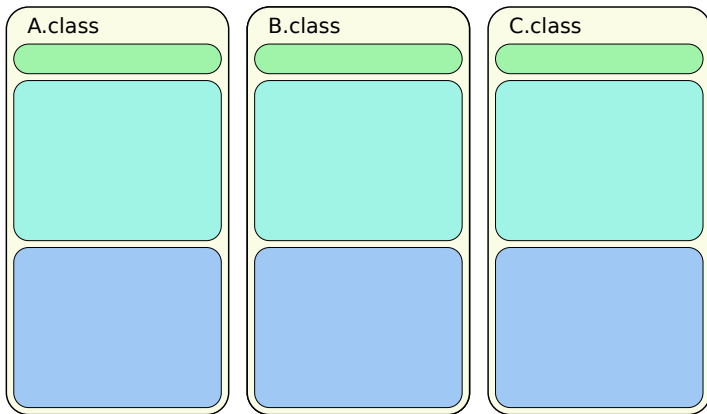
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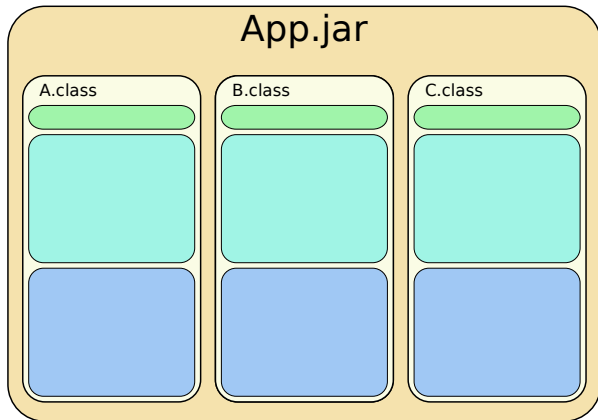
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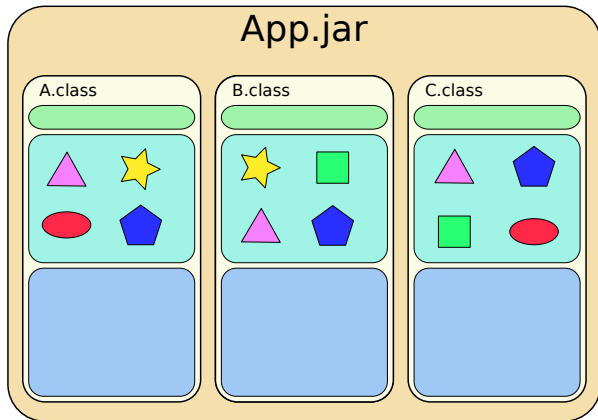
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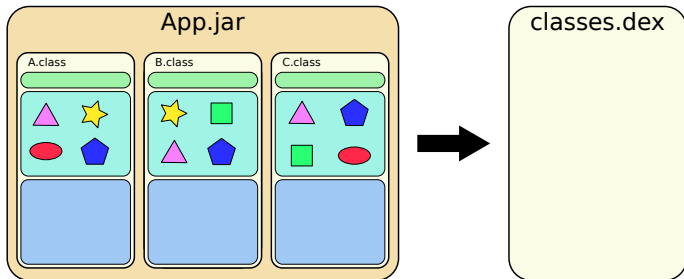
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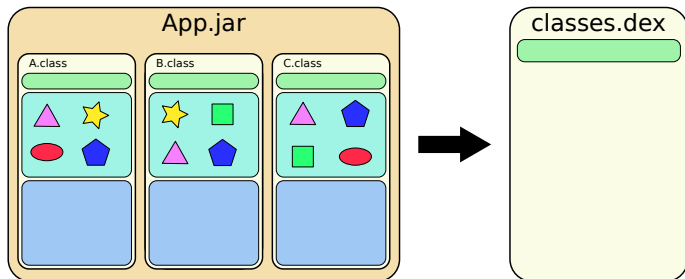
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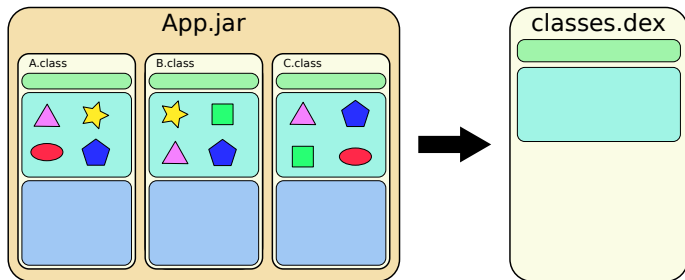
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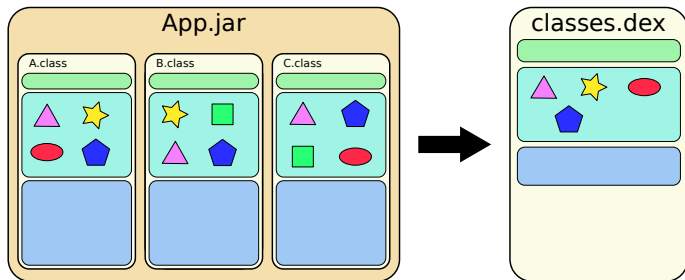
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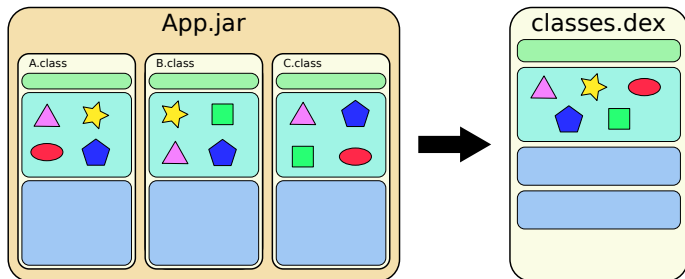
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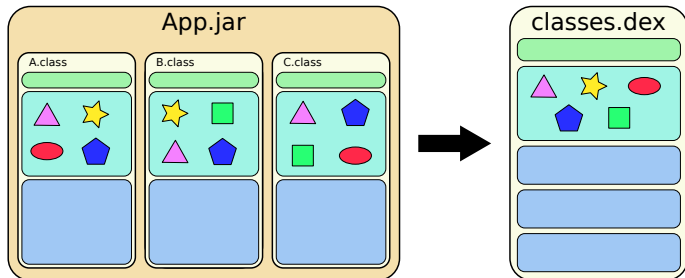
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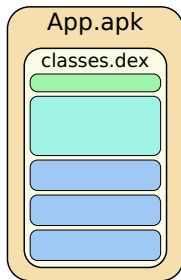
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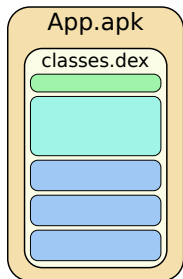
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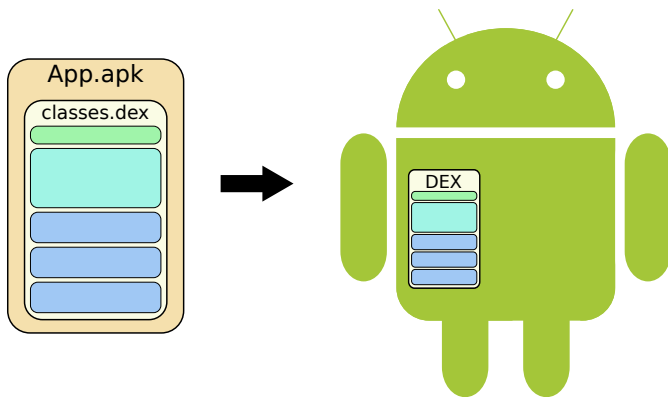
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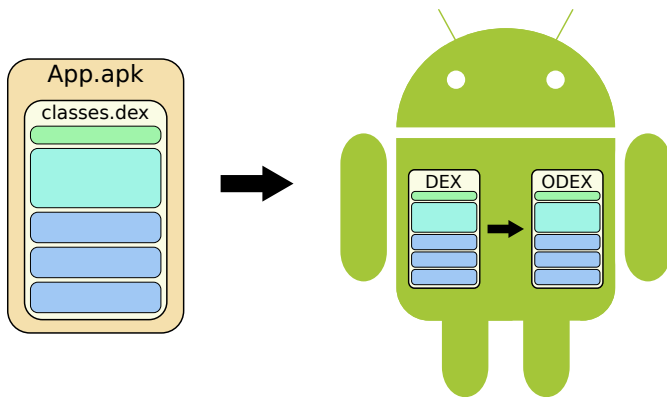
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Consequences

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

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Statically (AOT) compiled



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

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

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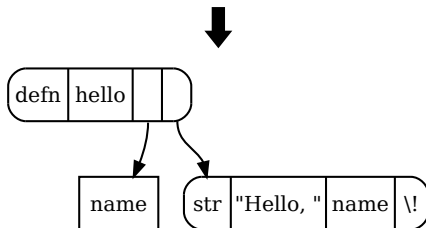
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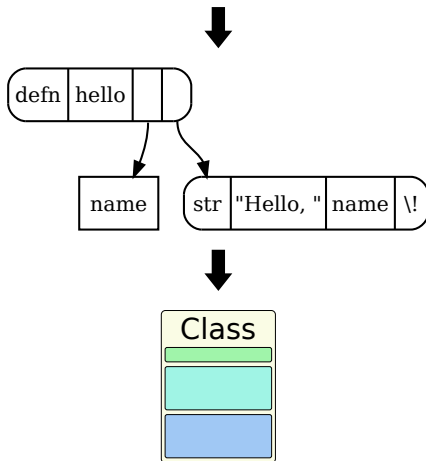
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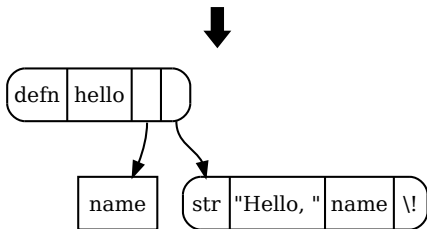


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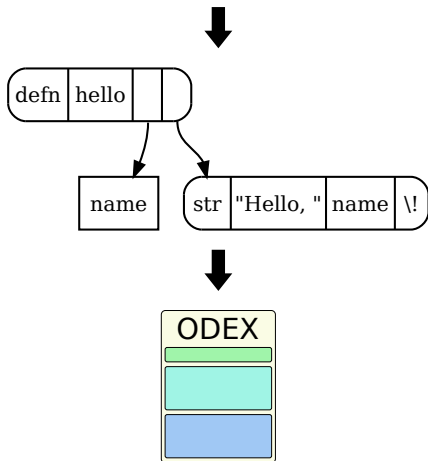
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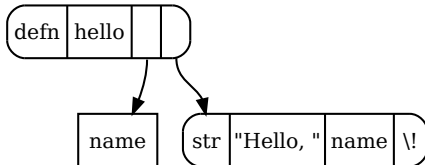
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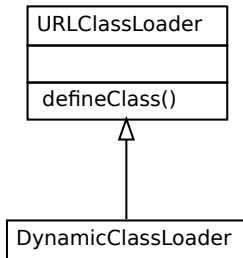
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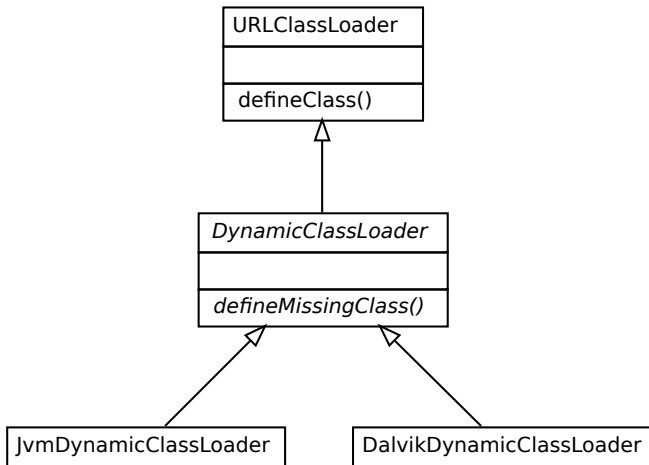
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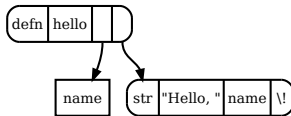
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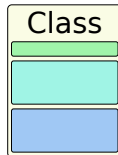
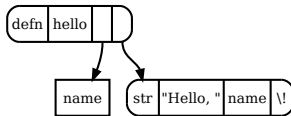
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The Dalvik process

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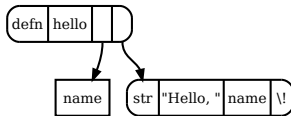
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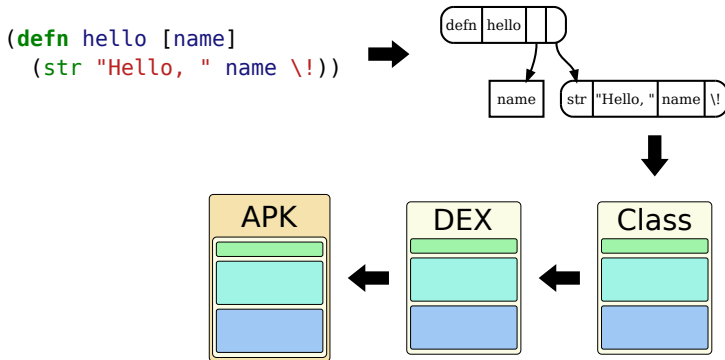
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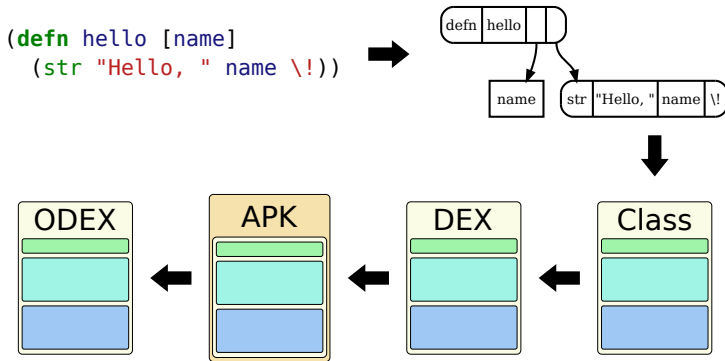
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Choosing the right ClassLoader

- ▶ 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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Dynamic
compilation

Why?

How?

Implementation details

Performance

Improving the
Clojure/Android
experience

Closing thoughts

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

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Closing thoughts

- ▶ 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

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Closing thoughts

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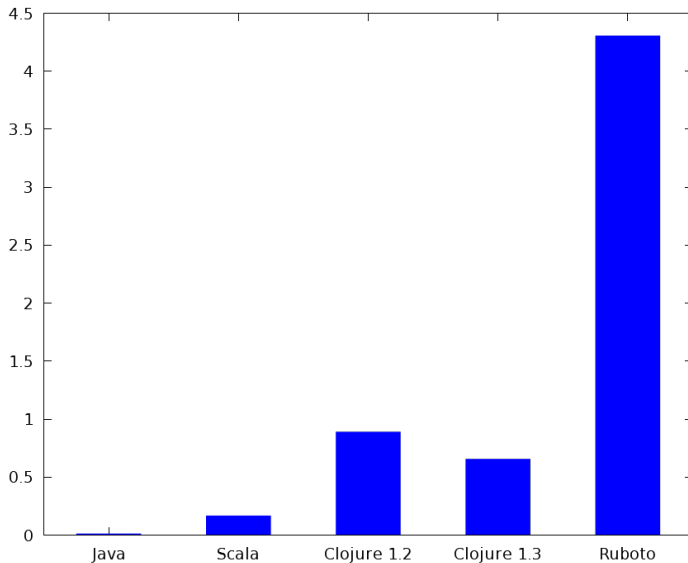
Improving the
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experience

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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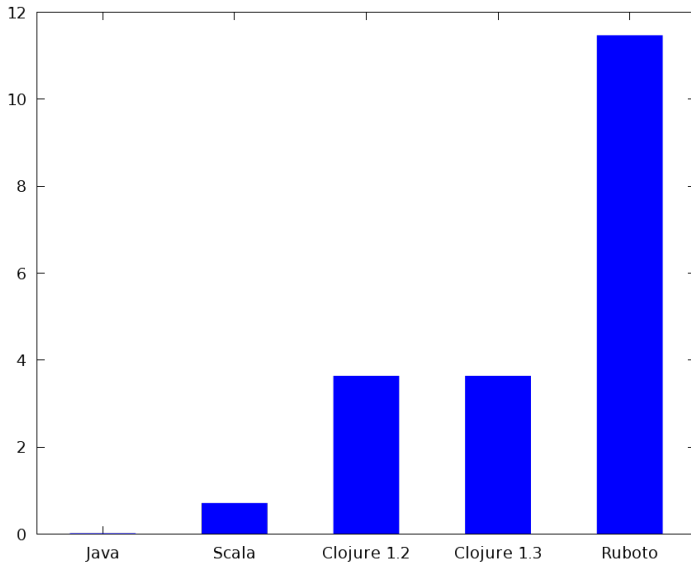
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Installed size (MB)



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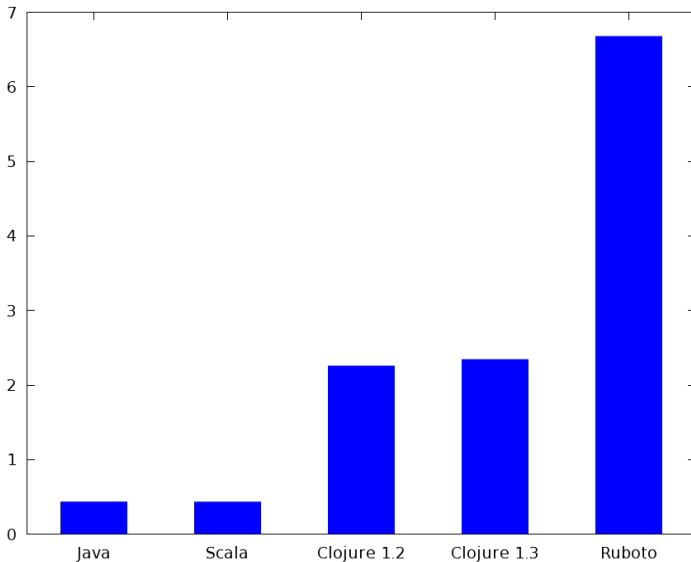
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Startup time (s)



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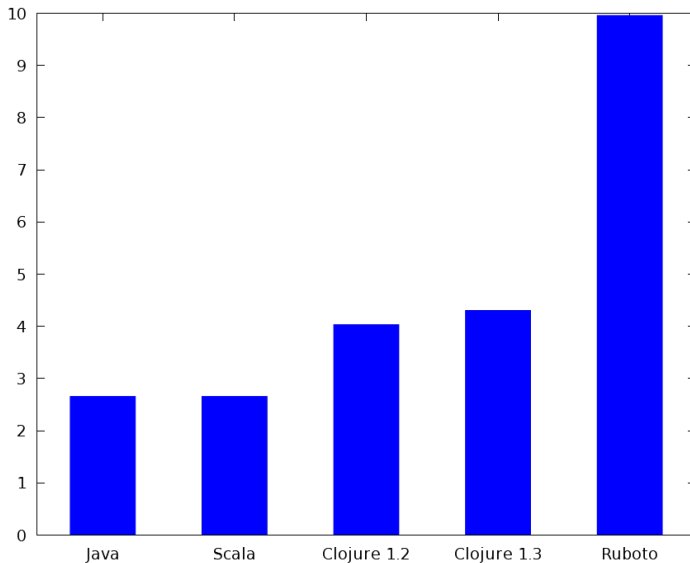
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Heap size (MB)



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Question

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Where did all the time and space go?

Answer

clojure.core

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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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Measuring time, a test

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```
// 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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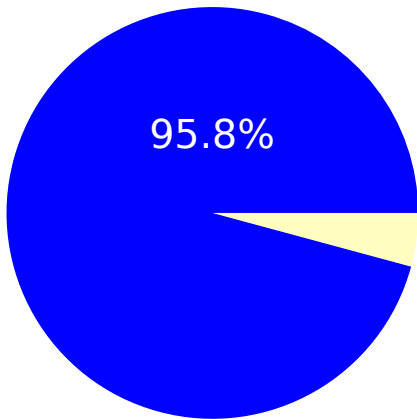
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Closing thoughts

Where did 7.8 seconds go?

CPU time

`clojure.lang.RT.doInit()`



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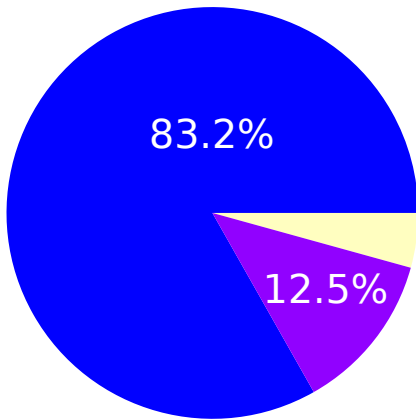
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Closing thoughts

Where did 7.8 seconds go?

CPU time

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



`(in-ns 'user)`

`(refer 'clojure.core)`

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Where did 7.8 seconds go?

Object churn

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| | 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

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Closing thoughts

Making Clojure a first-class language for Android development

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

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Neko: The Clojure/Android Toolkit

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Closing thoughts

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

Development tools

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Improving the
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Closing thoughts

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

Android development version of Clojure

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Closing thoughts

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

Build tools

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Closing thoughts

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

REPL/dynamic development tools

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Closing thoughts

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

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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?

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Closing thoughts

- ▶ 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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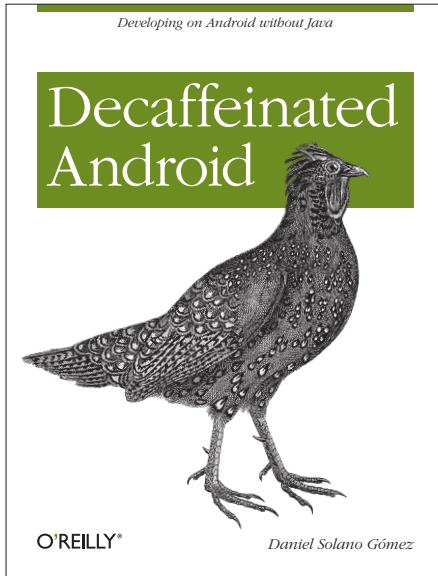
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Closing thoughts



Questions?

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E-mail daniel@solanogomez.org

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

Clojure REPL for Android:



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