Migrating to Modules

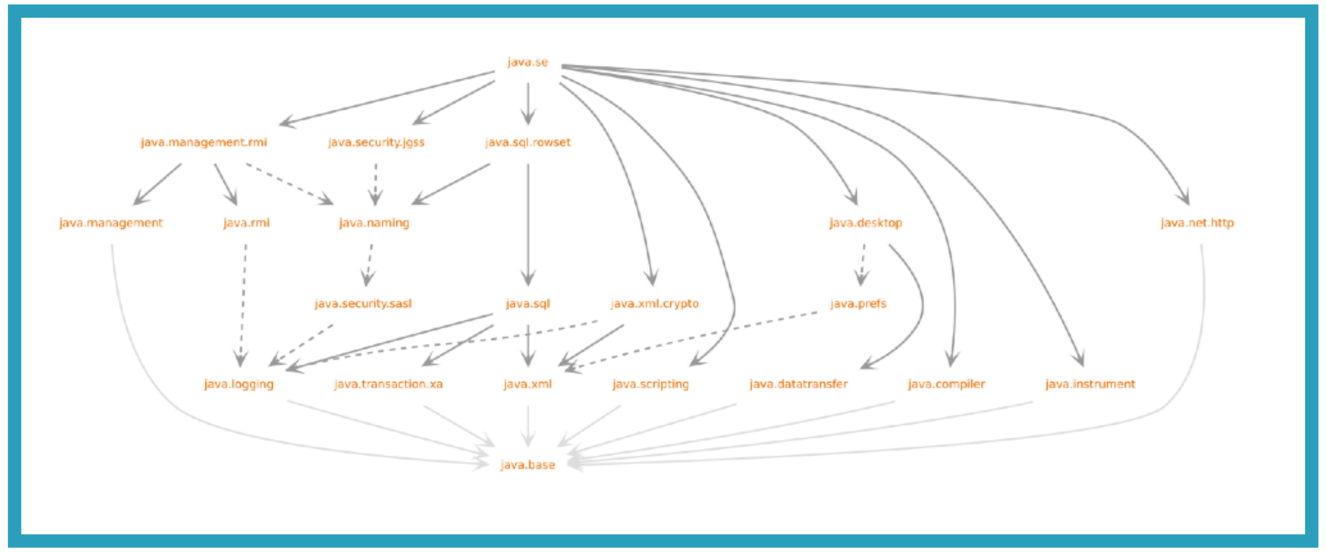
Sander Mak
Java Champion

@Sander_Mak   www.javamodularity.com

The Classpath in a Modular World

The Classpath in a Modular World

Modular JDK / Module path



The Classpath in a Modular World

Classpath

```
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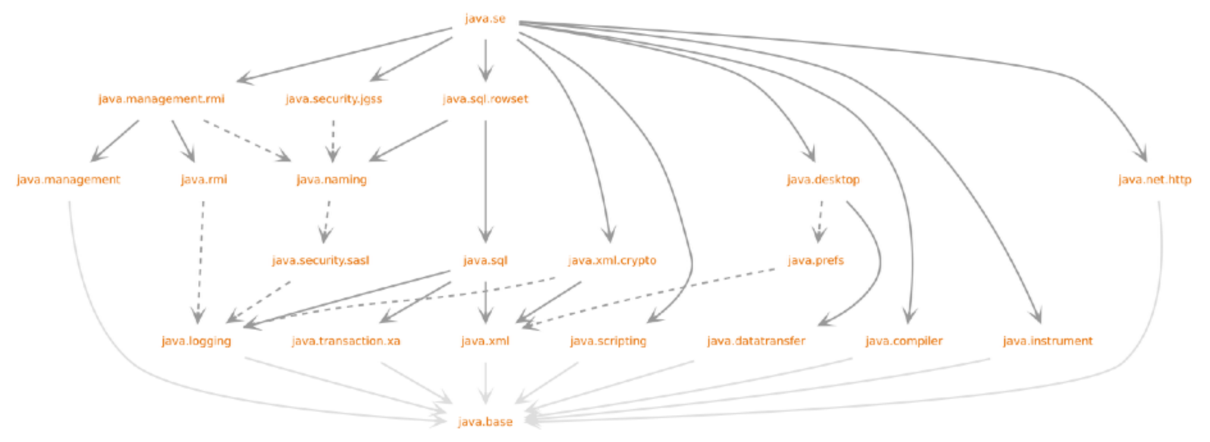
```

Modular JDK / Module path



The Classpath in a Modular World

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my-application.jar
dependency-1.0.jar
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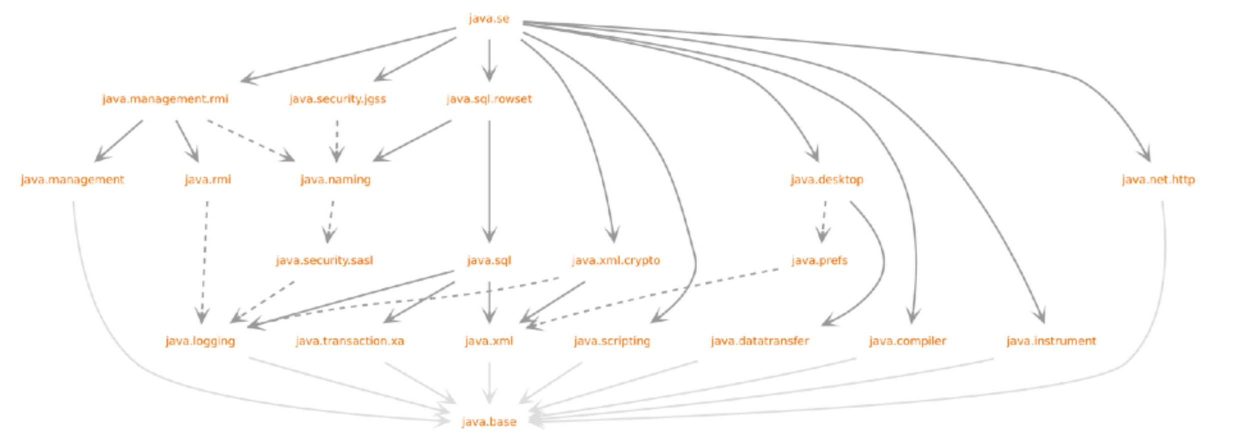

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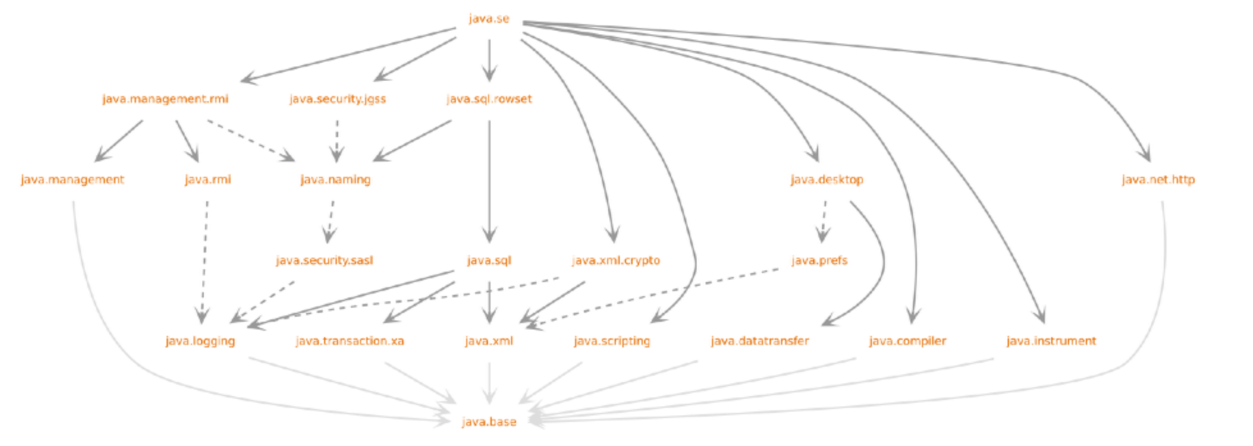

When your application and dependencies only use official Java APIs, *things should just work™*

The Classpath in a Modular World

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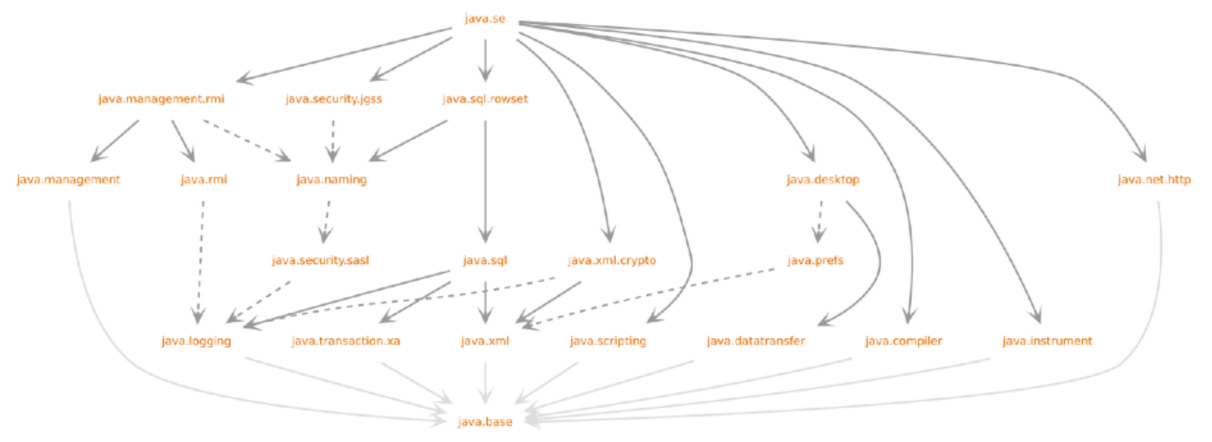
Modular JDK / Module path



The Classpath in a Modular World

~~Classpath~~ Unnamed module

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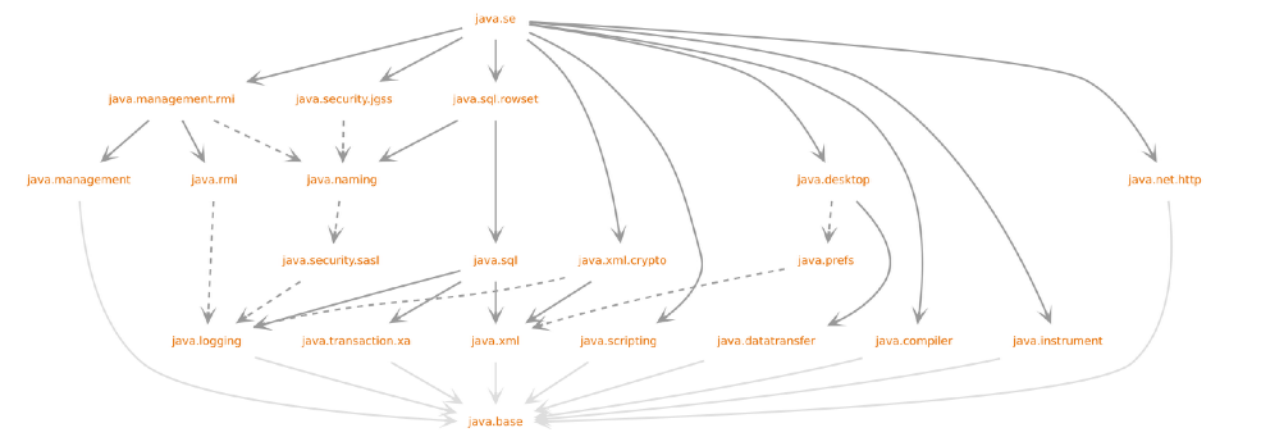

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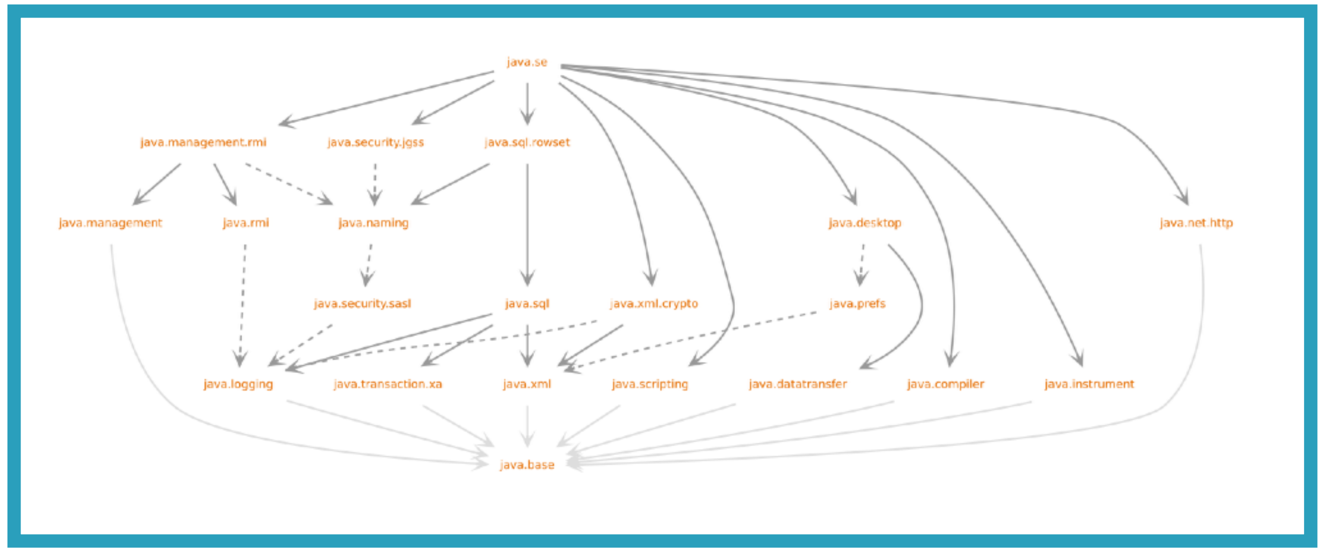

The unnamed module can read **everything** from the modular JDK **at run-time**

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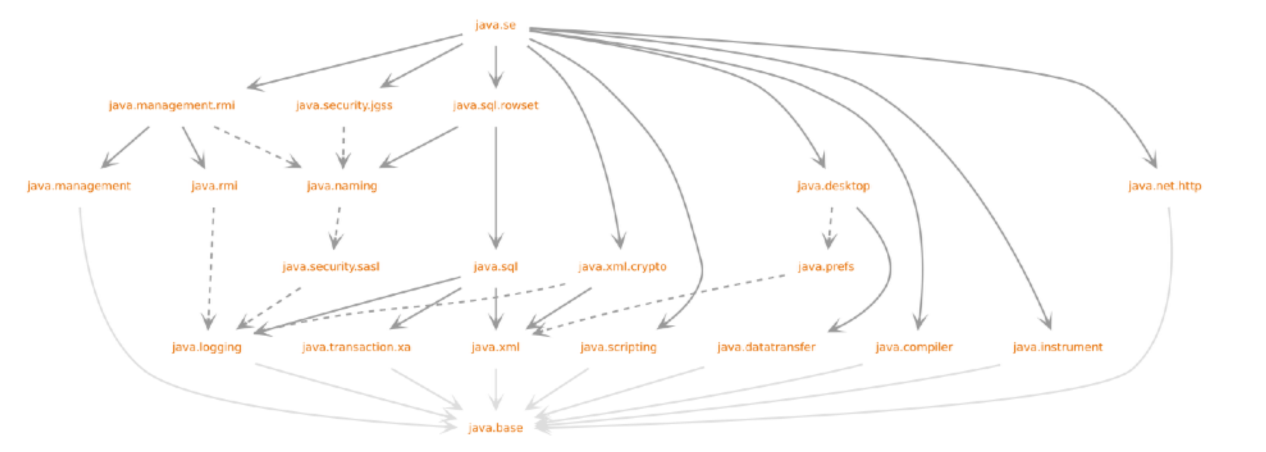

The unnamed module can read **everything** from the modular JDK **at run-time**

At **compile-time**, strong encapsulation is **enforced**

The Unnamed Module

Unnamed module

```
my-application.jar
dependency-1.0.jar
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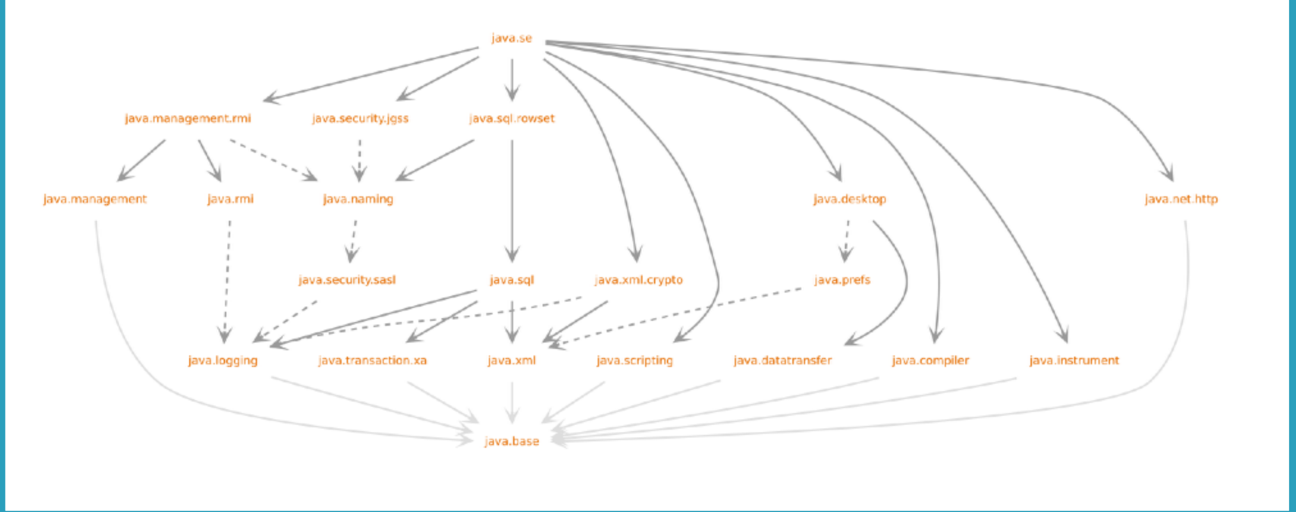
Modular JDK / Module path



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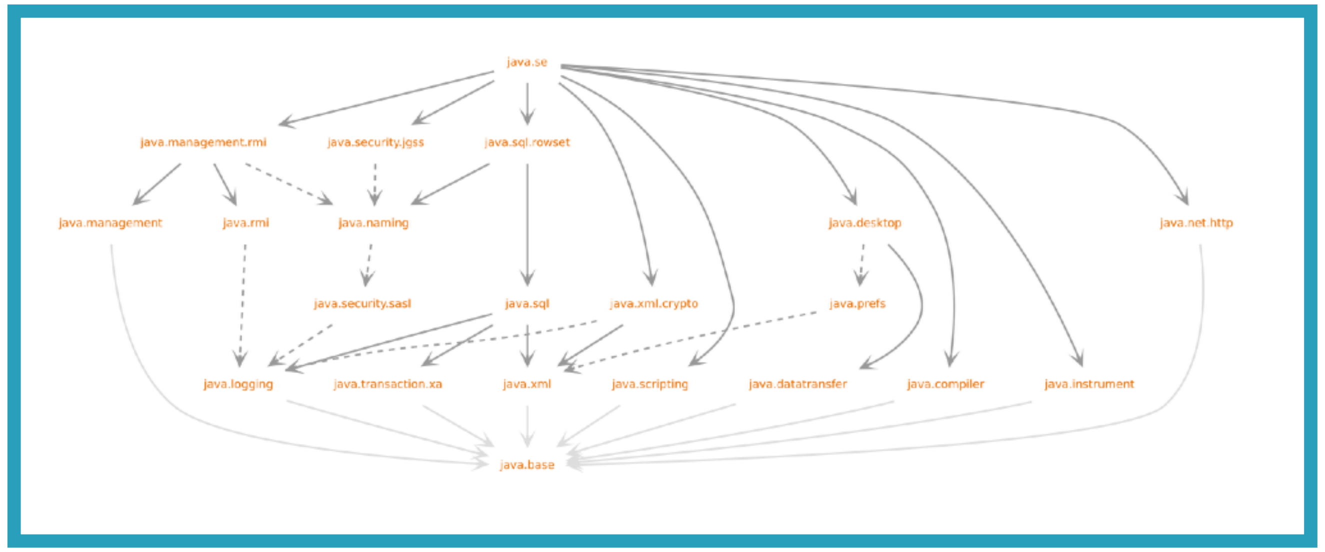
Modular JDK / Module path



Even types in packages that are **not exported**

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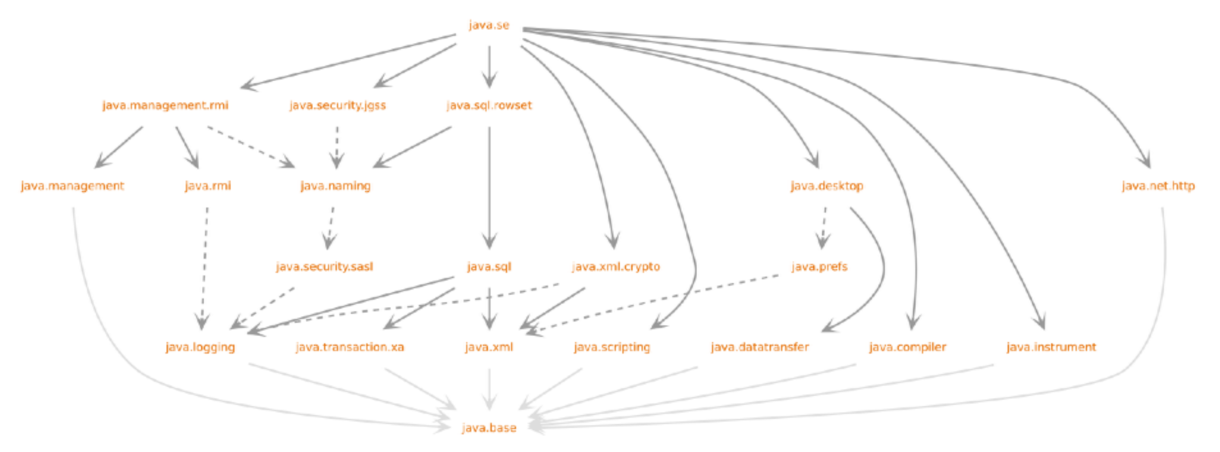

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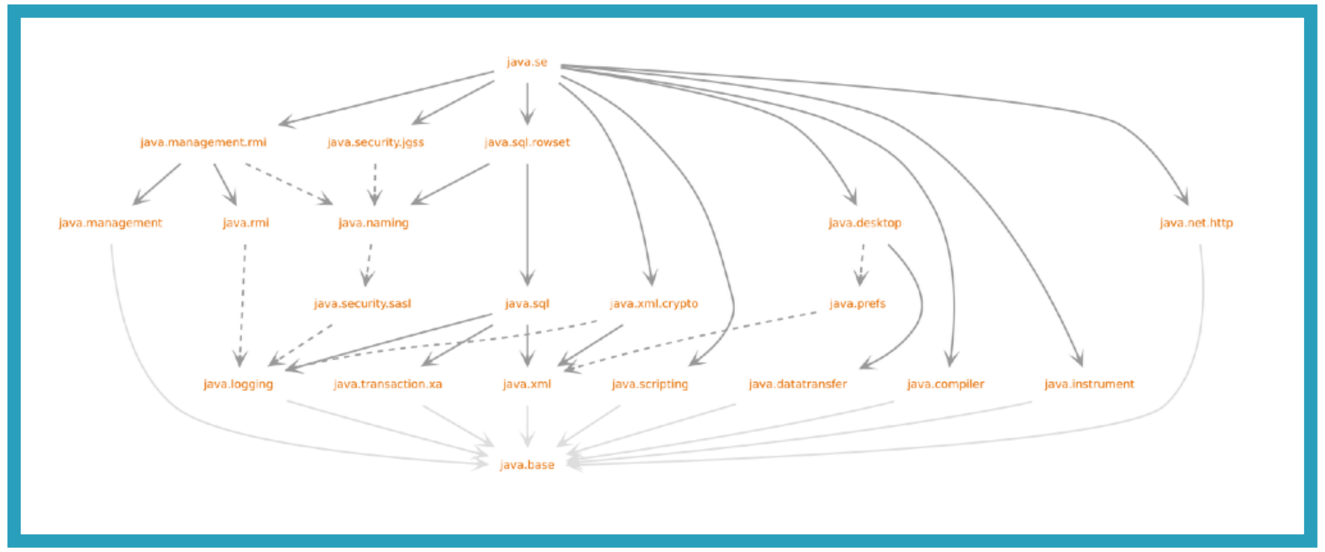


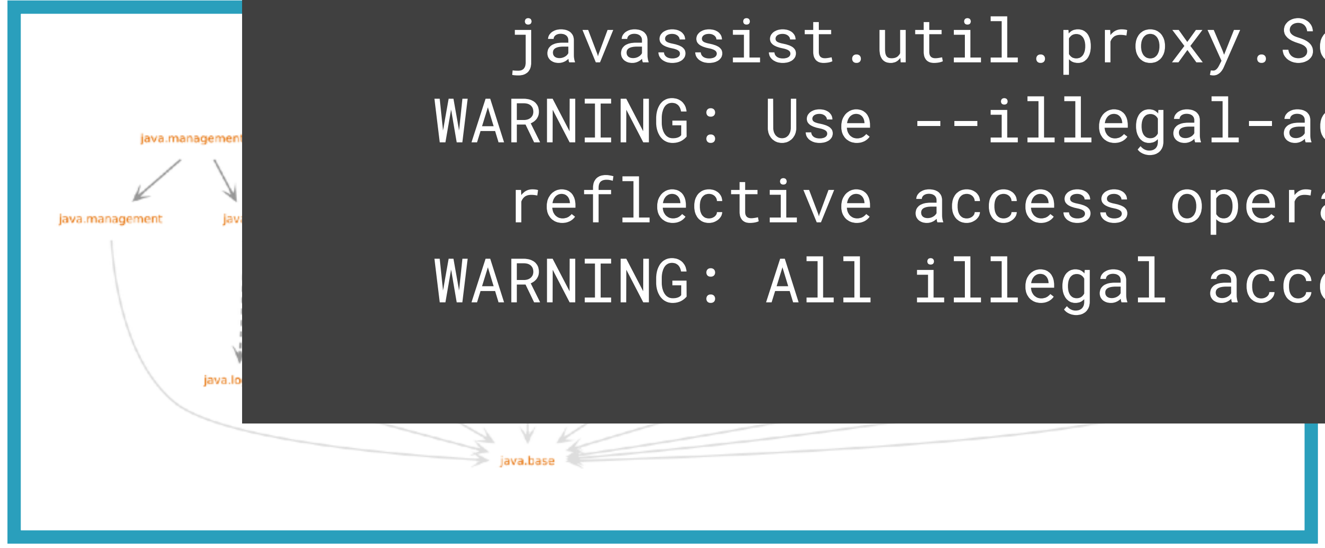
Even reflection on types in packages that are **not opened**

The Unnamed Module

Unnamed module

```
my-a
depe
```

Modul



```
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by javassist.util.proxy.SecurityActions
  (...javassist-3.20.0-GA.jar) to method
  java.lang.ClassLoader.defineClass(...)
WARNING: Please consider reporting this to the maintainers of
  javassist.util.proxy.SecurityActions
WARNING: Use --illegal-access=warn to enable warnings of further illegal
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WARNING: All illegal access operations will be denied in a future release
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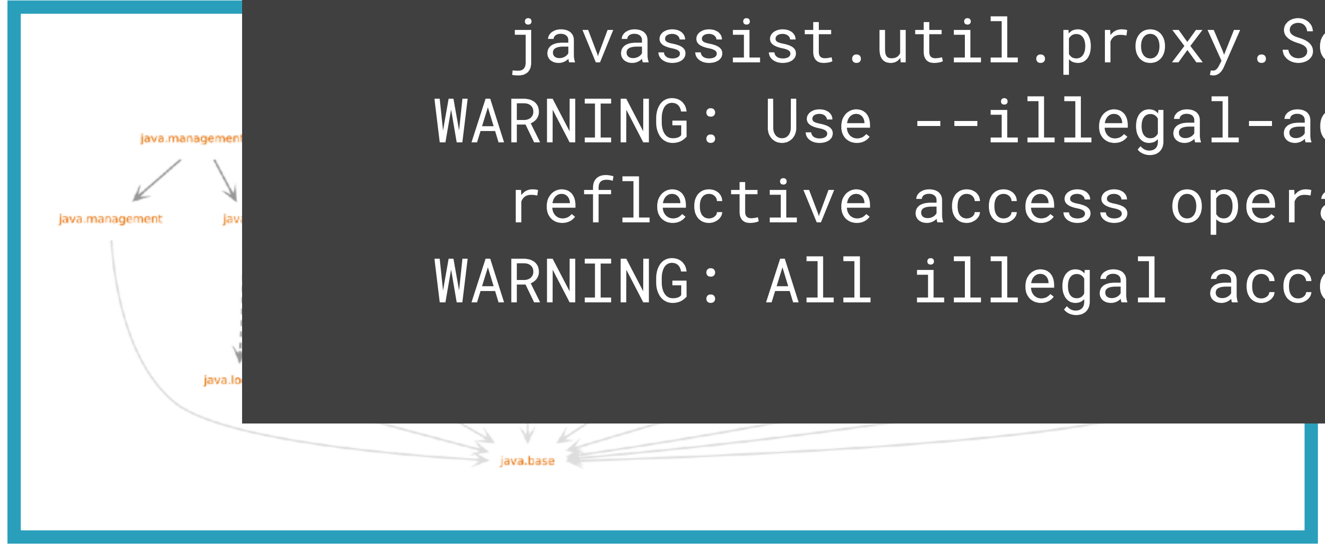
my-a

depe

Modul



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`--illegal-access=deny`

Opening Packages from the Command Line

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Upgrade to newer version

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java --add-opens java.base/java.lang=<module_name>
```

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Demo

Exporting Packages from the Command Line

Demo

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Migrating to Modules

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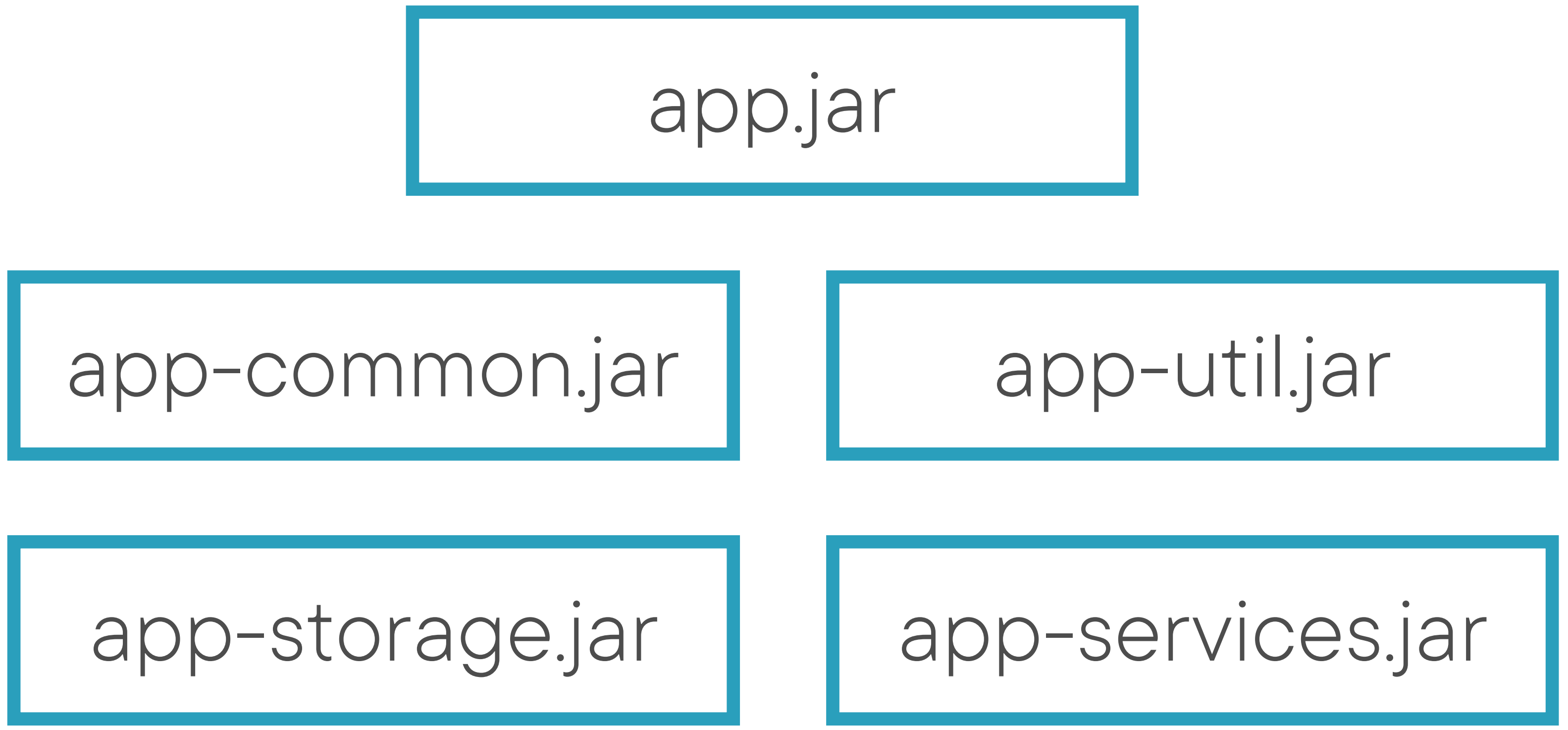
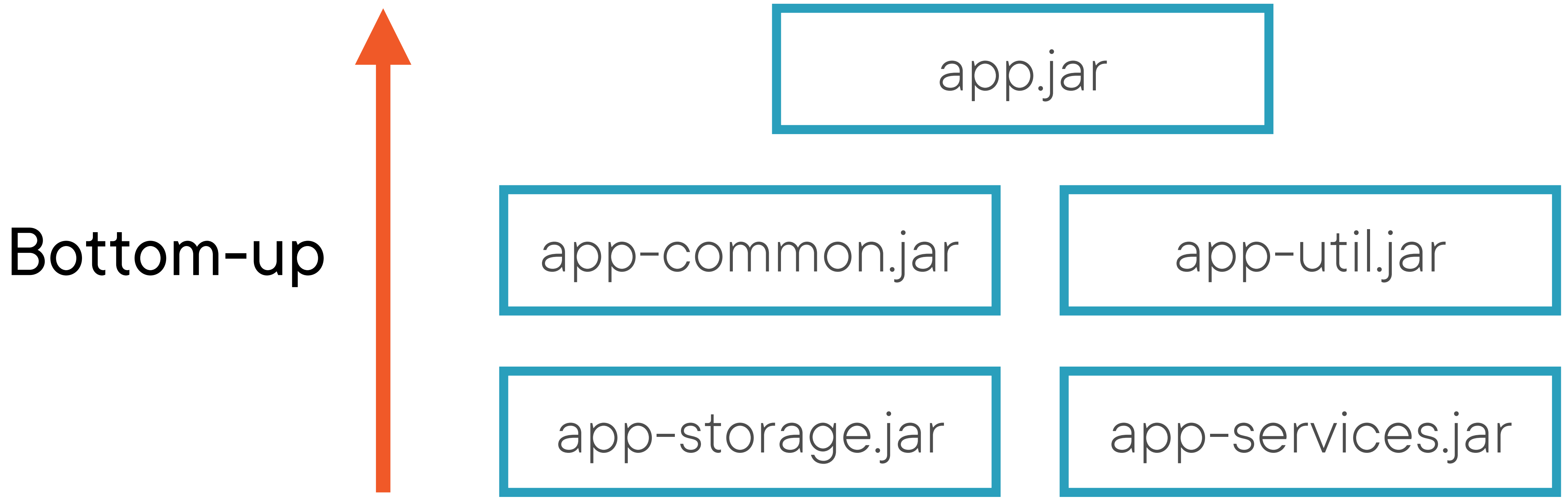
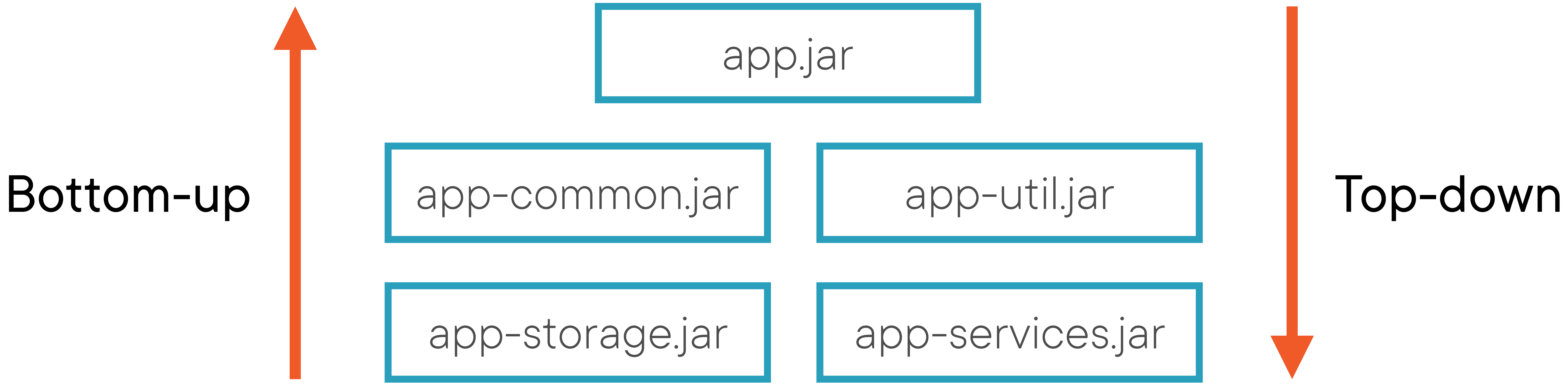


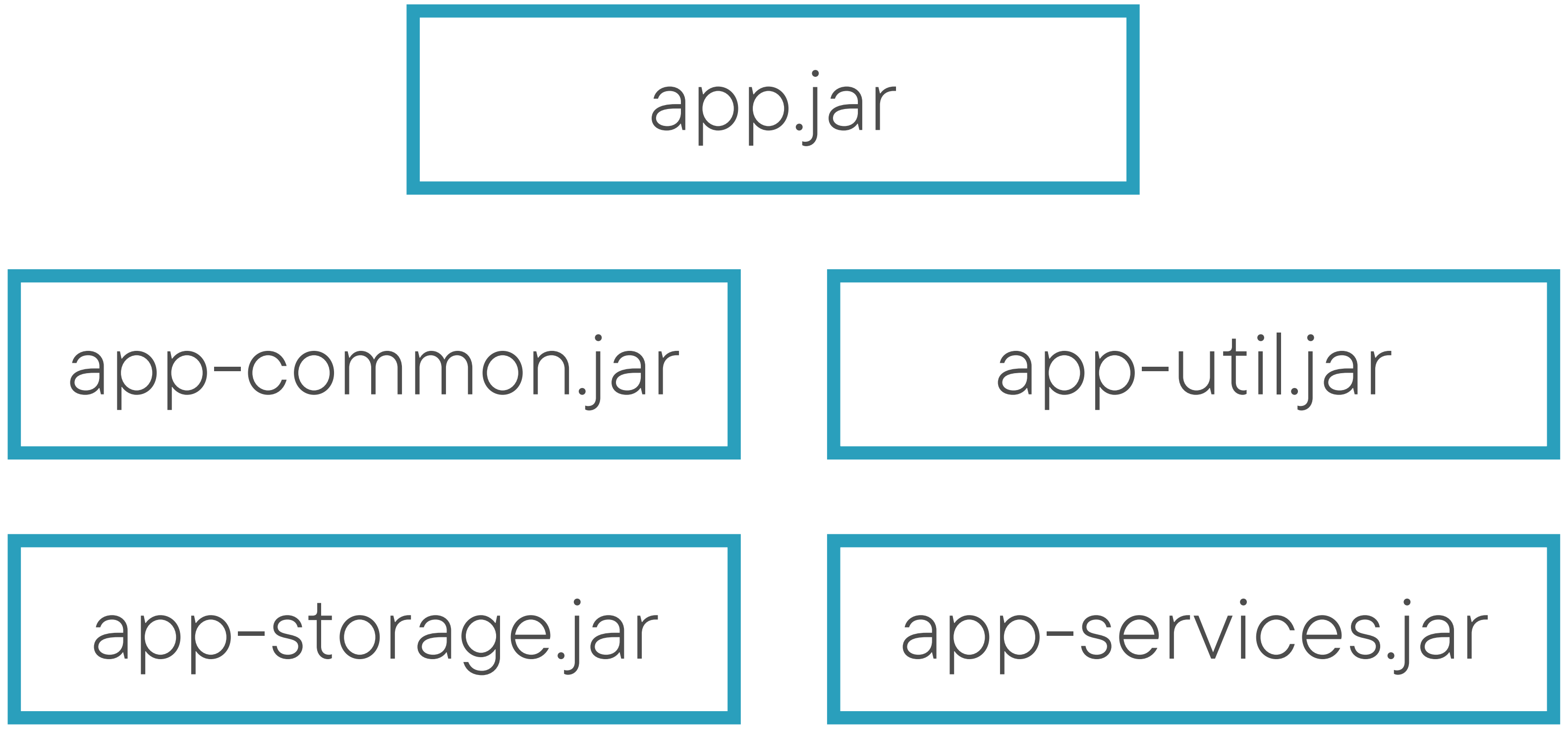
Migrating to Modules



Migrating to Modules



Bottom-up Migration



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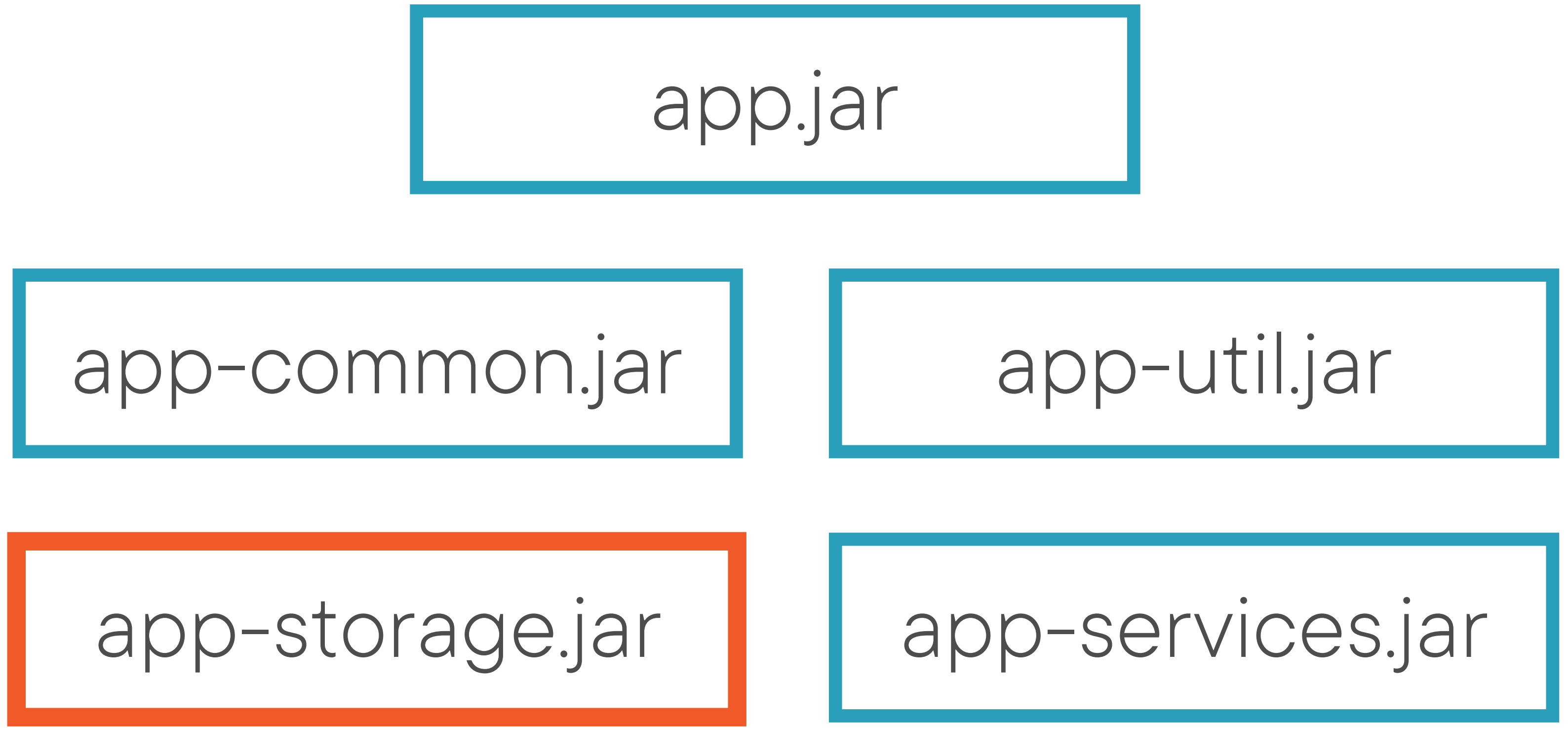

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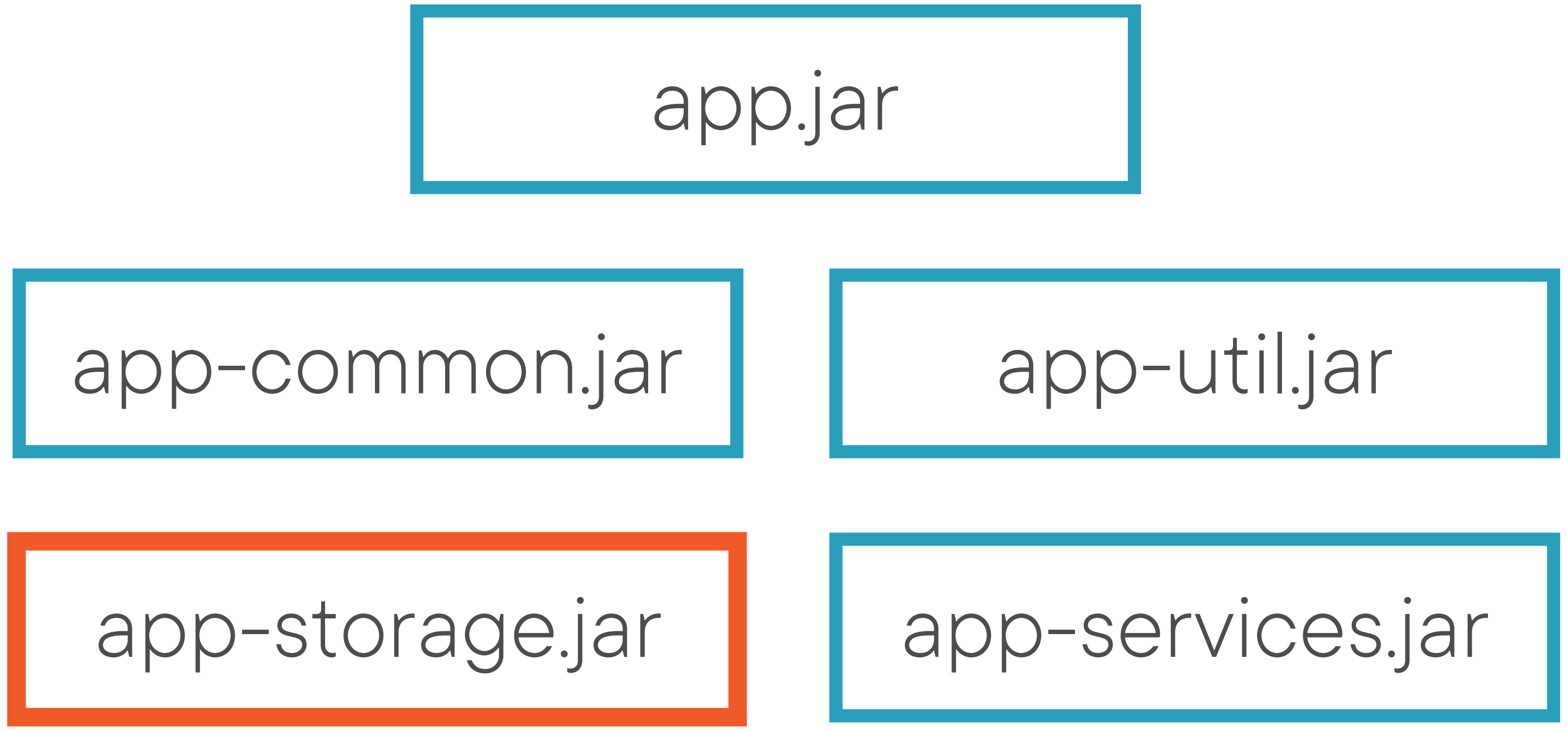

Starting with 'leaf' modules

- Write module-info.java
- Establish API
- Find JDK dependencies

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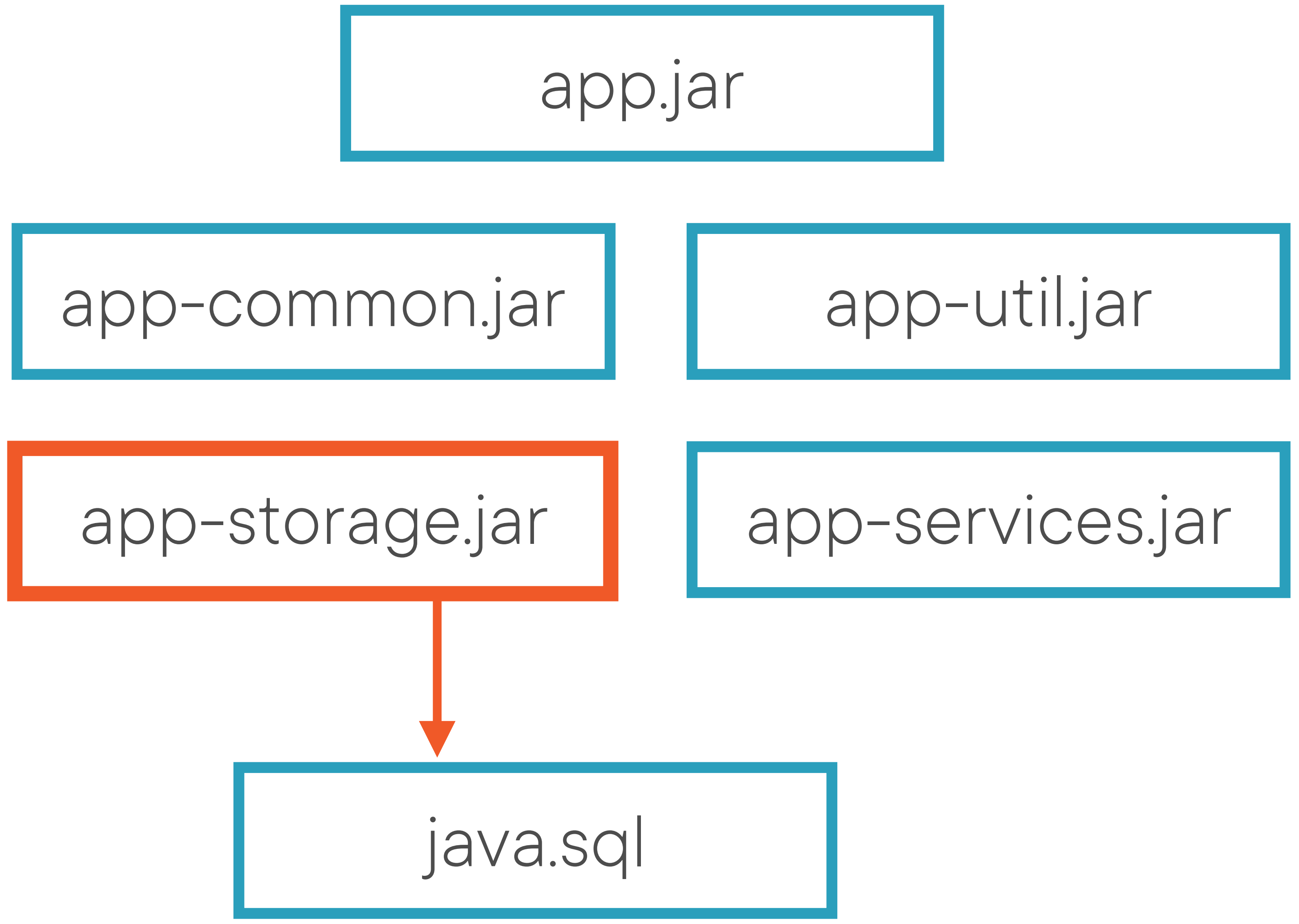

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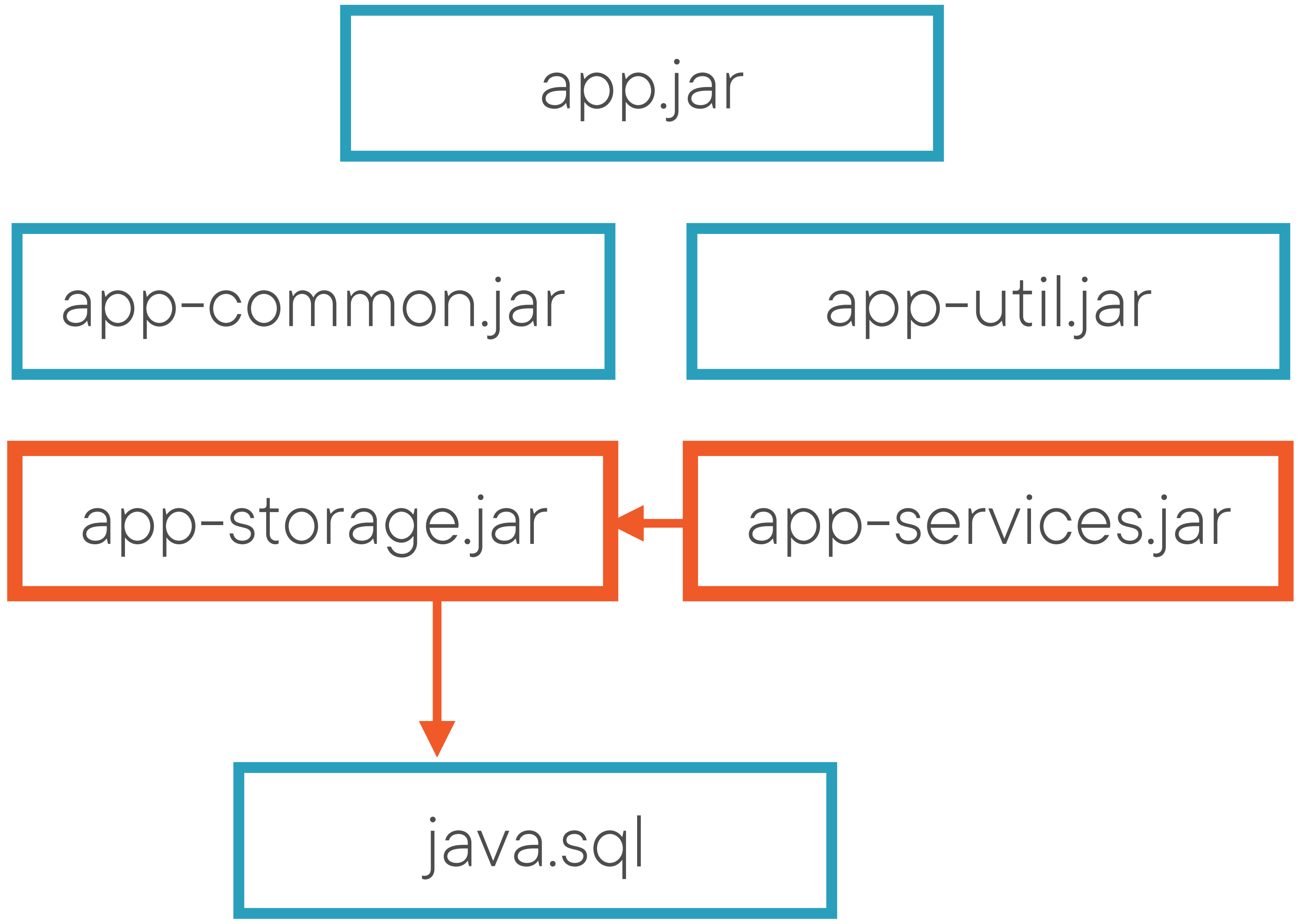

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- Write module-info.java
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Bottom-up Migration: Using Jdeps

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```
$ jdeps -s app-storage.jar
app-storage.jar -> java.base
app-storage.jar -> java.sql
```

Bottom-up Migration: Using Jdeps

```
$ jdeps -s app-storage.jar
app-storage.jar -> java.base
app-storage.jar -> java.sql
```

```
$ jdeps --generate-module-info . app-storage.jar
writing to ./app.storage/module-info.java
```

Bottom-up Migration: Limitations

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What if we don't control a dependency?

external-library.jar

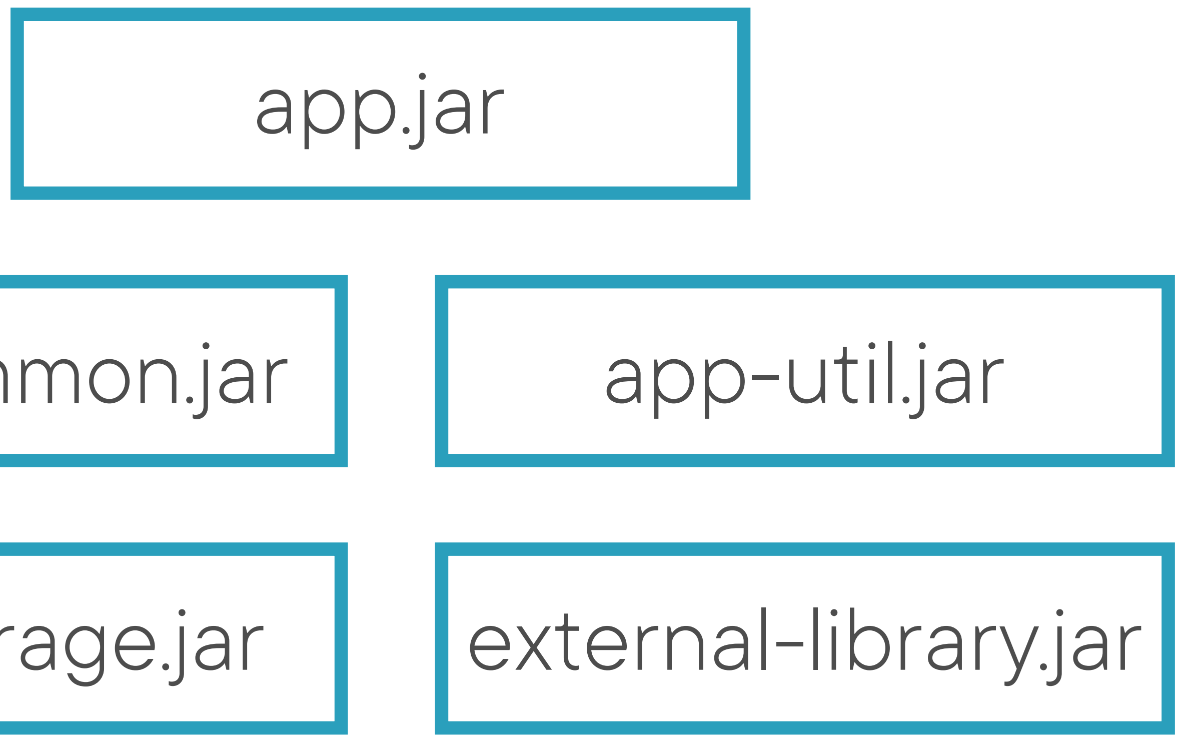
Bottom-up Migration: Limitations

What if we don't control a dependency?

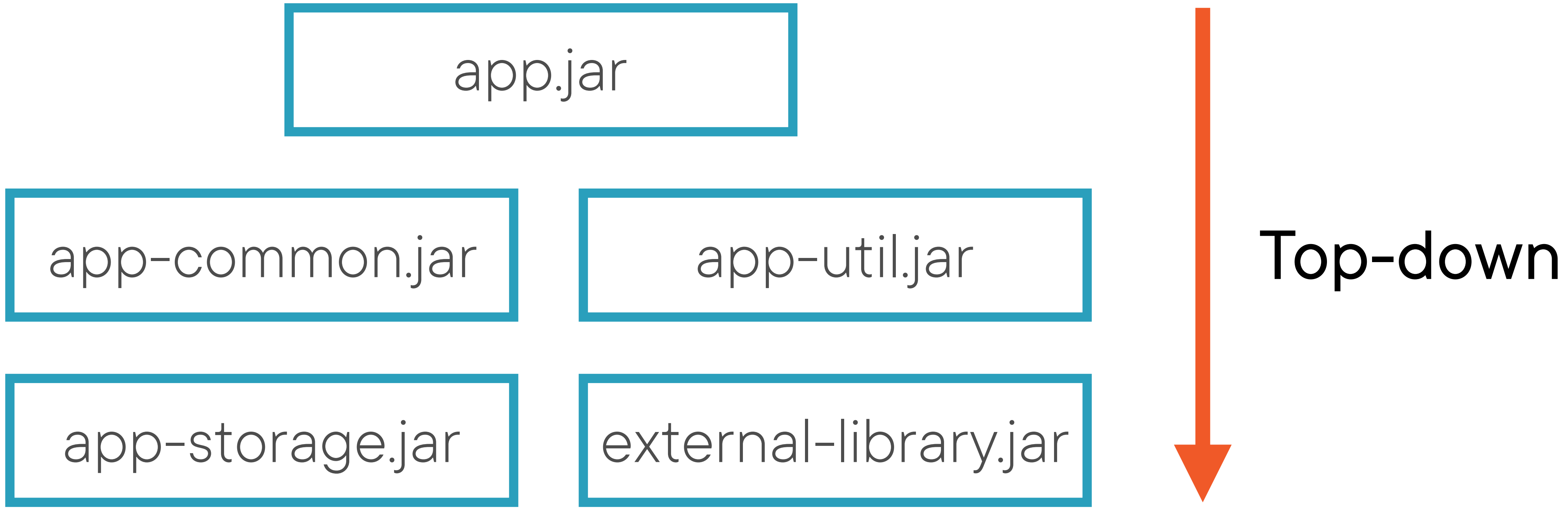
external-library.jar

- Wait for it to be modularized?
- Patch with our own module descriptor?

Top-down Migration



Top-down Migration



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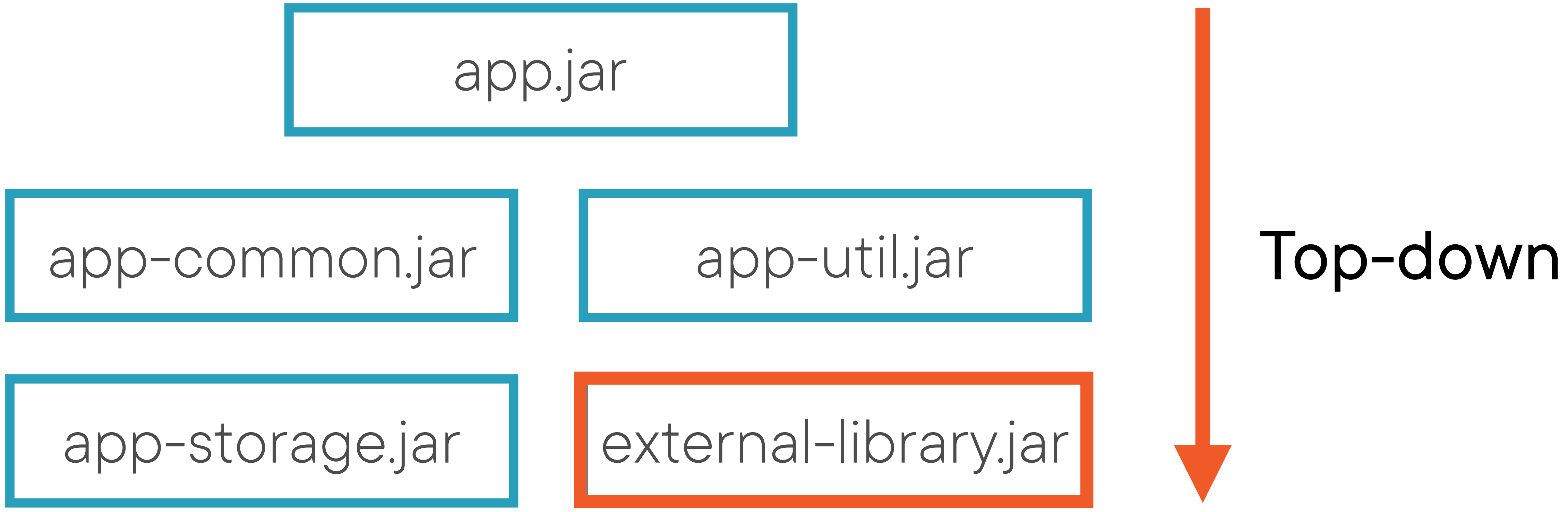
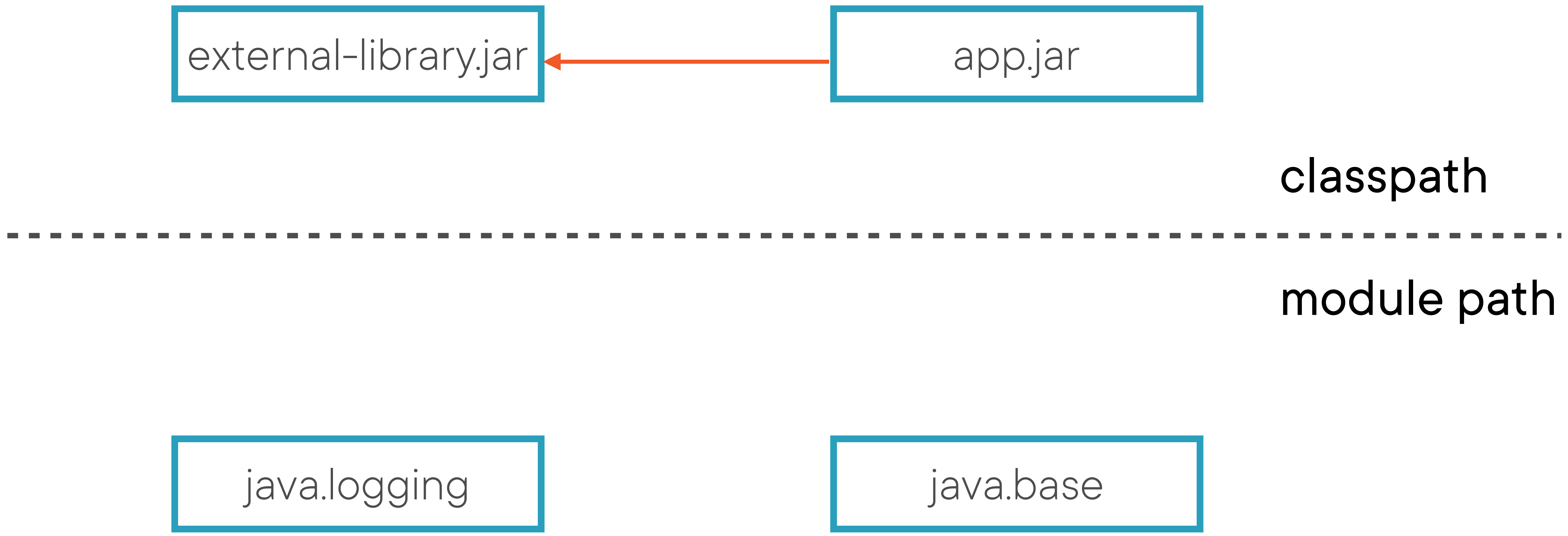


Automatic Modules



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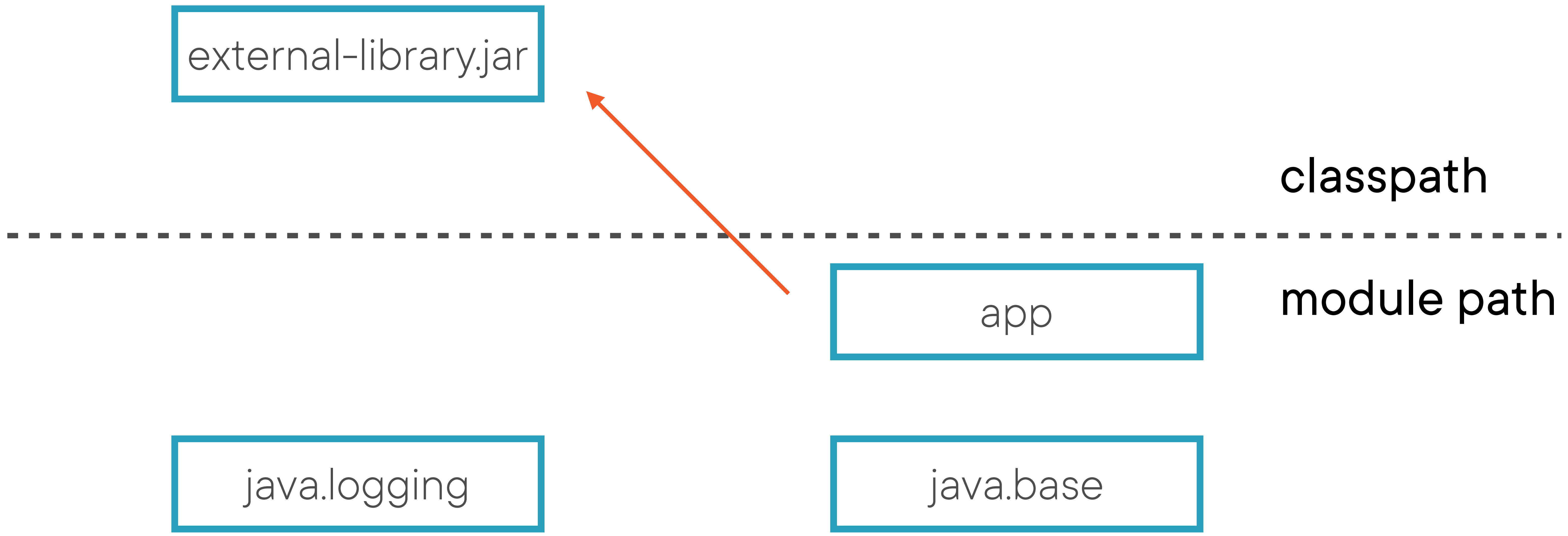

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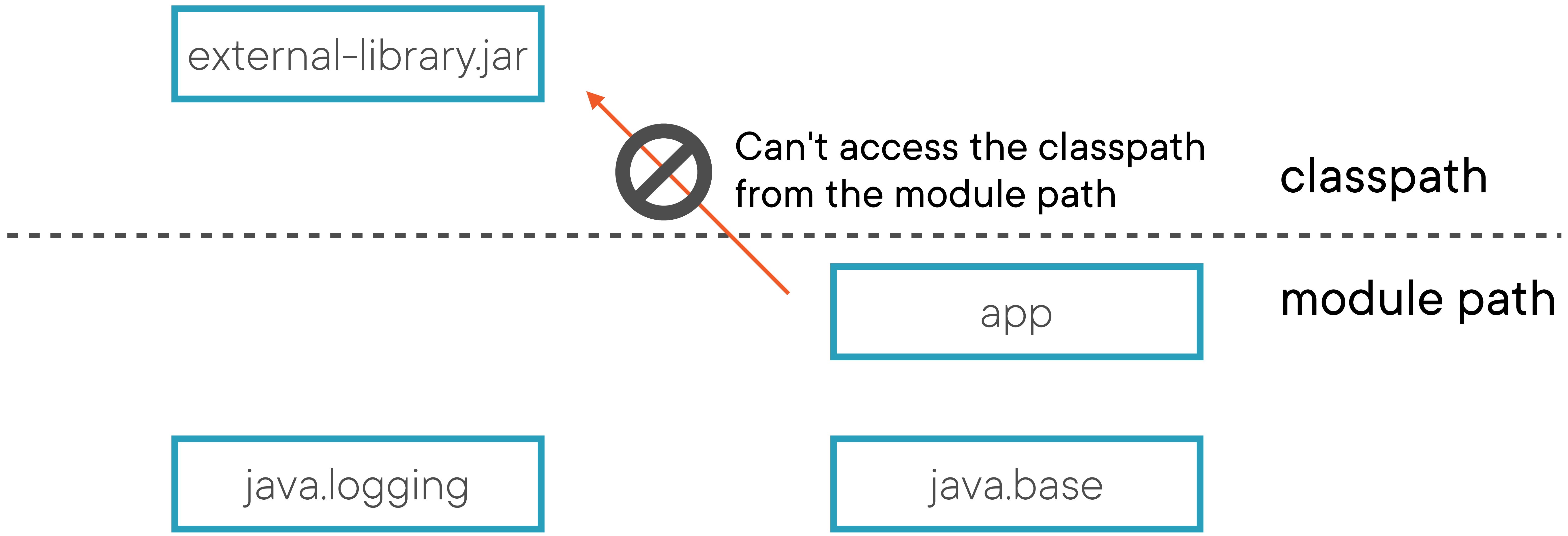

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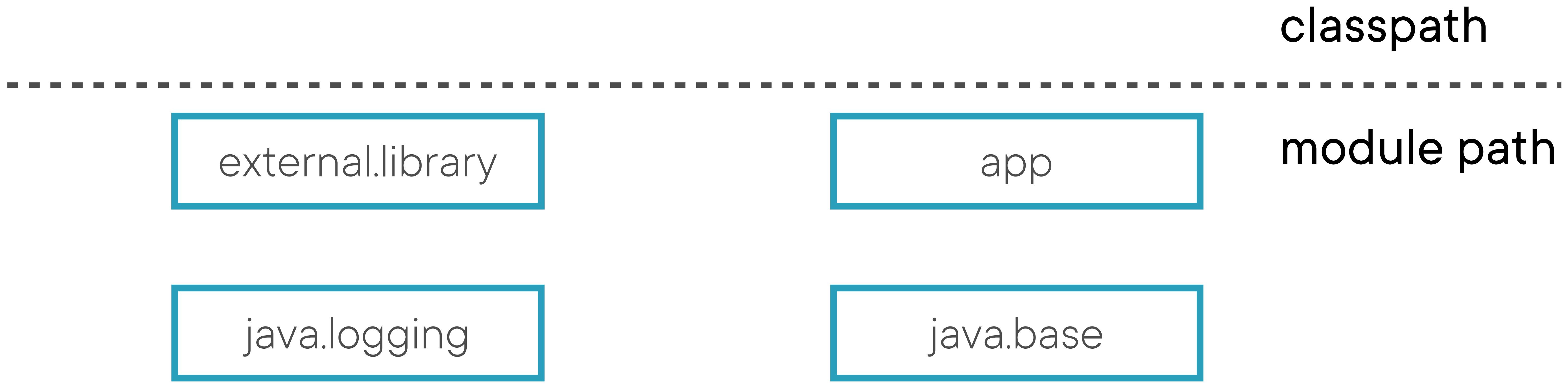

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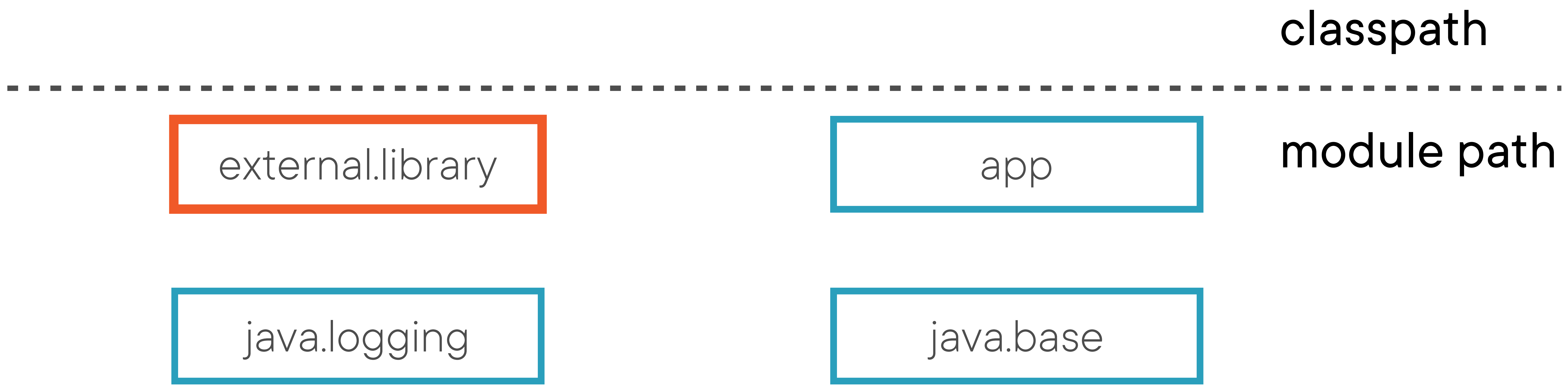

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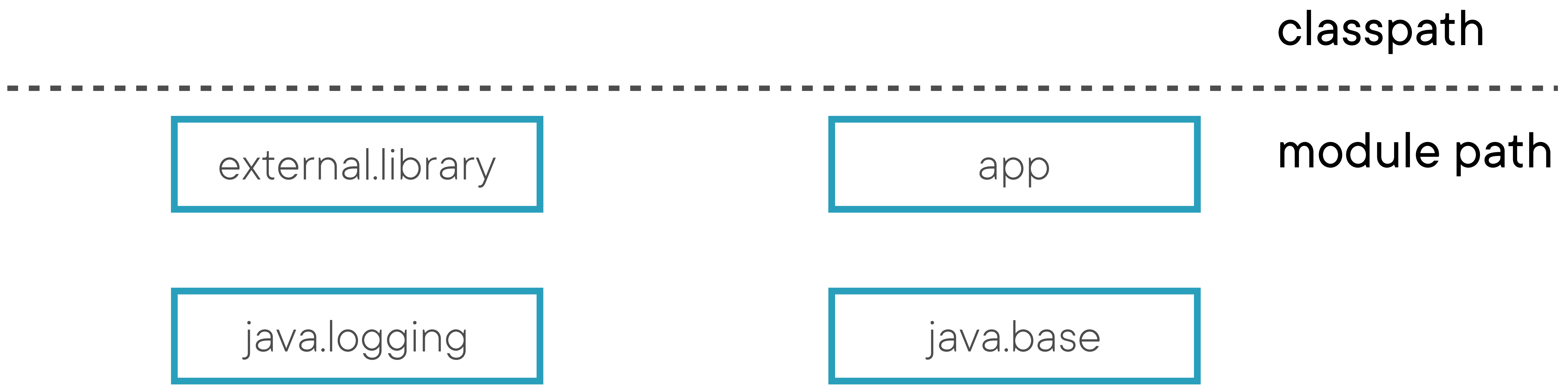

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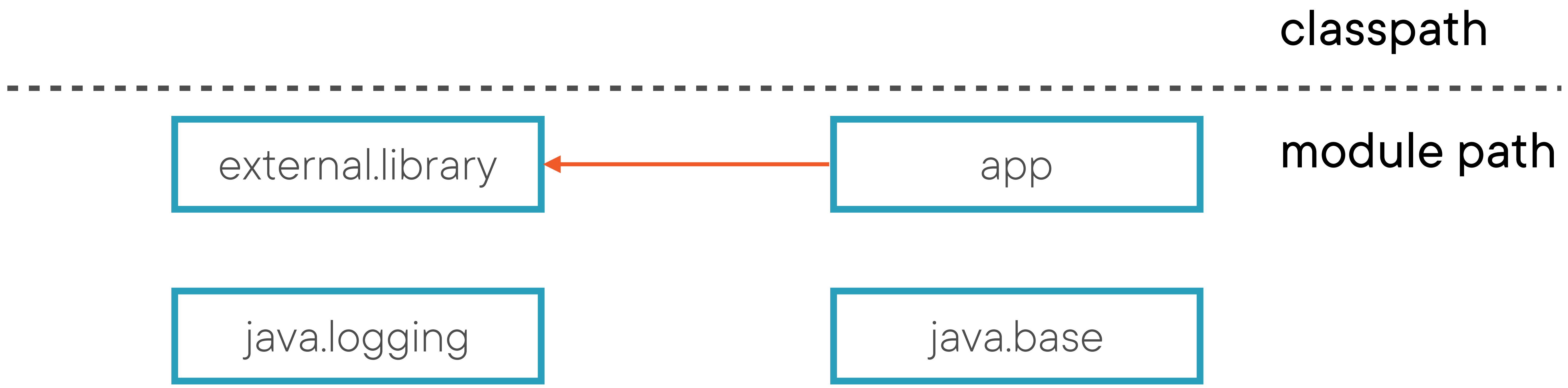

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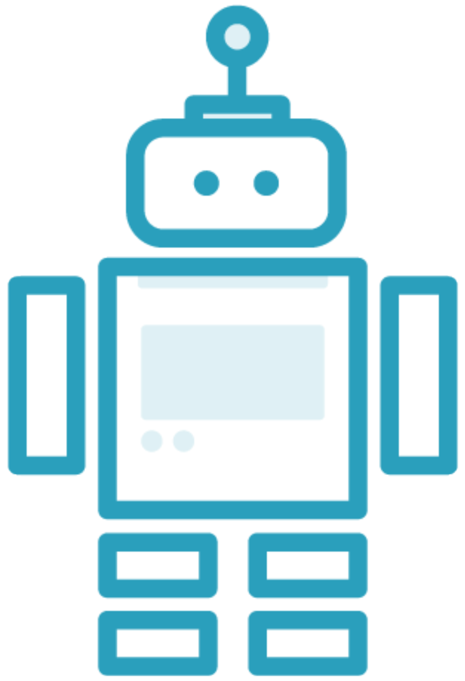
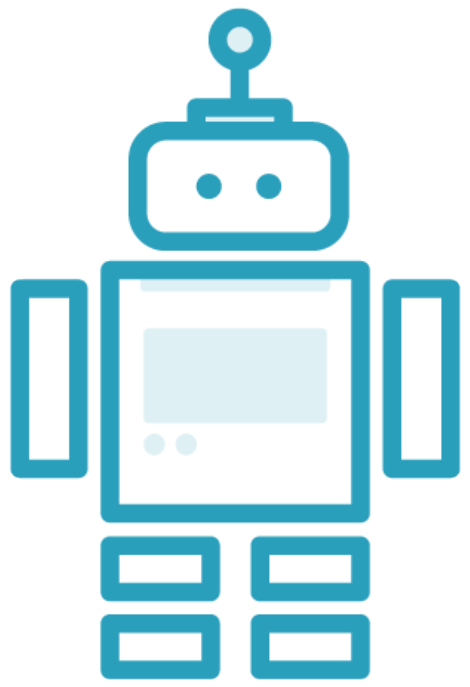


Put a non-modular JAR on the module path

Automatic Modules

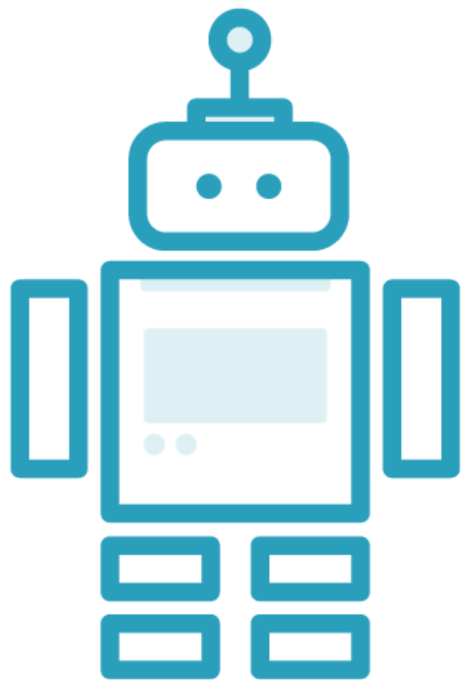


Put a non-modular JAR on the module path

– Name derived from JAR filename

See JavaDoc of `ModuleFinder`

Automatic Modules

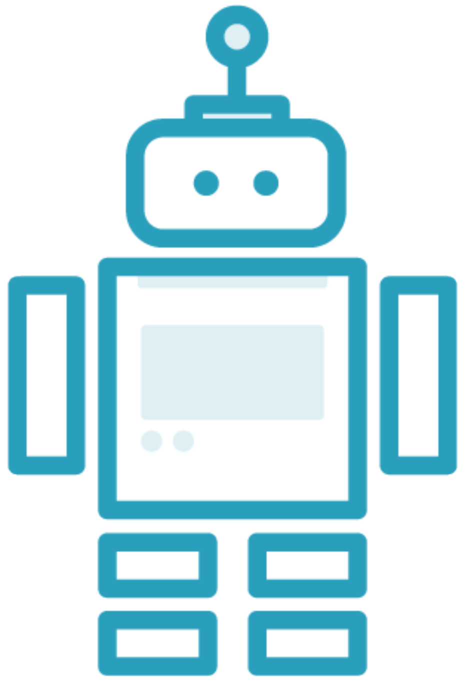


Put a non-modular JAR on the module path

- Name derived from JAR filename
- Or from `Automatic-Module-Name` header

In the JAR file's `META-INF/MANIFEST.MF`

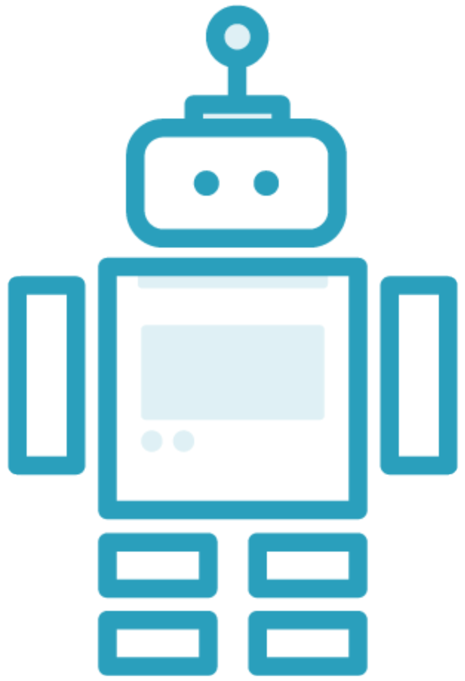
Automatic Modules



Put a non-modular JAR on the module path

- Name derived from JAR filename
- Or from `Automatic-Module-Name` header
- Exports & opens all packages

Automatic Modules



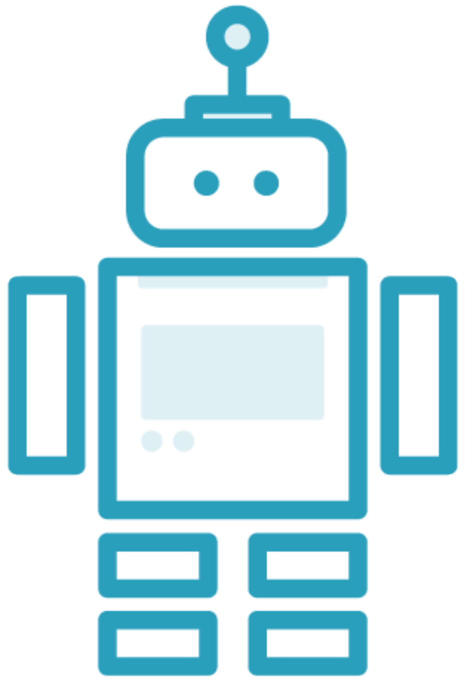
Put a non-modular JAR on the module path

- Name derived from JAR filename
- Or from `Automatic-Module-Name` header
- Exports & opens all packages
- Implicitly requires all resolved modules

Automatic Modules

Put a non-modular JAR on the module path

- Name derived from JAR filename
- Or from `Automatic-Module-Name` header
- Exports & opens all packages
- Implicitly requires all resolved modules
- Can access the classpath



Automatic Modules

Automatic modules are only meant to be used for migration

Automatic Modules

Course Wrap-up

Course Wrap-up

Introducing the Java Module System

Course Wrap-up

Introducing the Java Module System

Working with Modules

Course Wrap-up

Introducing the Java Module System

Working with Modules

Understanding the Modular JDK

Course Wrap-up

Introducing the Java Module System

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Using Services

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Migrating to Modules

Topics Not Discussed

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Advanced module system topics

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– Module Layer API

Topics Not Discussed

Advanced module system topics

- Module Layer API
- **Custom run-time images with jlink**

Topics Not Discussed

Advanced module system topics

- Module Layer API
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- **Resource loading with modules**

Topics Not Discussed

Advanced module system topics

– Module Layer API

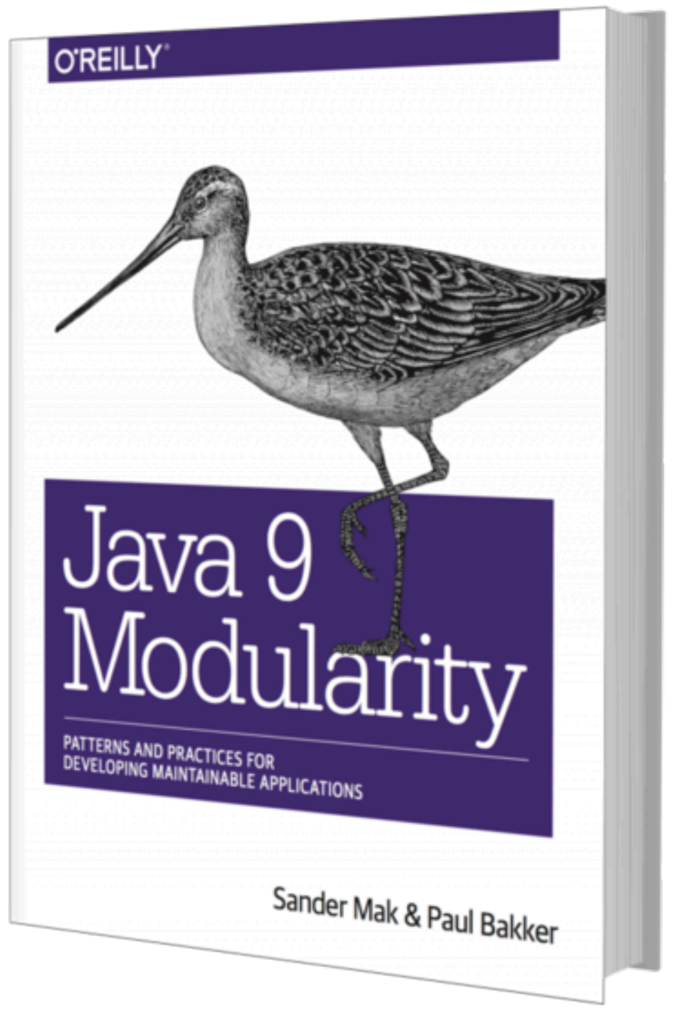
– Custom run-time images with jlink

– Resource loading with modules

– **Integration with build tools**

Additional Resources

Additional Resources


O'REILLY
Java 9 Modularity
PATTERNS AND PRACTICES FOR DEVELOPING MAINTAINABLE APPLICATIONS
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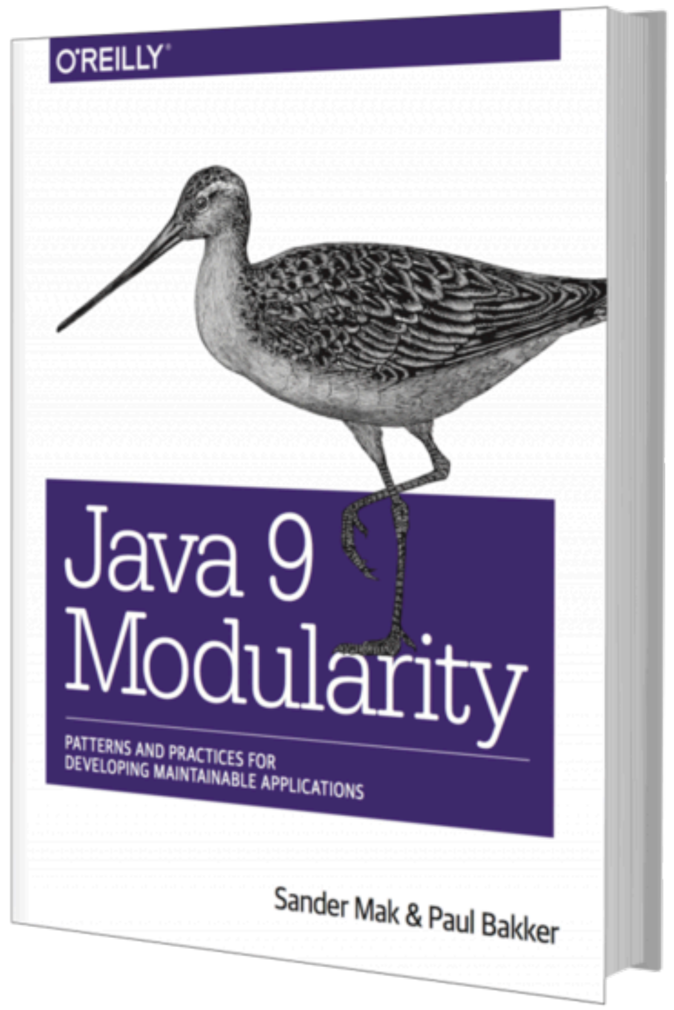
Additional Resources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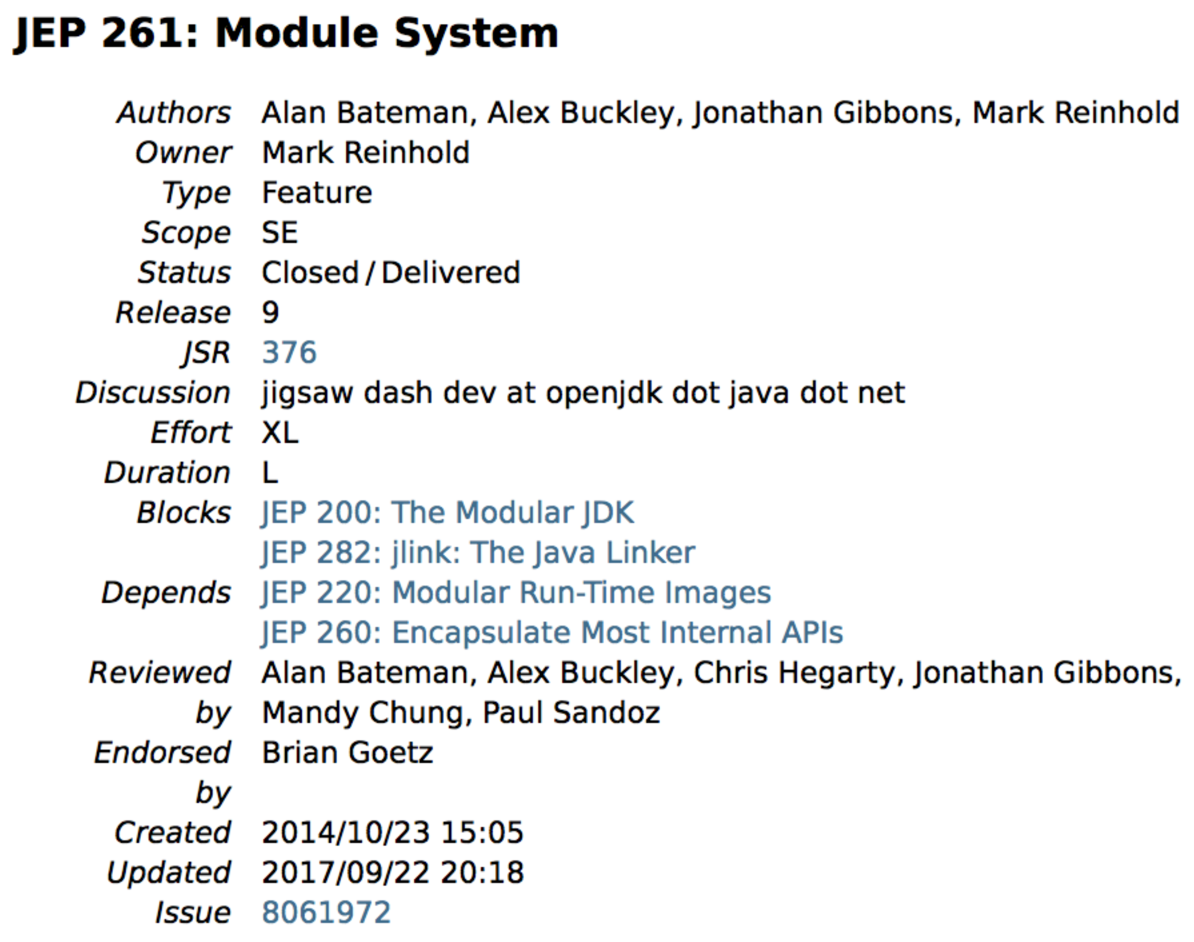

JEP 261: Module System

Authors	Alan Bateman, Alex Buckley, Jonathan Gibbons, Mark Reinhold
Owner	Mark Reinhold
Type	Feature
Scope	SE
Status	Closed / Delivered
Release	9
JSR	376
Discussion	jigsaw dash dev at openjdk dot java dot net
Effort	XL
Duration	L
Blocks	JEP 200: The Modular JDK JEP 282: jlink: The Java Linker
Depends	JEP 220: Modular Run-Time Images JEP 260: Encapsulate Most Internal APIs
Reviewed by	Alan Bateman, Alex Buckley, Chris Hegarty, Jonathan Gibbons, Mandy Chung, Paul Sandoz
Endorsed by	Brian Goetz
Created	2014/10/23 15:05
Updated	2017/09/22 20:18
Issue	8061972

openjdk.java.net/jeps/261

Additional Resources

What's New in Java {9,10,11}

Additional Resources

Additional Resources

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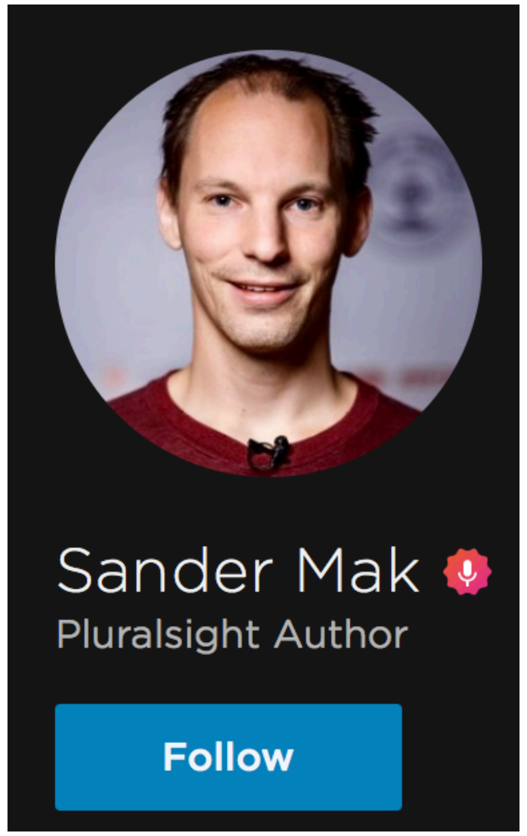

bit.ly/ps-sander