Modular Development with JDK 9

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February 2016

http://openjdk.java.net/projects/jigsaw

#Jfokus #Jigsaw

Introduction to Modular Development

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Background: Modularity Landscape

- Java Platform Module System
  - JSR 376, targeted for Java SE 9
- Java SE 9
  - JSR XXX, will own the modularization of the Java SE APIs
- OpenJDK Project Jigsaw
  - Reference implementation for JSR 376
  - JEP 200, 201, 220, 260, 261

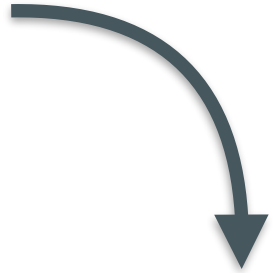
What is a module?

What is a module?

com.foo.bar

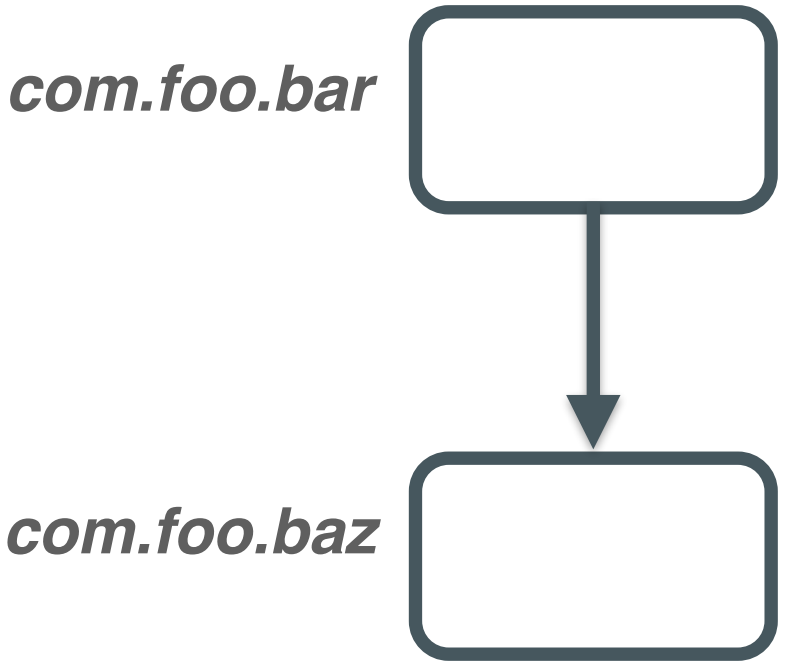
com.foo.bar.alpha.Alpha
com.foo.bar.alpha.AlphaFactory
com.foo.bar.beta.Beta
com.foo.bar.beta.BetaBlocker
:

```
module com.foo.bar {
}
```

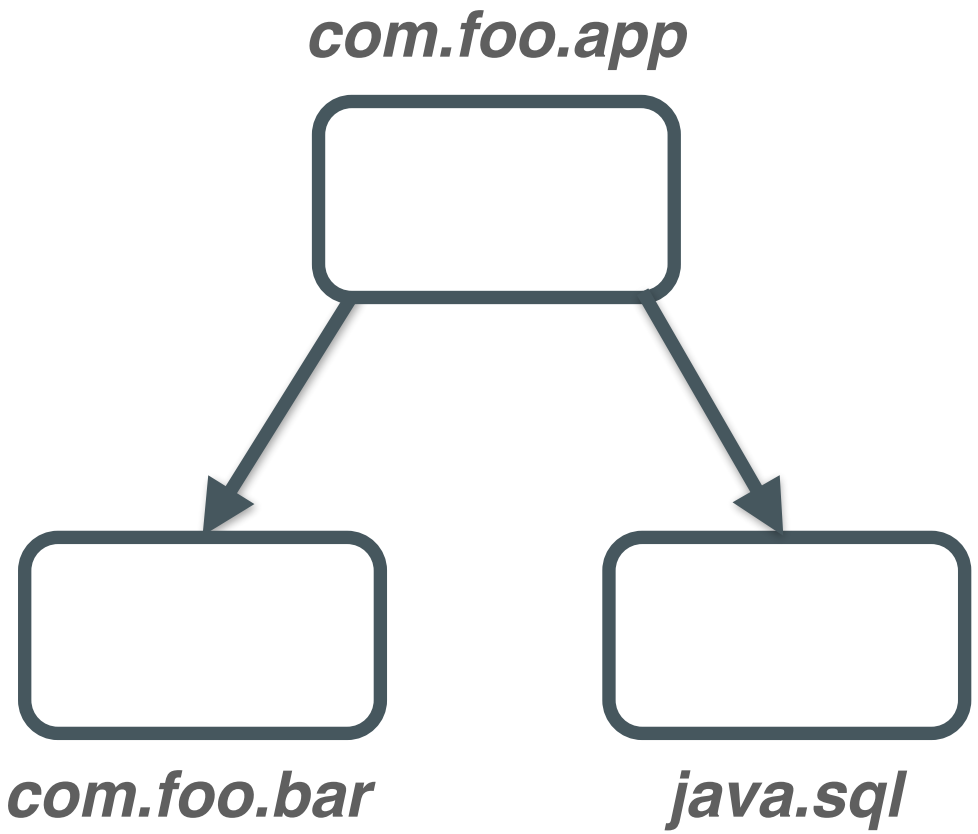


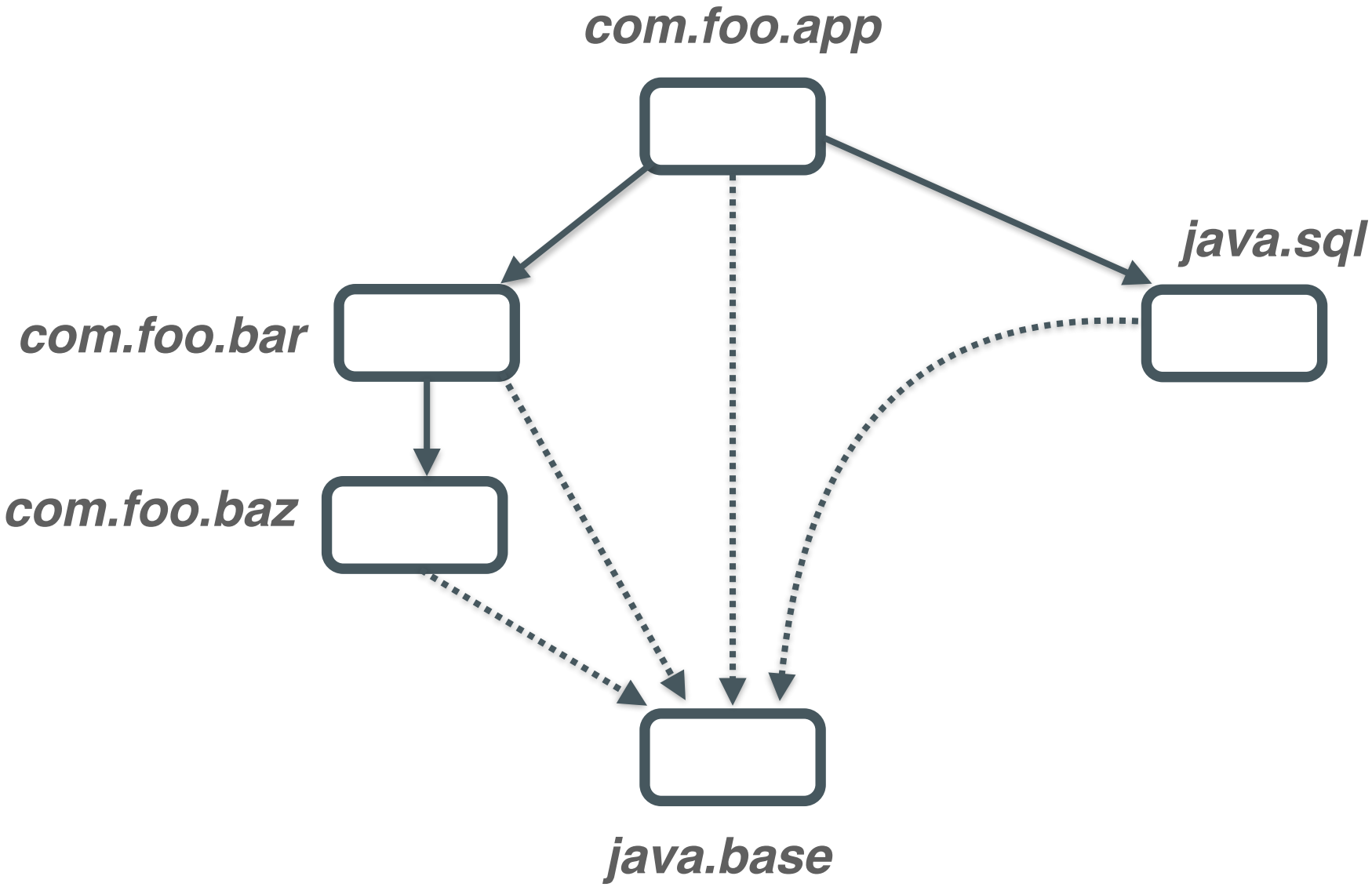
module-info.java
com/foo/bar/alpha/Alpha.java
com/foo/bar/alpha/AlphaFactory.java
com/foo/bar/beta/Beta.java
com/foo/bar/beta/BetaBlocker.java
:

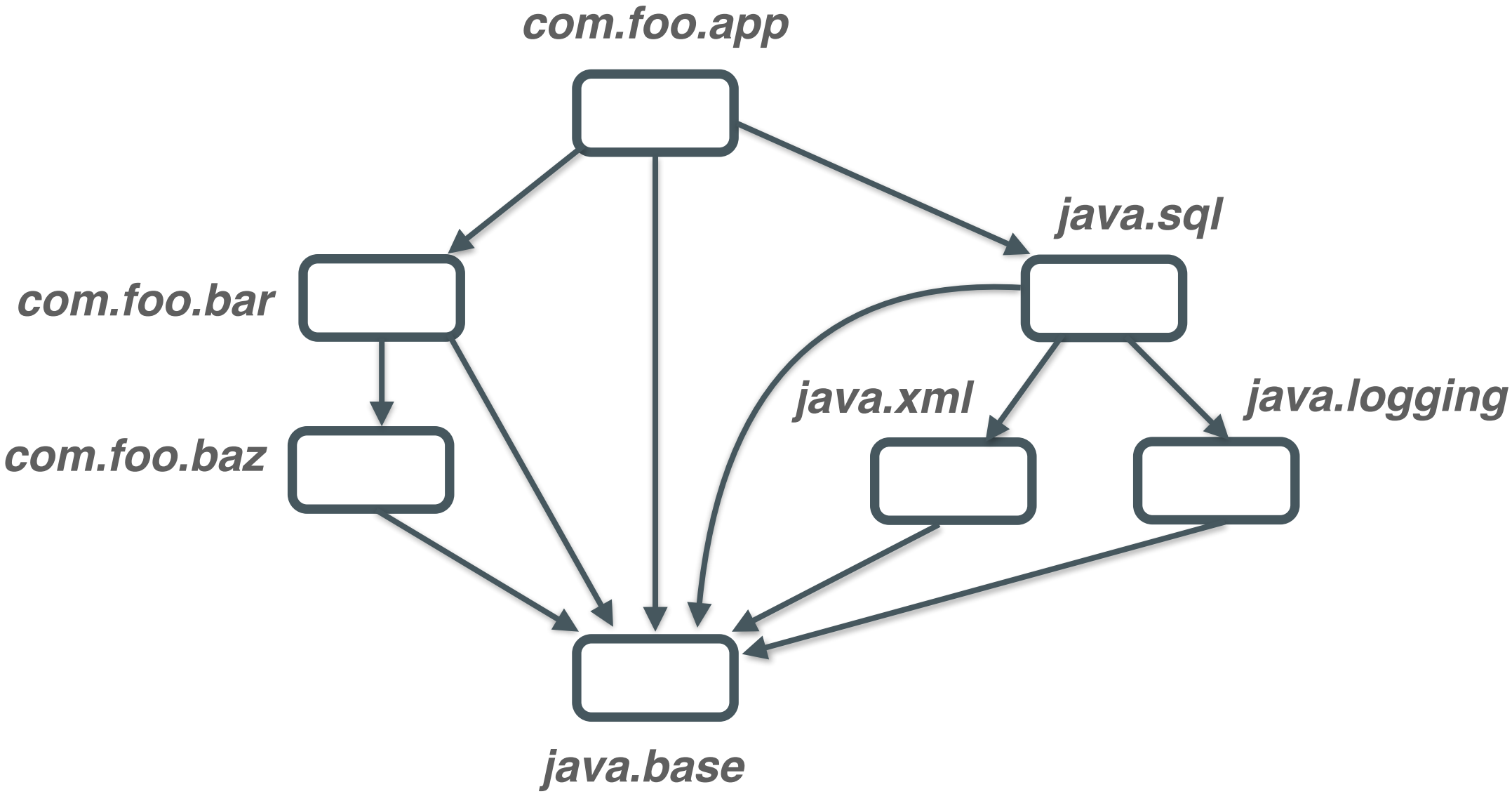
```
module com.foo.bar {
    requires com.foo.baz;
}
```

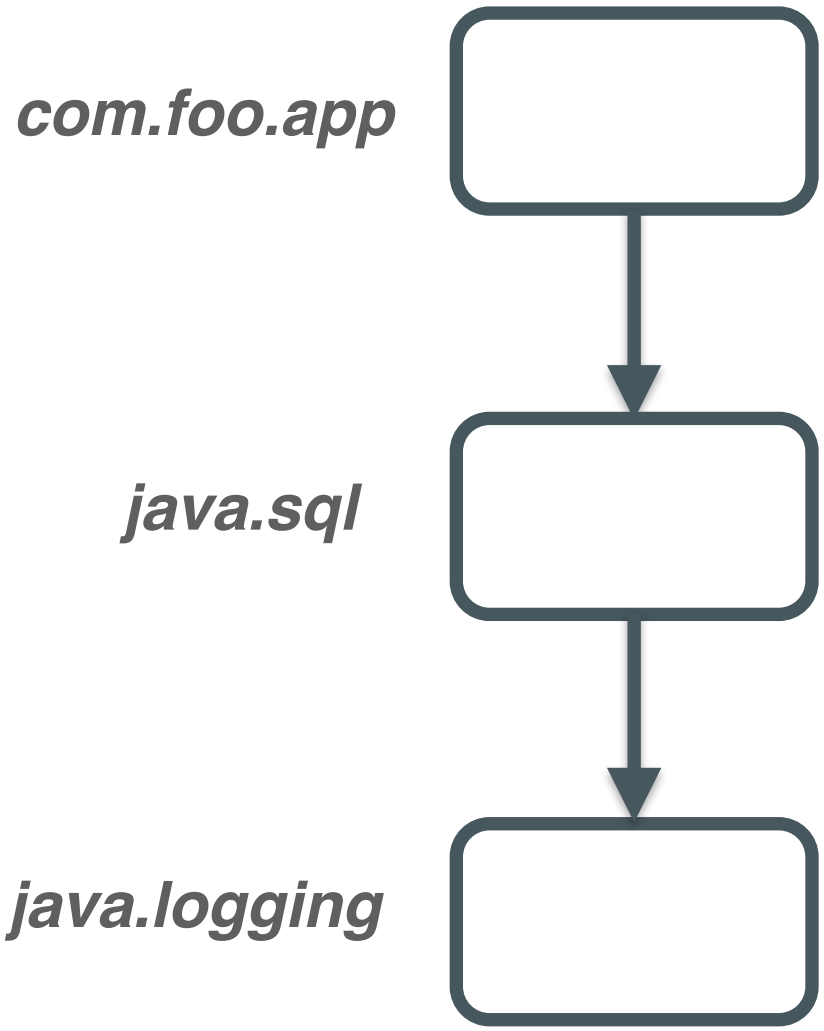


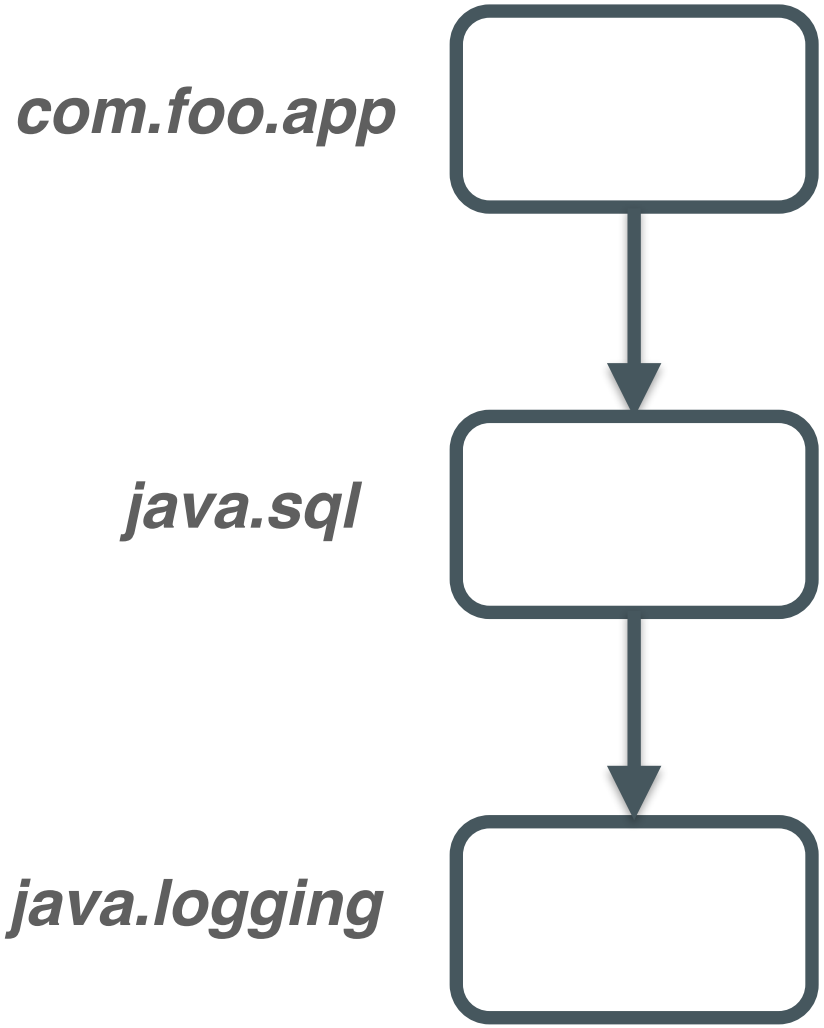
```
module com.foo.app {
    requires com.foo.bar;
    requires java.sql
}
```





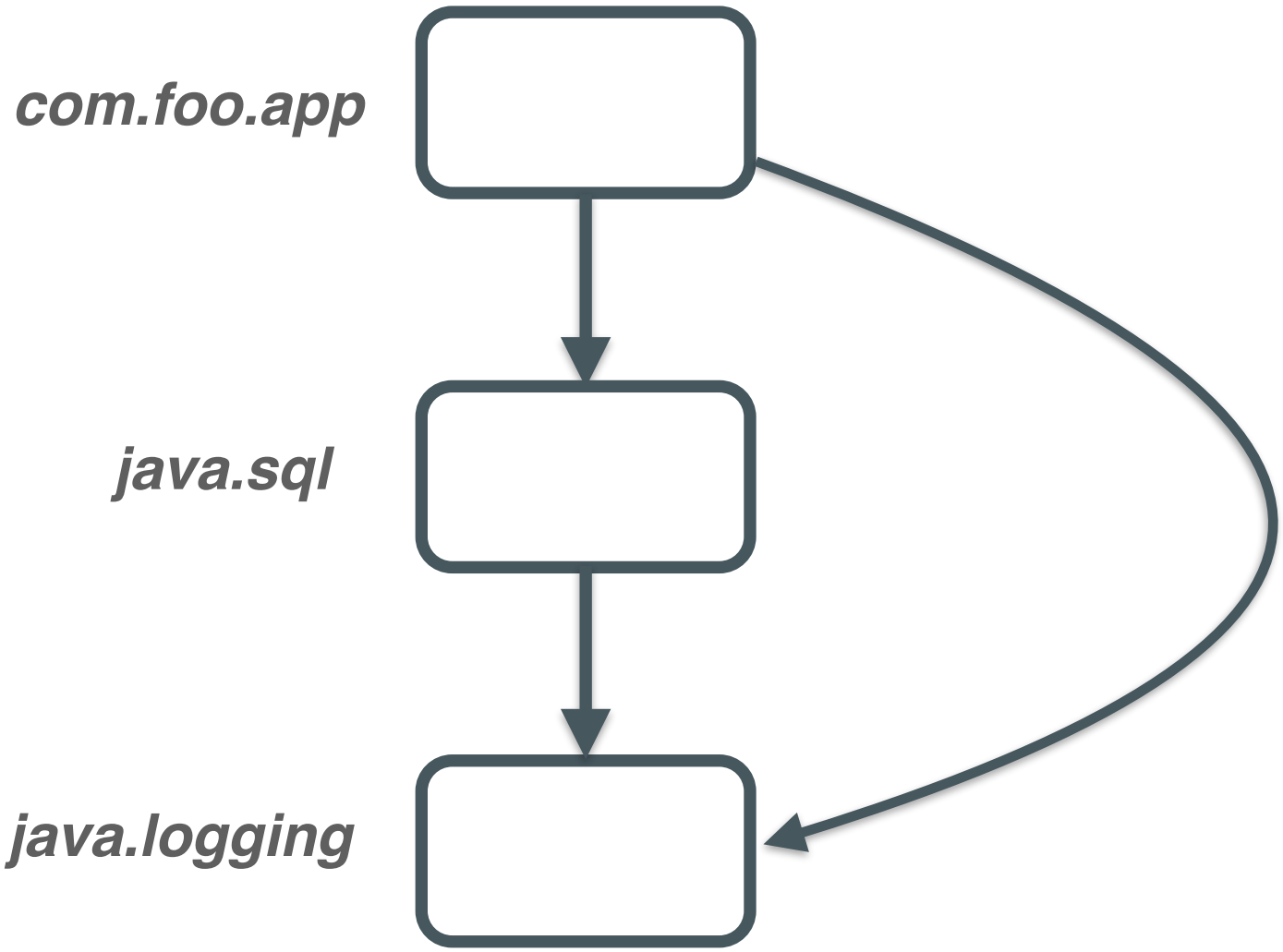


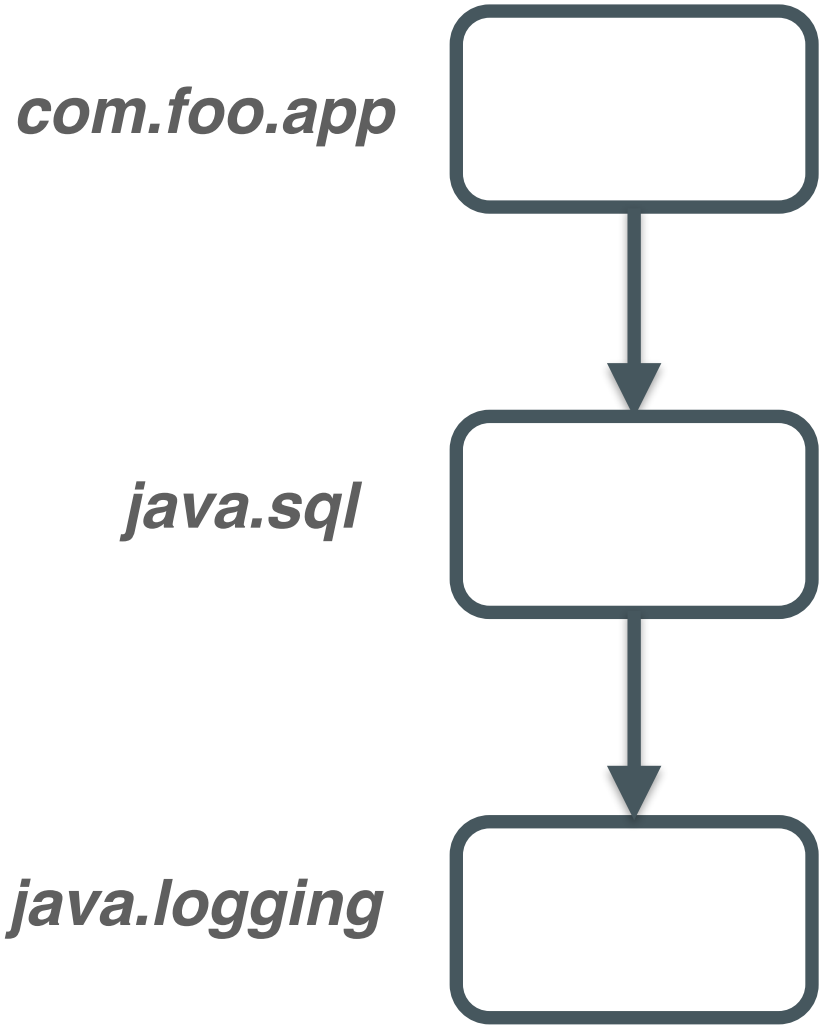




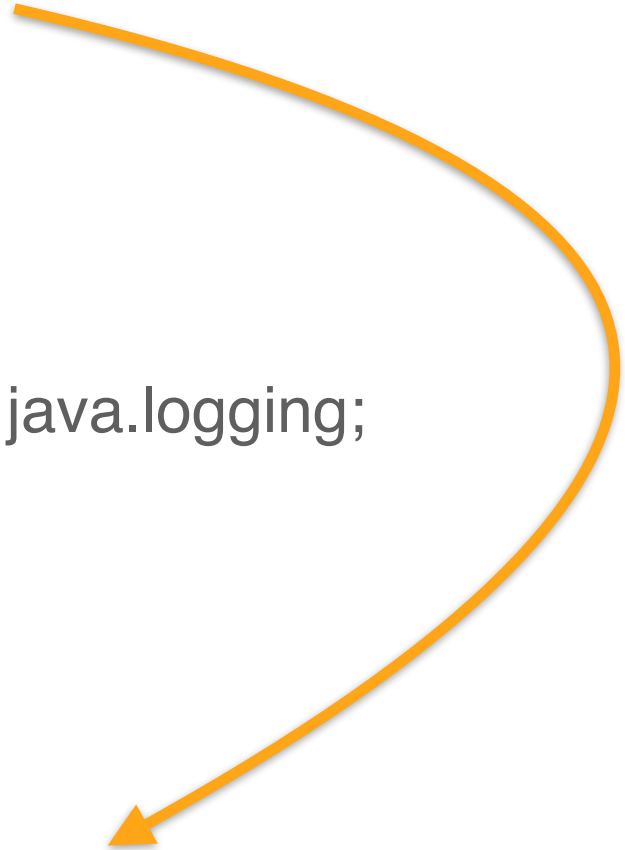
Driver d = …
d.getParentLogger().log(…)

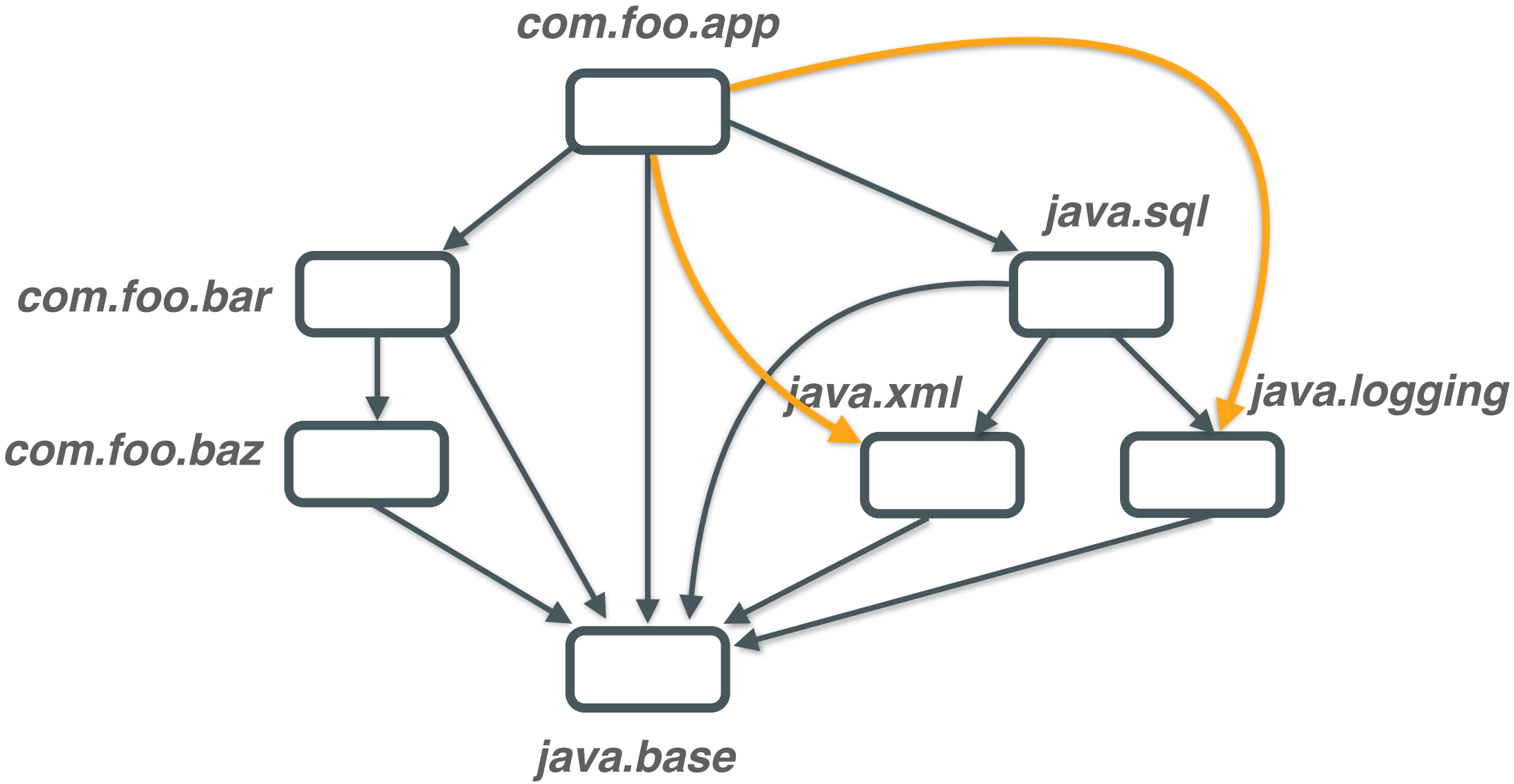
```
package java.sql;
import java.util.logging.Logger;

public class Driver {
    public Logger getParentLogger() { .. }
    :
}
```



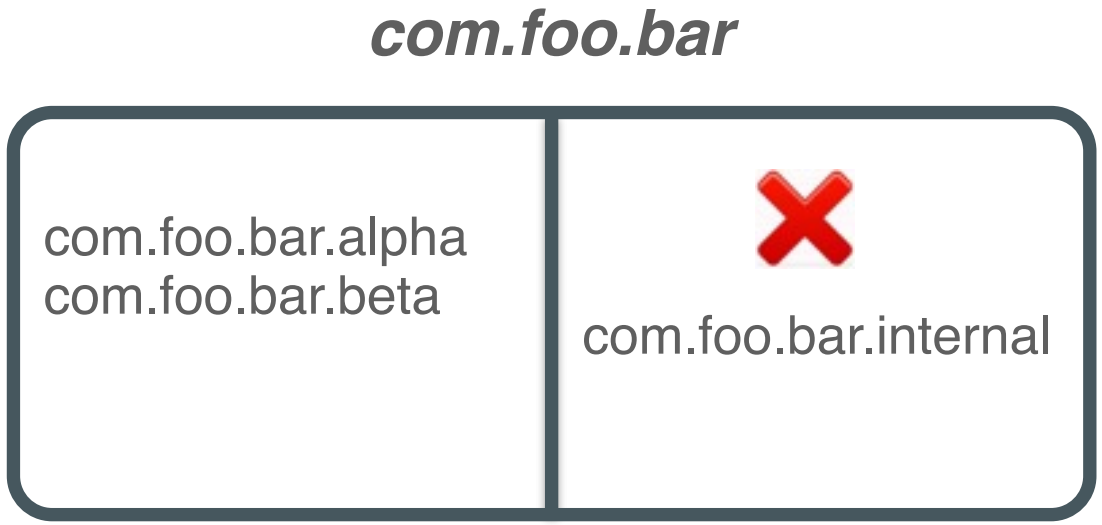



```
module java.sql {
        requires public java.logging;
        :
}
```

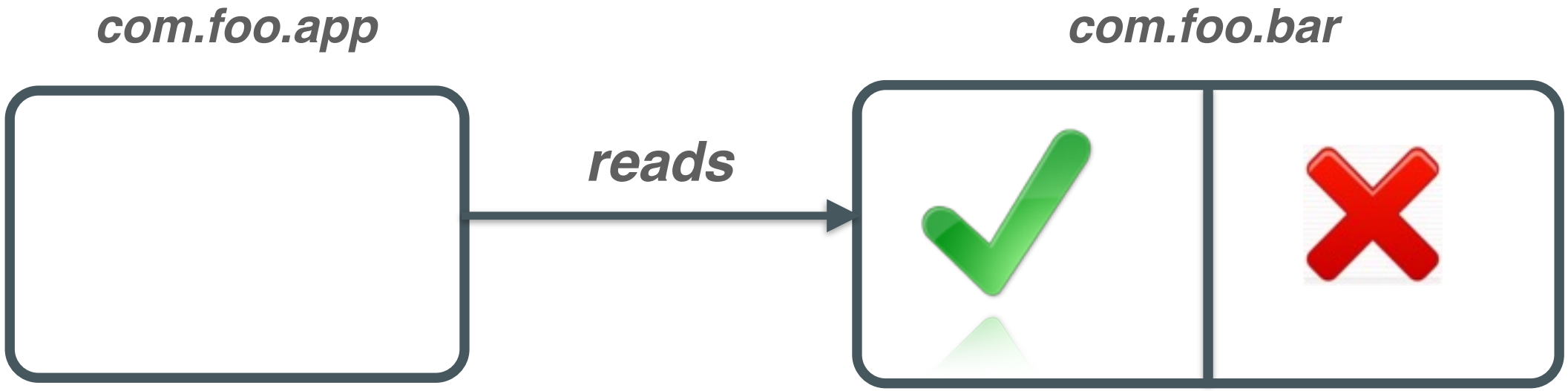




```
module com.foo.bar {
    exports com.foo.bar.alpha;
    exports com.foo.bar.beta;
}
```



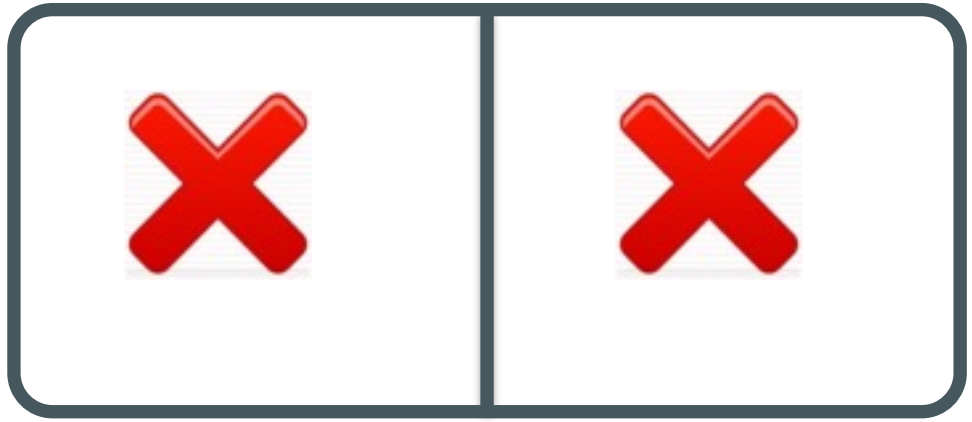
Accessibility



Accessibility

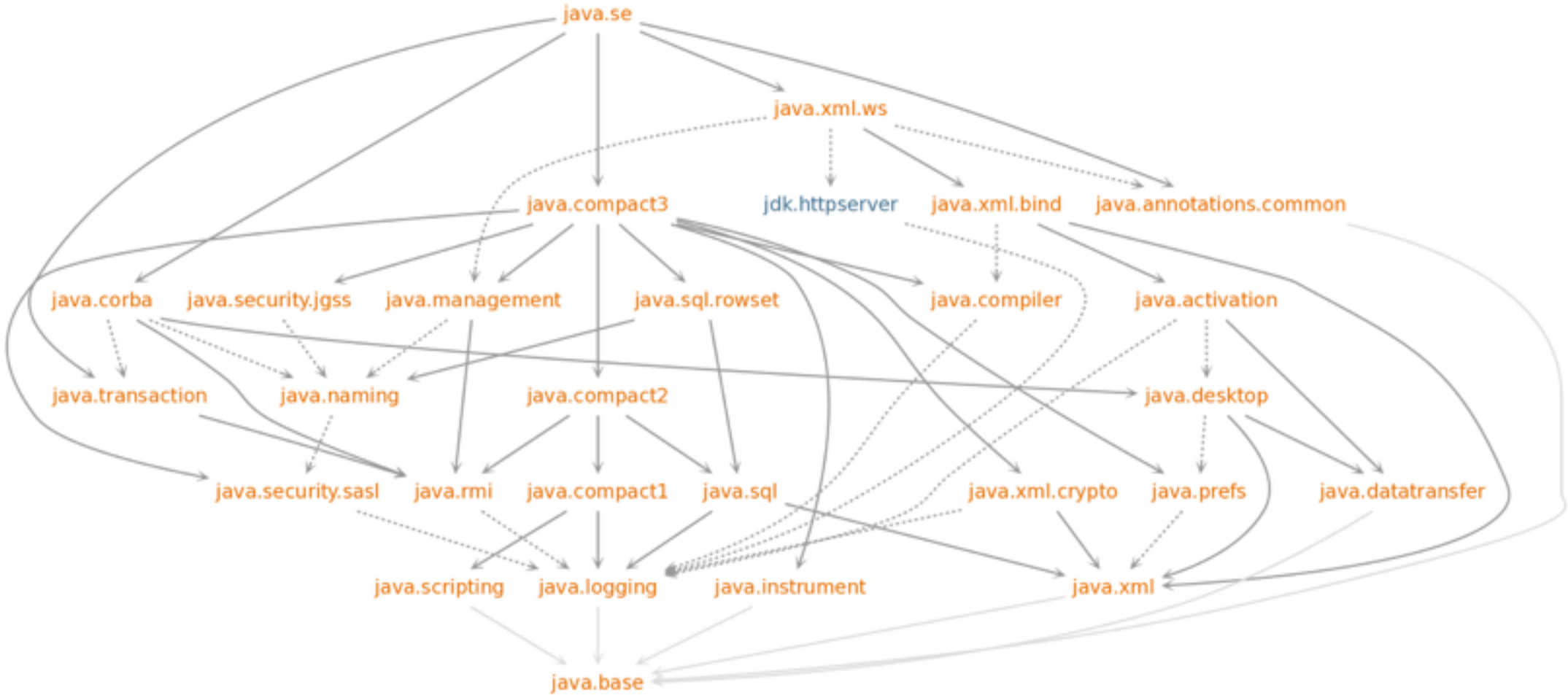
com.foo.app

com.foo.bar



public ⇏ accessible

Platform modules



$ java -listmods

```
java.activation@9
java.annotations.common@9
java.base@9
java.compact1@9
java.compact2@9
java.compact3@9
java.compiler@9
java.corba@9
java.datatransfer@9
java.desktop@9
java.instrument@9
java.logging@9
java.management@9
java.naming@9
java.prefs@9
java.rmi@9
java.scripting@9
java.se@9
java.security.jgss@9
java.security.sasl@9
java.smartcardio@9
java.sql@9
java.sql.rowset@9
java.transaction@9
java.xml@9
java.xml.bind@9
java.xml.crypto@9
java.xml.ws@9
jdk.attach@9
jdk.charsets@9
jdk.compiler@9
jdk.crypto.ec@9
jdk.crypto.pkcs11@9
jdk.hotspot.agent@9
jdk.httpserver@9
jdk.jartool@9
jdk.javadoc@9
jdk.jcmd@9
jdk.jconsole@9
jdk.jdeps@9
jdk.jdi@9
jdk.jdwp.agent@9
jdk.jlink@9
jdk.jvmstat@9
jdk.localedata@9
jdk.management@9
jdk.naming.dns@9
jdk.naming.rmi@9
jdk.pack200@9
jdk.policytool@9
jdk.rmic@9
jdk.scripting.nashorn@9
jdk.sctp@9
jdk.security.auth@9
jdk.security.jgss@9
jdk.xml.bind@9
jdk.xml.dom@9
jdk.xml.ws@9
jdk.zipfs@9
```

Compilation

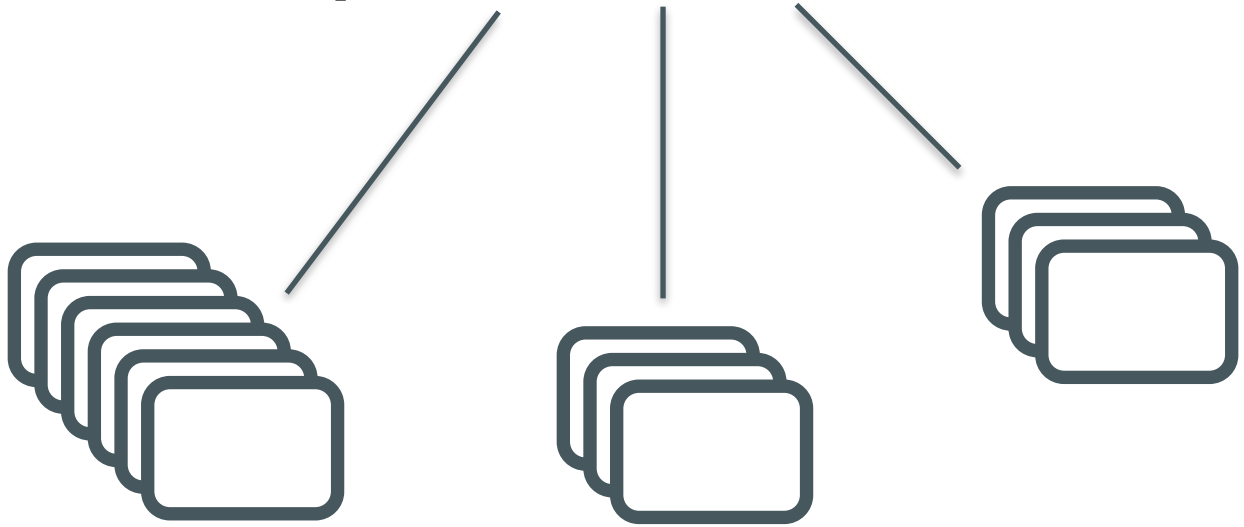
```
$ javac -d mods/com.foo.baz \
    src/com.foo.baz/module-info.java \
    src/com.foo.baz/com/foo/baz/Bazooka.java \
    :
```

src/com.foo.baz/module-info.java
src/com.foo.baz/com/foo/baz/Bazooka.java

mods/com.foo.baz/module-info.class
mods/com.foo.baz/com/foo/baz/Bazooka.class

module path

$ java **-modulepath dir1:dir2:dir3** …



Compilation

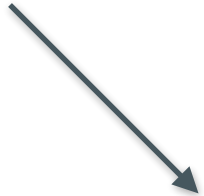
```
$ javac -modulepath mods -d mods/com.foo.bar \
    src/com.foo.bar/module-info.java \
    src/com.foo.bar/com/foo/bar/alpha/Alpha.class \
    :
```

src/com.foo.bar/module-info.java
src/com.foo.bar/com/foo/bar/alpha/Alpha.java
:

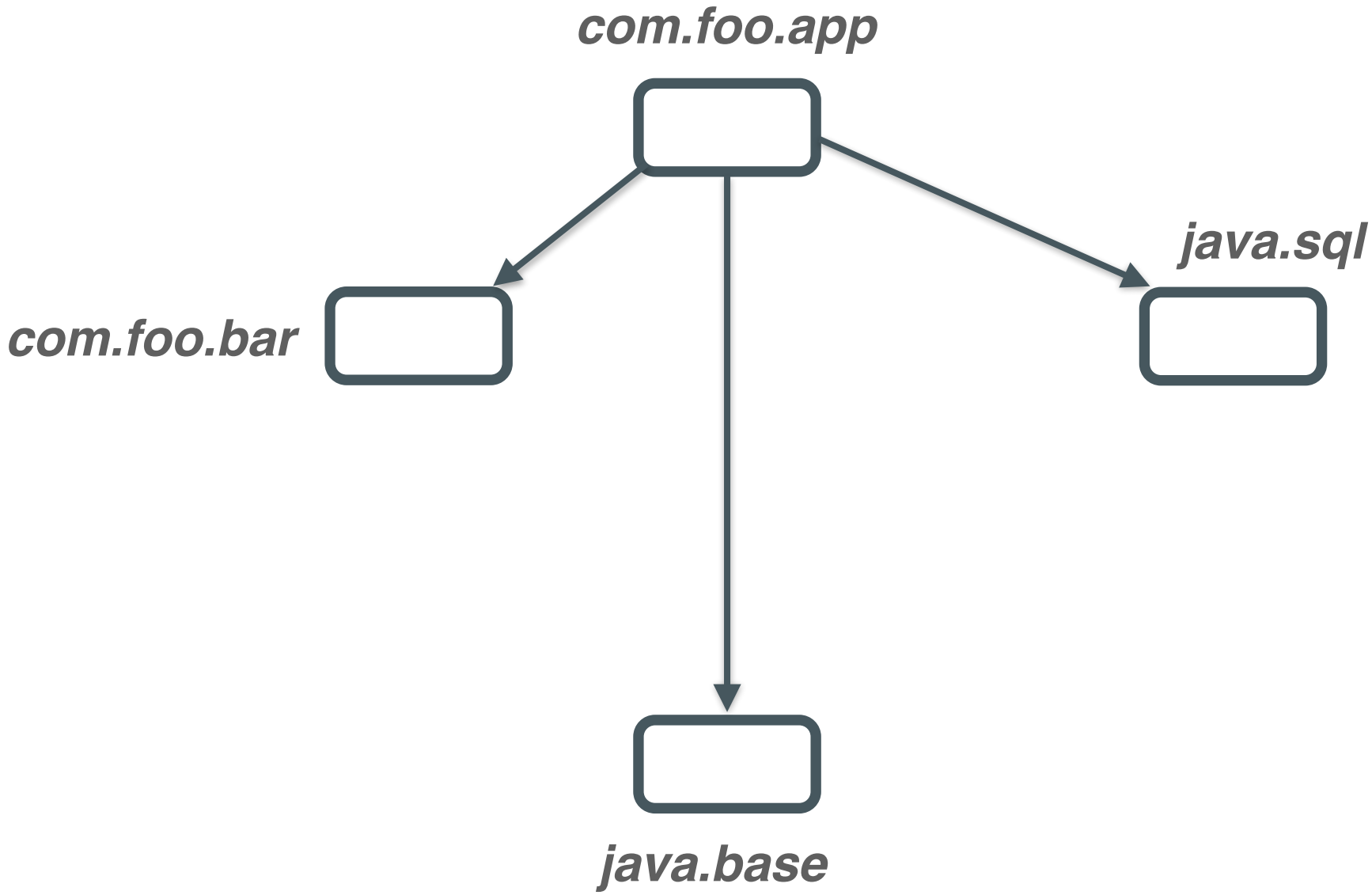
mods/com.foo.bar/module-info.class
mods/com.foo.bar/com/foo/bar/bar/Alpha.class
:

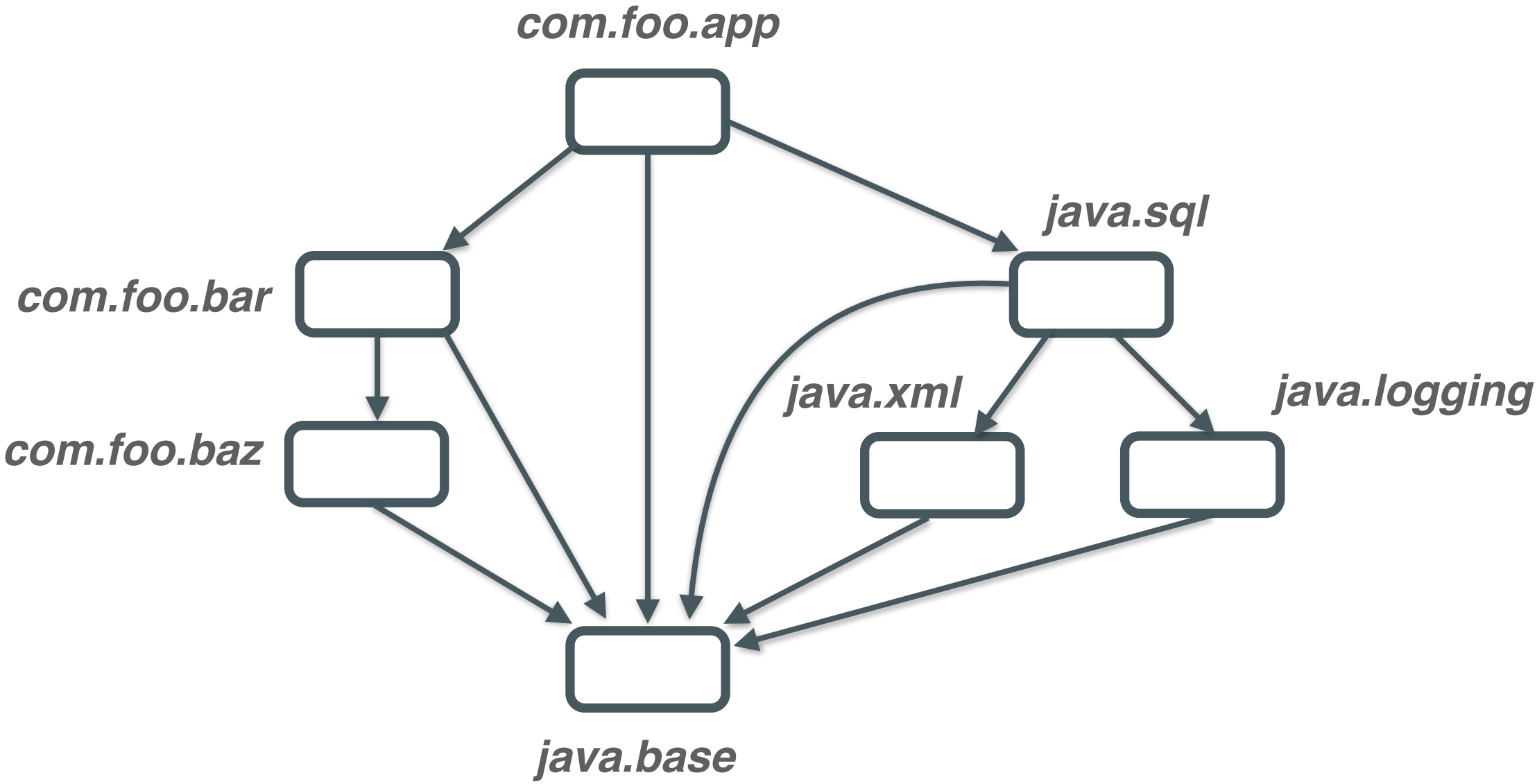
module name

main class



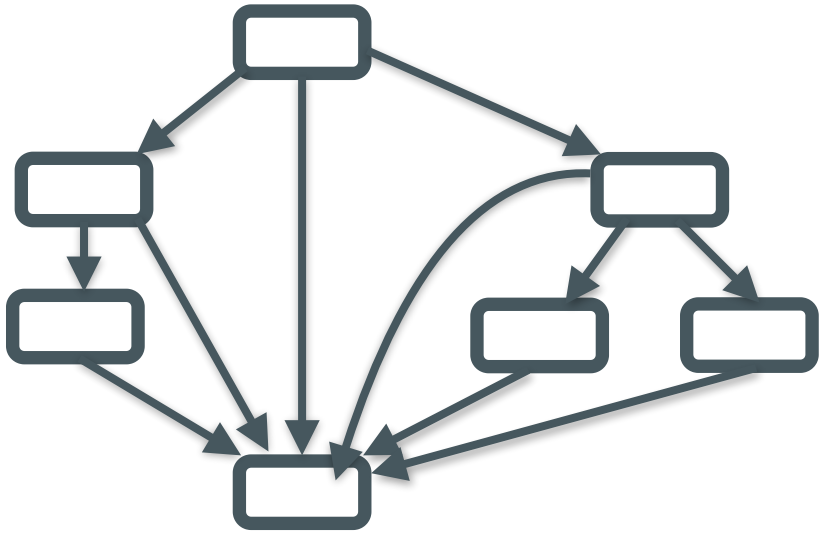
```
$ java -modulepath mods -m com.foo.app/com.foo.app.Main
Greetings from module com.foo.app!
```





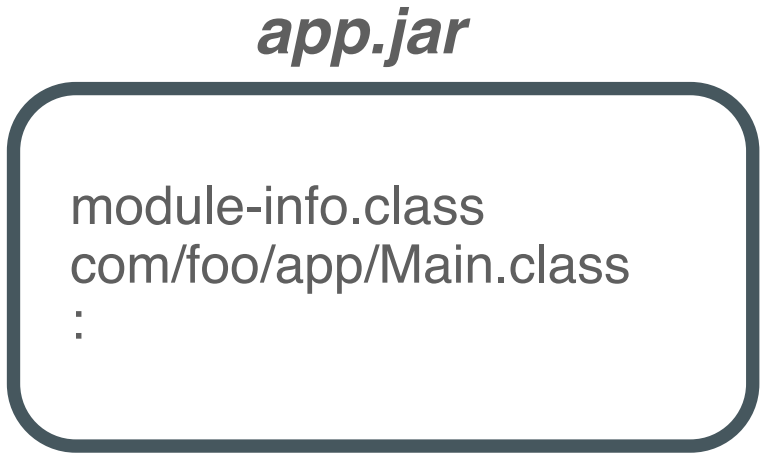
$ java **-Xdiag:resolver** -mp mods -m com.foo.app/com.foo.app.Main

```
[Resolve] Root module com.foo.app located
[Resolve]   (file:///d/mods/com.foo.app/)
[Resolve] Module com.foo.bar located, required by com.foo.app
[Resolve]   (file:///d/mods/com.foo.bar/)
[Resolve] Module java.base located, required by com.foo.app
[Resolve]   (jrt:/java.base)
[Resolve] Module java.sql located, required by com.foo.app
[Resolve]   (jrt:/java.sql)
[Resolve] Module com.foo.baz located, required by com.foo.bar
[Resolve]   (file:///d/mods/com.foo.baz/)
[Resolve] Module java.logging located, required by java.sql
[Resolve]   (jrt:/java.logging)
[Resolve] Module java.xml located, required by java.sql
[Resolve]   (jrt:/java.xml)
[Resolve] Resolve completed
[Resolve]   com.foo.app
[Resolve]   com.foo.bar
[Resolve]   com.foo.baz
[Resolve]   java.base
[Resolve]   java.logging
[Resolve]   java.sql
[Resolve]   java.xml
Greetings from module com.foo.app!
```



Packaging as modular JAR

mods/com.foo.app/module-info.class
mods/com.foo.app/com/foo/app/Main.class
:




```
$ jar --create --file mlib/app.jar \
    --main-class com.foo.app.Main \
     -C mods/com.foo.app .
```

```
$ jar --file mlib/app.jar -p

Name:
   com.foo.app
Requires:
   com.foo.bar
   java.base [ MANDATED ]
   java.sql
Main class:
   com.foo.app.Main
```

$ java **-mp mlib:mods** -m com.foo.app
Greetings from module com.foo.app!

classpath

com.foo.baz (mlib/baz.jar)

```
module-info.class
com/foo/baz/Bazooka.class
:
```

```
$ java -cp mlib/baz.jar:app.jar \
    com.foo.app.Main
```

module path

com.foo.baz (mlib/baz.jar)

```
module-info.class
com/foo/baz/Bazooka.class
:
```

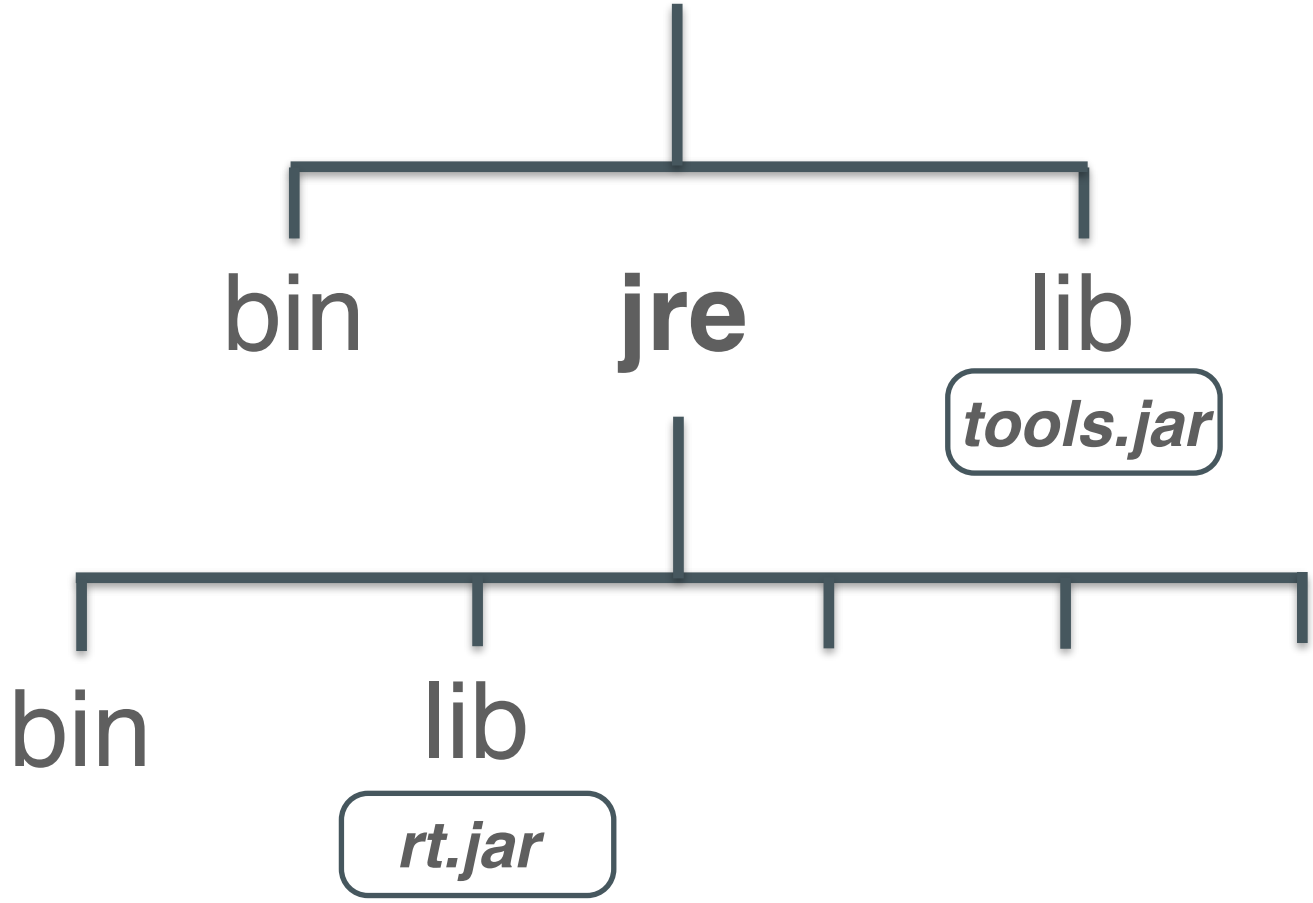
```
$ java -mp mlib -m myapp
```

classpath and module path

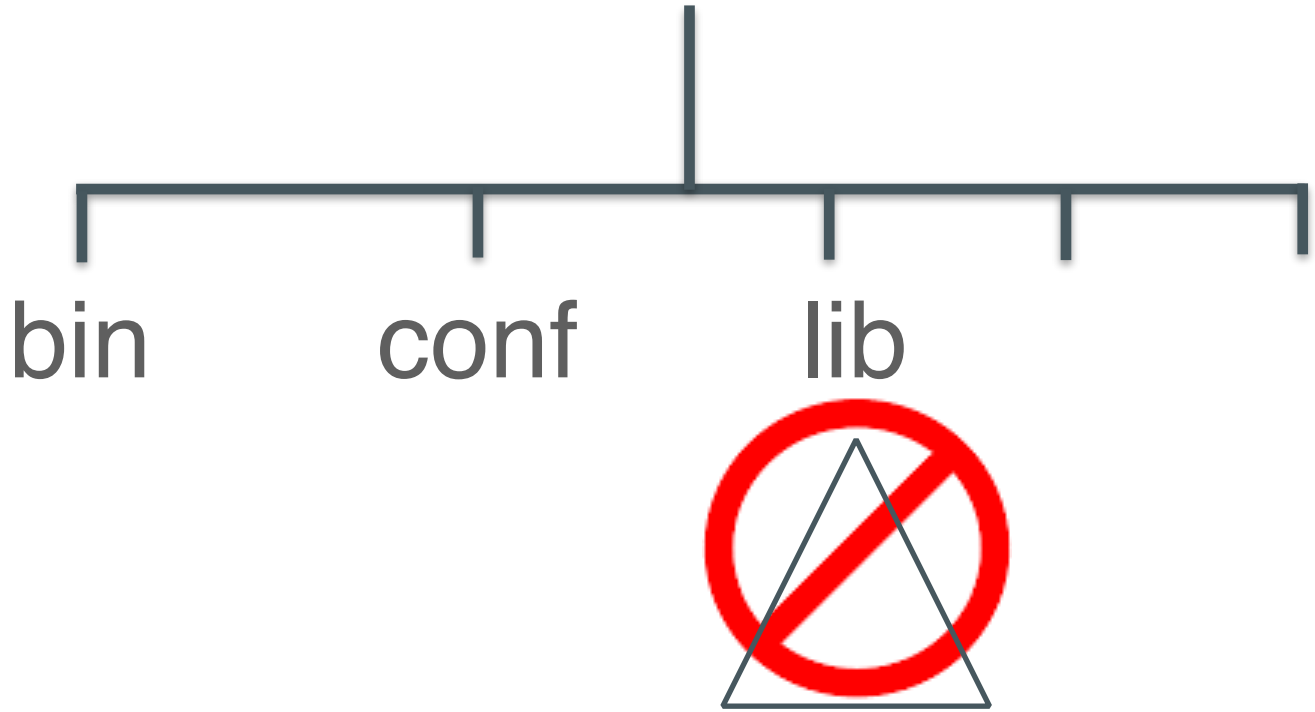
```
$ java -mp mlib -addmods com.foo.baz \
    -cp app.jar com.foo.app.Main
```

Linking

Legacy JDK image



Modular run-time image

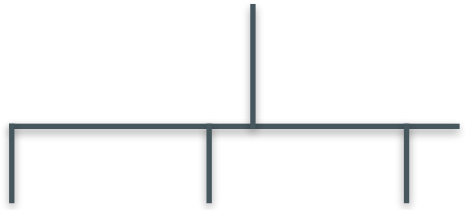


~~jre directory~~
~~rt.jar~~
~~tools.jar~~

Linking

jlink

modular
run-time
image



bin conf …

Linking

```
$ jlink --modulepath $JDKMODS --addmods java.base --output myimage

$ myimage/bin/java -listmods
java.base@9
```

Linking

```
$ jlink --modulepath $JDKMODS:$MYMODS --addmods com.foo.app --output myimage

$ myimage/bin/java -listmods
java.base@9
java.logging@9
java.sql@9
java.xml@9
com.foo.app
com.foo.bar
com.foo.baz
```

Summary

- Introduced basic concepts
- Introduced basic command lines to compile, run, package and link

More Information

OpenJDK Project Jigsaw page, this has links to all the JEPs

http://openjdk.java.net/projects/jigsaw/

mailto:jigsaw-dev@openjdk.java.net

Early Access Builds

http://openjdk.java.net/projects/jigsaw/ea

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Multi-module compilation

$ javac **-modulesourcepath src** -d mods $(find src -name “*.java”)

src/com.foo.app/module-info.java
src/com.foo.app/com/foo/app/Main/java
src/com.foo.bar/module-info.java
src/com.foo.bar/com/foo/bar/alpha/Alpha.java
src/com.foo.baz/module-info.java
src/com.foo.baz/com/foo/baz/Bazooka.java

:

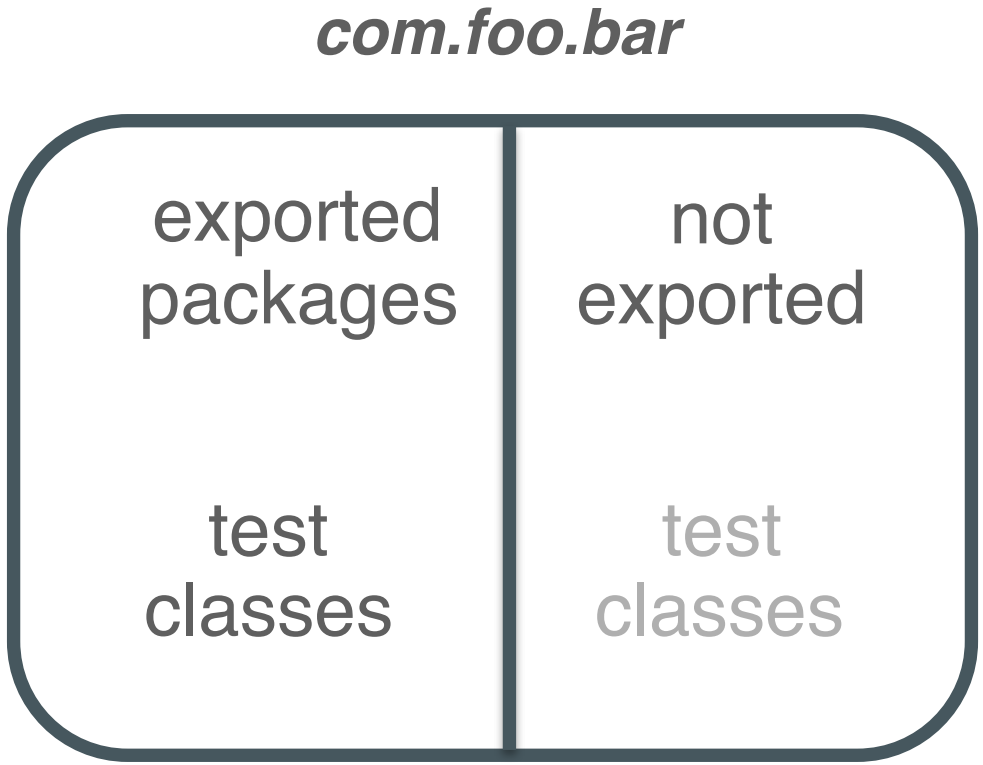
mods/com.foo.app/module-info.class
mods/com.foo.app/com/foo/app/Main.class
mods/com.foo.baz/module-info.class
mods/com.foo.baz/com/foo/baz/Bazooka.class
mods/com.foo.bar/module-info.class
mods/com.foo.bar/com/foo/bar/bar/Alpha.class
:

Testing

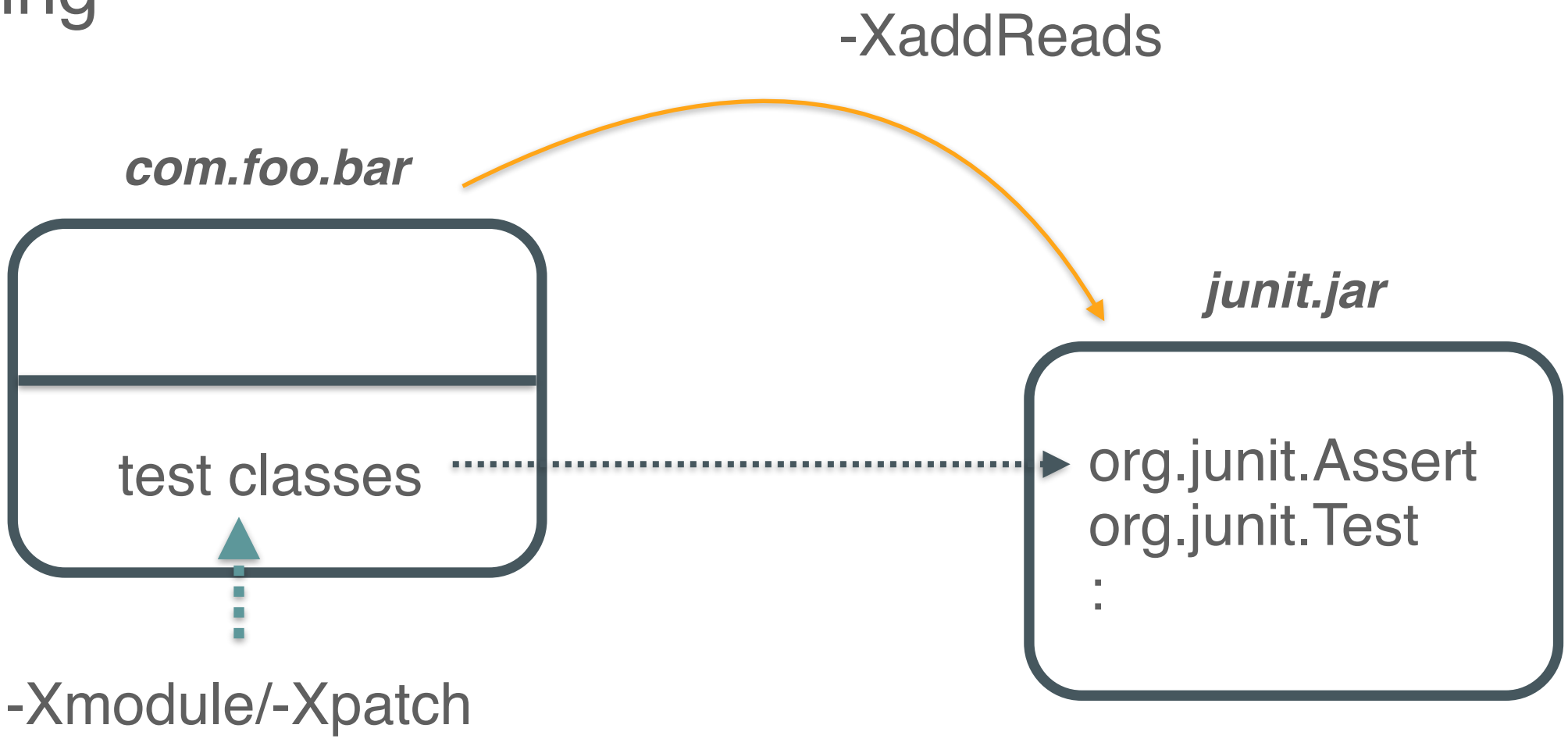
```
$ javac -cp lib/junit.jar -mp mods -d testclasses \
    test/com/foo/bar/alpha/test/AlphaTest.java

$ java -cp lib/junit.jar:testclasses -mp mods -addmods com.foo.bar \
    org.junit.runner.JUnitCore com.foo.bar.alpha.test.AlphaTest
```

Testing



Testing



Testing

```
$ javac -cp lib/junit.jar -mp mods -d testmods/com.foo.bar
    -Xmodule:com.foo.bar \
    test/com.foo.bar/com/foo/bar/alpha/AlphaTest.java

$ java -cp lib/junit.jar -mp mods -addmods com.foo.bar \
    -Xpatch:testmods -XaddReads:com.foo.bar=ALL-UNNAMED \
    org.junit.runner.JUnitCore com.foo.bar.alpha.AlphaTest
```