

Introduction to Modular Development

CON5118

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Sessions

- 1 Prepare for JDK 9
- 2 Introduction to Modular Development
- 3 Advanced Modular Development
- 4 Project Jigsaw: Under the Hood
- 5 Project Jigsaw Hack Session

What is a module?

com.foo.bar

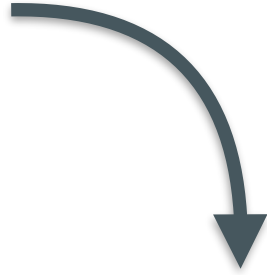


What is a module?

com.foo.bar

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

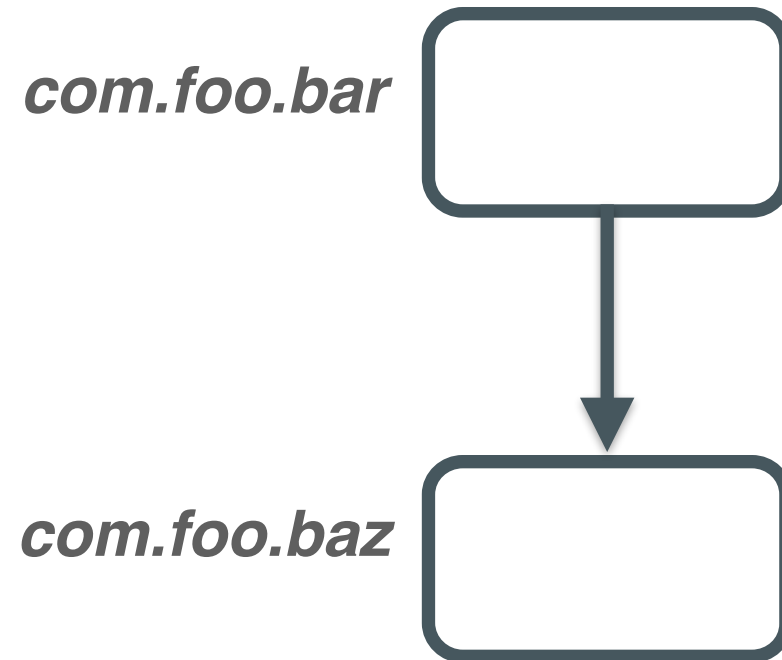
```
module com.foo.bar {  
}
```



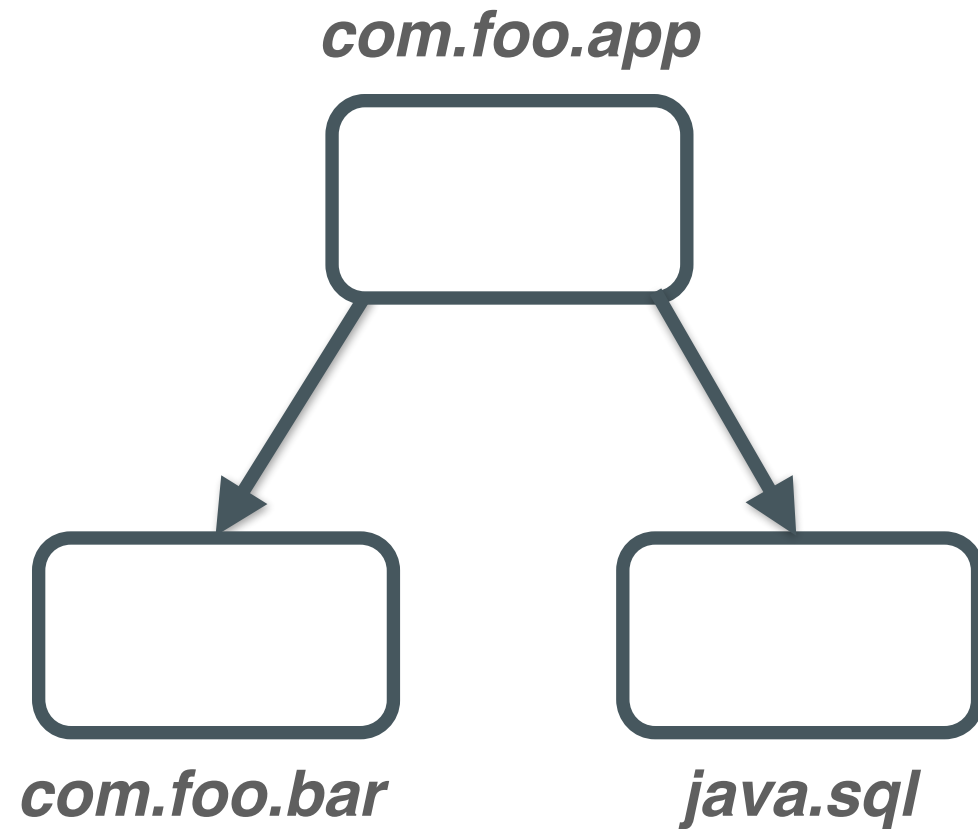
module-info.java

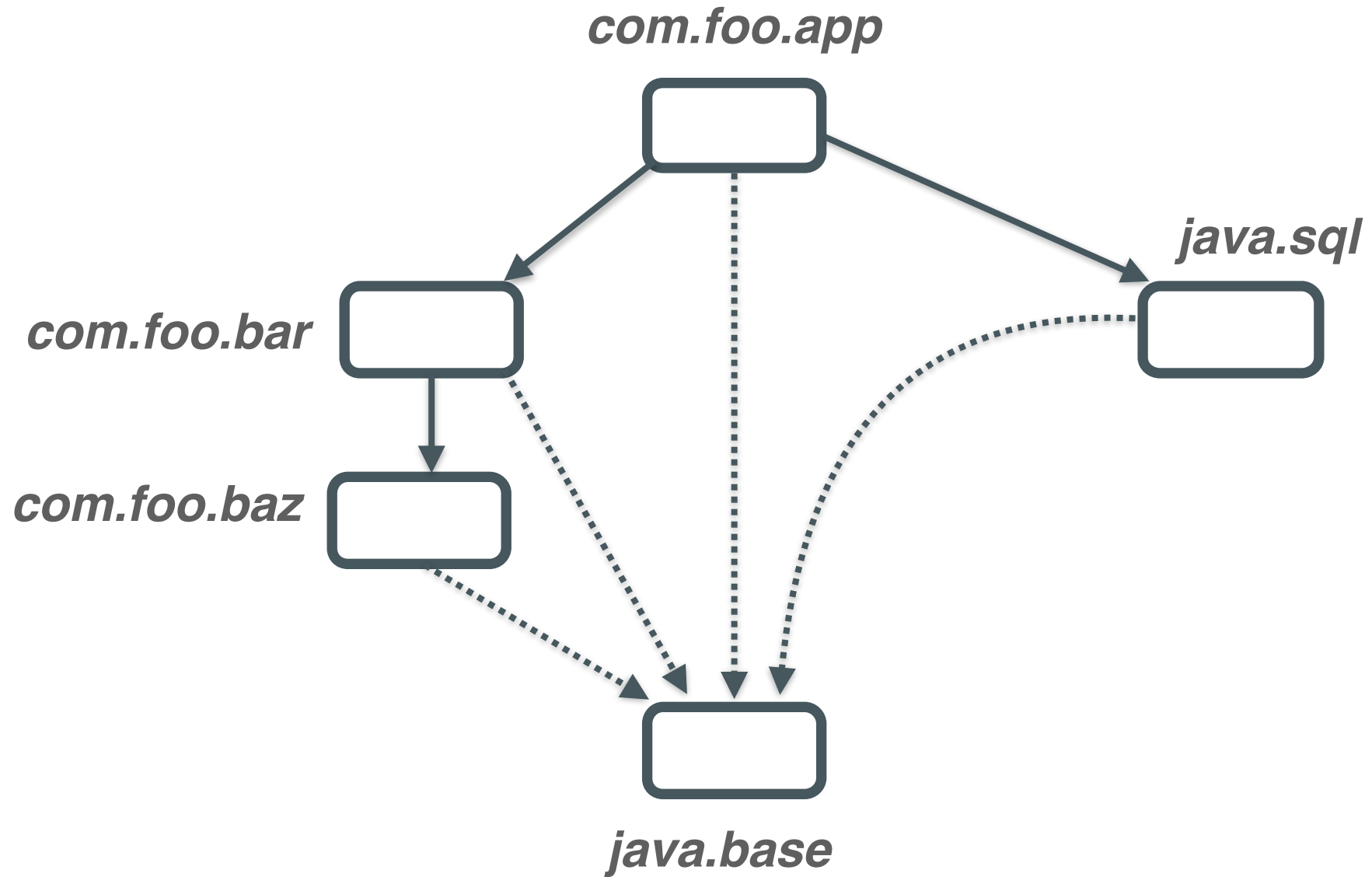
```
com/foo/bar/alpha/Alpha.java  
com/foo/bar/alpha/AlphaFactory.java  
com/foo/bar/beta/Beta.java  
com/foo/bar/beta/BetaBlocker.java  
:
```

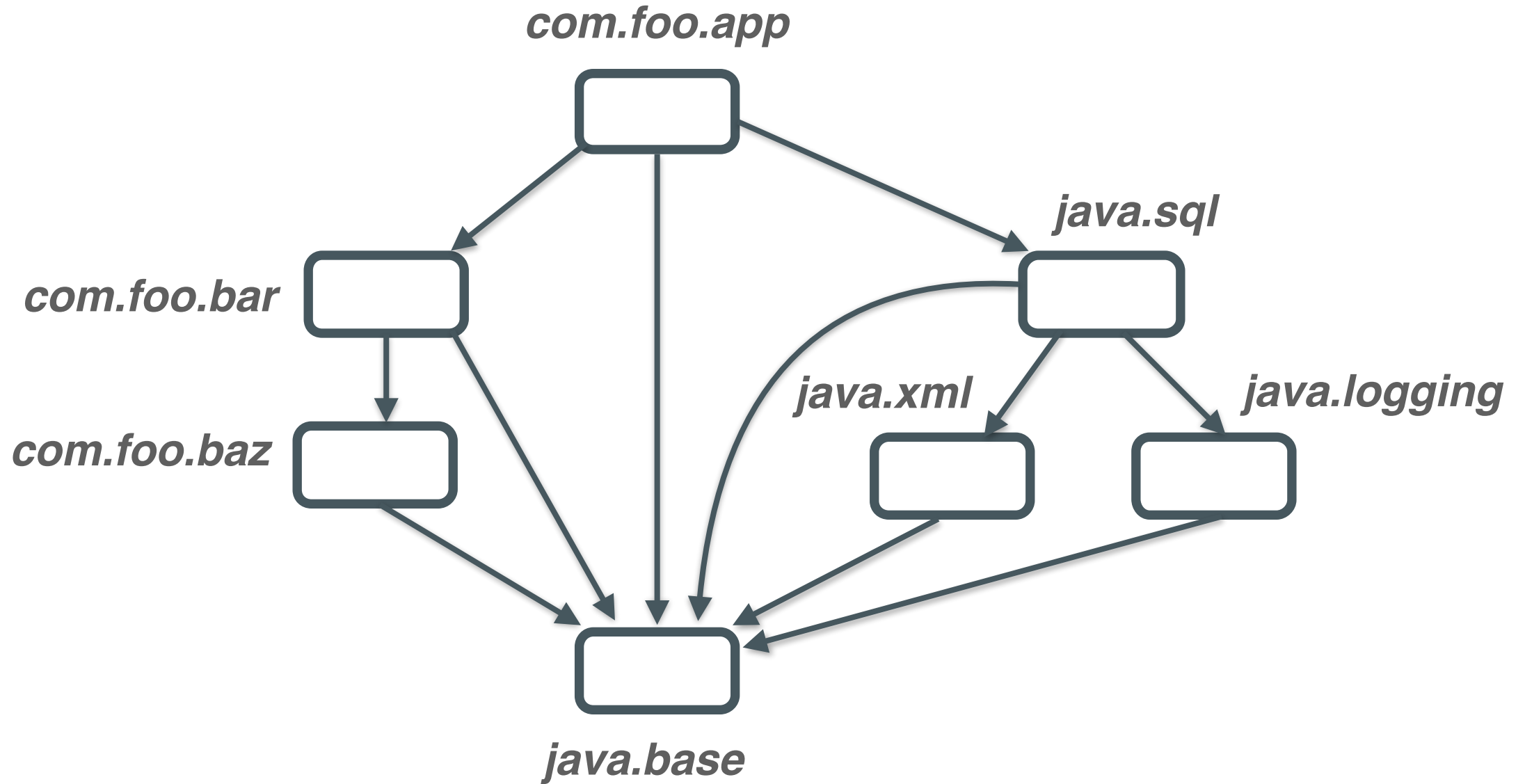
```
module com.foo.bar {  
    requires com.foo.baz;  
}
```



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







com.foo.app



java.sql



java.logging



com.foo.app



java.sql



java.logging



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

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

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

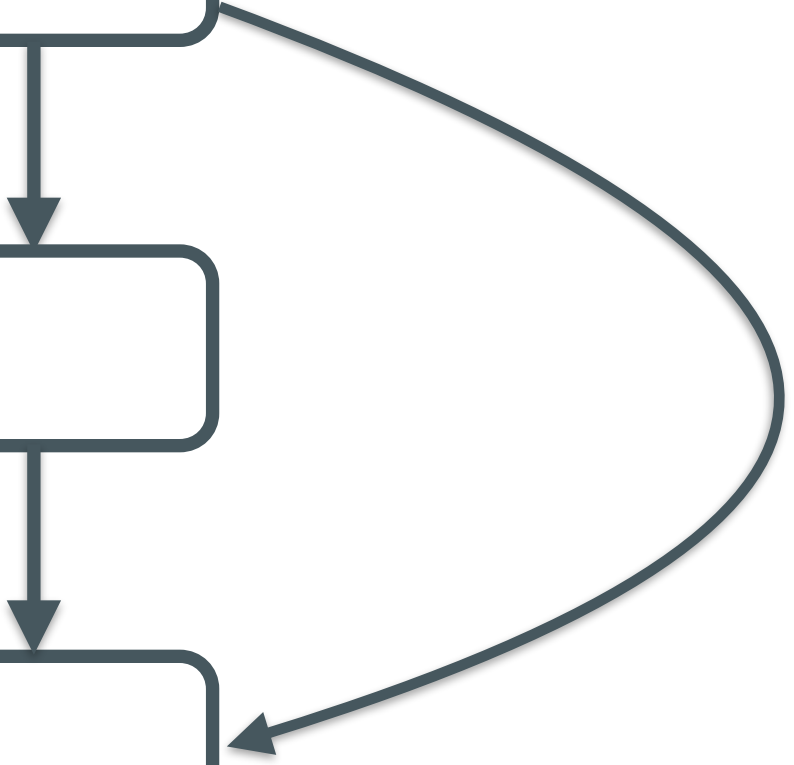
com.foo.app



java.sql



java.logging



com.foo.app



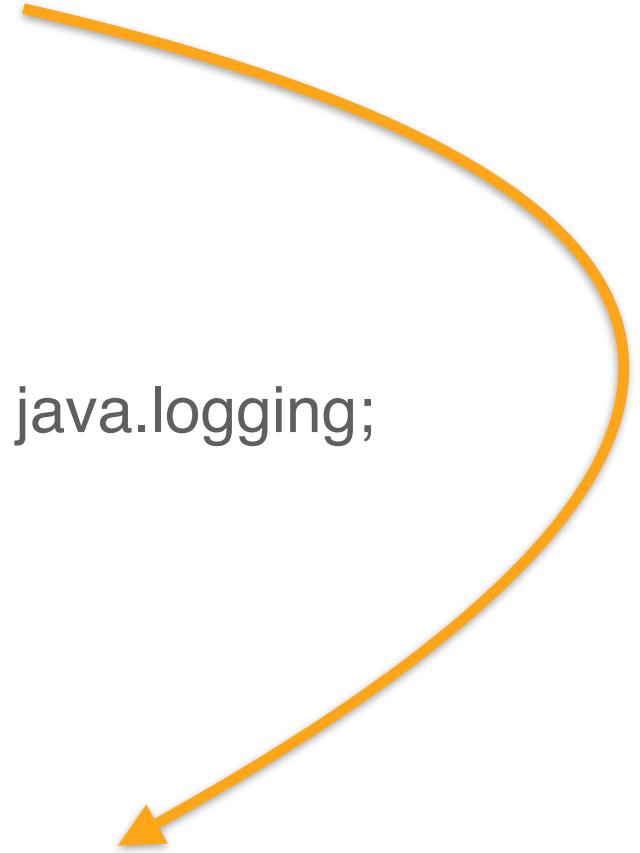
java.sql

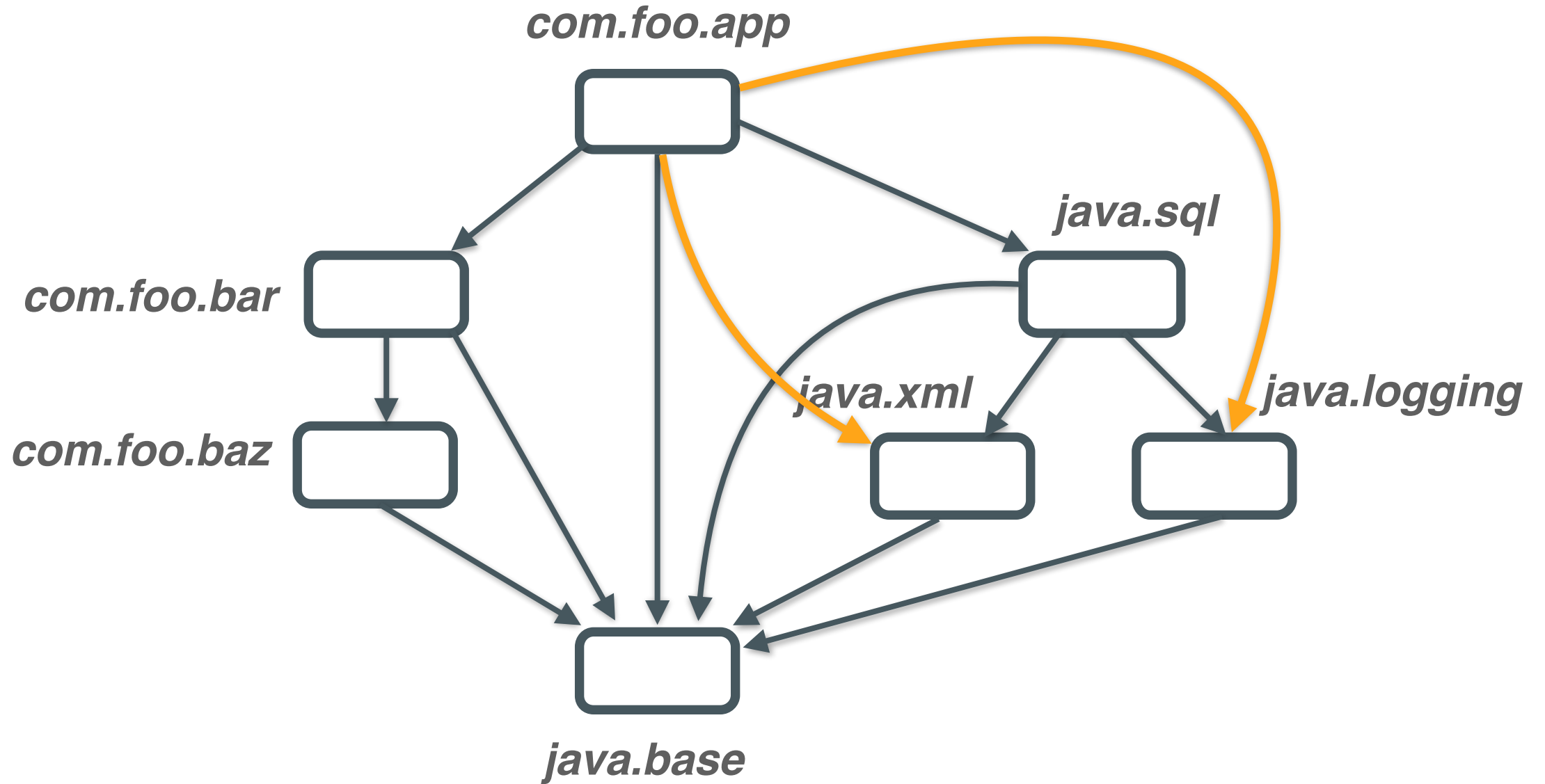


java.logging



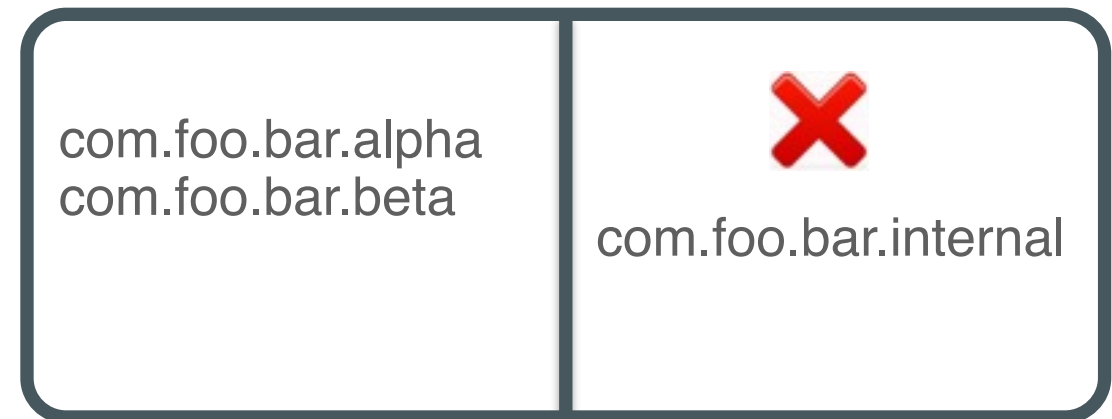
```
module java.sql {  
    requires public java.logging;  
    :  
}
```



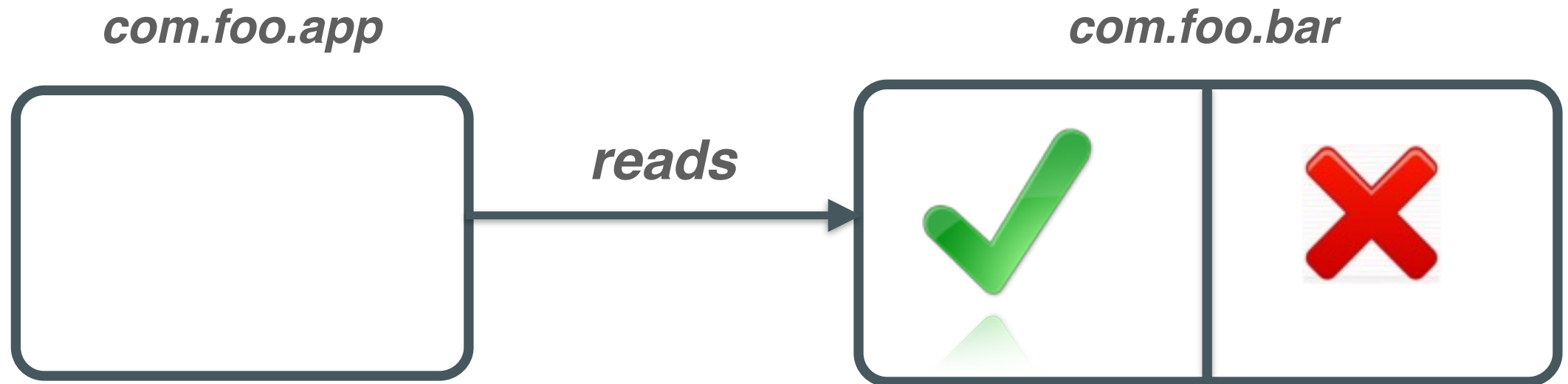


```
module com.foo.bar {  
    exports com.foo.bar.alpha;  
    exports com.foo.bar.beta;  
}
```

com.foo.bar



Accessibility

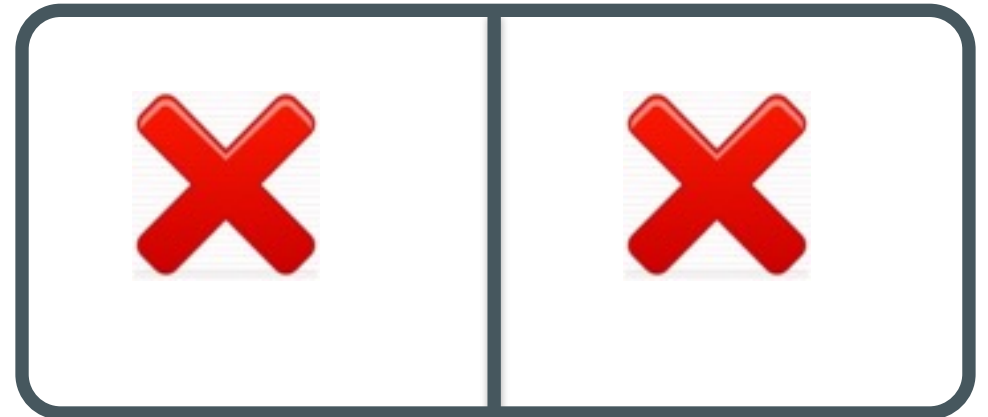


Accessibility

com.foo.app

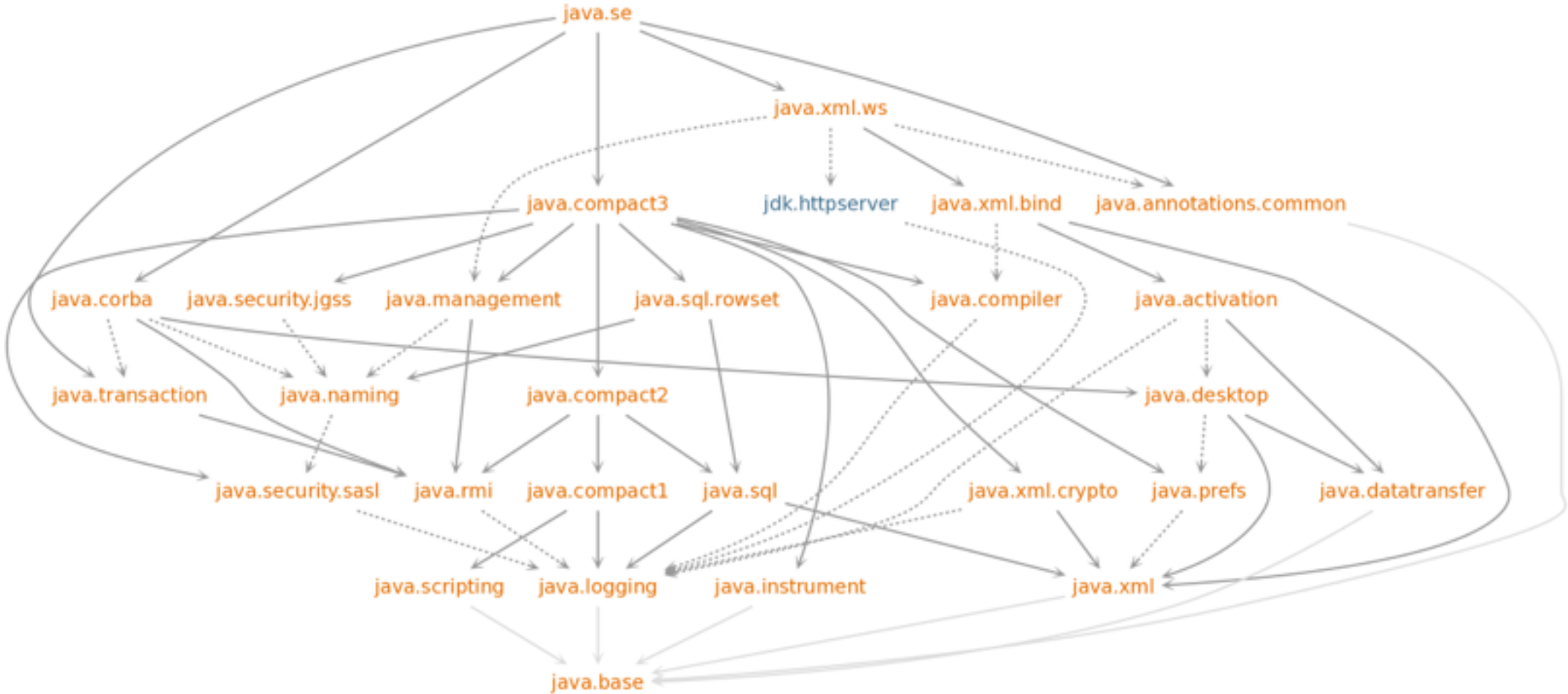


com.foo.bar



public \Rightarrow accessible

Platform modules



\$ java -listmods

```
java.activation@9.0
java.annotations.common@9.0
java.base@9.0
java.compact1@9.0
java.compact2@9.0
java.compact3@9.0
java.compiler@9.0
java.corba@9.0
java.datatransfer@9.0
java.desktop@9.0
java.instrument@9.0
java.logging@9.0
java.management@9.0
java.naming@9.0
java.prefs@9.0
java.rmi@9.0
java.scripting@9.0
java.se@9.0
java.security.jgss@9.0
java.security.sasl@9.0
java.smartcardio@9.0
java.sql@9.0
java.sql.rowset@9.0
java.transaction@9.0
java.xml@9.0
java.xml.bind@9.0
java.xml.crypto@9.0
java.xml.ws@9.0
jdk.attach@9.0
jdk.charsets@9.0
jdk.compiler@9.0
jdk.crypto.ec@9.0
jdk.crypto.pkcs11@9.0
jdk.hotspot.agent@9.0
jdk.httpserver@9.0
jdk.jartool@9.0
jdk.javadoc@9.0
jdk.jcmd@9.0
jdk.jconsole@9.0
jdk.jdeps@9.0
jdk.jdi@9.0
jdk.jdwp.agent@9.0
jdk.jlink@9.0
jdk.jvmstat@9.0
jdk.localedata@9.0
jdk.management@9.0
jdk.naming.dns@9.0
jdk.naming.rmi@9.0
jdk.pack200@9.0
jdk.policytool@9.0
jdk.rmic@9.0
jdk.scripting.nashorn@9.0
jdk.sctp@9.0
jdk.security.auth@9.0
jdk.security.jgss@9.0
jdk.xml.bind@9.0
jdk.xml.dom@9.0
jdk.xml.ws@9.0
jdk.zipfs@9.0
```

Compilation

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

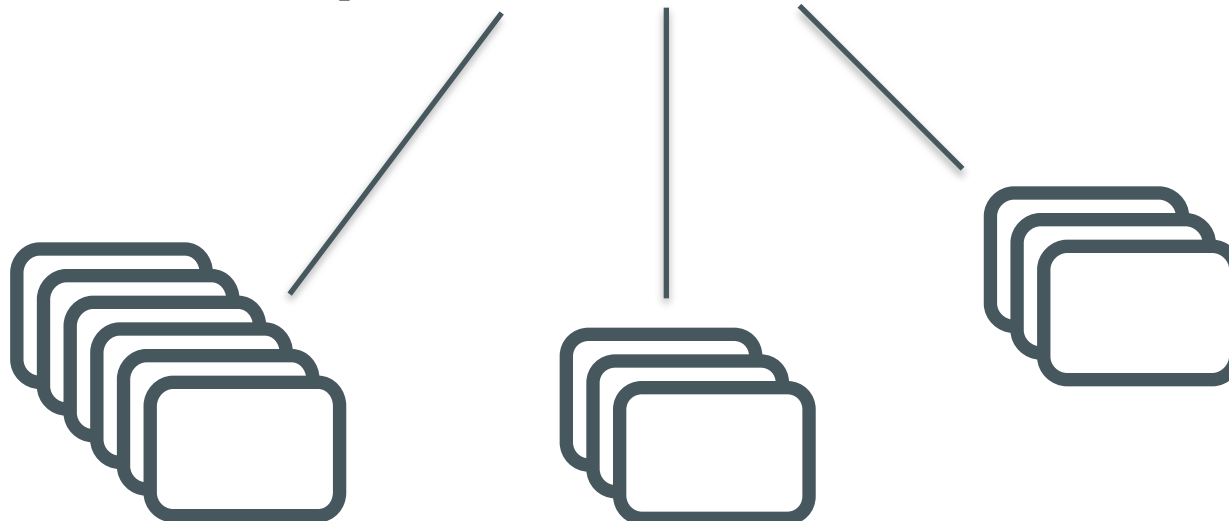
src/com.foo.baz/module-info.java
src/com.foo.baz/com/foo/baz/Bazooka.java



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 \  
  :
```

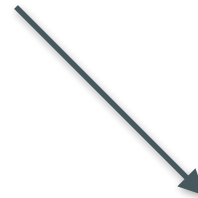
```
src/com.foo.bar/module-info.java  
src/com.foo.bar/com/foo/bar/alpha/Alpha.java  
:
```



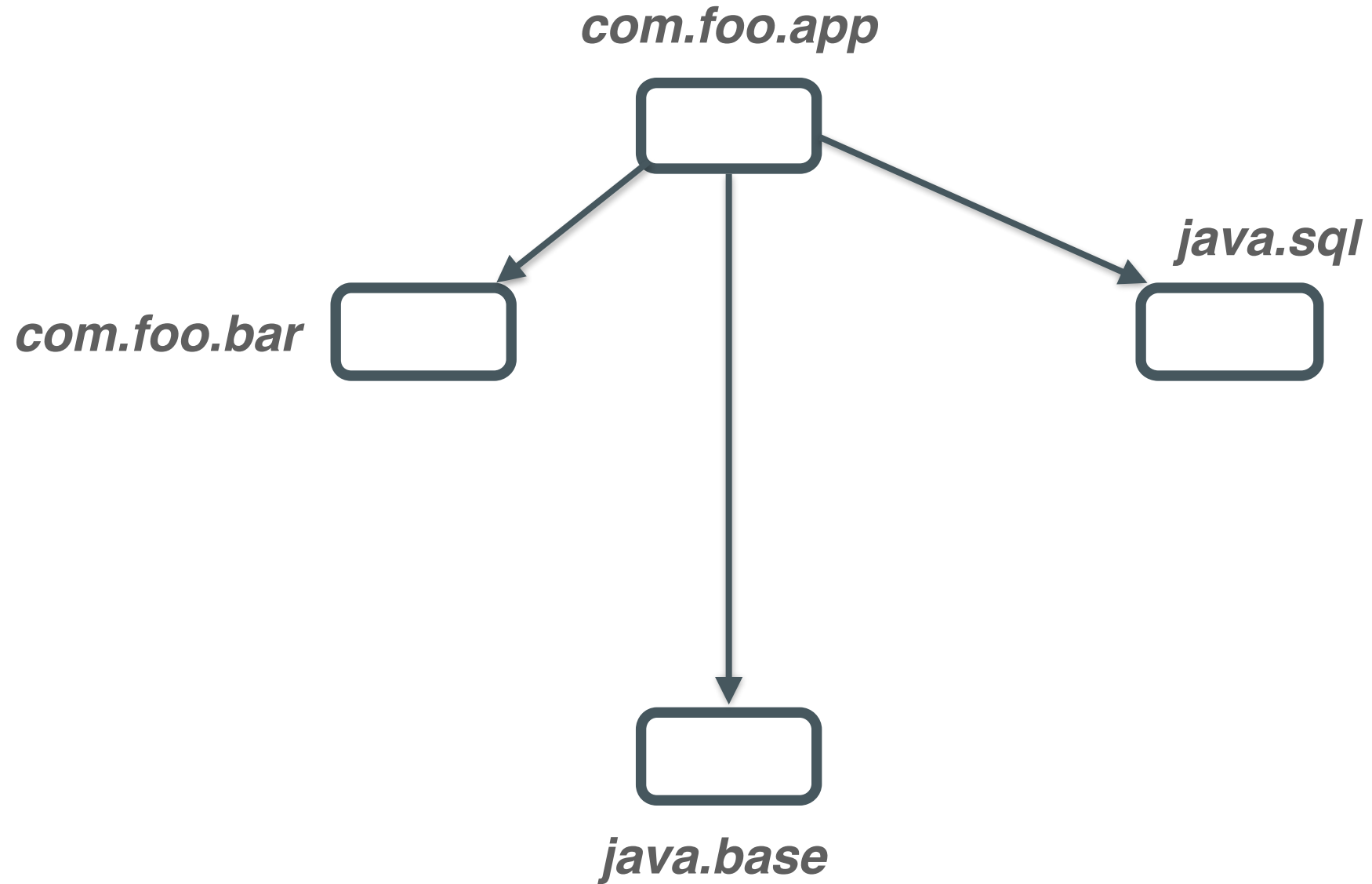
```
mods/com.foo.bar/module-info.class  
mods/com.foo.bar/com/foo/bar/bar/Alpha.class  
:
```

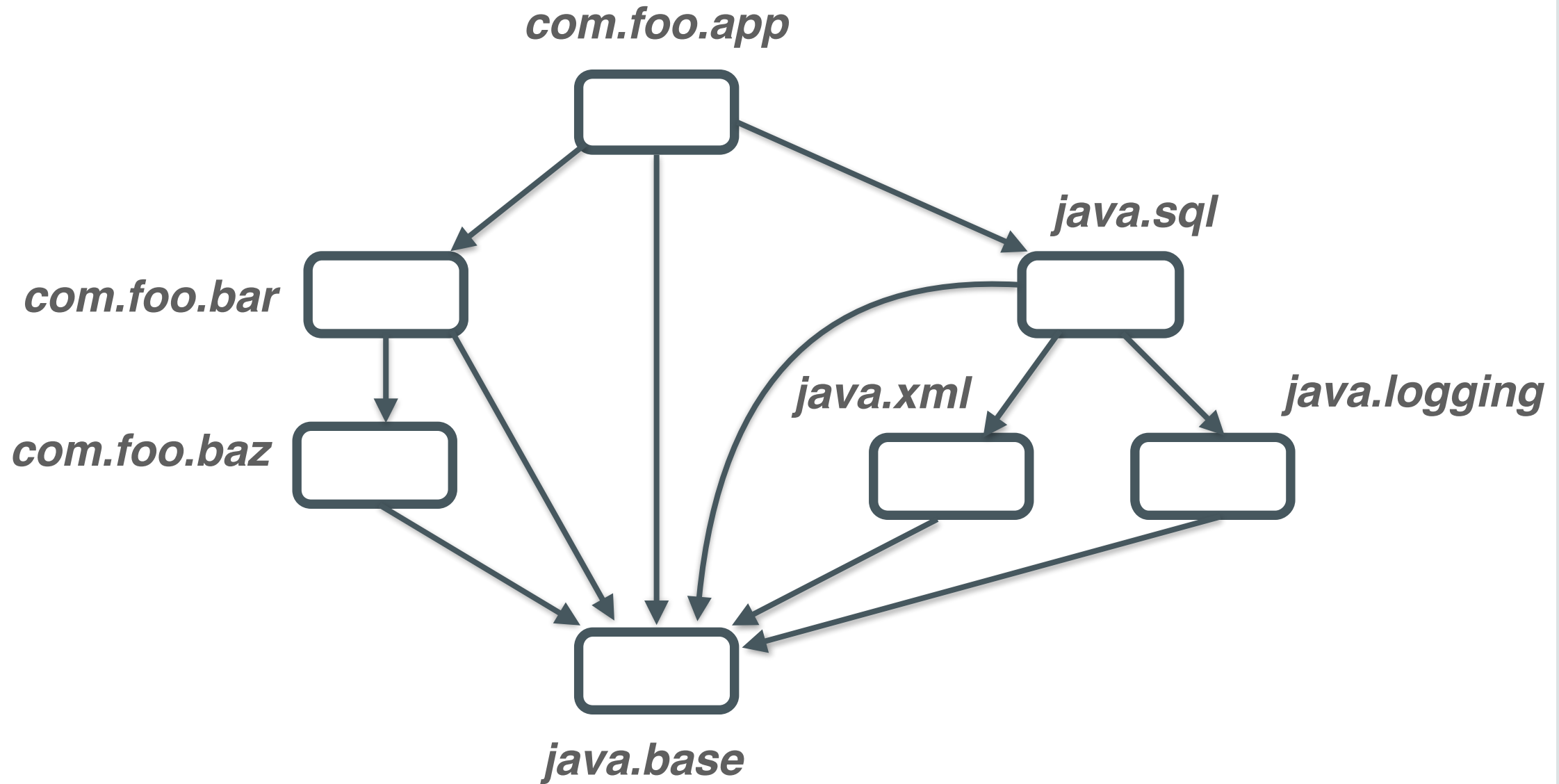
module name

main class



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

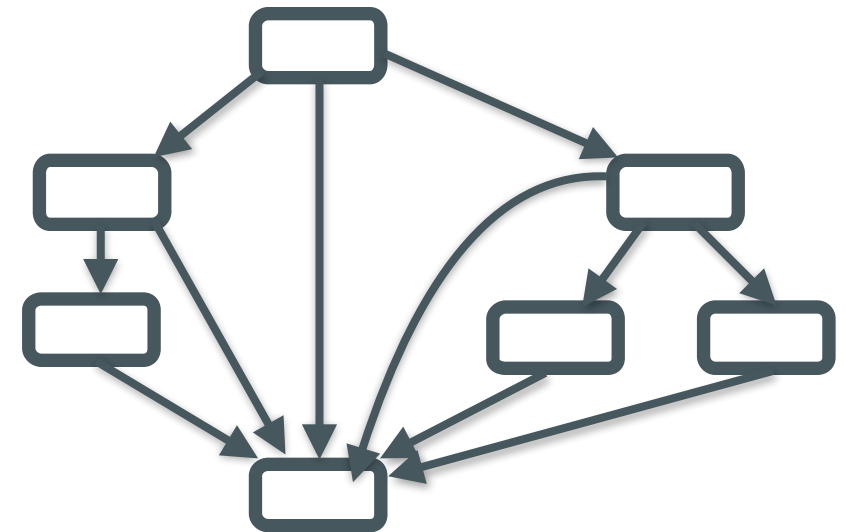





```
$ java -Xdiag:resolver -mp mods -m com.foo.app/com.foo.app.Main
```

```
[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  
:
```

app.jar

```
module-info.class  
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
```

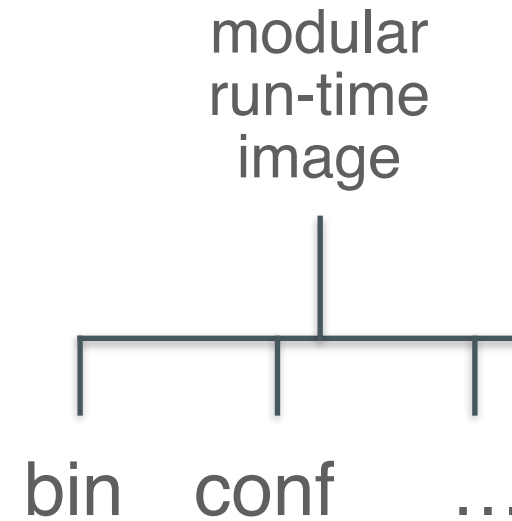

classpath and module path

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

Linking



jlink



Linking

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

```
$ myimage/bin/java -listmods  
java.base@9.0
```

Linking

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

```
$ myimage/bin/java -listmods
```

```
java.base@9.0
```

```
java.logging@9.0
```

```
java.sql@9.0
```

```
java.xml@9.0
```

```
com.foo.app
```

```
com.foo.bar
```

```
com.foo.baz
```

Summary

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

Other sessions, this room

- Advanced Modular Development @ 2.30pm
- Project Jigsaw: Under the Hood @ 5.30pm
- Project Jigsaw Hack Session @ Tuesday 8.30am

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

<https://jdk9.java.net/jigsaw/>

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JavaOne™


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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
```

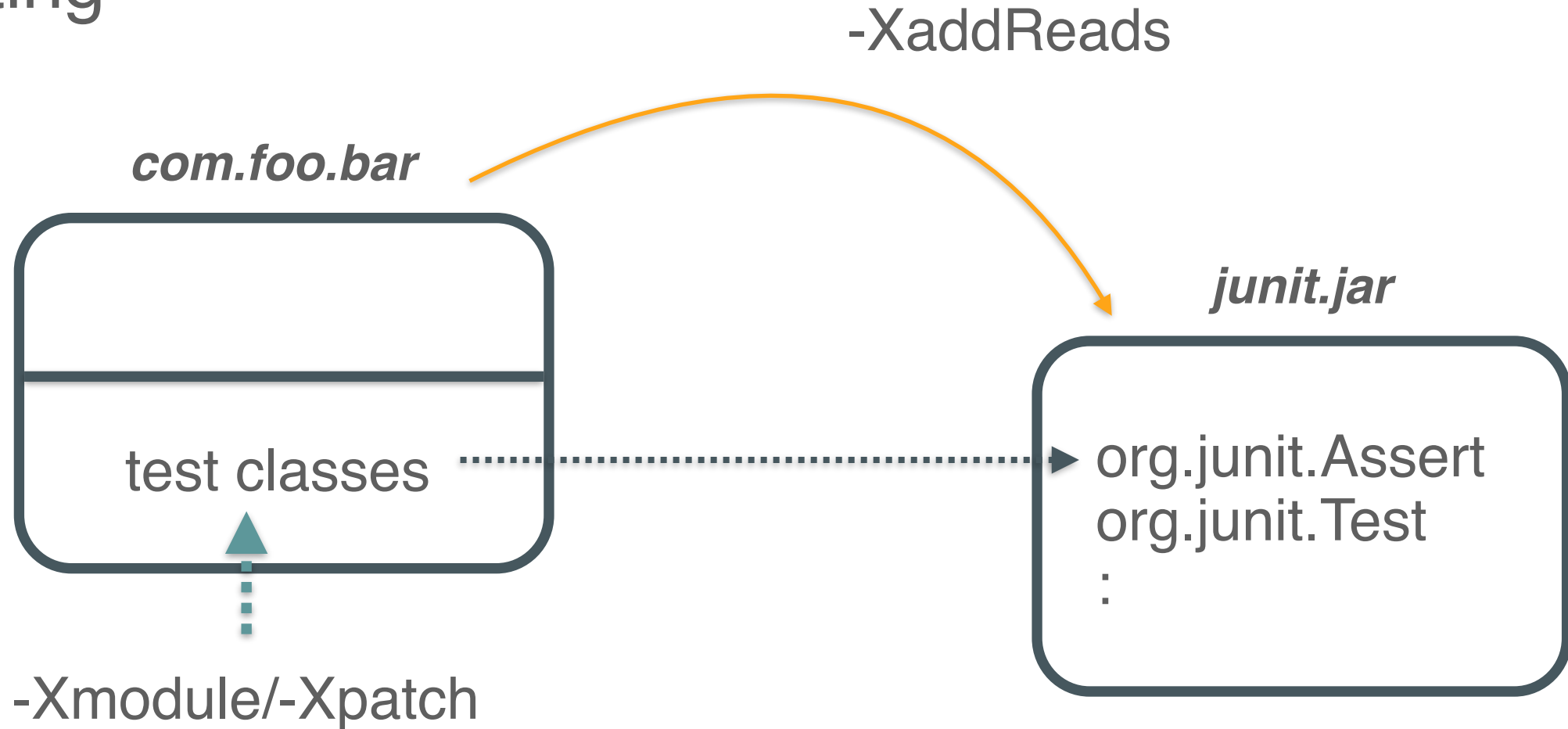
```
$ java -cp lib/junit.jar:testclasses -mp mods -addmods com.foo.bar \  
org.junit.runner.JUnitCore com.foo.bar.alpha.test.AlphaTest
```

Testing

com.foo.bar



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
```