

Les associations entre entités avec JPA

Contrôles des relations entre entités avec JPA.

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JPA offre une prise en charge complète pour la gestion des relations entre entités de différents types, que ce soit en mode un-vers-un (OneToOne), un-vers-plusieurs (OneToMany), ou plusieurs-vers-plusieurs (ManyToMany). Ces relations peuvent être configurées de manière unidirectionnelle ou bidirectionnelle.

1 One To One (1-1)

Dans certaines situations, lors de la modélisation orientée objet, il est nécessaire d'associer deux classes dans une relation un-à-un, mais en gardant une seule relation.

```
java.io.IOException: Cannot run
program "/opt/local/bin/dot": Exec
failed, error: 2 (No such file or
directory)
    at java.base/java.lang.ProcessBuilder.start(ProcessBuilder.java:1142)
    at java.base/java.lang.ProcessBuilder.start(ProcessBuilder.java:1142)
    at net.sourceforge.plantuml.dot.ProcessBuilder.start(ProcessBuilder.java:1142)
    at net.sourceforge.plantuml.dot.ProcessBuilder.start(ProcessBuilder.java:1142)
    at net.sourceforge.plantuml.dot.GraphvizVersionFinder.finder(java:126)
```

```
at net.sourceforge.plantuml.dot.GraphvizVersionFinder.finder(java:126)
at net.sourceforge.plantuml.dot.GraphvizRuntimeEnvironment.finder(java:126)
at net.sourceforge.plantuml.svek.DotStringFactory.generateDiagram(DotStringFactory.java:126)
at net.sourceforge.plantuml.svek.DotStringFactory.generateDiagram(DotStringFactory.java:126)
at net.sourceforge.plantuml.svek.GraphvizImageBuilder.generateImage(GraphvizImageBuilder.java:126)
at net.sourceforge.plantuml.svek.GraphvizImageBuilder.generateImage(GraphvizImageBuilder.java:126)
at net.sourceforge.plantuml.svek.GraphvizImageBuilder.generateImage(GraphvizImageBuilder.java:126)
at net.sourceforge.plantuml.svek.CucaDiagramFileMaker.generateDiagram(CucaDiagramFileMaker.java:126)
at net.sourceforge.plantuml.svek.CucaDiagramFileMaker.generateDiagram(CucaDiagramFileMaker.java:126)
at net.atmp.CucaDiagram.exportDiagramInternal(CucaDiagram.java:126)
at net.sourceforge.plantuml.classdiagram.ClassDiagram.exportDiagram(ClassDiagram.java:126)
at net.sourceforge.plantuml.UmlDiagram.exportDiagram(UmlDiagram.java:126)
at net.sourceforge.plantuml.AbstractPSystem.exportDiagram(AbstractPSystem.java:126)
at net.sourceforge.plantuml.SourceStringReader.outputDiagram(SourceStringReader.java:126)
at net.sourceforge.plantuml.SourceStringReader.outputDiagram(SourceStringReader.java:126)
at io.github.spencerpark.ijava.magics.JavaPlantUMLMagics.generateDiagram(JavaPlantUMLMagics.java:126)
at java.base/jdk.internal.reflect.DirectMethodHandleAccessor.invoke(DirectMethodHandleAccessor.java:126)
at java.base/java.lang.reflect.Method.invoke(Method.java:126)
at io.github.spencerpark.jupyter.kernel.magic.registerMagic(registerMagic.java:126)
at io.github.spencerpark.jupyter.kernel.magic.registerMagic(registerMagic.java:126)
at io.github.spencerpark.jupyter.kernel.magic.registerMagic(registerMagic.java:126)
at REPL.$JShell$59.do_it($JShell$59.java:65)
at java.base/jdk.internal.reflect.DirectMethodHandleAccessor.invoke(DirectMethodHandleAccessor.java:126)
at java.base/java.lang.reflect.Method.invoke(Method.java:126)
at io.github.spencerpark.ijava.execution.IJavaExecution.execute(IJavaExecution.java:126)
at java.base/java.util.concurrent.FutureTask.run(FutureTask.java:126)
at java.base/java.util.concurrent.ThreadPoolExecutor.runWorker(ThreadPoolExecutor.java:126)
at java.base/java.util.concurrent.ThreadPoolExecutor.runWorker(ThreadPoolExecutor.java:126)
at java.base/java.lang.Thread.run(Thread.java:1474)
```

```
Caused by: java.io.IOException: Exec
failed, error: 2 (No such file or
directory)
```

```
at java.base/java.lang.ProcessImpl.forkAndExec(Native
Method)
```

```
at java.base/java.lang.ProcessImpl.(ProcessImpl.java:300)
at java.base/java.lang.ProcessImpl.start(ProcessImpl.java:231)
at java.base/java.lang.ProcessBuilder.start(ProcessBuilder.java:1078)
... 34 more
```

Dot Executable: /opt/local/bin/dot
Dot executable does not exist
Cannot find Graphviz. You should try

```
@startuml
testdot
@enduml
```

or

```
java -jar plantuml.jar -testdot
```

Figure 1. – Un Customer a une Biography

```
No JDBC connection available.
Set system properties
'jdbc.url' (and optionally
'jdbc.user'/'jdbc.password'), or
provide a Connection in the kernel
environment.
```

Figure 2

Pour cela JPA propose des annotations spécifiques :

@Embeddable: Cette annotation indique que les membres d’une classe Java peuvent être persistés en tant qu’attributs de la classe qui les utilise. En d’autres termes, elle spécifie qu’une classe peut être utilisée comme composant réutilisable dont les propriétés peuvent être incorporées dans une autre entité.

@Embedded: Utilisée au niveau d’un membre de classe annoté avec **@Embeddable**, cette an-

notation indique que le membre annoté doit être intégré dans la relation. Cela signifie que les propriétés de la classe annotée avec **@Embeddable** seront incluses dans la table de la classe qui les utilise.

```
Error: failed to read file /
/home/jovyan/work/examples/github/ebpro/
sample-hellojpa/src/main/java/fr/
univtln/bruno/demos/jpa/hello/samples/
ex_biography/Biography.java: /home/jo-
vyan/work/examples/github/ebpro/sample-
hellojpa/src/main/java/fr/univtln/bruno/
demos/jpa/hello/samples/ex_biography/
Biography.java
```

Figure 3. – Embeddable.java

```
Error: failed to read file /
/home/jovyan/work/examples/github/ebpro/
sample-hellojpa/src/main/java/fr/
univtln/bruno/demos/jpa/hello/samples/
ex_biography/Customer.java: /home/jo-
vyan/work/examples/github/ebpro/sample-
hellojpa/src/main/java/fr/univtln/bruno/
demos/jpa/hello/samples/ex_biography/
Customer.java
```

Customer.java

On peut donc rendre persistente une instance de Customer associé à une instance de Biography.

```
import fr.univtln.bruno.demos.jpa.hello.samples.ex_biog
try (EntityManager entityManager =
emf.createEntityManager()) {
    entityManager.getTransaction().begin();

    Customer customer =
Customer.of("Jim");
    customer.setBiography(Biography.builder()
.brief("bla")
.extended("bla bla")
.build());
    entityManager.persist(customer);
```

```

    entityManager.getTransaction().commit();
}

```

dans une seule relation

```

No      JDBC      connection      available.
Set           system      properties
'jdbc.url'      (and      optionally
'jdbc.user'/'jdbc.password'), or
provide a Connection in the kernel
environment.

```

Figure 4

2 One to Many (1-N)

PlantUML 1.2026.0

This version of PlantUML is 277 days old, so you should consider upgrading from <https://plantuml.com/download>

[From string (line 6)]

```

@startuml
class Order {
    - id: long
    - date: LocalDateTime
}
class Line {
Syntax Error? (Assumed diagram type: class)

```

Figure 5. – Une Order a plusieurs Line

Error: failed to read file /home/jovyan/work/examples/github/ebpro/sample-hellojpa/src/main/java/fr/univtln/bruno/demos/jpa/hello/samples/ex_associations/ex_onetomany_b/Line.java: /home/jovyan/work/examples/github/ebpro/sample-hellojpa/src/main/java/fr/univtln/bruno/demos/jpa/hello/samples/ex_associations/ex_onetomany_b/Line.java

Error: failed to read file /home/jovyan/work/examples/github/ebpro/sample-hellojpa/src/main/java/fr/univtln/bruno/demos/jpa/hello/samples/ex_associations/ex_onetomany_b/Order.java: /home/jovyan/work/examples/github/ebpro/sample-hellojpa/src/main/java/fr/univtln/bruno/

demos/jpa/hello/samples/ex_associations/ex_onetomany_b/Order.java

```

No      JDBC      connection      available.
Set           system      properties
'jdbc.url'      (and      optionally
'jdbc.user'/'jdbc.password'), or
provide a Connection in the kernel
environment.

```

Figure 6

2.1 Avec deux entités

Dans le cas général, l'attribut de type `Collection<T>` est annoté avec `@OneToMany`.

L'attribut optionnel `mappedBy` indique le nom de l'attribut correspondant dans le type `T` si l'on souhaite une relation bi-directionnelle. L'autre entité (de Type `T`) est alors annotée avec `@ManyToOne`

Error: failed to read file /home/jovyan/work/examples/github/ebpro/sample-hellojpa/src/main/java/fr/univtln/bruno/demos/jpa/hello/samples/ex_associations/ex_onetomany_a/Order.java: /home/jovyan/work/examples/github/ebpro/sample-hellojpa/src/main/java/fr/univtln/bruno/demos/jpa/hello/samples/ex_associations/ex_onetomany_a/Order.java

Error: failed to read file /home/jovyan/work/examples/github/ebpro/sample-hellojpa/src/main/java/fr/univtln/bruno/demos/jpa/hello/samples/ex_associations/ex_onetomany_a/Line.java: /home/jovyan/work/examples/github/ebpro/sample-hellojpa/src/main/java/fr/univtln/bruno/demos/jpa/hello/samples/ex_associations/ex_onetomany_a/Line.java

```

14:52:39.922      [IJava-executor-0]
INFO      notebook  --  Order(id=1,
date=2026-10-14T14:52:39.778850)

```

```
[Line(id=2,      product=Scissor,
price=8.0), Line(id=3, product=Pen,
price=1.0),      Line(id=1,
product=Paper, price=5.0)]
```

```
No JDBC connection available.
Set system properties
'jdbc.url' (and optionally
'jdbc.user'/'jdbc.password'), or
provide a Connection in the kernel
environment.
```

Figure 7

```
No JDBC connection available.
Set system properties
'jdbc.url' (and optionally
'jdbc.user'/'jdbc.password'), or
provide a Connection in the kernel
environment.
```

Figure 8

3 Many to Many (N-M)

L'annotation `@ManyToMany` en Java Persistence API (JPA) est utilisée pour modéliser une relation many-to-many entre deux entités. La table d'association sera alors générée et utilisée implicitement.

**Dot Executable: /opt/local/bin/dot
Dot executable does not exist
Cannot find Graphviz. You should try**

```
@startuml
testdot
@enduml
```

or

```
java -jar plantuml.jar -testdot
```

Figure 9. – Un Customer a plusieurs adresses (qui peuvent être associées à d'autres)

```
No JDBC connection available.
Set system properties
'jdbc.url' (and optionally
'jdbc.user'/'jdbc.password'), or
provide a Connection in the kernel
environment.
```

Figure 10

```
Error: failed to read file /home/jovyan/work/
examples/github/ebpro/sample-hellojpa/
src/main/java/fr/univtln/bruno/demos/
jpa/hello/samples/ex_associations/
ex_manytomany/Customer.java: /home/jo-
vyan/work/examples/github/ebpro/sample-
hellojpa/src/main/java/fr/univtln/bruno/
demos/jpa/hello/samples/ex_associations/
ex_manytomany/Address.java
```

```
Error: failed to read file /home/jovyan/work/
examples/github/ebpro/sample-hellojpa/
src/main/java/fr/univtln/bruno/demos/
jpa/hello/samples/ex_associations/
ex_manytomany/Address.java: /home/jo-
vyan/work/examples/github/ebpro/sample-
hellojpa/src/main/java/fr/univtln/bruno/
demos/jpa/hello/samples/ex_associations/
ex_manytomany/Address.java
```

```
14:52:41.503 [IJava-executor-0] WARN
o.a.h.c.p.ResponseProcessCookies --
Invalid cookie header: "set-cookie: __cf_bm=Pn6ALuII739t
oLmWcI.4hDDCAV.NUKAI9ot.dntRwMAahFmxNy4hfn_yTi0BqR3.L9C
HttpOnly; SameSite=None; Secure;
Path=/;
Domain=repo.maven.apache.org;
Expires=Wed, 14 Oct 2026 15:22:41
GMT". Invalid 'expires' attribute:
Wed, 14 Oct 2026 15:22:41 GMT
14:52:41.718 [IJava-executor-0] WARN
o.a.h.c.p.ResponseProcessCookies --
Invalid cookie header: "set-cookie: __cf_bm=TXYjH20EjhVA
lEHe.F0jIjuKdh7gvew_Crw4noextsugR1vP0ostIUJMCrgjSJSAgTL
HttpOnly; SameSite=None; Secure;
```

```

Path=/;
Domain=repo.maven.apache.org;
Expires=Wed, 14 Oct 2026 15:22:41 GMT". Invalid 'expires' attribute:
Wed, 14 Oct 2026 15:22:41 GMT
14:52:41.787 [IJava-executor-0] WARN
o.a.h.c.p.ResponseProcessCookies --
Invalid cookie header: "set-cookie: __cf_b
qK.i10p19E3r7MbC3Z6gHsj2A1Wa4sxH2YdxYWLcq
HttpOnly; SameSite=None; Secure;
Path=/;
Domain=repo.maven.apache.org;
Expires=Wed, 14 Oct 2026 15:22:41 GMT". Invalid 'expires' attribute:
Wed, 14 Oct 2026 15:22:41 GMT
14:52:41.848 [IJava-executor-0] WARN
o.a.h.c.p.ResponseProcessCookies --
Invalid cookie header: "set-cookie: __cf_b
Alsb9JYBu1A5VHckouAcjYh7fMVA2RjgyPqkTXEyp
HttpOnly; SameSite=None; Secure;
Path=/;
Domain=repo.maven.apache.org;
Expires=Wed, 14 Oct 2026 15:22:41 GMT". Invalid 'expires' attribute:
Wed, 14 Oct 2026 15:22:41 GMT
14:52:41.912
[BasicRepositoryConnector-
repo.maven.apache.org-0-0] WARN
o.a.h.c.p.ResponseProcessCookies --
Invalid cookie header: "set-cookie: __cf_bm=pjDdEAj1N4PSV.S37u17U4xpGM9w8Ar10bLXLZ3vW9Q-1791989561
HttpOnly; SameSite=None; Secure;
Path=/;
Domain=repo.maven.apache.org;
Expires=Wed, 14 Oct 2026 15:22:41 GMT". Invalid 'expires' attribute:
Wed, 14 Oct 2026 15:22:41 GMT
14:52:41.957
[BasicRepositoryConnector-
repo.maven.apache.org-0-1] WARN
o.a.h.c.p.ResponseProcessCookies --
Invalid cookie header: "set-cookie: __cf_bm=808xAkgYHbHIfUZuSRM1qShP3PedlJHJrk8fHbfqoQk-1791989561
f7S0RyUdzSqZGeNlWs.kU_SFqW042RMA05quTmJJ1_hhj6wah5ta2k9ViMDE3oiuM_DYM_5.kEYUw07gCvtfw30gB1A2YsvRo
HttpOnly; SameSite=None; Secure;

Path=/;
Domain=repo.maven.apache.org;
Expires=Wed, 14 Oct 2026 15:22:41 GMT". Invalid 'expires' attribute:
Wed, 14 Oct 2026 15:22:41 GMT
14:52:41.976
[BasicRepositoryConnector-
repo.maven.apache.org-0-3] WARN yTJi14-1791989561
o.a.h.c.p.ResponseProcessCookies -- lUEG0bErC0plzQEpZ
Invalid cookie header: "set-cookie: __cf_bm=mpw7U0ugLeQs
ov0xXQfwDD4Au20BKCIqR0tBF3Lm52em40He.ttFw6X1JHTZBqPSdgE
HttpOnly; SameSite=None; Secure;
Path=/;
Domain=repo.maven.apache.org;
Expires=Wed, 14 Oct 2026 15:22:41 GMT". Invalid 'expires' attribute:
Wed, 14 Oct 2026 15:22:41 GMT
14:52:41.976 j1tpL8-1791989561
[BasicRepositoryConnector-
repo.maven.apache.org-0-2] WARN PxC02iQSH4VW6fvZ_
o.a.h.c.p.ResponseProcessCookies --
Invalid cookie header: "set-cookie: __cf_bm=iK98YaIC.Fgy
FwGhL8zyP46RnVCQc3SNy5zIdqvmyddaEaekyfcYNhGZDJBgdsHmDni
HttpOnly; SameSite=None; Secure;
Path=/;
Domain=repo.maven.apache.org;
Expires=Wed, 14 Oct 2026 15:22:41 GMT". Invalid 'expires' attribute:
Wed, 14 Oct 2026 15:22:41 GMT

No JDBC connection available.
Set system properties
'jdbc.url' (and optionally
'jdbc.user'/'jdbc.password'), or
provide a Connection in the kernel
environment.

```

Figure 11

```
No JDBC connection available.  
Set system properties  
'jdbc.url' (and optionally  
'jdbc.user'/'jdbc.password'), or  
provide a Connection in the kernel  
environment.
```

Figure 12

```
No JDBC connection available.  
Set system properties  
'jdbc.url' (and optionally  
'jdbc.user'/'jdbc.password'), or  
provide a Connection in the kernel  
environment.
```

Figure 13