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JPA 2.0

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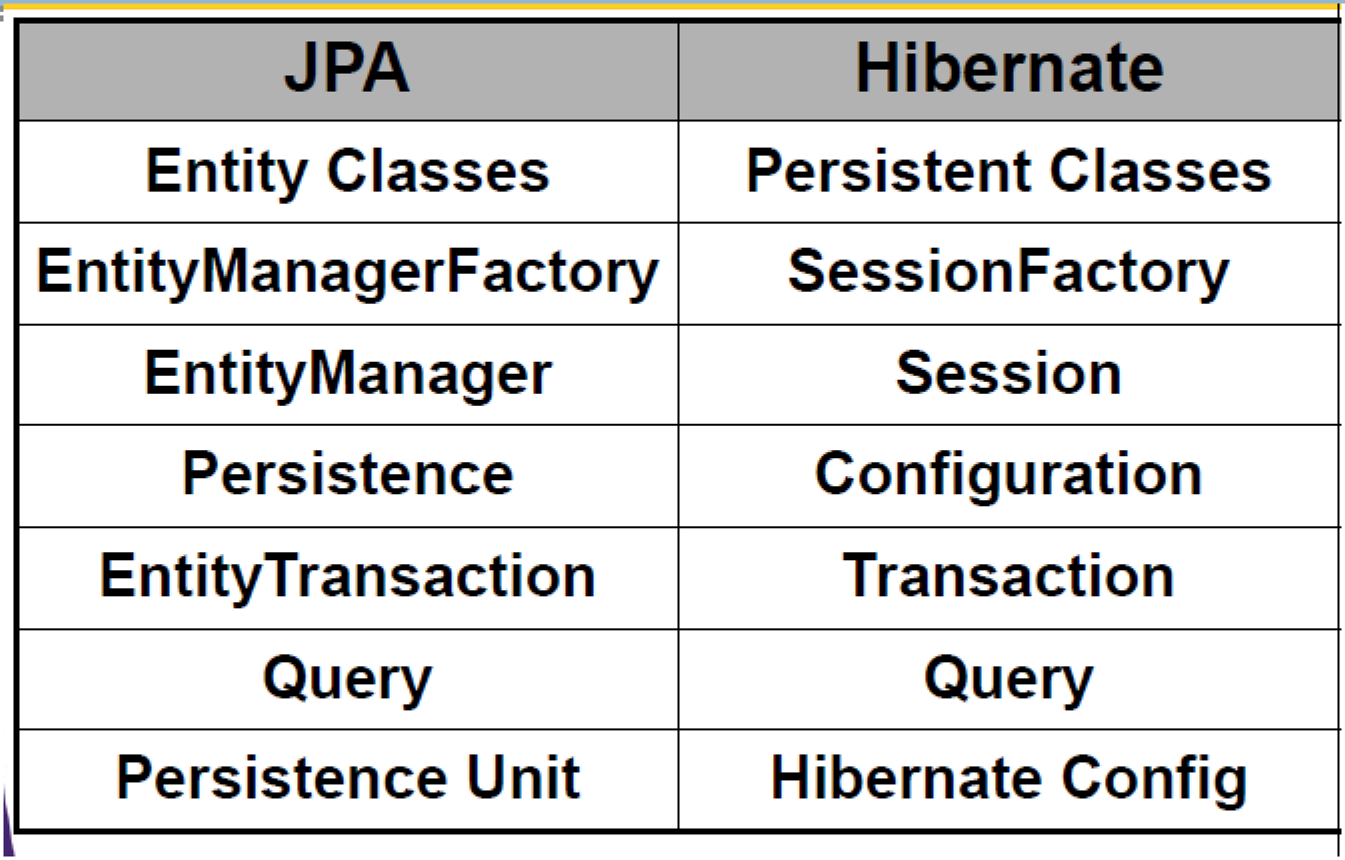
JPA?

- What is JPA?
  - JSR 220, JSR-317 ,Java Persistence 2.0
  - Specification implemented by : Hibernate , eclipseLink, topLink etc
  - JPA abstraction above JDBC
  - **javax.persistence package**

- Component of JPA?
  - ORM
  - Entity manager API CRUD operations
  - JPQL
  - Transactions and locking mechanisms when accessing data concurrently provided by:
    - Java Transaction API (JTA)
    - Resource-local (non-JTA)

  - Callbacks and listeners to hook business logic into the life cycle of a persistent

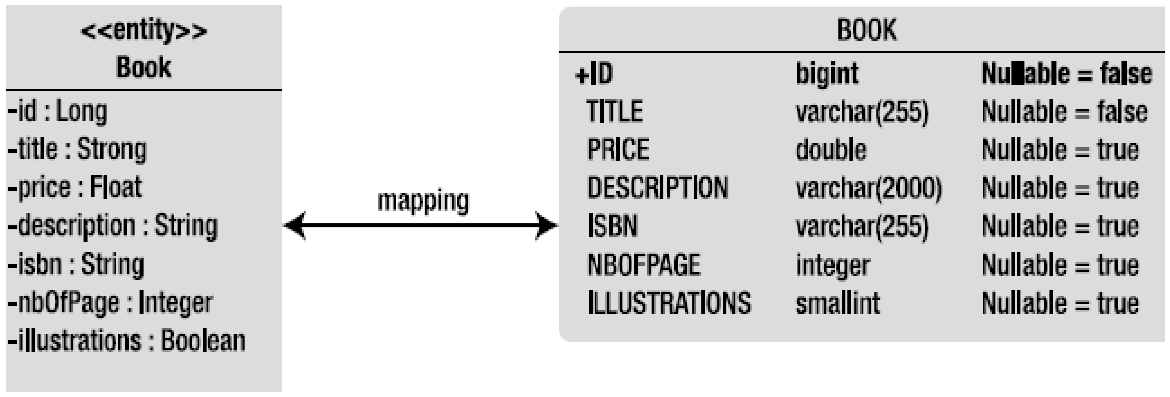
Hay Coming from hibernate World!



JPA	Hibernate
Entity Classes	Persistent Classes
EntityManagerFactory	SessionFactory
EntityManager	Session
Persistence	Configuration
EntityTransaction	Transaction
Query	Query
Persistence Unit	Hibernate Config

Entity

```
@Entity
public class Book {

    @Id @GeneratedValue
    private Long id;
    @Column(nullable = false)
    private String title;
    private Float price;
    @Column(length = 2000)
    private String description;
    private String isbn;
    private Integer nbOfPage;
    private Boolean illustrations;

    // Constructors, getters, setters
}
```



<<entity>>
Book
-id : Long
-title : Strong
-price : Float
-description : String
-isbn : String
-nbOfPage : Integer
-illustrations : Boolean
mapping
BOOK
+ID bigint Nullable = false
TITLE varchar(255) Nullable = false
PRICE double Nullable = true
DESCRIPTION varchar(2000) Nullable = true
ISBN varchar(255) Nullable = true
NBOFPAGE integer Nullable = true
ILLUSTRATIONS smallint Nullable = true

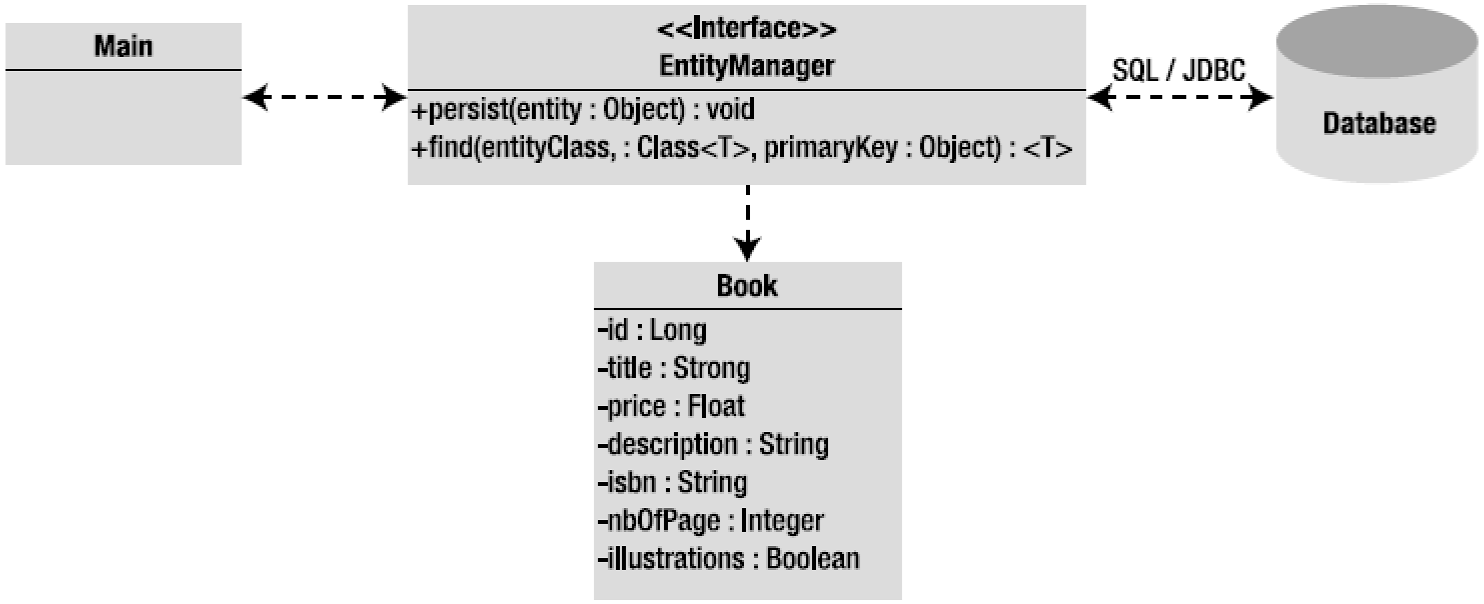
Rule to be Entity

Entity class must be:

1. Annotated with @javax.persistence.Entity
2. @javax.persistence.Id annotation must be used to denote primary key
3. Must have a no-arg constructor that has to be public or protected.
4. Must be a top-level class.
5. Entity class must not be final.
6. No methods or persistent instance variables of the entity class may be final
7. May implements Serializable interface

EntityManager interacts with Entity

```
EntityManagerFactory emf = Persistence.createEntityManagerFactory("chapter02PU");
EntityManager em = emf.createEntityManager();
em.persist(book);
```



EntityManager Methods

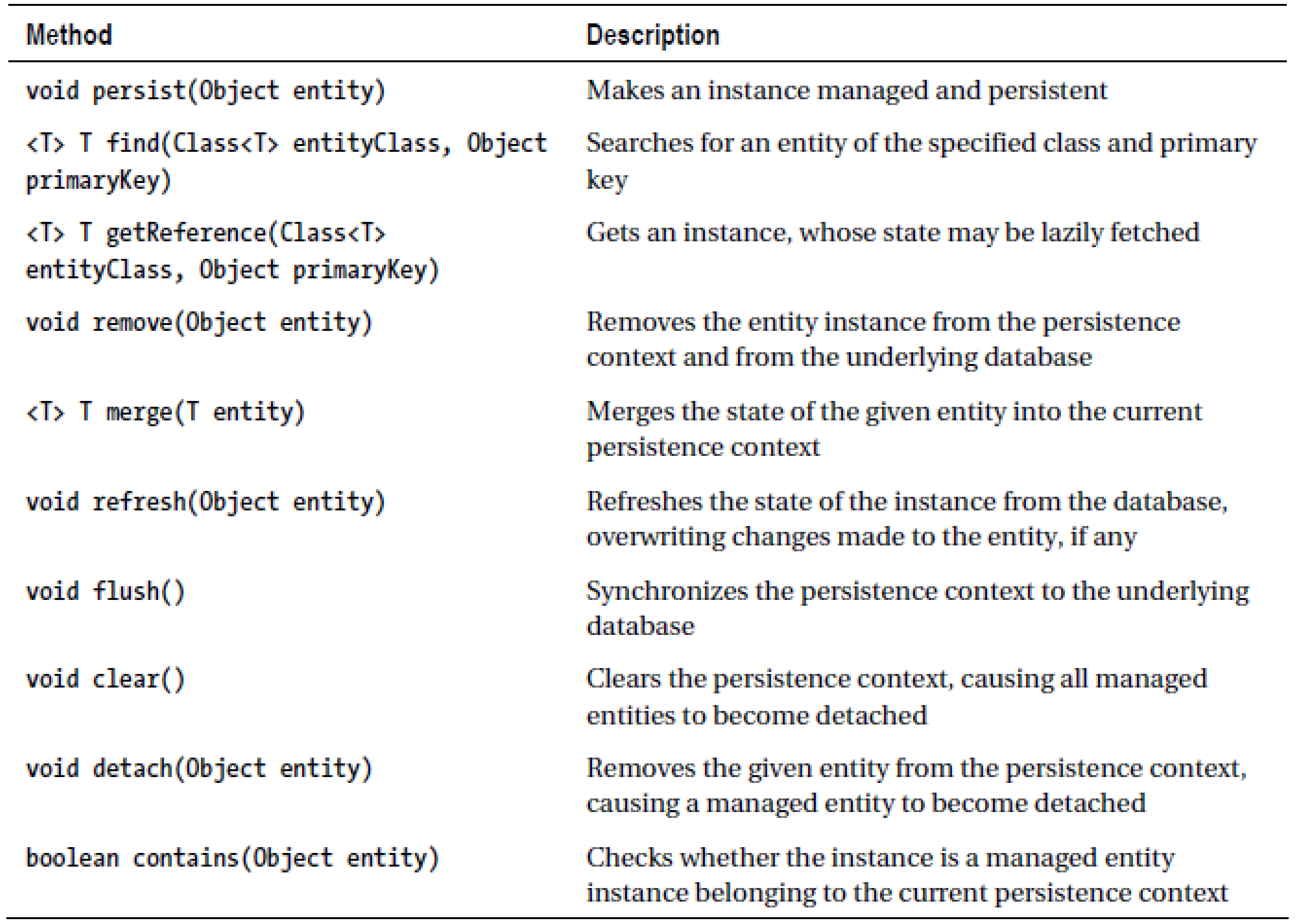
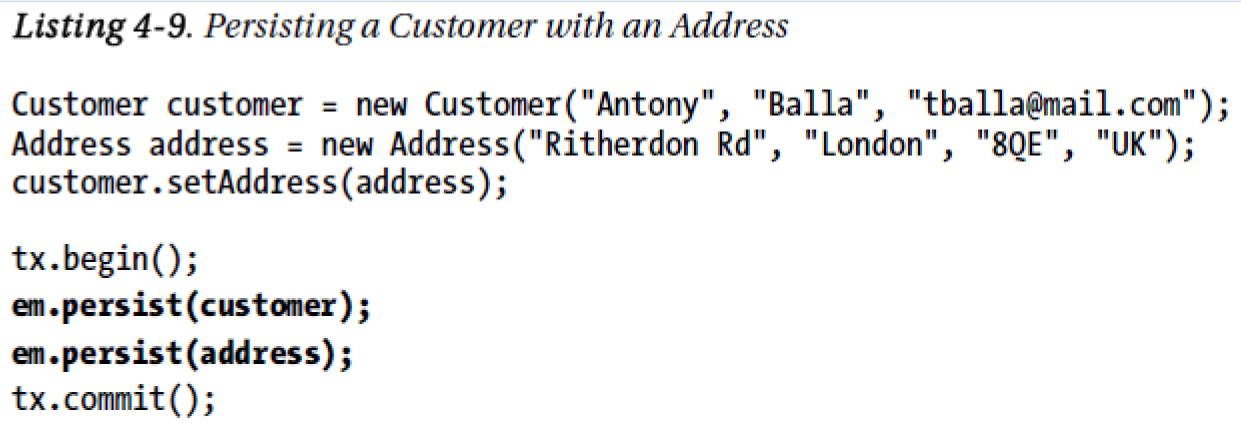


Table 4-1. EntityManager Interface Methods to Manipulate Entities

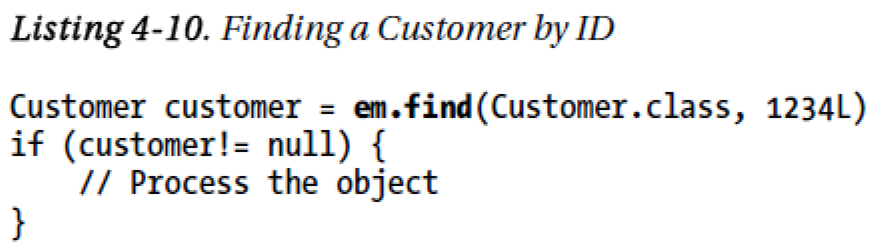
Method	Description
`void persist(Object entity)`	Makes an instance managed and persistent
`<T> T find(Class<T> entityClass, Object primaryKey)`	Searches for an entity of the specified class and primary key
`<T> T getReference(Class<T> entityClass, Object primaryKey)`	Gets an instance, whose state may be lazily fetched
`void remove(Object entity)`	Removes the entity instance from the persistence context and from the underlying database
`<T> T merge(T entity)`	Merges the state of the given entity into the current persistence context
`void refresh(Object entity)`	Refreshes the state of the instance from the database, overwriting changes made to the entity, if any
`void flush()`	Synchronizes the persistence context to the underlying database
`void clear()`	Clears the persistence context, causing all managed entities to become detached
`void detach(Object entity)`	Removes the given entity from the persistence context, causing a managed entity to become detached
`boolean contains(Object entity)`	Checks whether the instance is a managed entity instance belonging to the current persistence context

EntityManager Methods



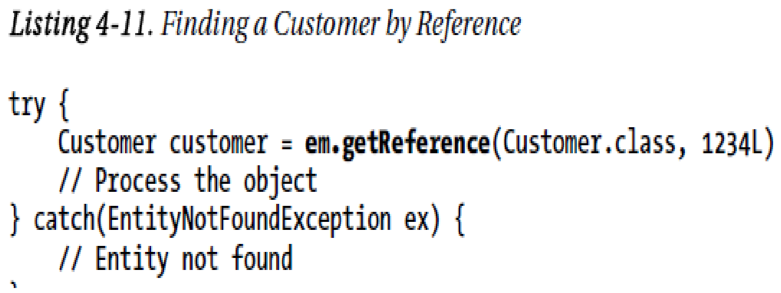
Listing 4-9. Persisting a Customer with an Address

```
Customer customer = new Customer("Antony", "Balla", "tballa@mail.com");
Address address = new Address("Ritherdon Rd", "London", "8QE", "UK");
customer.setAddress(address);

tx.begin();
em.persist(customer);
em.persist(address);
tx.commit();
```



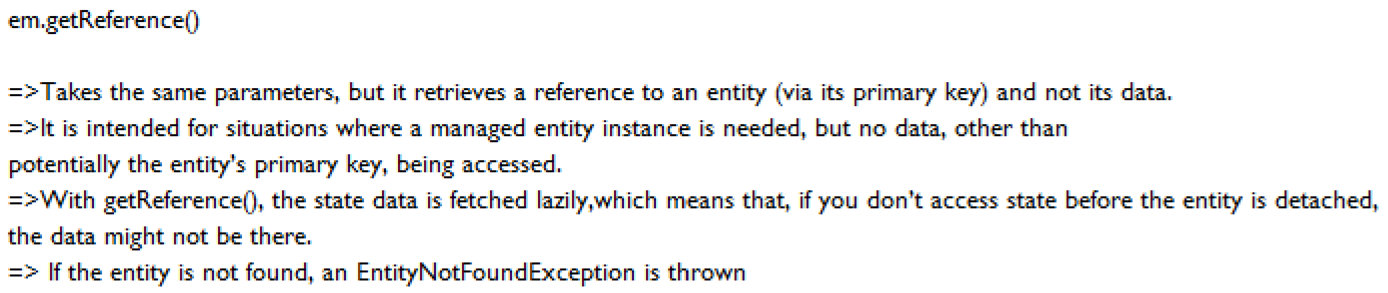
Listing 4-10. Finding a Customer by ID

```
Customer customer = em.find(Customer.class, 1234L)
if (customer!= null) {
    // Process the object
}
```



Listing 4-11. Finding a Customer by Reference

```
try {
    Customer customer = em.getReference(Customer.class, 1234L)
    // Process the object
} catch(EntityNotFoundException ex) {
    // Entity not found
}
```



em.getReference()

=>Takes the same parameters, but it retrieves a reference to an entity (via its primary key) and not its data.
=>It is intended for situations where a managed entity instance is needed, but no data, other than
potentially the entity's primary key, being accessed.
=>With getReference(), the state data is fetched lazily,which means that, if you don't access state before the entity is detached,
the data might not be there.
=> If the entity is not found, an EntityNotFoundException is thrown

EntityManager Methods remove()

```
Customer customer = new Customer("Antony", "Balla", "tballa@mail.com");
Address address = new Address("Ritherdon Rd", "London", "8QE", "UK");
customer.setAddress(address);

tx.begin();
em.persist(customer);
em.persist(address);
tx.commit();

tx.begin();
em.remove(customer);
tx.commit();
```

Listing 4-13. *The Customer Entity Dealing with Orphan Address Removal*

```
@Entity
public class Customer {

    @Id @GeneratedValue
    private Long id;
    private String firstName;
    private String lastName;
    private String email;
    @OneToOne (fetch = FetchType.LAZY, orphanRemoval=true)
    private Address address;

    // Constructors, getters, setters
}
```

EntityManager Methods persist(), flush(), refresh()

```
tx.begin();
em.persist(customer);
em.persist(address);
tx.commit();
```

```
tx.begin();
em.persist(customer);
em.flush();
em.persist(address);
tx.commit();
```

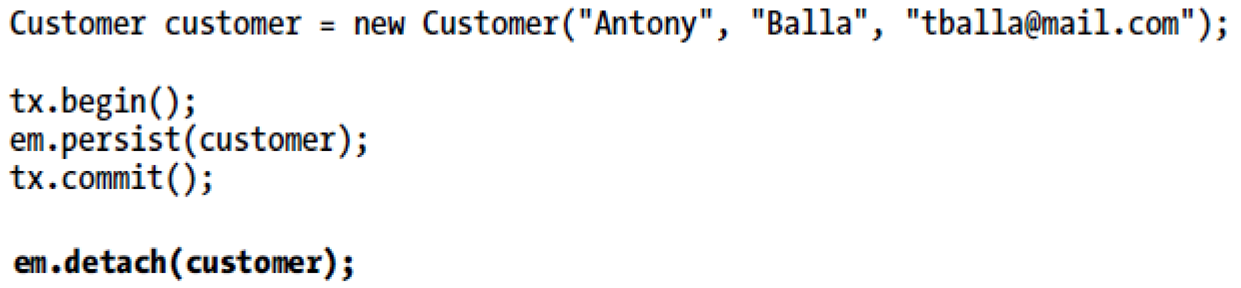
Forcing persistence to flush the data, to synch with DB

```
Customer customer = em.find(Customer.class, 1234L)
assertEquals(customer.getFirstName(), "Antony");

customer.setFirstName("William");

em.refresh(customer);
assertEquals(customer.getFirstName(), "Antony");
```

The **refresh() method is used for data synchronization in the opposite direction of the flush, meaning it**
overwrites the current state of a managed entity with data as it is present in the database. A typical case
is where the **EntityManager.refresh() method is used to undo changes that have been done to the entity**
in memory only. The test class snippet in Listing 4-14 finds a **Customer by ID, changes its first name, and**
undoes this change using the **refresh() method.**

EntityManager Methods :Clear and Detach

- The clear() method is straightforward: it empties the persistence context, causing all managed entities to become detached.
- The detach(Object entity) method removes the given entity from the persistence context.

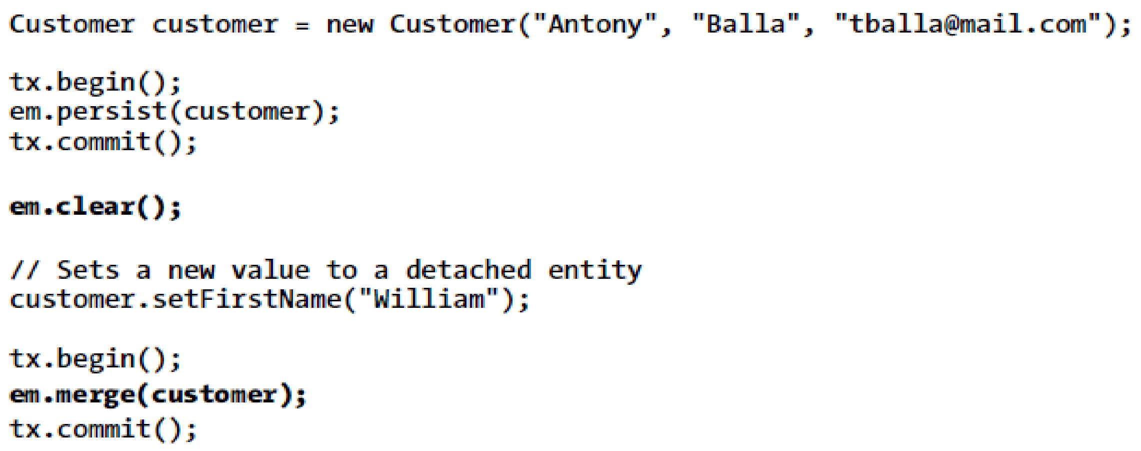


```
Customer customer = new Customer("Antony", "Balla", "tballa@mail.com");

tx.begin();
em.persist(customer);
tx.commit();

em.detach(customer);
```

ronized to the

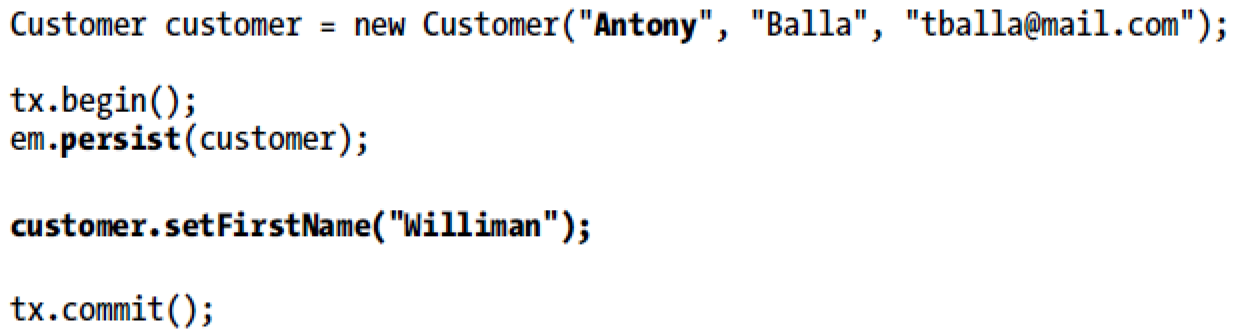
Merging an Entity

- A detached entity is no longer associated with a persistence context. If you want to manage it, you need to merge it.
- Let’s take the example of an entity that needs to be displayed in a JSF page. The entity is first loaded from the database in the persistent layer (it is managed), it is returned from an invocation of a local EJB (it is detached because the transaction context ends), the presentation layer displays it (it is still detached), and then it returns to be updated to the database.
- However, at that moment, the entity is detached and needs to be attached again, or merged, to synchronize its state with the database.



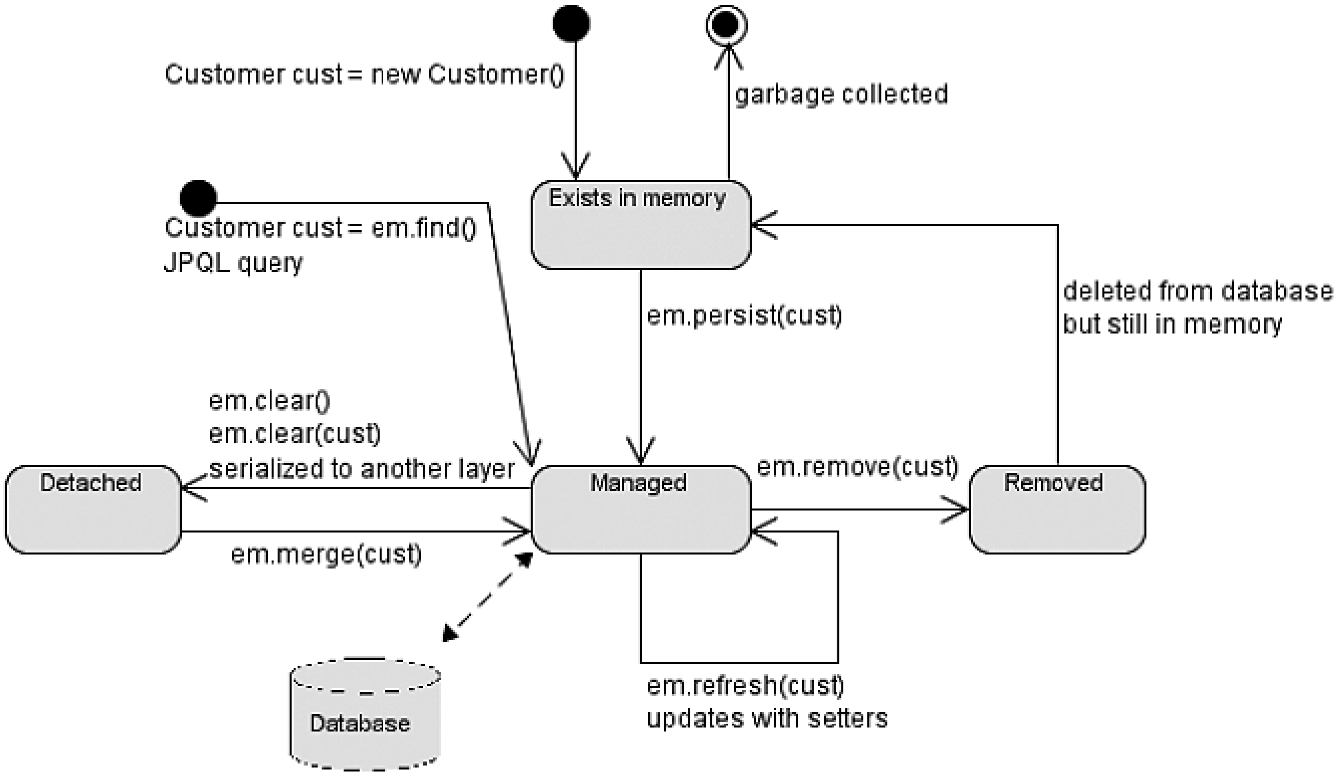
```
Customer customer = new Customer("Antony", "Balla", "tballa@mail.com");

tx.begin();
em.persist(customer);
tx.commit();

em.clear();

// Sets a new value to a detached entity
customer.setFirstName("William");

tx.begin();
em.merge(customer);
tx.commit();
```

Updating an Entity

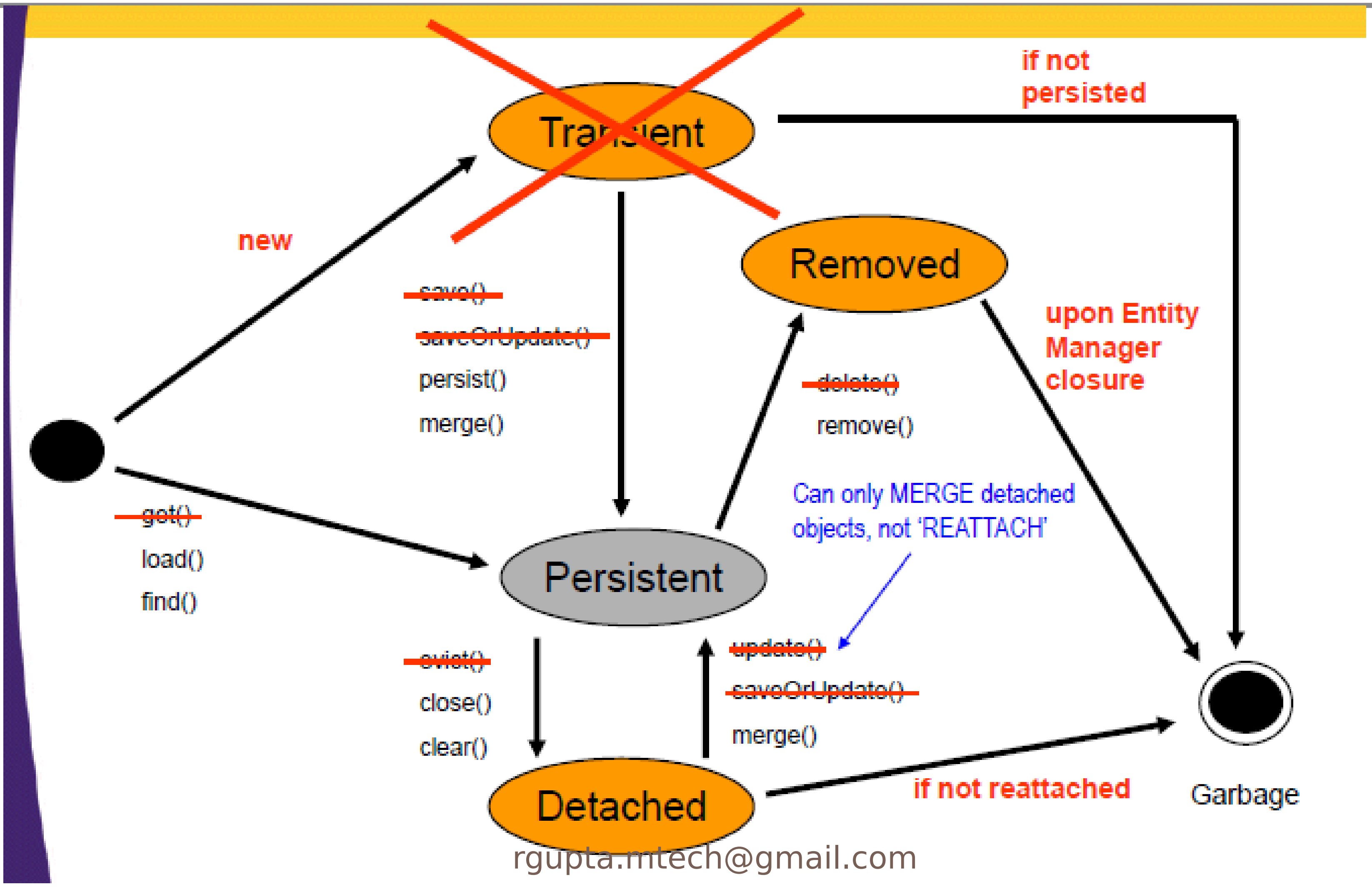


```
Customer customer = new Customer("Antony", "Balla", "tballa@mail.com");

tx.begin();
em.persist(customer);

customer.setFirstName("Williman");

tx.commit();
```

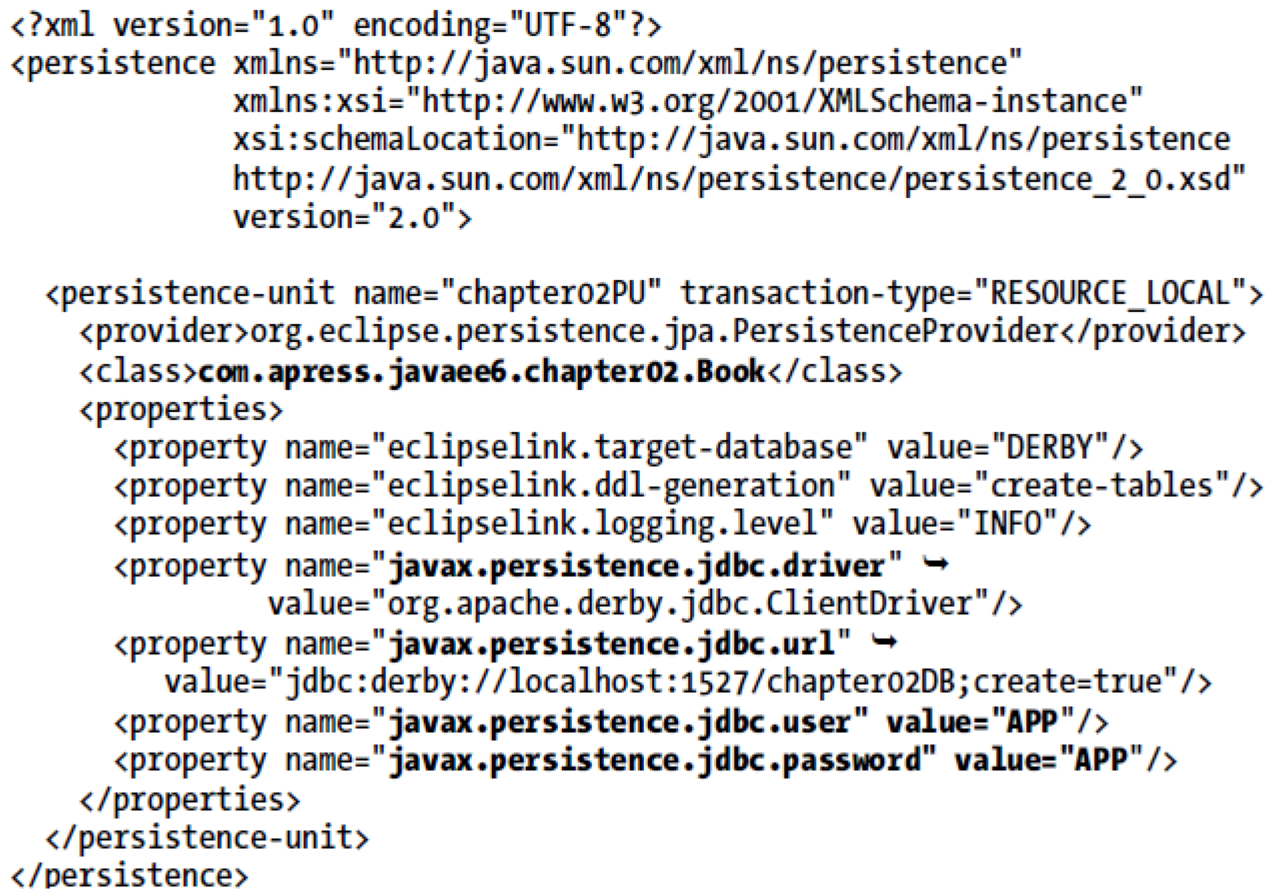
Entity Life Cycle



Entity Life Cycle

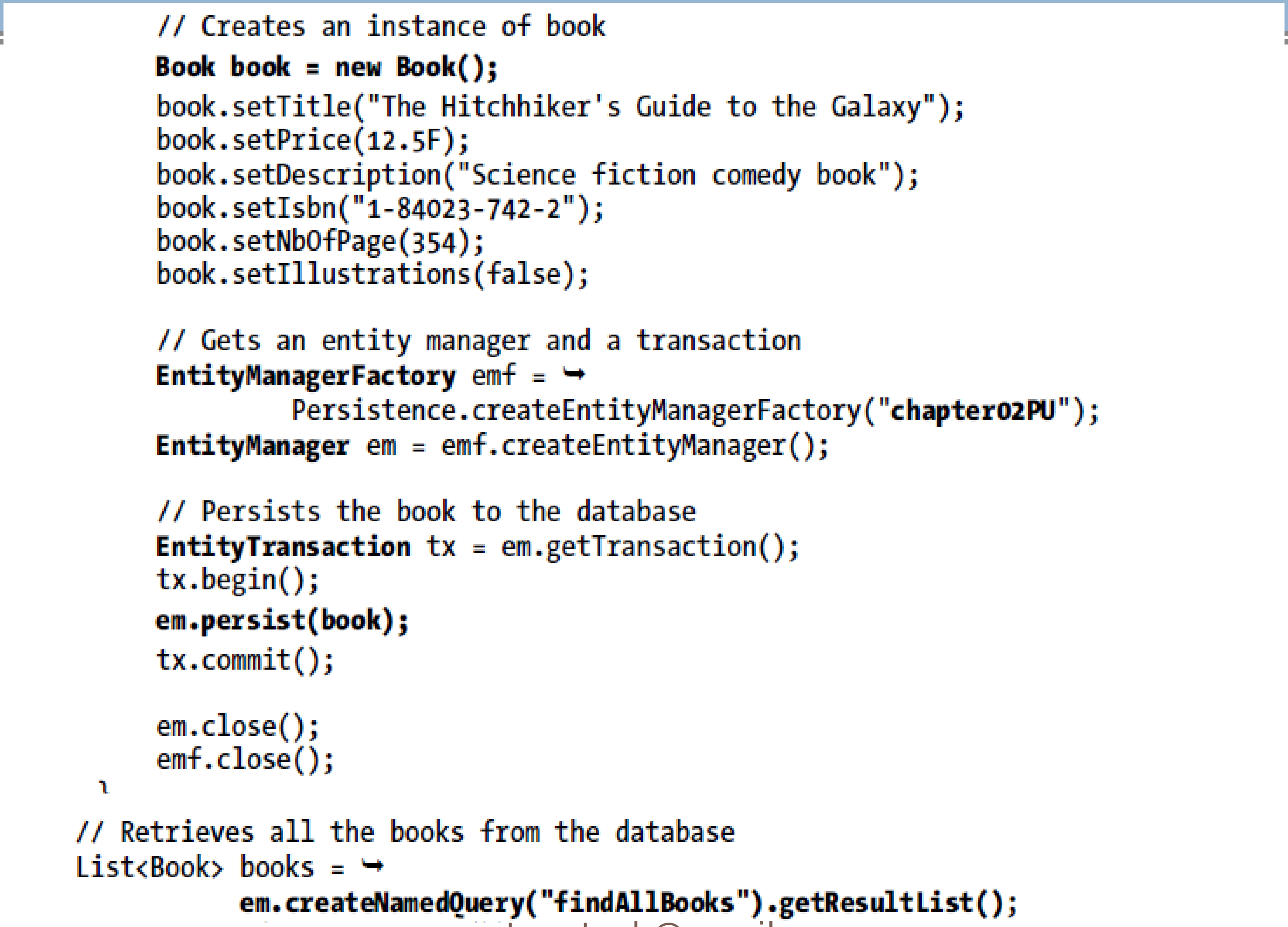


persistence.xml



```xml
<?xml version="1.0" encoding="UTF-8"?>
<persistence xmlns="http://java.sun.com/xml/ns/persistence"
             xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xsi:schemaLocation="http://java.sun.com/xml/ns/persistence
             http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd"
             version="2.0">

  <persistence-unit name="chapter02PU" transaction-type="RESOURCE_LOCAL">
    <provider>org.eclipse.persistence.jpa.PersistenceProvider</provider>
    <class>com.apress.javaee6.chapter02.Book</class>
    <properties>
      <property name="eclipselink.target-database" value="DERBY"/>
      <property name="eclipselink.ddl-generation" value="create-tables"/>
      <property name="eclipselink.logging.level" value="INFO"/>
      <property name="javax.persistence.jdbc.driver" ➥
                value="org.apache.derby.jdbc.ClientDriver"/>
      <property name="javax.persistence.jdbc.url" ➥
         value="jdbc:derby://localhost:1527/chapter02DB;create=true"/>
      <property name="javax.persistence.jdbc.user" value="APP"/>
      <property name="javax.persistence.jdbc.password" value="APP"/>
    </properties>
  </persistence-unit>
</persistence>
```

Inserting Record



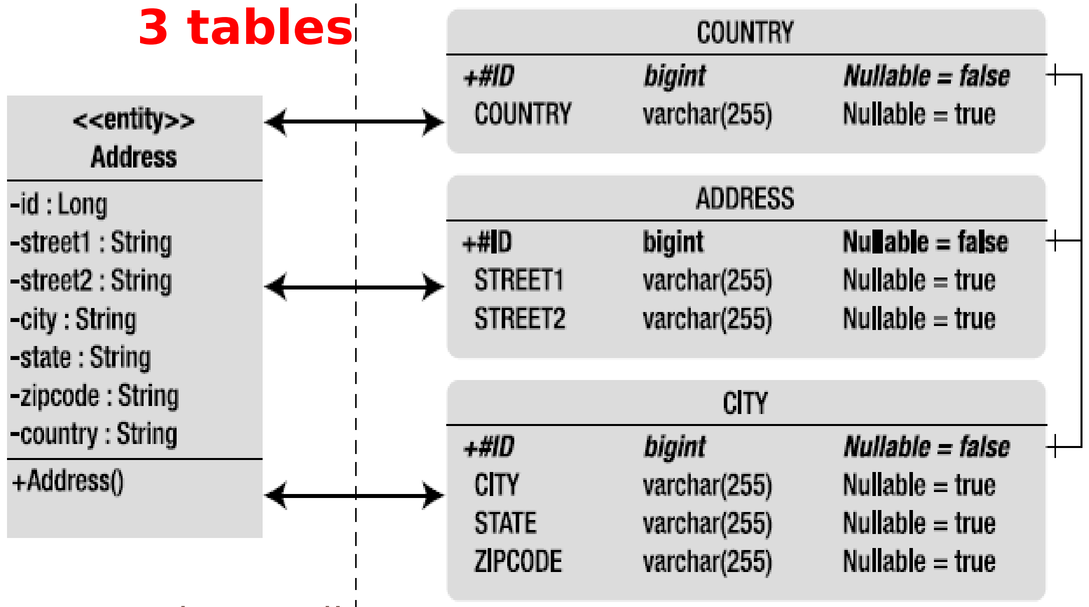
```
        // Creates an instance of book
        Book book = new Book();
        book.setTitle("The Hitchhiker's Guide to the Galaxy");
        book.setPrice(12.5F);
        book.setDescription("Science fiction comedy book");
        book.setIsbn("1-84023-742-2");
        book.setNbOfPage(354);
        book.setIllustrations(false);

        // Gets an entity manager and a transaction
        EntityManagerFactory emf = ➥
                Persistence.createEntityManagerFactory("chapter02PU");
        EntityManager em = emf.createEntityManager();

        // Persists the book to the database
        EntityTransaction tx = em.getTransaction();
        tx.begin();
        em.persist(book);
        tx.commit();

        em.close();
        emf.close();
    }
// Retrieves all the books from the database
List<Book> books = ➥
        em.createNamedQuery("findAllBooks").getResultList();
```

@SecondaryTable

- Data need to spread across multiple tables called *secondary tables*
- *Use annotation* @SecondaryTable to associate a secondary
  @SecondaryTables (with an “s”) for
  bles

```
@Entity
@SecondaryTables({
    @SecondaryTable(name = "city"),
    @SecondaryTable(name = "country")
})
public class Address {

    @Id
    private Long id;
    private String street1;
    private String street2;
    @Column(table = "city")
    private String city;
    @Column(table = "city")
    private String state;
    @Column(table = "city")
    private String zipcode;
    @Column(table = "country")
    private String country;

    // Constructors, getters, setters
}
```

Entity Address Mapped to 3 tables



<<entity>>
Address
-id : Long
-street1 : String
-street2 : String
-city : String
-state : String
-zipcode : String
-country : String
+Address()
COUNTRY
+#ID bigint Nullable = false
COUNTRY varchar(255) Nullable = true
ADDRESS
+#ID bigint Nullable = false
STREET1 varchar(255) Nullable = true
STREET2 varchar(255) Nullable = true
CITY
+#ID bigint Nullable = false
CITY varchar(255) Nullable = true
STATE varchar(255) Nullable = true
ZIPCODE varchar(255) Nullable = true

@Id and @GeneratedValue

```
@Entity
public class Book {

    @Id
    @GeneratedValue(strategy = GenerationType.AUTO)
    private Long id;
    private String title;
    private Float price;
    private String description;
    private String isbn;
    private Integer nbOfPage;
    private Boolean illustrations;

    // Constructors, getters, setters
}
```

SEQUENCE
IDENTITY
TABLE
AUTO

Composite Primary Keys

The Primary Key Class Is Annotated with @Embeddable

```
@Embeddable
public class NewsId {

    private String title;
    private String language;

    // Constructors, getters, setters, equals, and hashcode
}
```

The Entity Embeds the Primary Key Class with @EmbeddedId

```
@Entity
public class News {

    @EmbeddedId
    private NewsId id;
    private String content;

    // Constructors, getters, setters
}
```

```
NewsId pk = new NewsId("Richard Wright has died", "EN")
News news = em.find(News.class, pk);
```

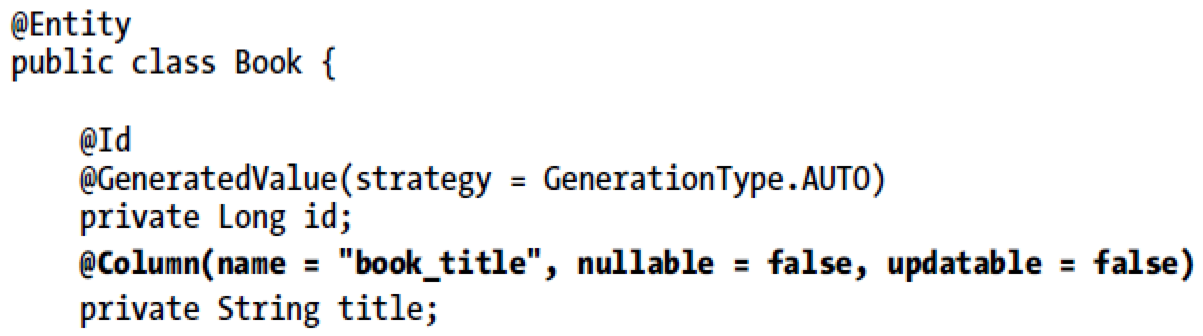
@Basic

```
@Target({METHOD, FIELD}) @Retention(RUNTIME)
public @interface Basic {
    FetchType fetch() default EAGER;
    boolean optional() default true;
}
```

```
@Entity
public class Track {

    @Id
    @GeneratedValue(strategy = GenerationType.AUTO)
    private Long id;
    private String title;
    private Float duration;
    @Basic(fetch = FetchType.LAZY)
    @Lob
    private byte[] wav;
    private String description;

    // Constructors, getters, setters
}
```

@Column

- Define properties of an column



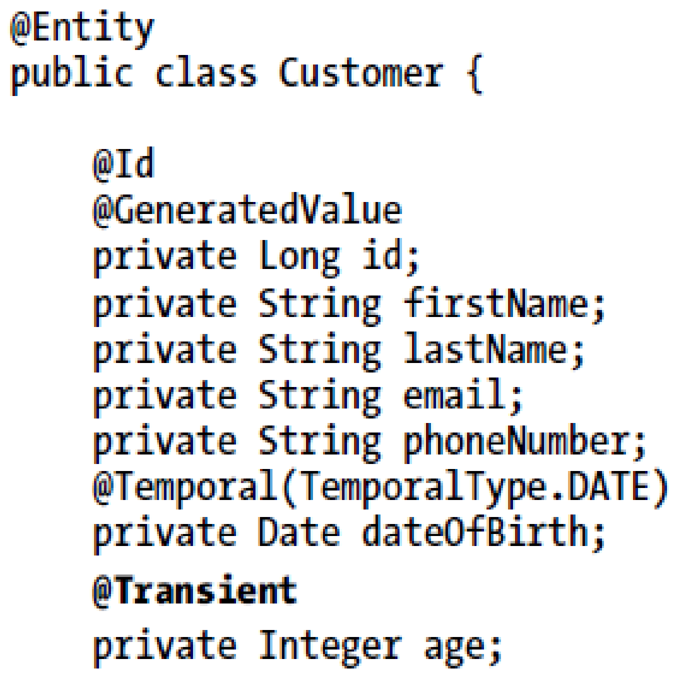
```
@Entity
public class Book {

    @Id
    @GeneratedValue(strategy = GenerationType.AUTO)
    private Long id;
    @Column(name = "book_title", nullable = false, updatable = false)
    private String title;
```

@Temporal

```
@Entity
public class Customer {

    @Id
    @GeneratedValue
    private Long id;
    private String firstName;
    private String lastName;
    private String email;
    private String phoneNumber;
    @Temporal(TemporalType.DATE)
    private Date dateOfBirth;
    @Temporal(TemporalType.TIMESTAMP)
    private Date creationDate;
```

```
create table CUSTOMER (
    ID BIGINT not null,
    FIRSTNAME VARCHAR(255),
    LASTNAME VARCHAR(255),
    EMAIL VARCHAR(255),
    PHONENUMBER VARCHAR(255),
    DATEOFBIRTH DATE,
    CREATIONDATE TIMESTAMP,
    primary key (ID)
);
```

@Transient



```
@Entity
public class Customer {

    @Id
    @GeneratedValue
    private Long id;
    private String firstName;
    private String lastName;
    private String email;
    private String phoneNumber;
    @Temporal(TemporalType.DATE)
    private Date dateOfBirth;
    @Transient
    private Integer age;
```

- Don’t get stored in DB

@Enumerated

```
public enum CreditCardType {
    VISA,
    MASTER_CARD,
    AMERICAN_EXPRESS
}
```

```
@Entity
@Table(name = "credit_card")
public class CreditCard {

    @Id
    private String number;
    private String expiryDate;
    private Integer controlNumber;
    private CreditCardType creditCardType;

    // Constructors, getters, setters
}
```

Mapping an Enumerated Type with String

```
@Entity
@Table(name = "credit_card")
public class CreditCard {

    @Id
    private String number;
    private String expiryDate;
    private Integer controlNumber;
    @Enumerated(EnumType.STRING)
    private CreditCardType creditCardType;

    // Constructors, getters, setters
}
```

Collection of Basic Types

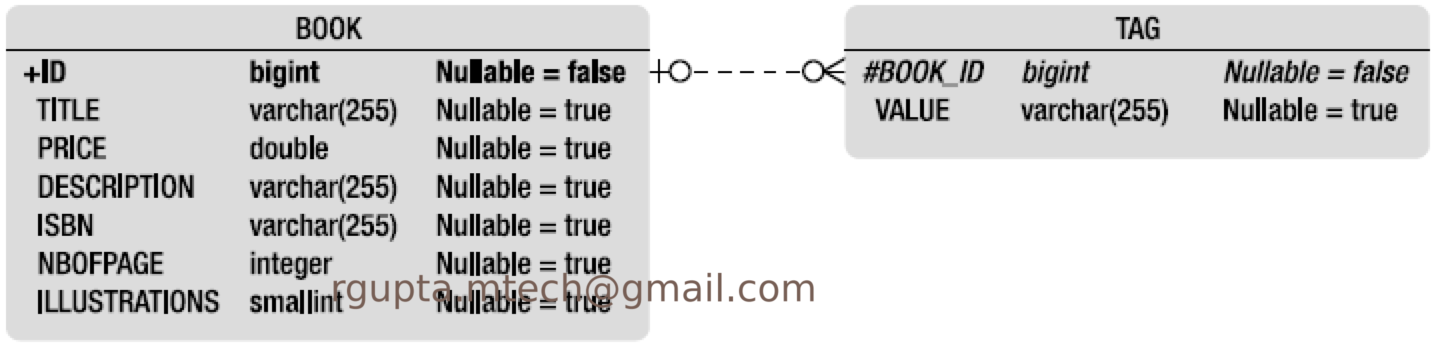
- @ElementCollection annotation is used to indicate that an attribute of type java.util.Collection contains a collection of instances of basic types (i.e., nonentities)

- Attribute can be of the following types:
  - **• java.util.Collection: Generic root interface in the collection hierarchy.**
  - **• java.util.Set: Collection that prevents the insertion of duplicate elements.**
  - **• java.util.List: Collection used when the elements need to be retrieved in some**
  - user-defined order.

Collection of Basic Types

Book Entity with collection of Strings

```
@Entity
public class Book {

    @Id
    @GeneratedValue(strategy = GenerationType.AUTO)
    private Long id;
    private String title;
    private Float price;
    private String description;
    private String isbn;
    private Integer nbOfPage;
    private Boolean illustrations;
    @ElementCollection(fetch = FetchType.LAZY)
    @CollectionTable(name = "Tag")
    @Column(name = "Value")
    private List<String> tags = new ArrayList<String>();

    // Constructors, getters, setters
}
```



BOOK

+ID	bigint	Nullable = false
TITLE	varchar(255)	Nullable = true
PRICE	double	Nullable = true
DESCRIPTION	varchar(255)	Nullable = true
ISBN	varchar(255)	Nullable = true
NBOFPAGE	integer	Nullable = true
ILLUSTRATIONS	smallint	Nullable = true

TAG

#BOOK_ID	*bigint*	*Nullable = false*
VALUE	varchar(255)	Nullable = true

Embeddables

```
@Embeddable
public class Address {

    private String street1;
    private String street2;
    private String city;
    private String state;
    private String zipcode;
    private String country;

    // Constructors, getters, setters
}
```

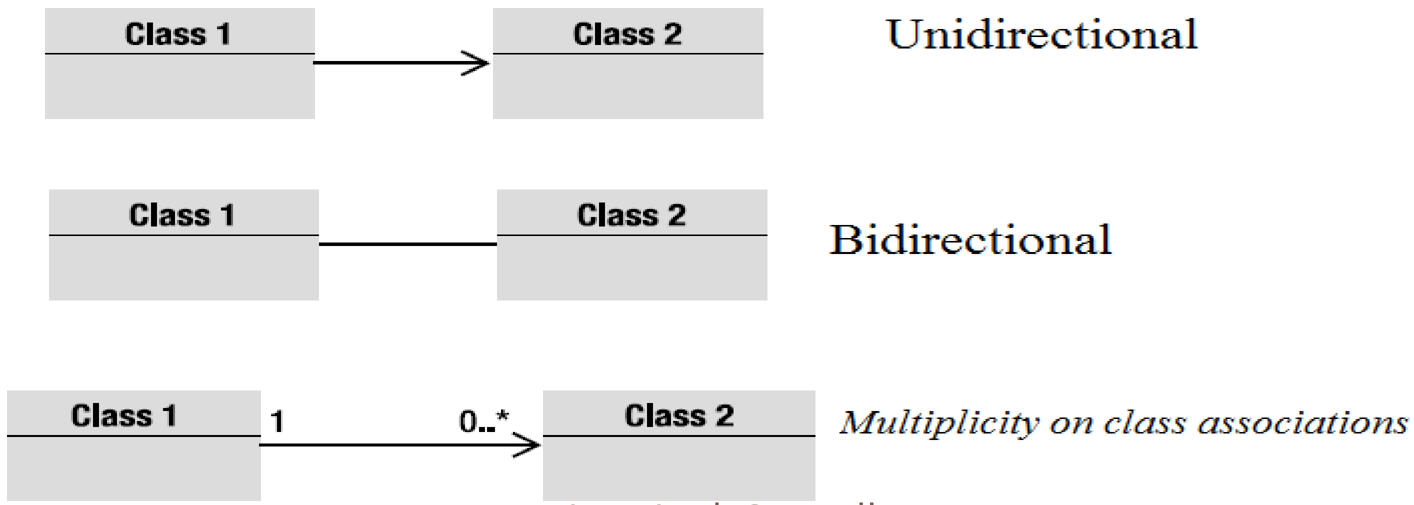
```
@Entity
public class Customer {

    @Id @GeneratedValue
    private Long id;
    private String firstName;
    private String lastName;
    private String email;
    private String phoneNumber;
    @Embedded
    private Address address;

    // Constructors, getters, setters
}
```

Listing 3-35. *Structure of the CUSTOMER Table with All the Address Attributes*

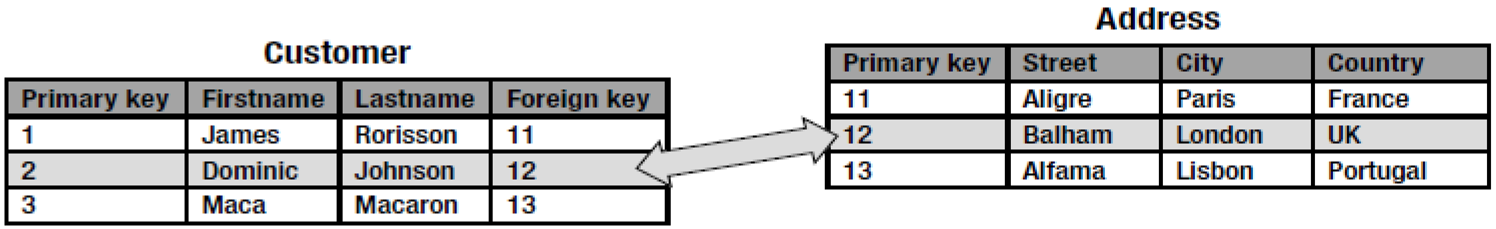
```
create table CUSTOMER (
  ID BIGINT not null,
  LASTNAME VARCHAR(255),
  PHONENUMBER VARCHAR(255),
  EMAIL VARCHAR(255),
  FIRSTNAME VARCHAR(255),
  STREET2 VARCHAR(255),
  STREET1 VARCHAR(255),
  ZIPCODE VARCHAR(255),
  STATE VARCHAR(255),
  COUNTRY VARCHAR(255),
  CITY VARCHAR(255),
  primary key (ID)
);
```

Relationship Mapping

- OO relations
  - Association between the Objects
    - IS-A, HAS-A, USE-A
- An association has a direction:
  - *Unidirectional*
  -



Relationships in Relational Databases



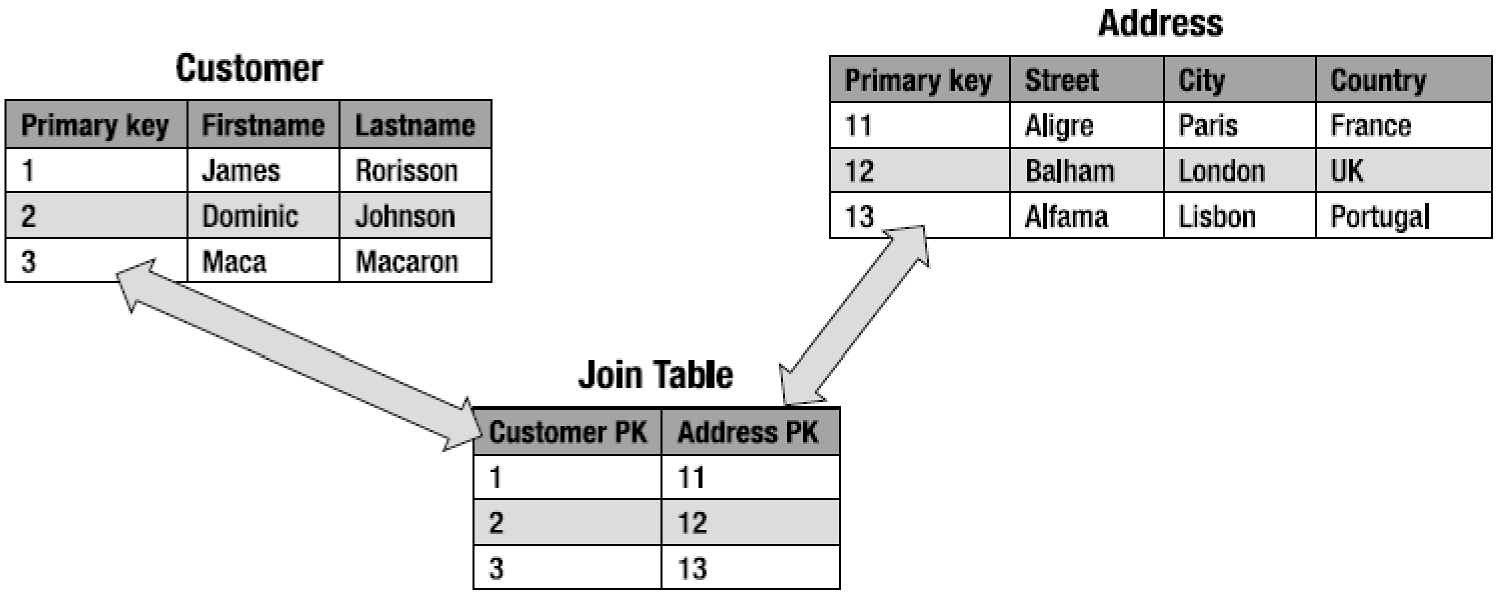
Customer

Primary key	Firstname	Lastname	Foreign key
1	James	Rorisson	11
2	Dominic	Johnson	12
3	Maca	Macaron	13

Address

Primary key	Street	City	Country
11	Aligre	Paris	France
12	Balham	London	UK
13	Alfama	Lisbon	Portugal

Figure 3-9. A relationship using a join column



Customer

Primary key	Firstname	Lastname
1	James	Rorisson
2	Dominic	Johnson
3	Maca	Macaron

Address

Primary key	Street	City	Country
11	Aligre	Paris	France
12	Balham	London	UK
13	Alfama	Lisbon	Portugal

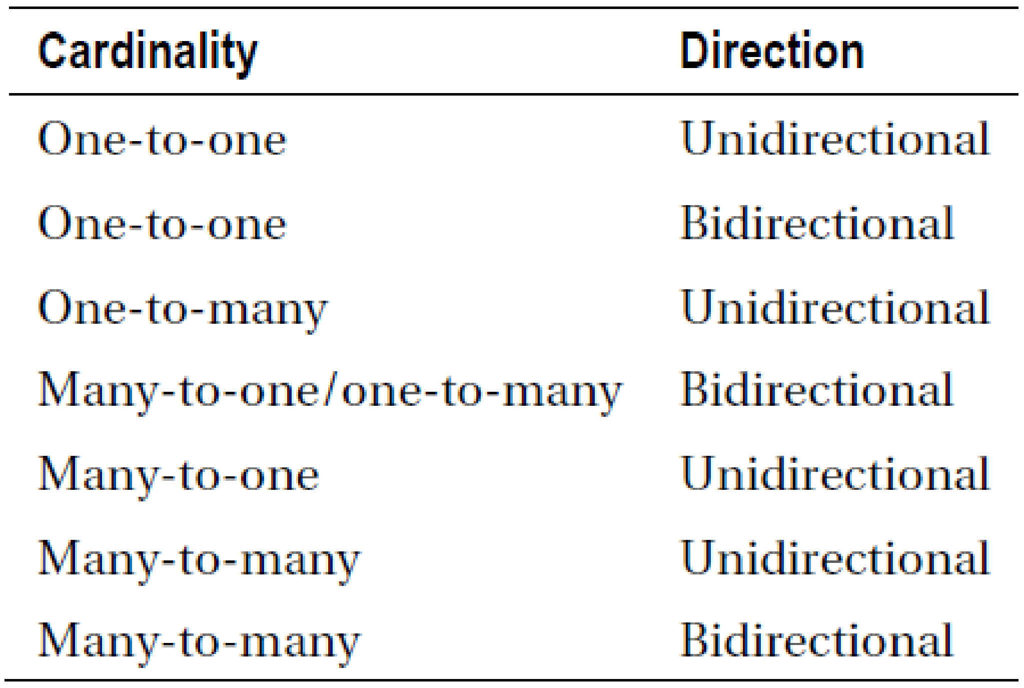
Join Table

Customer PK	Address PK
1	11
2	12
3	13

Figure 3-10. A relationship using a join table

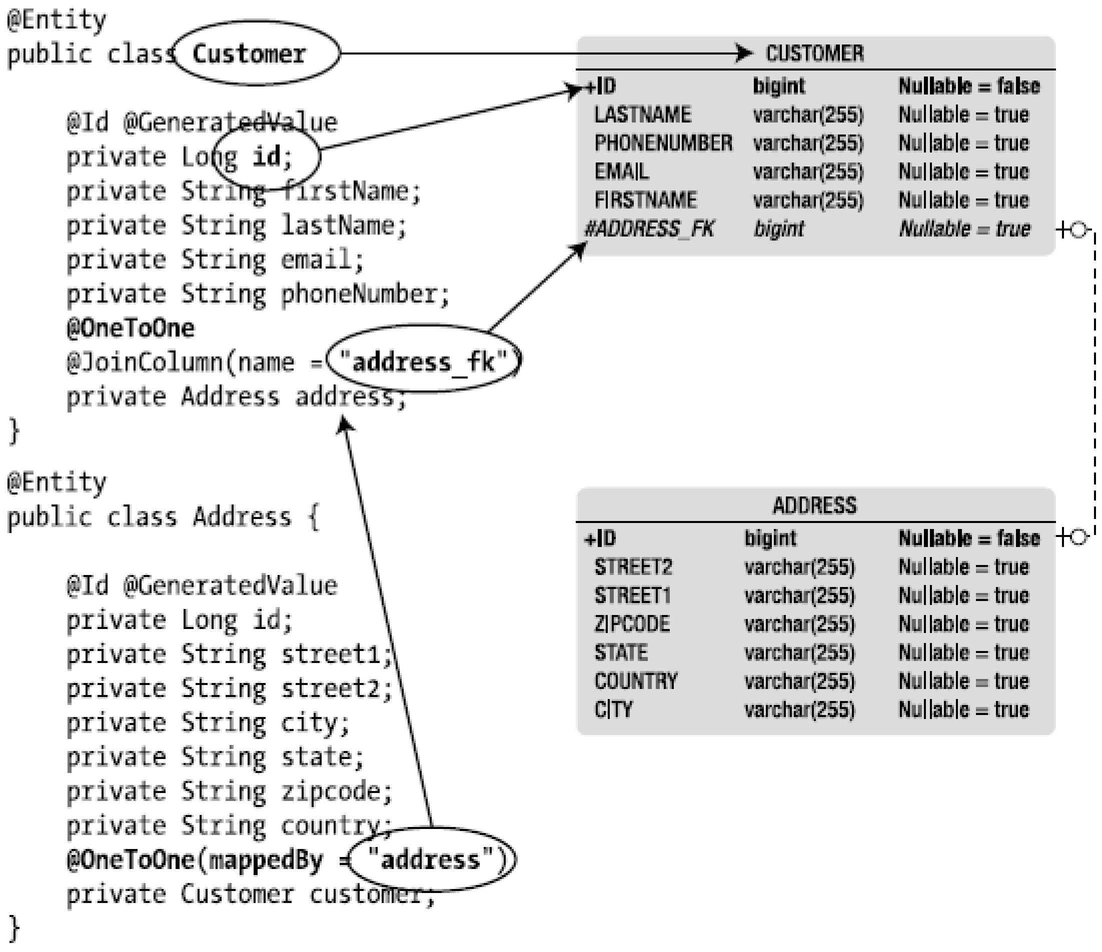
Entity Relationships

Table 3-1. All Possible Cardinality-Direction Combinations



Cardinality	Direction
One-to-one	Unidirectional
One-to-one	Bidirectional
One-to-many	Unidirectional
Many-to-one/one-to-many	Bidirectional
Many-to-one	Unidirectional
Many-to-many	Unidirectional
Many-to-many	Bidirectional

One to one Bidirectional



```
@Entity
public class Customer

    @Id @GeneratedValue
    private Long id;
    private String firstName;
    private String lastName;
    private String email;
    private String phoneNumber;
    @OneToOne
    @JoinColumn(name = "address_fk")
    private Address address;
}

@Entity
public class Address {

    @Id @GeneratedValue
    private Long id;
    private String street1;
    private String street2;
    private String city;
    private String state;
    private String zipcode;
    private String country;
    @OneToOne(mappedBy = "address")
    private Customer customer;
}
```

CUSTOMER

+ID	bigint	Nullable = false
LASTNAME	varchar(255)	Nullable = true
PHONENUMBER	varchar(255)	Nullable = true
EMAIL	varchar(255)	Nullable = true
FIRSTNAME	varchar(255)	Nullable = true
#ADDRESS_FK	bigint	Nullable = true

ADDRESS

+ID	bigint	Nullable = false
STREET2	varchar(255)	Nullable = true
STREET1	varchar(255)	Nullable = true
ZIPCODE	varchar(255)	Nullable = true
STATE	varchar(255)	Nullable = true
COUNTRY	varchar(255)	Nullable = true
CITY	varchar(255)	Nullable = true

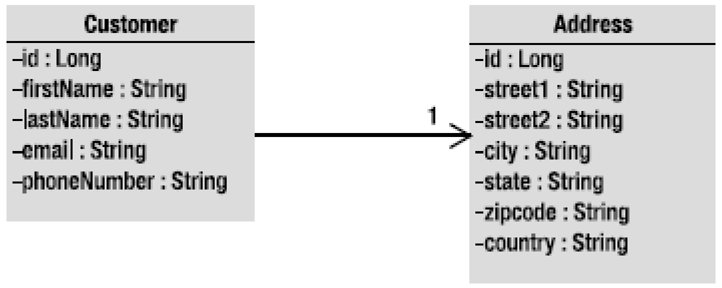
Figure 3-14. Customer and Address code with database mapping

One to one Unidirectional

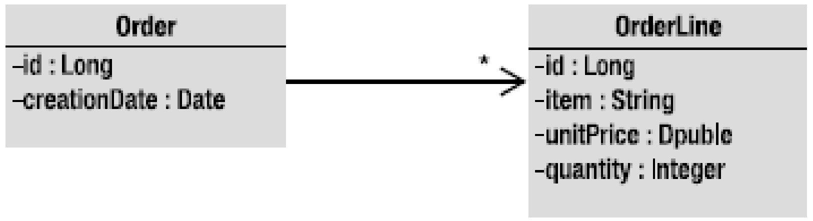
```
@Entity
public class Customer {

    @Id @GeneratedValue
    private Long id;
    private String firstName;
    private String lastName;
    private String email;
    private String phoneNumber;
    private Address address;

    // Constructors, getters, setters
}
```

Listing 3-39. An Address Entity

```
@Entity
public class Address {

    @Id @GeneratedValue
    private Long id;
    private String street1;
    private String street2;
    private String city;
    private String state;
    private String zipcode;
    private String country;

    // Constructors, getters, setters
}
```



One to many unidirectional



```
@Entity
public class Order {

    @Id @GeneratedValue
    private Long id;
    @Temporal(TemporalType.TIMESTAMP)
    private Date creationDate;
    private List<OrderLine> orderLines;

    // Constructors, getters, setters
}
```

Listing 3-45. An OrderLine

```
@Entity
@Table(name = "order_line")
public class OrderLine {

    @Id @GeneratedValue
    private Long id;
    private String item;
    private Double unitPrice;
    private Integer quantity;

    // Constructors, getters, setters
}
```

One to many unidirectional

- Previous annotations leads to mapping that relies on the configuration-by exception paradigm.
- By default relationships use a join table to keep the relationship information, with two foreign key columns. One foreign key column refers to the table **ORDER and has the same type as its primary key, and the other** refers to **ORDER_LINE. The name of this joined table is the name of both entities, separated by the _** symbol.

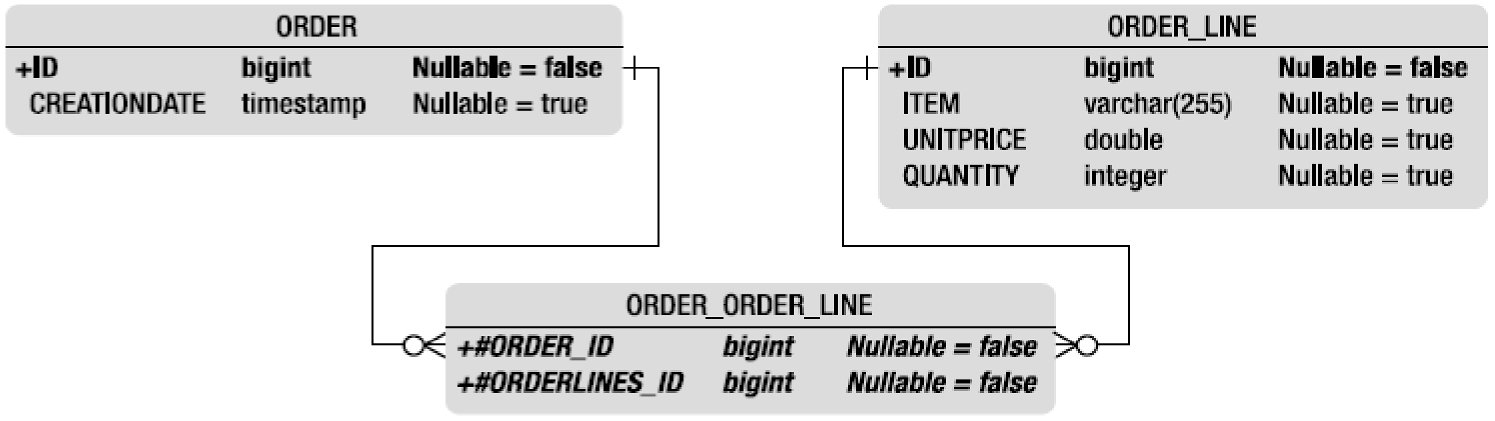

ORDER
+ID bigint Nullable = false
CREATIONDATE timestamp Nullable = true
ORDER_LINE
+ID bigint Nullable = false
ITEM varchar(255) Nullable = true
UNITPRICE double Nullable = true
QUANTITY integer Nullable = true
ORDER_ORDER_LINE
+#ORDER_ID bigint Nullable = false
+#ORDERLINES_ID bigint Nullable = false

Figure 3-17. Join table between ORDER *and* ORDER_LINE

One to many unidirectional

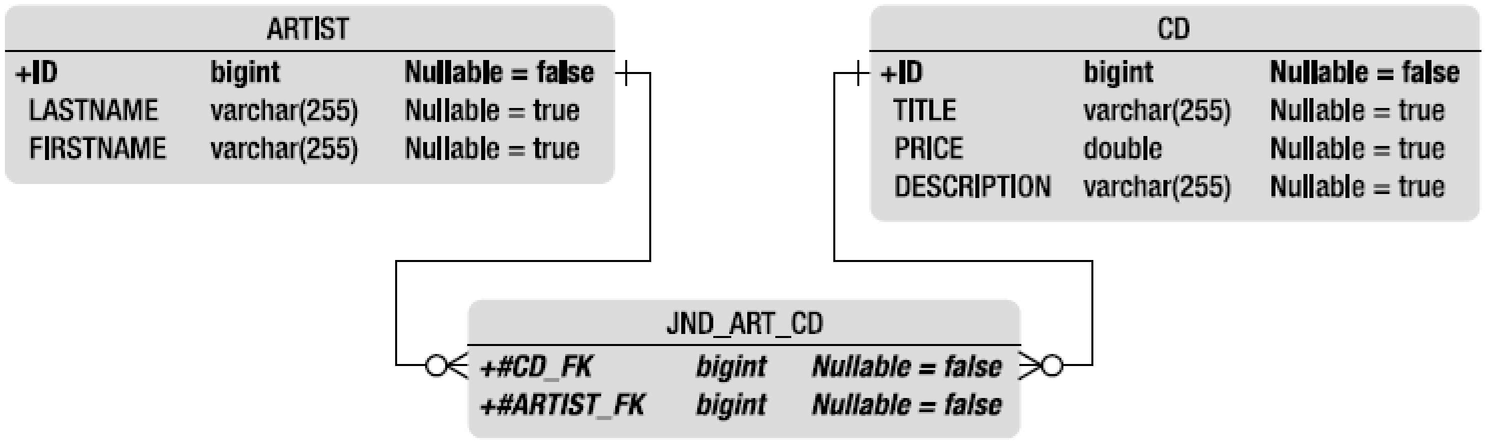
```
@Entity
public class Order {

    @Id @GeneratedValue
    private Long id;
    @Temporal(TemporalType.TIMESTAMP)
    private Date creationDate;
    @OneToMany
    @JoinTable(name = "jnd_ord_line",
        joinColumns = @JoinColumn(name = "order_fk"),
        inverseJoinColumns = @JoinColumn(name = "order_line_fk") )
    private List<OrderLine> orderLines;

    // Constructors, getters, setters
}
```

```
create table JND_ORD_LINE (
    ORDER_FK BIGINT not null,
    ORDER_LINE_FK BIGINT not null,
    primary key (ORDER_FK, ORDER_LINE_FK),
    foreign key (ORDER_LINE_FK) references ORDER_LINE(ID),
    foreign key (ORDER_FK) references ORDER(ID)
);
```

Many to Many Bi-directional

```
@Entity
public class CD {

    @Id @GeneratedValue
    private Long id;
    private String title;
    private Float price;
    private String description;
    @ManyToMany(mappedBy = "appearsOnCDs")
    private List<Artist> createdByArtists;

    // Constructors, getters, setters
}
```

```
@Entity
public class Artist {

    @Id @GeneratedValue
    private Long id;
    private String firstName;
    private String lastName;
    @ManyToMany
    @JoinTable(name = "jnd_art_cd", ➥
        joinColumns = @JoinColumn(name = "artist_fk"), ➥
        inverseJoinColumns = @JoinColumn(name = "cd_fk"))
    private List<CD> appearsOnCDs;

    // Constructors, getters, setters
}
```


ARTIST
+ID bigint Nullable = false
LASTNAME varchar(255) Nullable = true
FIRSTNAME varchar(255) Nullable = true
CD
+ID bigint Nullable = false
TITLE varchar(255) Nullable = true
PRICE double Nullable = true
DESCRIPTION varchar(255) Nullable = true
JND_ART_CD
+#CD_FK bigint Nullable = false
+#ARTIST_FK bigint Nullable = false

Fetching Relationships

- Consider four entities related by eager

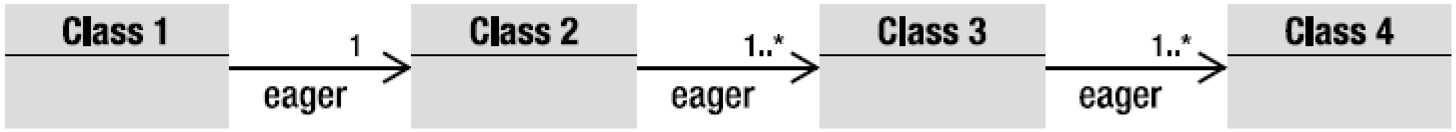


Figure 3-20. Four entities with eager relationships

```
class1.getClass2().getClass3().getClass4()
```

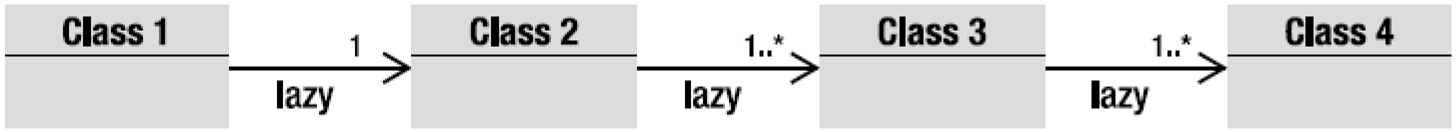


Figure 3-21. Four entities with lazy relationships

Fetching Relationships

Listing 3-52. *An Order with an Eager Relationship to* `OrderLine`

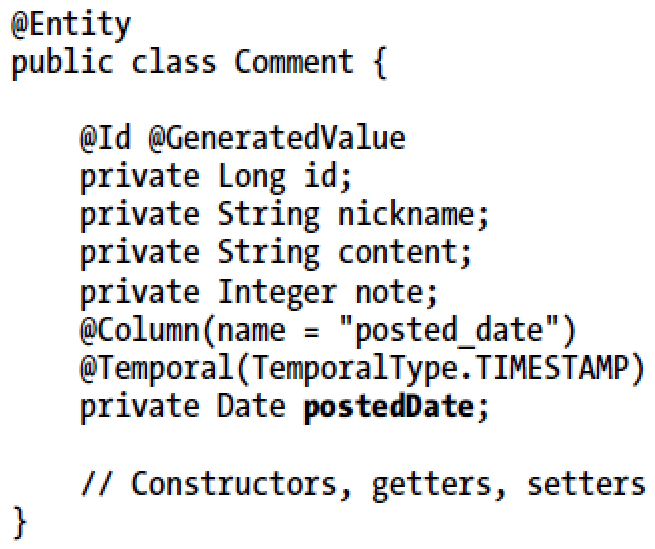
```
@Entity
public class Order {

    @Id @GeneratedValue
    private Long id;
    @Temporal(TemporalType.TIMESTAMP)

      private Date creationDate;
      @OneToMany(fetch = FetchType.EAGER)
      private List<OrderLine> orderLines;

      // Constructors, getters, setters
  }
```

Table 3-2. *Default Fetching Strategies*

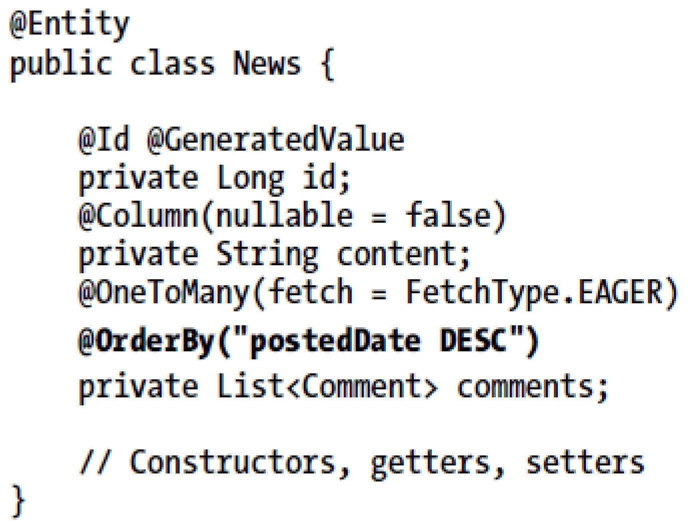
Annotation	Default Fetching Strategy
@OneToOne	EAGER
@ManyToOne	EAGER
@OneToMany	LAZY
@ManyToMany	LAZY

@OrderBy

- Dynamic ordering can be done with the @OrderBy annotation. “Dynamically” means that the ordering of the elements of a collection is made when the association is retrieved



```
@Entity
public class Comment {

    @Id @GeneratedValue
    private Long id;
    private String nickname;
    private String content;
    private Integer note;
    @Column(name = "posted_date")
    @Temporal(TemporalType.TIMESTAMP)
    private Date postedDate;

    // Constructors, getters, setters
}
```



```
@Entity
public class News {

    @Id @GeneratedValue
    private Long id;
    @Column(nullable = false)
    private String content;
    @OneToMany(fetch = FetchType.EAGER)
    @OrderBy("postedDate DESC")
    private List<Comment> comments;

    // Constructors, getters, setters
}
```

Inheritance Mapping

- JPA has three different strategies to choose from:-
  - ***A single-table-per-class hierarchy strategy***
    - *The sum of the attributes of the entire* entity hierarchy is flattened down to a single table
    - This is the default strategy
  - ***A joined-subclass strategy***
    - *In this approach, each entity in the hierarchy, concrete* or abstract, is mapped to its own dedicated table.
  - ***A table-per-concrete-class strategy***
    - *This strategy maps each concrete entity* hierarchy to its own separate table

Inheritance Mapping

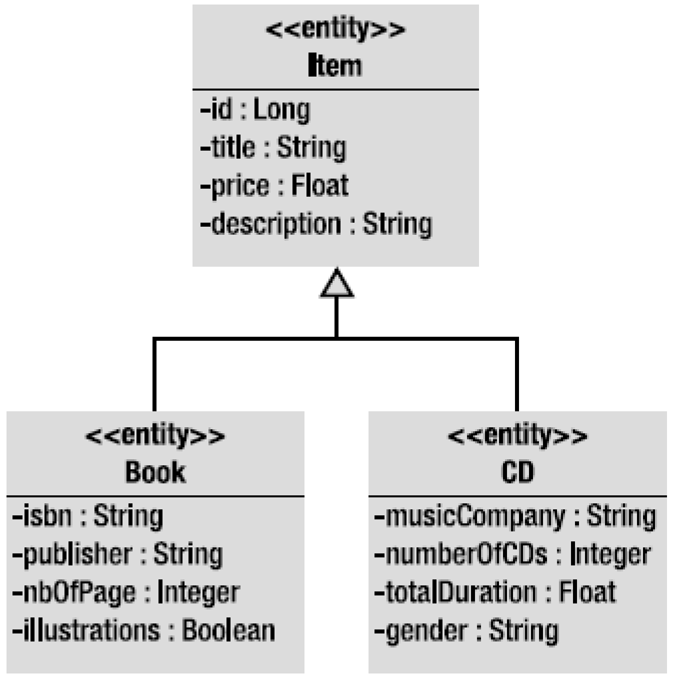
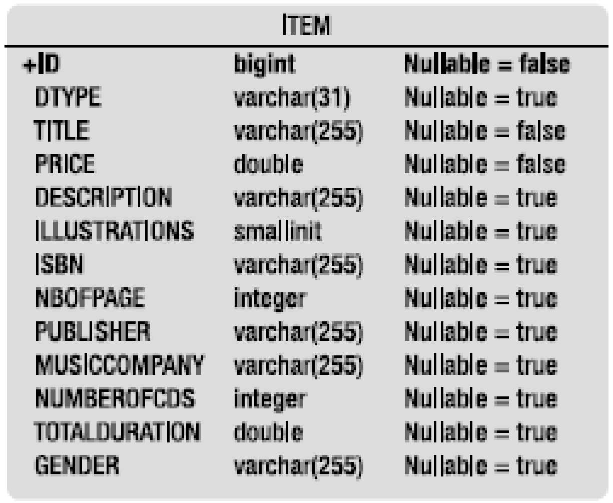


Figure 3-22. *Inheritance hierarchy between* `CD`, `Book`, *and* `Item`

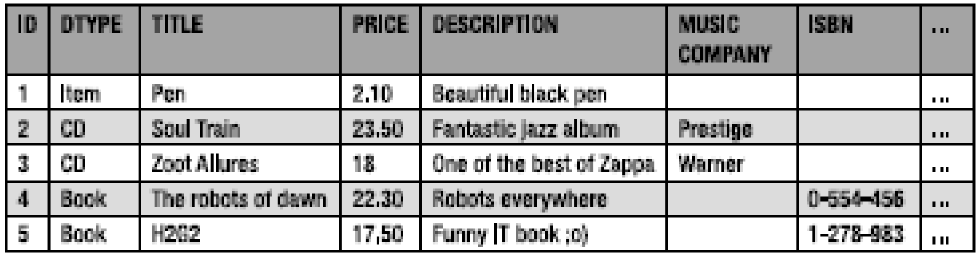
Single-Table-per-Class Hierarchy Strategy

```java
@Entity
public class Item {

    @Id @GeneratedValue
    protected Long id;
    @Column(nullable = false)
    protected String title;
    @Column(nullable = false)
    protected Float price;
    protected String description;

    // Constructors, getters, setters
}

@Entity
public class Book extends Item {

    private String isbn;
    private String publisher;
    private Integer nbOfPage;
    private Boolean illustrations;

    // Constructors, getters, setters
}

@Entity
public class CD extends Item {

    private String musicCompany;
    private Integer numberOfCDs;
    private Float totalDuration;
    private String gender;

    // Constructors, getters, setters
}
```



ITEM		
+ID	bigint	Nullable = false
DTYPE	varchar(31)	Nullable = true
TITLE	varchar(255)	Nullable = false
PRICE	double	Nullable = false
DESCRIPTION	varchar(255)	Nullable = true
ILLUSTRATIONS	smallinit	Nullable = true
ISBN	varchar(255)	Nullable = true
NBOFPAGE	integer	Nullable = true
PUBLISHER	varchar(255)	Nullable = true
MUSICCOMPANY	varchar(255)	Nullable = true
NUMBEROFCDS	integer	Nullable = true
TOTALDURATION	double	Nullable = true
GENDER	varchar(255)	Nullable = true

Figure 3-23. ITEM table structure



ID	DTYPE	TITLE	PRICE	DESCRIPTION	MUSIC COMPANY	ISBN	...
1	Item	Pen	2.10	Beautiful black pen			...
2	CD	Soul Train	23.50	Fantastic jazz album	Prestige		...
3	CD	Zoot Allures	18	One of the best of Zappa	Warner		...
4	Book	The robots of dawn	22.30	Robots everywhere		0-554-456	...
5	Book	H2G2	17.50	Funny IT book ;o)		1-278-983	...

Figure 3-24. Fragment of the ITEM table filled with data

Single-Table-per-Class Hierarchy Strategy(II)

- Discriminator column is called DTYPE by default, is of type String (mapped to a VARCHAR), and contains the name of the entity.
- If the defaults don’t suit, the @DiscriminatorColumn annotation allows you to change the name and the data type.
- By default, the value of this column is the entity name to which it refers, although an entity may override this value using the @DiscriminatorValue annotation.

Single-Table-per-Class Hierarchy Strategy(III)

Listing 3-61. Item Redefines the Discriminator Column

```
@Entity
@Inheritance(strategy = InheritanceType.SINGLE_TABLE)
@DiscriminatorColumn (name="disc", ➥
                      discriminatorType = DiscriminatorType.CHAR)
@DiscriminatorValue("I")
public class Item {

    @Id @GeneratedValue
    protected Long id;
    protected String title;
    protected Float price;
    protected String description;

    // Constructors, getters, setters
}
```

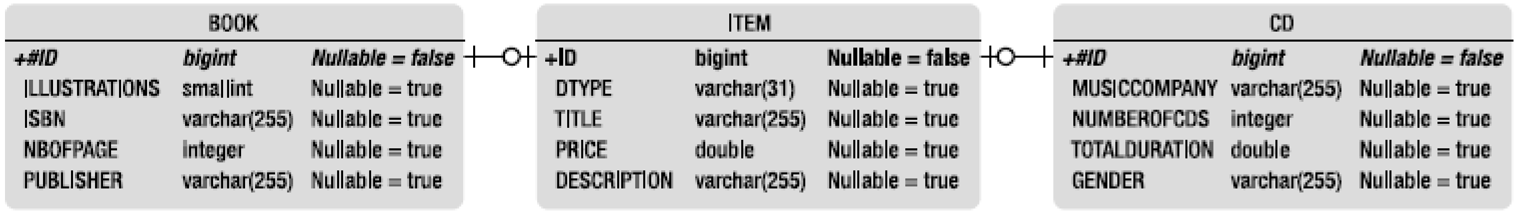
```
@Entity
@DiscriminatorValue("B")
public class Book extends Item {

    private String isbn;
    private String publisher;
    private Integer nbOfPage;
    private Boolean illustrations;

    // Constructors, getters, setters
}
```

ID	DTYPE	TITLE	PRICE	DESCRIPTION	MUSIC COMPANY	ISBN	...
1	I	Pen	2.10	Beautiful black pen			...
2	C	Soul Train	23,50	Fantastic jazz album	Prestige		...
3	C	Zoot Allures	18	One of the best of Zappa	Warner		...
4	B	The robots of dawn	22.30	Robots everywhere		0-554-456	...
5	B	H2G2	17,50	Funny IT book ;o)		1-278-983	...

```
@Entity
@DiscriminatorValue("C")
public class CD extends Item {

    private String musicCompany;
    private Integer numberOfCDs;
    private Float totalDuration;
    private String gender;

    // Constructors, getters, setters
}
```

Joined-Subclass Strategy

```
@Entity
@Inheritance(strategy = InheritanceType.JOINED)
public class Item {

    @Id @GeneratedValue
    protected Long id;
    protected String title;
    protected Float price;
    protected String description;

    // Constructors, getters, setters
}
```



BOOK

+#ID	*bigint*	*Nullable = false*
ILLUSTRATIONS	smallint	Nullable = true
ISBN	varchar(255)	Nullable = true
NBOFPAGE	integer	Nullable = true
PUBLISHER	varchar(255)	Nullable = true

ITEM

+ID	bigint	Nullable = false
DTYPE	varchar(31)	Nullable = true
TITLE	varchar(255)	Nullable = true
PRICE	double	Nullable = true
DESCRIPTION	varchar(255)	Nullable = true

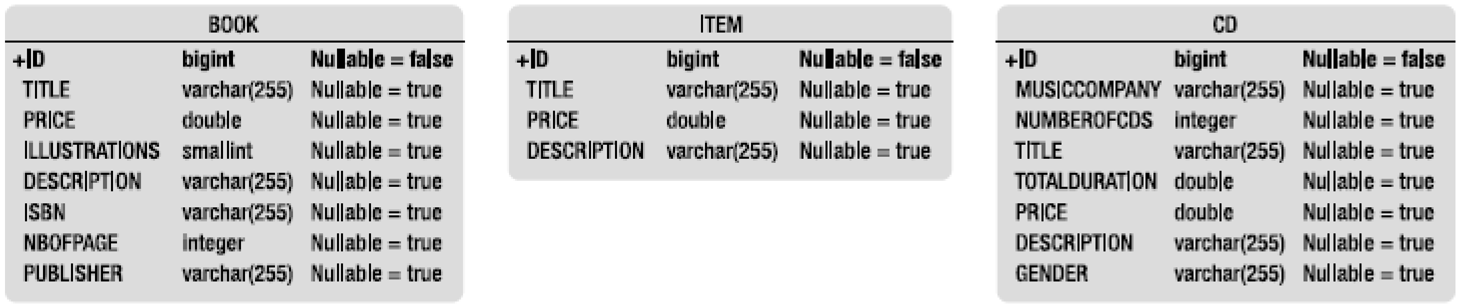
CD

+#ID	*bigint*	*Nullable = false*
MUSICCOMPANY	varchar(255)	Nullable = true
NUMBEROFCDS	integer	Nullable = true
TOTALDURATION	double	Nullable = true
GENDER	varchar(255)	Nullable = true

Figure 3-26. *Mapping inheritance with a joined-subclass strategy*

Table-per-Concrete-Class Strategy

```
@Entity
@Inheritance(strategy = InheritanceType.TABLE_PER_CLASS)
public class Item {

    @Id @GeneratedValue
    protected Long id;
    protected String title;
    protected Float price;
    protected String description;

    // Constructors, getters, setters
}
```



BOOK		
+ID	bigint	Nullable = false
TITLE	varchar(255)	Nullable = true
PRICE	double	Nullable = true
ILLUSTRATIONS	smallint	Nullable = true
DESCRIPTION	varchar(255)	Nullable = true
ISBN	varchar(255)	Nullable = true
NBOFPAGE	integer	Nullable = true
PUBLISHER	varchar(255)	Nullable = true

ITEM		
+ID	bigint	Nullable = false
TITLE	varchar(255)	Nullable = true
PRICE	double	Nullable = true
DESCRIPTION	varchar(255)	Nullable = true

CD		
+ID	bigint	Nullable = false
MUSICCOMPANY	varchar(255)	Nullable = true
NUMBEROFCDS	integer	Nullable = true
TITLE	varchar(255)	Nullable = true
TOTALDURATION	double	Nullable = true
PRICE	double	Nullable = true
DESCRIPTION	varchar(255)	Nullable = true
GENDER	varchar(255)	Nullable = true

Figure 3-27. BOOK and CD tables duplicating ITEM columns

JPQL

- Under the hood, JPQL uses the mechanism of mapping to transform a JPQL query into language comprehensible by an SQL database.
- The query is executed on the underlying database with SQL and JDBC calls, and then entity instances have their attributes set and are returned to the

```
SELECT b
FROM Book b
```

simplest JPQL query selects all the instances of a single entity

```
SELECT b
FROM Book b
WHERE b.title = 'H2G2'
```

```
SELECT c
FROM Customer c
WHERE c.firstName = 'Vincent' AND c.address.country = 'France'
```

```
SELECT c
FROM Customer c
```

A simple SELECT returns an entity. For example, if a Customer entity has an alias called c, SELECT c will return an entity or a list of entities

```
SELECT c.firstName, c.lastName
FROM Customer c
```

```
SELECT c.address.country.code
FROM Customer c
```

```
SELECT c
FROM Customer c
WHERE c.firstName = 'Vincent'
```

Binding Parameters

```
SELECT c
FROM Customer c
WHERE c.firstName = ?1 AND c.address.country = ?2
```

Positional parameters **are designated by the question mark (?) followed by an integer (e.g., ?1)**

```
SELECT c
FROM Customer c
WHERE c.firstName = :fname AND c.address.country = :country
```

Named parameters **can also be used and are designated by a String identifier that is prefixed by the colon (:) symbol. When the query is executed, the parameter names that should be replaced need to be specified**