Managing Entities

Entities are managed by the entity manager, which is represented by `javax.persistence.EntityManager` instances. Each `EntityManager` instance is associated with a persistence context: a set of managed entity instances that exist in a particular data store. A persistence context defines the scope under which particular entity instances are created, persisted, and removed.
The `EntityManager` interface defines the methods that are used to interact with the persistence context.

The `EntityManager` Interface

The `EntityManager` API creates and removes persistent entity instances, finds entities by the entity's primary key, and allows queries to be run on entities.

Container-Managed Entity Managers

With a **container-managed entity manager**, an `EntityManager` instance's persistence context is automatically propagated by the container to all application components that use the `EntityManager` instance within a single Java Transaction API (JTA) transaction.

JTA transactions usually involve calls across application components. To complete a JTA transaction, these components usually need access to a single persistence context. This occurs when an `EntityManager` is injected into the application components by means of the `javax.persistence.PersistenceContext` annotation. The persistence context is automatically propagated with the current JTA transaction, and `EntityManager` references that are mapped to the same persistence unit provide access to the persistence context within that transaction. By automatically propagating the persistence context, application components don't need to pass references to `EntityManager` instances to each other in order to make changes within a single transaction. The Java EE container manages the lifecycle of container-managed entity managers.

To obtain an `EntityManager` instance, inject the entity manager into the application component:

```
@PersistenceContext
EntityManager em;
```

Application-Managed Entity Managers

With an **application-managed entity manager**, on the other hand, the persistence context is not propagated to application components, and the lifecycle of `EntityManager` instances is managed by the application.

Application-managed entity managers are used when applications need to access a persistence context that is not propagated with the JTA transaction across `EntityManager` instances in a particular persistence unit. In this case, each `EntityManager` creates a new, isolated persistence context. The `EntityManager` and its associated persistence context are created and destroyed explicitly by the application. They are also used when directly injecting `EntityManager` instances can't be done because `EntityManager` instances are not thread-safe. `EntityManagerFactory` instances are thread-safe.

Applications create `EntityManager` instances in this case by using the `createEntityManager` method of `javax.persistence.EntityManagerFactory`.

To obtain an `EntityManager` instance, you first must obtain an `EntityManagerFactory` instance by injecting it into the application component by means of the `javax.persistence.PersistenceUnit` annotation:

```
@PersistenceUnit
EntityManagerFactory emf;
```

Then obtain an `EntityManager` from the `EntityManagerFactory` instance:

```
EntityManager em = emf.createEntityManager();
```

Application-managed entity managers don't automatically propagate the JTA transaction context. Such applications need to manually gain access to the JTA transaction manager and add transaction demarcation information when performing entity operations. The `javax.transaction.UserTransaction` interface defines methods to begin, commit, and roll back transactions. Inject an instance of `UserTransaction` by creating an instance variable annotated with `@Resource`:

```
@Resource
```

```
UserTransaction utx;
```

To begin a transaction, call the `UserTransaction.begin` method. When all the entity operations are complete, call the `UserTransaction.commit` method to commit the transaction.
The `UserTransaction.rollback` method is used to roll back the current transaction.

The following example shows how to manage transactions in an application that uses an application-managed entity manager:

```
@PersistenceContext
EntityManagerFactory emf;
EntityManager em;
@Resource
UserTransaction utx;
...
em = emf.createEntityManager();
try {
  utx.begin();
  em.persist(SomeEntity);
  em.merge(AnotherEntity);
  em.remove(ThirdEntity);
  utx.commit();
} catch (Exception e) {
  utx.rollback();
}
```

Finding Entities Using the `EntityManager`

The `EntityManager.find` method is used to look up entities in the data store by the entity's primary key:

```
@PersistenceContext
EntityManager em;
public void enterOrder(int custID, Order newOrder) {
    Customer cust = em.find(Customer.class, custID);
    cust.getOrders().add(newOrder);
    newOrder.setCustomer(cust);
}
```

Managing an Entity Instance's Lifecycle

You manage entity instances by invoking operations on the entity by means of an `EntityManager` instance. Entity instances are in one of four states: new, managed, detached, or removed.

- New entity instances have no persistent identity and are not yet associated with a persistence context.
- Managed entity instances have a persistent identity and are associated with a persistence context.
- Detached entity instances have a persistent identity and are not currently associated with a persistence context.
- Removed entity instances have a persistent identity, are associated with a persistent context, and are scheduled for removal from the data store.

Persisting Entity Instances

New entity instances become managed and persistent either by invoking the `persist` method or by a cascading `persist` operation invoked from related entities that have the `cascade=PERSIST` or `cascade=ALL` elements set in the relationship annotation. This means that the entity's data is stored to the database when the transaction associated with the `persist` operation is completed. If the entity is already managed, the `persist` operation is ignored, although the `persist` operation will cascade to related entities that have the `cascade` element set to `PERSIST` or `ALL` in the relationship annotation. If `persist` is called on a removed entity instance, the entity becomes managed. If the entity is detached, either `persist` will throw an `IllegalArgumentException`, or the transaction commit will fail.

```
@PersistenceContext
EntityManager em;
```

```
...
public LineItem createLineItem(Order order, Product product,
        int quantity) {
    LineItem li = new LineItem(order, product, quantity);
    order.getLineItems().add(li);
    em.persist(li);
    return li;
}
```

The `persist` operation is propagated to all entities related to the calling entity that have the `cascade` element set to `ALL` or `PERSIST` in the relationship annotation:

```
@OneToMany(cascade=ALL, mappedBy="order")
public Collection<LineItem> getLineItems() {
    return lineItems;
}
```

Removing Entity Instances

Managed entity instances are removed by invoking the `remove` method or by a cascading `remove` operation invoked from related entities that have the `cascade=REMOVE` or `cascade=ALL` elements set in the relationship annotation. If the `remove` method is invoked on a new entity, the `remove` operation is ignored, although `remove` will cascade to related entities that have the `cascade` element set to `REMOVE` or `ALL` in the relationship annotation. If `remove` is invoked on a detached entity, either `remove` will throw an `IllegalArgumentException`, or the transaction commit will fail. If invoked on an already removed entity, `remove` will be ignored. The entity's data will be removed from the data store when the transaction is completed or as a result of the `flush` operation.

```
public void removeOrder(Integer orderId) {
    try {
        Order order = em.find(Order.class, orderId);
        em.remove(order);
    }...
```

In this example, all `LineItem` entities associated with the order are also removed, as `Order.getLineItems` has `cascade=ALL` set in the relationship annotation.

Synchronizing Entity Data to the Database

The state of persistent entities is synchronized to the database when the transaction with which the entity is associated commits. If a managed entity is in a bidirectional relationship with another managed entity, the data will be persisted, based on the owning side of the relationship.

To force synchronization of the managed entity to the data store, invoke the `flush` method of the `EntityManager` instance. If the entity is related to another entity and the relationship annotation has the `cascade` element set to `PERSIST` or `ALL`, the related entity's data will be synchronized with the data store when `flush` is called.

If the entity is removed, calling `flush` will remove the entity data from the data store.

Persistence Units

A persistence unit defines a set of all entity classes that are managed by `EntityManager` instances in an application. This set of entity classes represents the data contained within a single data store.

Persistence units are defined by the `persistence.xml` configuration file. The following is an example `persistence.xml` file:

```
<persistence>
    <persistence-unit name="OrderManagement">
        <description>This unit manages orders and customers.
            It does not rely on any vendor-specific features and can
            therefore be deployed to any persistence provider.
        </description>
        <jta-data-source>jdbc/MyOrderDB</jta-data-source>
        <jar-file>MyOrderApp.jar</jar-file>
```

```
        <class>com.widgets.Order</class>
        <class>com.widgets.Customer</class>
    </persistence-unit>
</persistence>
```

This file defines a persistence unit named `OrderManagement`, which uses a JTA-aware data source: `jdbc/MyOrderDB`. The `jar-file` and `class` elements specify managed persistence classes: entity classes, embeddable classes, and mapped superclasses. The `jar-file` element specifies JAR files that are visible to the packaged persistence unit that contain managed persistence classes, whereas the `class` element explicitly names managed persistence classes.

The `jta-data-source` (for JTA-aware data sources) and `non-jta-data-source` (for non-JTA-aware data sources) elements specify the global JNDI name of the data source to be used by the container.

The JAR file or directory whose `META-INF` directory contains `persistence.xml` is called the root of the persistence unit. The scope of the persistence unit is determined by the persistence unit's root. Each persistence unit must be identified with a name that is unique to the persistence unit's scope.

Persistent units can be packaged as part of a WAR or EJB JAR file or can be packaged as a JAR file that can then be included in an WAR or EAR file.

- If you package the persistent unit as a set of classes in an EJB JAR file,`persistence.xml` should be put in the EJB JAR's `META-INF` directory.
- If you package the persistence unit as a set of classes in a WAR file,`persistence.xml` should be located in the WAR file's `WEB-INF/classes/META-INF` directory.
- If you package the persistence unit in a JAR file that will be included in a WAR or EAR file, the JAR file should be located in either
    - The `WEB-INF/lib` directory of a WAR
    - The EAR file's library directory

    Note - In the Java Persistence API 1.0, JAR files could be located at the root of an EAR file as the root of the persistence unit. This is no longer supported. Portable applications should use the EAR file's library directory as the root of the persistence unit.