# ORM / JPA / JPQL

## ORM

### OBJECT RELATIONAL MAPPING

Store and manipulate objects in database
Store business entities (java objects) as relational entities (database tables)

Bridge between object models (Java program) and relational models (database program)

Table structure in database versus graph structure in objects (references containing references)

OO -> Non scalar values -> Several values -> Object / Array

Relational database -> Scalar values -> Only one value -> Int / String

Java: Collections are used to manage lists of objects
Databases: Tables are used to manage lists of entities

Conversion of data:

Conversion between object values into groups of simple values
Tables in relational database <-> Classes in object oriented language
Rows in relational database <-> Objects in object oriented language

Virtual object database

Advantages

Reduces amount of written code
No low level JDBC / SQL code
Independence of and separation from database / schema
Only OO paradigm

Disadvantages

Low level is not clear
Not optimally designed databases
Difficulties with mismatching object system to relational database

High level of abstraction / Low level JDBC and SQL code

The main goal is to do less work when working with persistence of objects

Mismatch issues

- How are tables, columns and rows mapped to objects?
- How are relationships handled?
- How is inheritance handled?
- How is composition and aggregation handled?
- How are conflicting database type systems handled?

## JPA

Specification / Set of interfaces / Not a product
Classes and interfaces are used for storing entities into a database as a record

**4 areas**

Java persistence involves 4 areas:

- Java Persistence API
  - Implementation specification
- Object relational mapping metadata
  - Metadata / annotations used for mapping
- JPQL – Java Persistence Query language
  - Query entities and relationships
- Java Persistence Criteria API
  - Alternative way of defining a JPQL query

**ORM / Hibernate & EclipseLink / JPA**

*ORM*

Approach of taking object oriented data and mapping to a relational database

Concept / process of converting the data from object oriented language to relational DB and vice versa

*JPA*

High level API and specification that different ORM tools can implement, so that it provides the flexibility for developers to change the implementation from one ORM to another

*Provider*

Implementation of an ORM framework

Persistence library

- EclipseLink 2.6.4
- Hibernate 5.2.10

**JDBC**

Database driver

- Handles conversion between databases automatically

**JPA in Netbeans - Generate tables from classes**

1. Create maven project
2. Create new empty database / schema
3. Create database connection (MySQL Connector/J driver)
4. Create persistence unit (EclipseLink/Hibernate)
5. Add dependency mysql-connector-java 5.1.43
6. Create packages entity and jpacontrol
7. Create entity.java class in entity package and add it to persistence unit
8. Create structure.java class in jpacontrol package

**JPA in Netbeans - Generate classes from tables**

1. Create maven project
2. Use existing database / schema
3. Create database connection (MySQL Connector/J driver)
4. Create persistence unit (EclipseLink/Hibernate)
5. Add dependency mysql-connector-java 5.1.43
6. Create packages entity and jpacontrol
7. Create new entity classes from database
8. Add tables, deselect JAXB annotations and use columns names in relationships
9. Create structure.java class in jpacontrol package

## JAVA PERSISTENCE API

**PersistenceUnit**

Registers the database and specifies entity classes

persistence.xml

- create / drop-and-create / none
- drop-and-create does not remove old tables just overwrites

import javax.persistence.Persistence
Persistence.generateSchema(PUName, PUProperties)

**SQL**

Can be executed via persistence unit
Create new folder scripts in src/main/resources
Create new SQL file in scripts folder
Add SQL file to persistence unit

**Entity classes**

Entity package
Empty constructor
Setters / Getters
ToString

## OBJECT RELATIONAL MAPPING METADATA

**3 purposes**

- Identify persistent classes
- Override default JPA behavior
- Provide JPA implementation with information that it cannot get by just reflecting on the persistent class

**Entities / Rules**

- Lightweight persistence domain object
- Typically represents a table in a relational database and each entity instance corresponds to a row in that table.
- Entities <-> Tables / Instance <-> Row
- Configuration by exception / Only apply when changes are required
- Class must be annotated with the **@Entity** annotation
- Class must at least have a public or protected, no-argument constructor
- Class must not be declared final
- No methods or persistent instance variables must be declared final
- If an entity instance is passed by value as a detached object, the class must implement the Serializable interface
- Entities may extend both entity and non-entity classes, and non-entity classes may extend entity classes
- Persistent instance variables must be declared private, protected, or package-private and can be accessed directly only by the entity class's methods

## ANNOTATIONS

Annotations make it possible to configure entities
Annotations are used for classes, properties, and methods
Annotations starts with '@' symbol
@Entity
@Table(name="tbl_person")
Rename table
@Column(name="PERSON_ID")
Rename column

**Date time**

@Temporal(TemporalType.DATE)
private Date creationDate;
@Temporal(TemporalType.TIMESTAMP)
private Date expirationDate;

**Transient**

**Primary keys - AutoGenerated values**
@Id
@GeneratedValue
(strategy = GenerationType.AUTO) -> Persistence provider chooses strategy
(strategy = GenerationType.IDENTITY) -> Auto increment values
(strategy = GenerationType.SEQUENCE) -> Use a sequence for values
(strategy = GenerationType.TABLE) –> Use a table for values

**Enums**

**Relationships**
ElementCollection
Cardinality
One / Many
@OneToOne / @OneToMany / @ManyToMany
Direction
Unidirectional / Bidirectional

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

Alt+Enter -> Choose relationship

MappedBy
(mappedBy = "address")
Owning side / Field
@JoinColumn
Owned side / Field
Cascading
Parent / Child associations
Trigger what happens to children when parent changes
CascadeType
Persist / All
Delete other
orphanRemoval = true
Fetch
Eager / Lazy

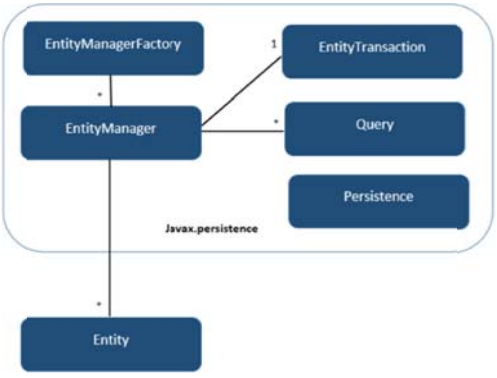
**Inheritance**

3 strategies for mapping inheritance in database tables
SingleTable, Joined, TablePerClass

- SingleTable: A single table is used to store all of the instances of the entire inheritance hierarchy
  + Single table inheritance is the simplest, and default, and often the best performing solution.
  + Works well when the hierarchy is relatively simple and stable
  - Problematic when adding attributes
- Joined: A table is defined for each class in the inheritance hierarchy to store only the local attributes of that class
  + Joined inheritance is the inheritance strategy that most closely mirrors the object model into the data model
  - Querying can have performance impact

- TablePerClass : A table per concrete entity class where all attributes of the root entity will also be mapped to columns of the child entity table
  + Performs well when querying instances of one entity
  - Denormalizes the model

## ENTITYMANAGER / ENTITYMANAGERFACTORY




Query the managed objects using the Entity Manager
Query objects and fields instead of tables and columns

Entities are managed by entity managers which are javax.persistence.EntityManager instances
Each EntityManager instance is associated with a persistence context / a set of managed entity instances

Central piece in JPA that manages the state and life cycle of entities and is able to handle JPQL queries

```
EntityManagerFactory emf = Persistence.createEntityManagerFactory( "NamePU" );
EntityManager em = emf.createEntityManager();
```

There are two main states for entities: managed / detached

Can create, retrieve, update or delete objects from a database

persist, merge, find, remove

Persist:
Use for new entities
Entity becomes managed / Changes afterwards are saved
em.persist(new Employee("John", "Richards"));

Merge:
Use for existing changed entities
Entity does not become managed / Changes afterwards are not saved

em.merge(new Employee(“John”, “Richards”));

Find:

Entity becomes managed / Changes afterwards are saved

Combination of class and primary key

em.find(Employee.class, 1);

Remove:

Remove a retrieved object

em.remove(employee);