

## ORM

### 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

JPA = 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 2.5.2 / 2.7.3

Hibernate 5.3.6

org.eclipse.persistence

org.hibernate

## MYSQL Connector

JDBC driver that provides connectivity to MySQL servers for applications developed in the Java

Maven dependency -> ""

MySQL Server 5 => mysql : mysql-connector 5.1.39

MySQL Server 8 => mysql : mysql-connector 8.0.12

## JPA in Netbeans - Generate tables from classes

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

## JPA in Netbeans - Generate classes from tables

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

## Updating EclipseLink

Use single eclipselink dependency in pom.xml

```
<dependency>
  <groupId>org.eclipse.persistence</groupId>
  <artifactId>org.eclipse.persistence.jpa</artifactId>
  <version>2.7.3</version>
</dependency>
```

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## JAVA PERSISTENCE API

### PersistenceUnit

Registers the database and specifies entity classes

Design / Source

XML file

Other sources...

`src/main/resources/META-INF/persistence.xml`

persistence.xml

create / drop-and-create / none

drop-and-create does not remove old or changed tables just empties

Add / Remove entity classes to persist

Logging SQL and parameters

```
<property name="eclipselink.logging.level.sql" value="fine" />
<property name="eclipselink.logging.parameters" value="true" />
```

SQL scripts

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

import javax.persistence.Persistence

Persistence.generateSchema(PUName, PUProperties)

To generate schema

Persistence.createEntityManagerFactory(PUName)

To get entity manager factory

HashMap of persistence unit properties can be altered to change persistence unit properties, such as user, password, sql script or table generation strategies

### Entity classes

Entity package

Empty constructor

Setters / Getters

Add to arraylists

ToString

Equals / hashCode

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## 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

@Transient

Do not persist field in database

### 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

@TableGenerator(name="TG", allocationSize=10, initialValue=22)

@GeneratedValue(strategy=GenerationType.TABLE, generator="TG")

### Relationships

Enums

@Enumerated(EnumType.STRING)

Use enum strings

ElementCollection

@ElementCollection()

OneToMany (NonEntities)

Cardinality

One / Many

@OneToOne / @OneToMany / @ManyToMany

Direction

Unidirectional / Bidirectional

Alt + Enter -> Choose relationship

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
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MappedBy

(mappedBy = "address")

Owning side / Field

@JoinColumn

Owned side / Field

Create "Add to arraylist method" for arraylists, besides set arraylist and get arraylist methods

Fetch

Eager: Fetch fields immediately for entities

(fetch = FetchType.EAGER)

Lazy: Fetch fields when used for entities

(fetch = FetchType.LAZY)

Cascading

Parent / Child associations

Trigger what happens to children when parent changes

Cascade

@ManyToMany(cascade = CascadeType.ALL)

Cascade operations to referenced fields

OrphanRemoval

@OneToMany(orphanRemoval = true)

Removes orphans more strictly on OneToOne and OneToMany relations

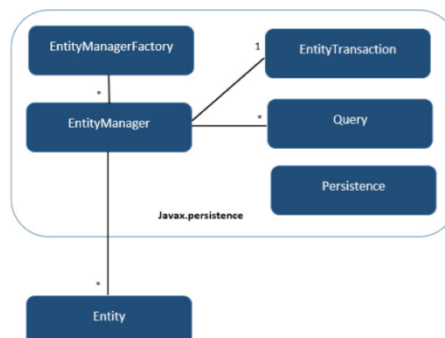
## Inheritance

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



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

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

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

persist, find, merge, 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 becomes unmanaged / 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);`

Detach:

Entity becomes unmanaged / Changes afterwards are not saved  
`em.detach(employee);`

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## FACADESETUP

FaçadeInterface

```
public User getUser(Long id);  
public User addUser(User u);  
public User deleteUser(Long id);  
public User editUser(User u);  
public List<User> getUsers();
```

Façade

```
private EntityManagerFactory emf;  
  
public FaçadeUser(EntityManagerFactory emf)  
{  
    this.emf = emf;  
}  
  
@Override  
public User getUser(Long id)  
{  
    EntityManager em = emf.createEntityManager();  
    User u = null;  
    try  
    {  
        em.getTransaction().begin();
```

```

        u = em.find(User.class, id);
        em.getTransaction().commit();
        return u;
    }
    finally
    {
        em.close();
    }
}

```

#### FacadeTest

```

FacadeUser fu = new FacadeUser( Persistence.createEntityManagerFactory( "jpapu" ) );
fu.getUser(1l);

```

## JPQL

### Similar to SQL / Not SQL

JPQL	Object oriented query language	Objects
SQL	Structured query language	Tables

### Two types of queries

#### Named queries

Used for static queries that will be used many times in the application  
Can be defined once in entity and then reused

#### Dynamic queries

Normally used when the query depends on the context  
Needs to be translated when invoked

## Queries

### Named

```

@NamedQueries(
{
    @NamedQuery(name = "findAllPersonsByFirstName", query="Select p from Person p where p.firstName = :firstName"),
    @NamedQuery(name = "findAllPersonsByMail", query = "SELECT p FROM Person p WHERE p.mail = :mail")
})

```

```

@NamedQuery(name = "findAllPersons", query = "SELECT p FROM Person p")

```

### Dynamic

```

Query Nquery = em.createNamedQuery("findAllPersonsByLastName");

```

```

Query Dquery1 = em.createQuery("SELECT p FROM Person p");
Query Dquery2 = em.createQuery("SELECT UPPER(p.firstName) from Person p");
Query Dquery3 = em.createQuery("SELECT MAX(p.phoneNumber) from Person p");
Query Dquery4 = em.createQuery "SELECT p FROM Person p JOIN p.addresses a WHERE a.city = :city");

```

### Parameters

```

query.setParameter("firstName", "Dan");

```

### SingleResult

```

int phoneNumber = (int) query.getSingleResult();

```

### ResultList

```

List<Person> persons = query.getResultList();
for(Person p:persons)
{
    System.out.println("Person : " + p);
}

```

## JPA CRITERIA API

Used to define more advanced, dynamic queries for entities

javax.persistence.criteria