

Java Persistence API



A Short Course (Part I)

Jeferson Souza, MSc.

(jefecomp)

jefecomp.official@gmail.com

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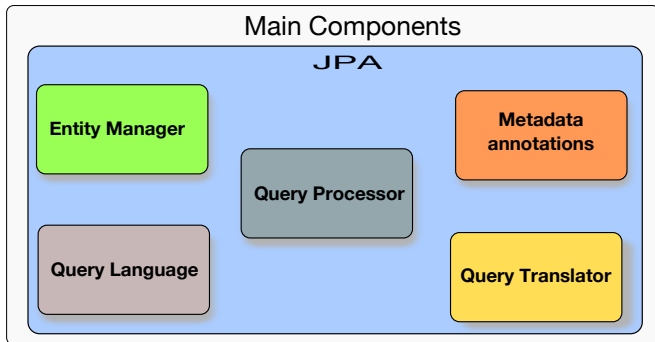
WHAT IS THE JAVA PERSISTENCE API?

- ▶ The Java Persistence API (JPA) is a specification defining a standard way to persist objects on storage systems;
- ▶ The JPA itself is part of the Enterprise Java Beans (EJBs) 3.0 specification, which is defined in the JSR 220 (<https://jcp.org/en/jsr/detail?id=220>);
- ▶ In theory, the storage system utilised to persist objects of Java applications can be anything. However, JPA has been initially designed to allow saving and querying Plain Old Java Objects (POJOs) on relational databases such as MySQL, PostgreSQL, Oracle, etc;

JPA FEATURES

- ▶ Object-oriented data and persistence model;
- ▶ Rich Metadata annotations for definition of persistence entities;
- ▶ Object and query-level caching support;
- ▶ Transactional object model support;
- ▶ Enable on both JavaEE and JavaSE applications.

MAIN COMPONENTS



The main abstract components of the Java Persistence API.

ENTITY MANAGER

- ▶ Responsible to manager the life cycle of persistence entities within a domain dubbed Persistence Context;
- ▶ Exposed interface with operations for save, delete, update, and query of entities on a storage system;
- ▶ Internal characteristics and behaviour depends on JPA implementations;

ENTITY MANAGER (1)

```
public interface EntityManager {  
    public void persist(Object entity);  
    public <T> merge (T entity);  
    public void remove (Object entity);  
    public <T> find (Class<T> entityClass, Object primaryKey);  
    public <T> getReference (Class<T> entityClass, Object primaryKey);  
    public void flush();  
  
    .  
    .  
    .  
  
}
```

METADATA ANNOTATIONS

- ▶ The way a POJO is identified as a persistence entity by JPA;
- ▶ Types of annotations:
 - ▶ Entity Definition and Inheritance (*@Entity, @MappedSuperClass, ...*);
 - ▶ Entity Relations (*@OneToOne, @OneToMany, @ManyToOne, @ManyToMany*);
 - ▶ Object Relational Mapping (*@Id, @Table, @Column, @JoinColumn, ...*).

METADATA ANNOTATIONS (1)

Entity Example:

@Entity

public class Person **implements** Serializable {

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}

METADATA ANNOTATIONS (2)

- ▶ Types of annotations:
 - ▶ Query definition(*@NamedQuery, @NamedNativeQuery, ...*);
 - ▶ Management and context definitions (*@PersistenceUnit, @PersistenceContext, ...*);
 - ▶ Callback methods(*@PrePersist, @PostUpdate, @PreRemove, ...*).
- ▶ Internal characteristics and behaviour of a Entity Manager depends directly on JPA implementations.

METADATA ANNOTATIONS (3)

Example of NamedQuery:

```
@NamedQuery(name="findAllPersons", query="SELECT p FROM Person  
p")  
public class Person {
```

```
...  
}
```

Usage:

```
private EntityManager em;
```

```
...
```

```
TypedQuery<Person> query = em.createNamedQuery("findAllPersons",  
Person.class);
```

```
List<Person> results = query.getResultList();
```

QUERY LANGUAGE

Example:

```
Select p FROM Person p
```

- ▶ An specific query language to load objects from a given storage systems;
- ▶ The specified query language is dubbed Java Persistence Query Language (JPQL);
- ▶ A lot of similarities with Structured Query Language (SQL), but object-oriented;

QUERY LANGUAGE(1)

Three Common (and important!) clauses:

- ▶ SELECT: **SELECT** address **FROM** Address address;
- ▶ UPDATE: **UPDATE** Person person **SET** person.surname = 'Souza' **WHERE** person.name = 'Jeferson';
- ▶ DELETE: **DELETE FROM** Person person **WHERE** person.name = 'Jeferson'.

The JPQL has much more clauses we can use to build object-oriented queries. Keeping its use as minimum as possible reduces the complexity of your Data Access Object (DAO) layer.

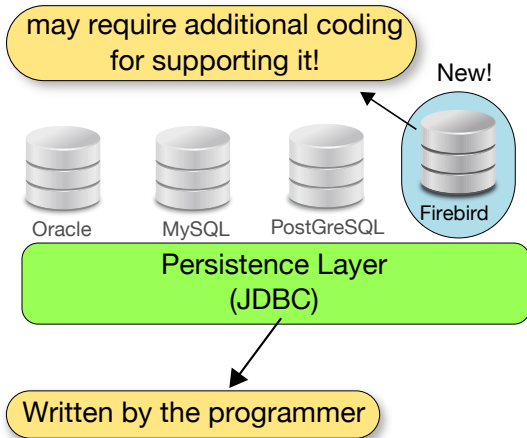
QUERY PROCESSOR

- ▶ Processing the received query to identify the elements involved; separating JPQL commands, entities, and dynamic parameters.
- ▶ Using the Query translator to actually transform a JPQL query into, e.g., a specific SQL query for the target database system.

QUERY TRANSLATOR

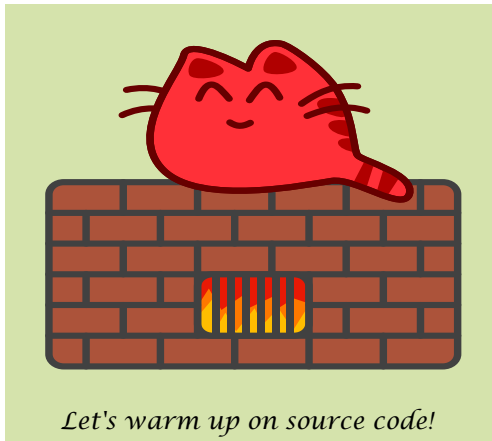
- ▶ Translates the pre-processed JPQL query to, e.g., the specific SQL dialect of the target database system;
- ▶ Although SQL is a standard language, almost all database systems have their own specify subset of non-standard clauses which boost performance on query processing. JPA implementations then take advantage of Dialect classes to perform a more efficient $JPQL \iff SQL$ translation.

PURE JDBC MODEL

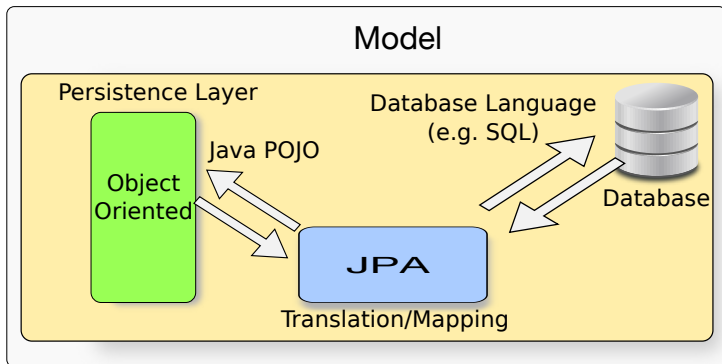


Sometimes (i.e., **OFTEN!**) a modular and stable Pure JDBC model is hard to achieve.

PURE JDBC MODEL (1)



JPA MODEL

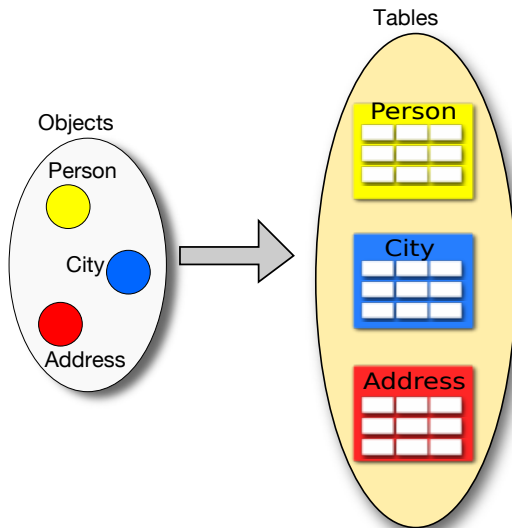


Transparent translation and mapping of a object oriented model to different kind of storage systems.

JPA MODEL (1)



OBJECT-RELATIONAL MAPPING (ORM)



MAPPING STRATEGIES

- ▶ A Table Per Concrete Class;
- ▶ A Single Table Per Class Hierarchy;
- ▶ A Joined Subclass Strategy.

A TABLE PER CONCRETE CLASS

Advantages:

- ▶ Direct mapping between classes defined on the Object Oriented model and Tables on a given database;
- ▶ All properties (included those inherited from a superclass) are included as table columns.

Drawbacks:

- ▶ Poor query performance when the Object Oriented model has many relations between entities;
- ▶ A considerable number of SQL JOINS must be need to retrieve a given set of objects from database.

A TABLE PER CLASS HIERARCHY

Advantages:

- ▶ Classes sharing common properties are grouped within a single table;
- ▶ Fast queries when the purpose is to find entities which are part of the same class hierarchy.

Drawbacks:

- ▶ As all subclasses are grouped on the same table, all specific fields of each subclass should be nullable;
- ▶ All basic validations required to guarantee model consistency on a given subclass when inserting and/or updating data must be done by the programmer.

A JOINED SUBCLASS STRATEGY

Advantages:

- ▶ Superclass and Subclass fields are represented as separated tables.
- ▶ Provides support for polymorphic relationships.

Drawbacks:

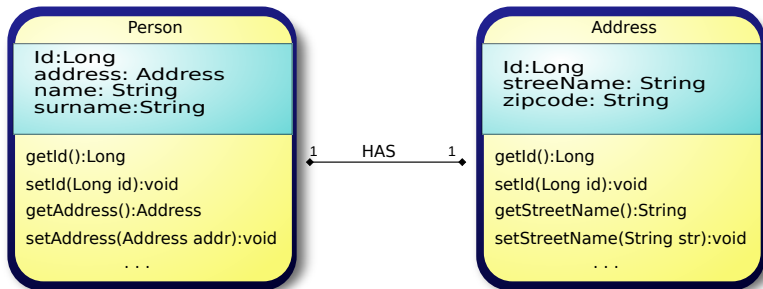
- ▶ May require or or more SQL JOIN operations to instantiate objects from specific subclasses;
- ▶ The performance of database access is dependent on the complexity of class hierarchy.

RELATIONSHIP BETWEEN ENTITIES

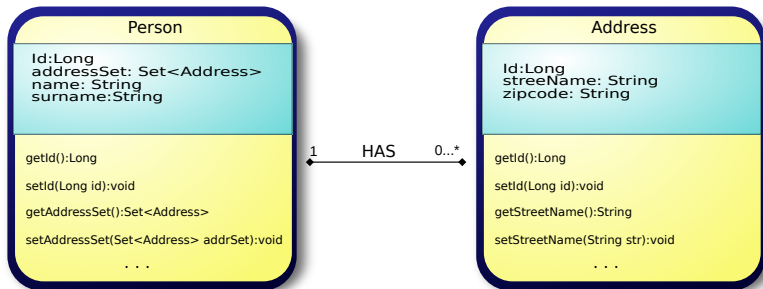
The relationship between persistent entities can be of four different types (excluding inheritance):

- ▶ OneToOne;
- ▶ OneToMany;
- ▶ ManyToOne;
- ▶ ManyToMany.

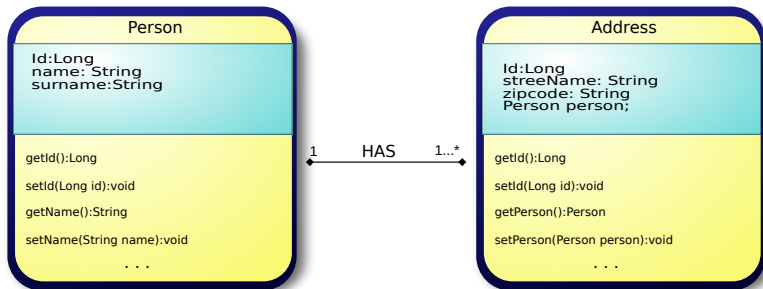
ONEToONE



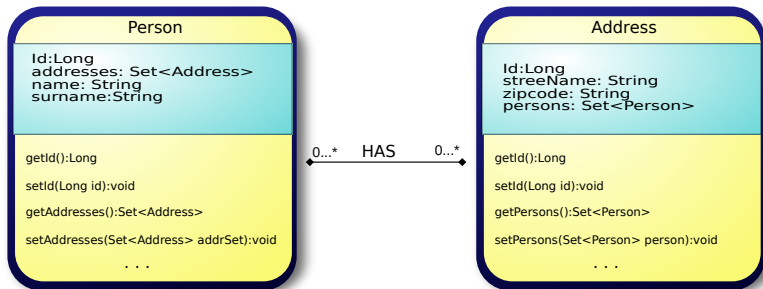
ONEToMANY



MANYTOONE



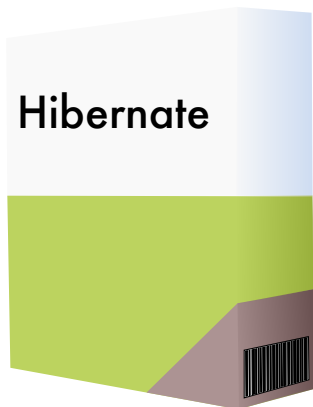
MANYToMANY



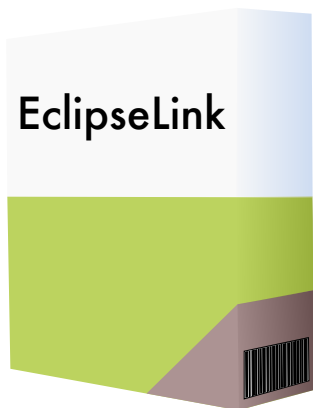
PERSISTENCE PROVIDER

- ▶ It is the concrete implementation of the JPA exposed interfaces;
- ▶ As the behaviour of implementations are not defined within the Standard, different Persistence Providers may behave differently on the same set of inputs;
- ▶ The two most utilised persistence providers are the *Hibernate* and the *EclipseLink*.

HIBERNATE: THE ENTREPRENEUR



ECLIPSELINK: THE REFERENCE IMPLEMENTATION



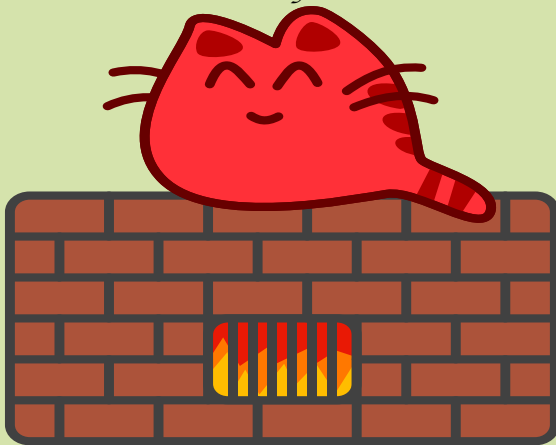
THE COMPLETE HELLO WORLD JPA EXAMPLE



EXTERNAL SOURCES

- ▶ JPA Specification: JSR 220 (<https://www.jcp.org/en/jsr/detail?id=220>);
- ▶ OpenClipart (<https://openclipart.org/>);
- ▶ Inkscape (<https://inkscape.org/en/>);
- ▶ L^AT_EX Project (<http://www.latex-project.org/>);
- ▶ L^AT_EX Beamer (<https://bitbucket.org/rivanvx/beamer/wiki/Home>).

That's it folks!



Thank you for your attention!