

ORM, Java Persistence API & Related Patterns

www.cs.uoi.gr/~zarras/http://www.cs.uoi.gr/~zarras/se.htm

<https://docs.spring.io/spring-data/jpa/docs/current/reference/html/#jpa.query-methods>
<https://www.vogella.com/tutorials/JavaPersistenceAPI/article.html/>
<https://www.baeldung.com/spring-data-derived-queries>

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What is ORM ?

Mapping objects to database relations and **vice versa** is called **Object-Relational Mapping (ORM)**.

The **KEY IDEA** is that

→ we have a DB **relation/table** in the Data layer per **class** of objects in the Domain layer and

→ each **object** is stored as a **table row**

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What is JPA?

The **Java Persistence API (JPA)** is an **approach to ORM** for Java objects.

Via JPA the developer can **map, store, update** and **retrieve data** from relational databases to **Java objects** and vice versa.

JPA is a **specification** from Oracle

https://download.oracle.com/otn-pub/jcp/persistence-2_1-fr-eval-spec/javaPersistence.pdf?AuthParam=1647415880_273dae2fb012962231cd5758a30e83d3

It can have multiple compliant **implementations** **Hibernate**, **EclipseLink** and **Apache OpenJPA**.

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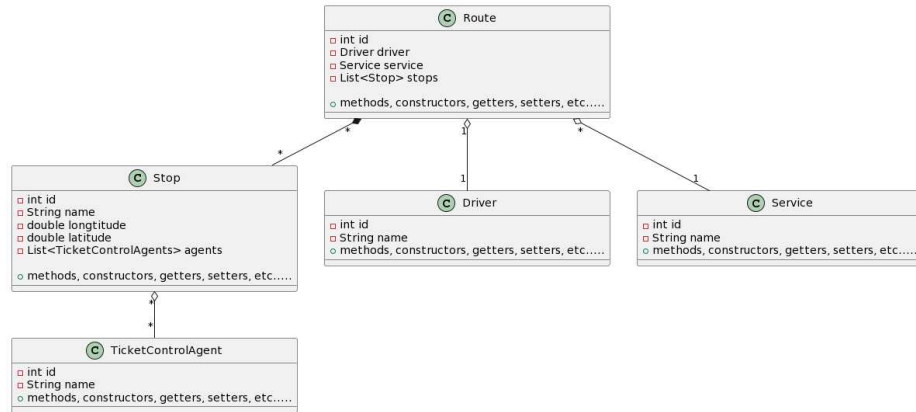
How do we organize Domain layer?



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Domain Model

An **object model** of the **domain** that incorporates both **behavior** and **data**. A different **object per table tuple/row**.....



Example:

<https://github.com/zarras/my803-EAAP-tutorials/tree/main/foreignkey.mapping>

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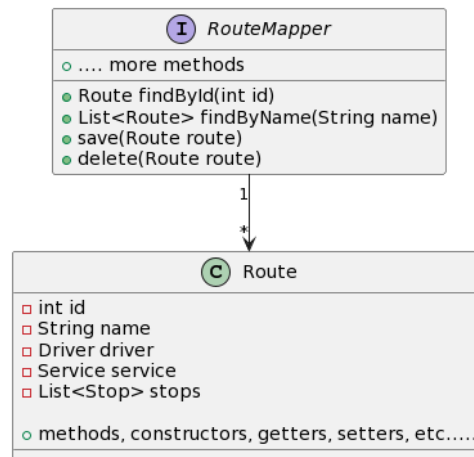
**How do we transfer data from/to the
Domain layer to/from the Data
Layer ?**

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Domain Model and Data Mapper

A layer of **Mappers** moves data between objects and a database while keeping them independent of each other and the mapper itself.

Also Known As: Repository, Data Access Object (DAO)



Example:

<https://github.com/zarras/myy803-EAAP-tutorials/tree/main/foreignkey.mapping>

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Data Mapper

A layer of **Mappers** moves data between objects and a database while keeping them independent of each other and the mapper itself.

The Data Mapper is a layer of software that separates the in-memory objects from the database. Its responsibility is to transfer data between the two and also to isolate them from each other.

With Data Mapper the in-memory objects needn't know even that there's a database present.

Also Known As: Repository, Data Access Object (DAO)

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How to map objects to tuples (table rows) ?

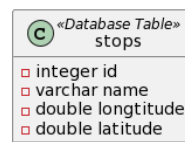
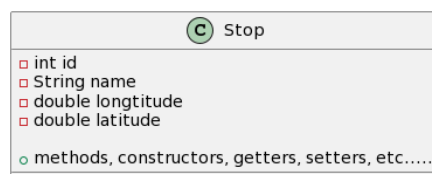
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Identity Field

Saves a *database ID field* in an *object* to maintain identity between an *in-memory object* and a *table row*.

Intent

In essence, **Identity Field** is simple. All you do is *store the primary key* of the relational database table in the *object's fields*.



Example:

<https://github.com/zarras/myy803-EAAP-tutorials/tree/main/foreignkey.mapping>

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Foreign Key Mapping

Maps an association between objects to a foreign key reference between tables.

Objects can refer to each other directly by object references. To **save** these **objects** to a **database**, it's vital to **save these references**.

A **Foreign Key Mapping** maps an **object reference** to a **foreign key** in the database.

Example:

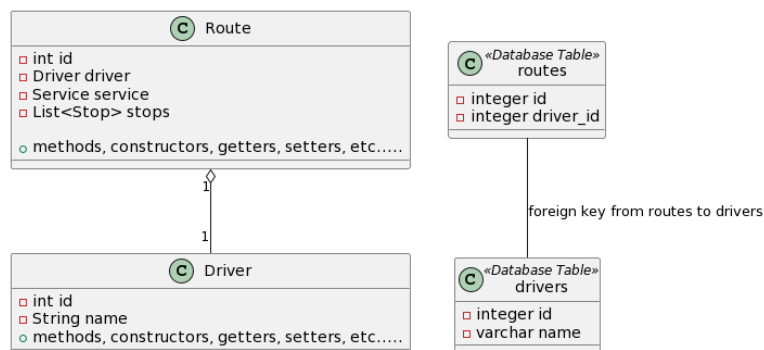
<https://github.com/zarras/myy803-EAAP-tutorials/tree/main/foreignkey.mapping>

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Foreign Key Mapping

Maps an association between objects to a foreign key reference between tables.

One-to-One relation – Route to Driver

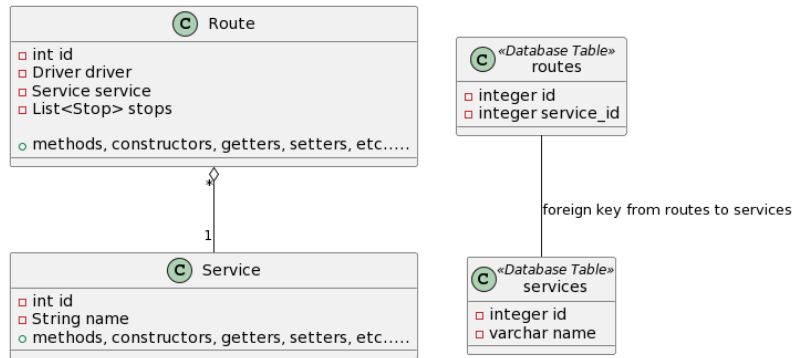


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Foreign Key Mapping

Maps an association between objects to a foreign key reference between tables.

Many-to-One relation – Route to Service

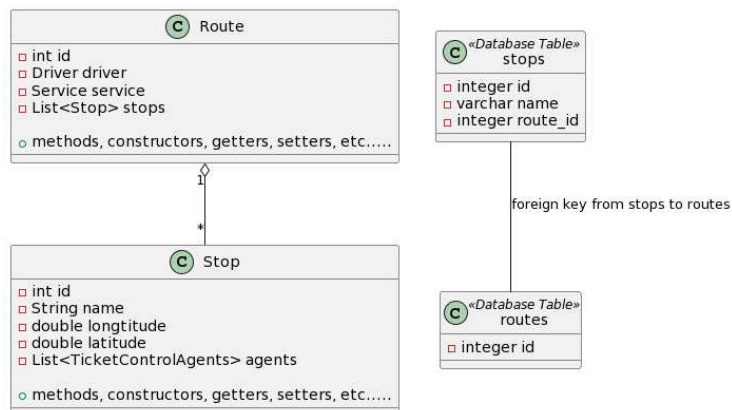


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Foreign Key Mapping

Maps an association between objects to a foreign key reference between tables.

One-to-Many relation – Route to Stop



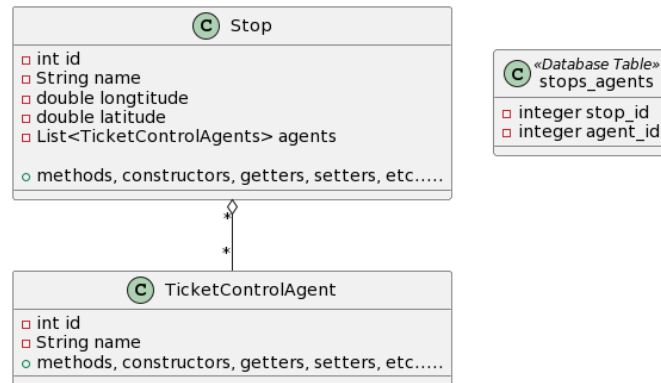
Example:

<https://github.com/zarras/myy803-EAAP-tutorials/tree/main/foreignkey.mapping>

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Association Table Mapping

Saves a **Many-to-Many association** as a **table with foreign keys** to the **tables** that are linked by the association.



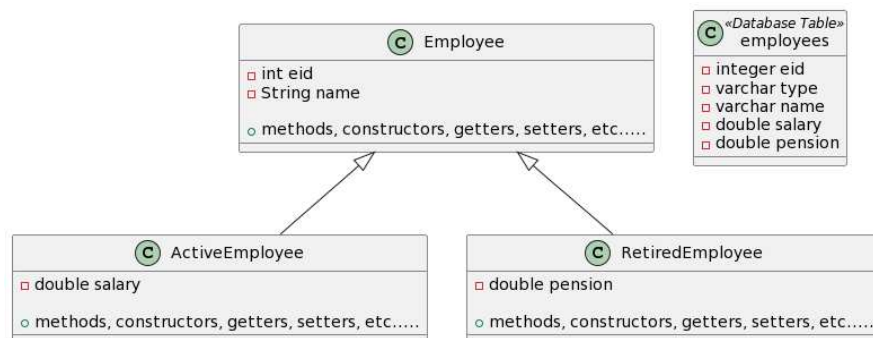
Example:

<https://github.com/zarras/myy803-EAAP-tutorials/tree/main/foreignkey.mapping>

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Single Table Inheritance

Represents an **inheritance hierarchy of classes** as a **single table** that has columns for all the fields of the various classes.



Example:

<https://github.com/zarras/myy803-EAAP-tutorials/tree/main/singletable.inheritance>



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Single Table Inheritance

There's only **a single table to worry about** on the database. There are **no joins** in retrieving data. Any **refactoring** that pushes fields up or down the hierarchy **doesn't change the DB**.

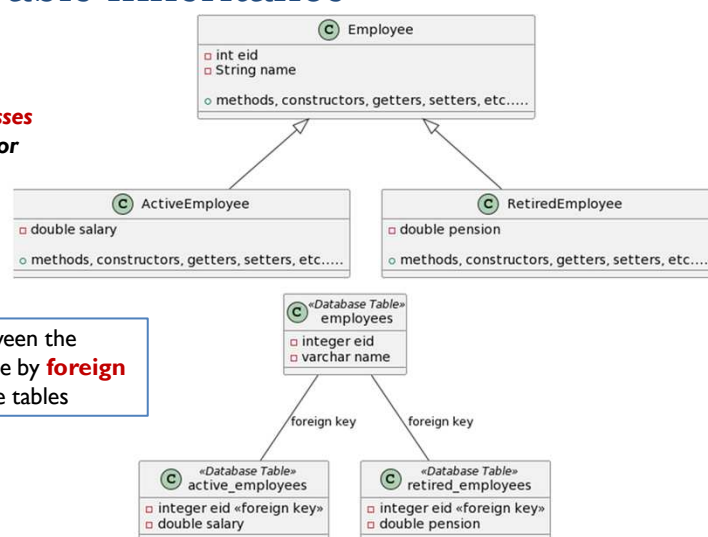
Fields are sometimes **relevant** and sometimes not, which can be **confusing**. Columns used only by some subclasses lead to **wasted space** in the database. The single table may end up being too **large**.



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Class Table Inheritance

Represents an inheritance hierarchy of classes with one table for each class.



The **linking** between the tables can be done by **foreign keys** between the tables

Example:

<https://github.com/zarras/myy803-EAAP-tutorials/tree/main/classtable.inheritance>

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Class Table Inheritance

Represents an **inheritance hierarchy of classes** with **one table for each class**.

All columns are relevant for every row so tables are easier to understand and don't waste space.

The relationship between the domain model and the database is straightforward.

Need to touch multiple tables to load an object, which means a join or multiple queries and sewing in memory.

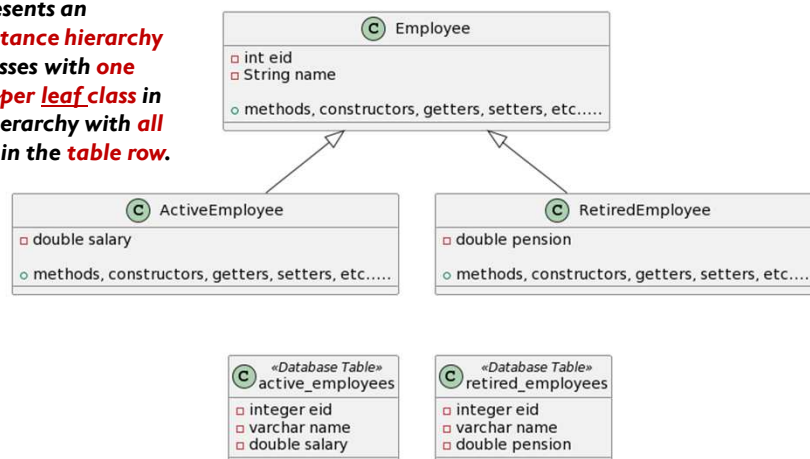
Any refactoring of fields up or down the hierarchy causes database changes.



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Concrete Table Inheritance

Represents an **inheritance hierarchy of classes** with **one table per leaf class** in the hierarchy with **all fields in the table row**.



Example:

<https://github.com/zarras/myy803-EAAP-tutorials/tree/main/concretetable.inheritance>

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Concrete Table Inheritance

Represents an **inheritance hierarchy** of classes with **one table per leaf class** in the hierarchy with **all fields in the table row**.

Each table is self-contained and has **no irrelevant fields**.

There are **no joins** to do when reading the data from the concrete mappers.

Each table is accessed only when that class is accessed, which can **spread the access load**.

Redundancy in the data

With **fields are pushed up or down** the hierarchy, you don't have to **alter the table definitions**.

If a **superclass field changes**, you **need to change each table**.

