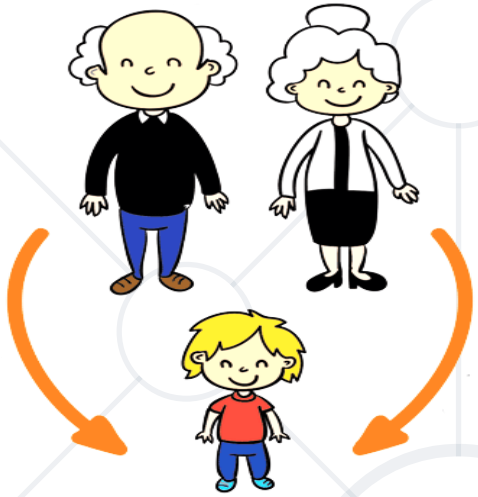
Hibernate (JPA) Code First Entity Relations

Advanced Mapping



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#Java-DB

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Java Persistence API Inheritance

Fundamental Inheritance Concepts

Inheritance

- Inheritance is a fundamental concept in most programming languages
  - SQL does not support this kind of relationships
- Implemented by any JPA framework by **inheriting** and **mapping Entities**

JPA Inheritance Strategies

- Implemented by the `javax.persistence.Inheritance` annotation
- The following mapping strategies are used to map the entity data to the underlying database:
  - A single **table per class** hierarchy
  - A table per **concrete entity class**
  - "**Join**" strategy – mapping common fields in a single table

Table Per Class Strategy

- **Table creation for each entity**
  - A table defined for each concrete class in the inheritance
  - Allows inheritance to be used in the object model, when it does not exist in the data model
- Querying root or branch classes can be very difficult and **inefficient**

Table Per Class Strategy: Example

Vehicle.java

```
@Entity
@Inheritance(strategy = InheritanceType.TABLE_PER_CLASS)
public abstract class Vehicle {
    @Id
    @GeneratedValue(strategy = GenerationType.TABLE)
    private long id;
    @Basic
    private String type;
    protected Vehicle() {}
    protected Vehicle(String type) {
        this.type = type;
    }
}
```

Inheritance type

A table generator is used for each table

Table Per Class Strategy: Example

Bike.java

```
@Entity
@Table(name = "bikes")
public class Bike extends Vehicle {
    private final static String type = "BIKE";
    public Bike(){
        super(type);
    }
}
```

Table Name

Car.java

```
@Entity
@Table(name = "cars")
public class Car extends Vehicle {
    private final static String type = "CAR";
    public Car(){
        super(type);
    }
}
```

Table Name

Table Per Class Strategy: Example

Main.java

```
..
Vehicle bike = new Bike();
Vehicle car = new Car();

em.persist(bike);
em.persist(car);
```

- Result:

bikes	
id	type
1	"BIKE"

cars	
id	type
2	"CAR"

Table Per Class Strategy: Conclusion

- **Disadvantages**:
  - Repeating information in each table
  - Changes in super class involves changes in all subclass tables
  - No foreign keys involved (unrelated tables)
- **Advantages**:
  - No NULL values – no unneeded fields
  - Simple style to implement inheritance mapping

Table Per Class: Joined

- Table is defined for each class in the inheritance hierarchy
  - Storing of that class **only the local attributes**
  - Each table must store object's **primary key**

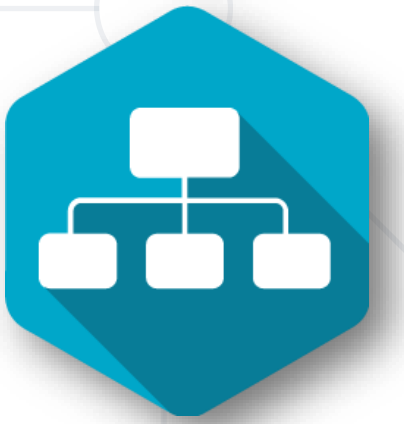

Table Per Class Strategy: Example

Vehicle.java

```
@Entity
@Table(name = "vehicles")
@Inheritance(strategy = InheritanceType.JOINED)
public abstract class Vehicle {
    @Id
    @GeneratedValue(strategy = GenerationType.TABLE)
    private int id;

    @Basic
    private String type;

    protected Vehicle() {}
    protected Vehicle(String type) {
        this.type = type;
    }
}
```

Inheritance type

A table generator is used for each table

Table Per Class Strategy: Example

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TransportationVehicle.java

```
@MappedSuperclass
public abstract class TransportationVehicle extends Vehicle {
    private int loadCapacity;
    public TransportationVehicle(){ }
    public TransportationVehicle(String type,int loadCapacity) {
        super(type);
        this.loadCapacity = loadCapacity;

    }

    // Getters and setters
}
```

Table Per Class Strategy: Example

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PassengerVehicle.java

```
@MappedSuperclass
public abstract class PassengerVehicle extends Vehicle {
    private int numOfPassengers;

    public PassengerVehicle() { }
    public PassengerVehicle(String type,int numOfPassengers) {
        super(type);
        this.numOfPassengers = numOfPassengers;
    }

    // Getters and setters
}
```

Table Per Class Strategy: Example

Truck.java

```
@Entity
public class Truck extends TransportationVehicle {
    private final static String type = "TRUCK";
    private int numOfContainers;
    public Truck(){ }
    public Truck(String type, int numOfContainers,
int loadCapacity) {
        super(type,loadCapacity);
        this.numOfContainers = numOfContainers; }
    // Getters and setters
}
```

Car.java

```
@Entity
public class Car extends PassengerVehicle {
    private final static String type = "CAR";

    public Car(){ }

    public Car(String type,int numOfPassengers){
        super(type, numOfPassengers);
    }
    // Getters and setters
}
```

Results – Joined Strategy

- After persist:

vehicles	
id	type
1	CAR
2	TRUCK

cars	
id	numOfPassengers
1	2

trucks		
id	numOfContainers	loadCapacity
1	2	5

Results – Joined Strategy

- **Disadvantages**:
  - Multiple JOINS - for deep hierarchies it may give poor performance
- **Advantages**:
  - No NULL values
  - No repeating information
  - Foreign keys involved
  - Reduced changes in schema on superclass changes

Table Per Class: Single Table

- **Simplest** and typically the best performing and best solution
  - A single table is used to store all the instances of the **entire inheritance hierarchy**
  - A column for every attribute of every class
  - A **discriminator column** is used to determine to which class the particular row belongs to

SINGLE TABLE: Example

Vehicle.java

```
@Entity
@Table(name = "vehicles")
@Inheritance(strategy=InheritanceType.SINGLE_TABLE)
@DiscriminatorColumn(name = "type")
public abstract class Vehicle {
    @Id
    @GeneratedValue(strategy = GenerationType.TABLE)
    private int id;
    @Basic
    @Column(insertable = false,updatable = false)
    private String type;
    protected Vehicle() {}
    protected Vehicle(String type) {
        this.type = type;
    } }
```

Inheritance type

A table generator is used for each table

Table Per Class Strategy: Example

TransportationVehicle.java

```
@MappedSuperclass
public abstract class TransportationVehicle extends Vehicle {
    private int loadCapacity;
     public TransportationVehicle() { }
     public TransportationVehicle(String type, int loadCapacity) {
        super(type);
        this.loadCapacity = loadCapacity;
    }
    // Getters and setters
}
```

Table Per Class Strategy: Example

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PassengerVehicle.java

```
@MappedSuperclass
public abstract class PassengerVehicle extends Vehicle {
    private int noOfpassengers;

    public PassengerVehicle() { }

    public PassengerVehicle(String type, int noOfpassengers) {
        super(type);
        this.noOfpassengers = noOfpassengers;
    }

    // Getters and setters
}
```

Table Per Class Strategy: Example

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Truck.java

```
@Entity
@DiscriminatorValue(value = "truck")
public class Truck extends TransportationVehicle {
    private final static String type = "TRUCK";
    private int noOfContainers;

    // Constructors
    // Getters and setters
}
```

Car.java

```
@Entity
@DiscriminatorValue(value = "car")
public class Car extends PassengerVehicle {
    private final static String type = "CAR";
    public Car() { }
    public Car(){
        super(type);
    }
}
```

Results – Joined Strategy

- After persist:

vehicles				
id	type	loadCapacity	noOfPassengers	noOfContainers
1	truck	…	…	…
2	car	…	…	…

Discriminator column

Table Relations

One-to-One, One-to-Many, Many-to-Many

Database Relationships

- There are several types of database relationships:
  - **One to One** Relationships
  - **One to Many** and **Many to One** Relationships
  - **Many to Many** Relationships
  - **Self Referencing** Relationships

One-To-One – Unidirectional

One-To-One – Unidirectional

BasicShampoo.java

```
@Entity
@Table(name = "shampoos")
public abstract class BasicShampoo implements Shampoo {

//…
    @OneToOne(optional = false)
    @JoinColumn(name = "label_id",
    referencedColumnName = "id")
    private BasicLabel label;

//…
}
```

One-To-One relationship

Runtime evaluation

Column name in table shampoos

Column name in table label

One-To-One – Bidirectional

One-To-One – Bidirectional

BasicLabel.java

```
@Entity
@Table(name = "labels")
public class BasicLabel implements Label{
//…

    @OneToOne(mappedBy = "label",
    targetEntity = BasicShampoo.class)
    private BasicShampoo basicShampoo;

//…
}
```

Field in entity BasicShampoo

Entity for the mapping

Many-To-One – Unidirectional

Many-To-One – Unidirectional

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BasicShampoo.java

```
@Entity
@Table(name = "shampoos")
public abstract class BasicShampoo implements Shampoo {

//…
    @ManyToOne(optional = false)
    @JoinColumn(name = "batch_id", referencedColumnName = "id")
    private ProductionBatch batch;
//…
}
```

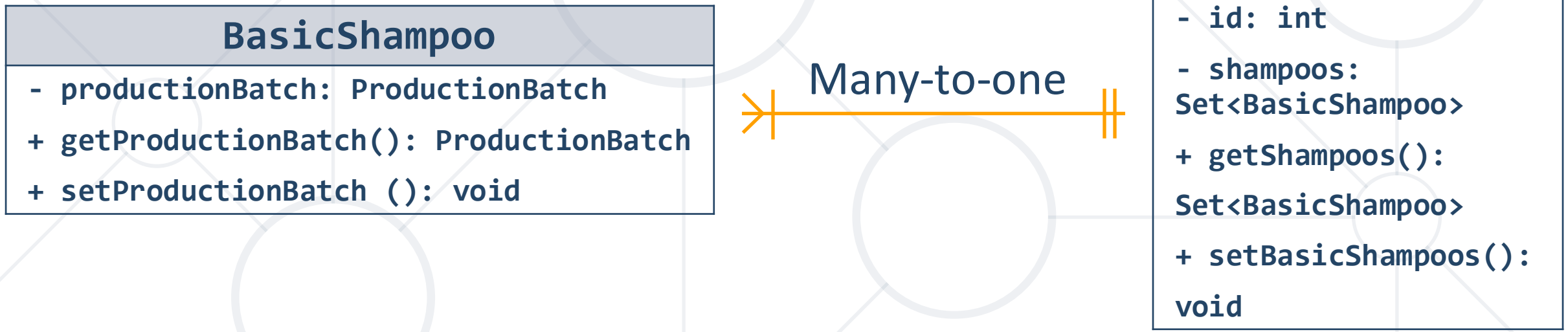
Many-To-One relationship

Runtime evaluation

Column name in table shampoos

Column name in table batches

One-To-Many – Bidirectional



One-To-Many – Bidirectional

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ProductionBatch.java

```
@Entity
@Table(name = "batches")
public class ProductionBatch implements Batch {
//…

    @OneToMany(mappedBy = "batch", targetEntity = BasicShampoo.class,
            fetch = FetchType.LAZY, cascade = CascadeType.ALL)
    private Set<Shampoo> shampoos;

//…
}
```

Field in entity BasicShampoo

Entity for the mapping

Fetching type

Cascade type

Many-To-Many – Unidirectional

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BasicShampoo.java

```
@Entity
@Table(name = "shampoos")
public abstract class BasicShampoo implements Shampoo {

//…
    @ManyToMany
    @JoinTable(name = "shampoos_ingredients",
    joinColumns = @JoinColumn(name = "shampoo_id", referencedColumnName = "id"),
    inverseJoinColumns = @JoinColumn(name = "ingredient_id",
                    referencedColumnName = "id"))
    private Set<BasicIngredient> ingredients;
//…
}
```

Many-To-Many relationship

Mapping table

Column in shampoos

Column in ingredients

Column in mapping table

Many-To-Many – Bidirectional

BasicIngredient.java

```
@Entity
@Table(name = "ingredients")
@Inheritance(strategy = InheritanceType.SINGLE_TABLE)
@DiscriminatorColumn(name = "type", discriminatorType = Discri
minatorType.STRING)
public abstract class BasicIngredient implements Ingredient {
//…

    @ManyToMany(mappedBy = "ingredients",
  targetEntity = BasicShampoo.class)
    private Set<BasicShampoo> shampoos;
//…
}
```

Field in entity BasicShampoo

Entity for the mapping

Lazy Loading – Fetch Types

- Fetching – retrieve objects from the database
  - Fetched entities are stored in the **Persistence Context** as cache
- Retrieval of an entity object might cause automatic retrieval of **additional** entity objects

Fetching Strategies

- Fetching Strategies
  - EAGER – retrieves all entity objects reachable through fetched entity
    - Can cause **slowdown** when used with a big data source
  - **LAZY** – retrieves all reachable entity objects **only when fetched entity's getter method is called**

```
University university = em.find((long) 1); // collection students = null

// The collection holding the students is populated when the getter is called
university.getStudents();
```

Cascading

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- JPA translates **entity state transitions** to database **DML** statements
  - This behavior is configured through the **CascadeType** mappings
- **`CascadeType.PERSIST`**: means that save() or persist() operations cascade to related entities
- **`CascadeType.MERGE`**: means that related entities are merged into managed state when the owning entity is merged
- **`CascadeType.REFRESH`**: does the same thing for the refresh() operation

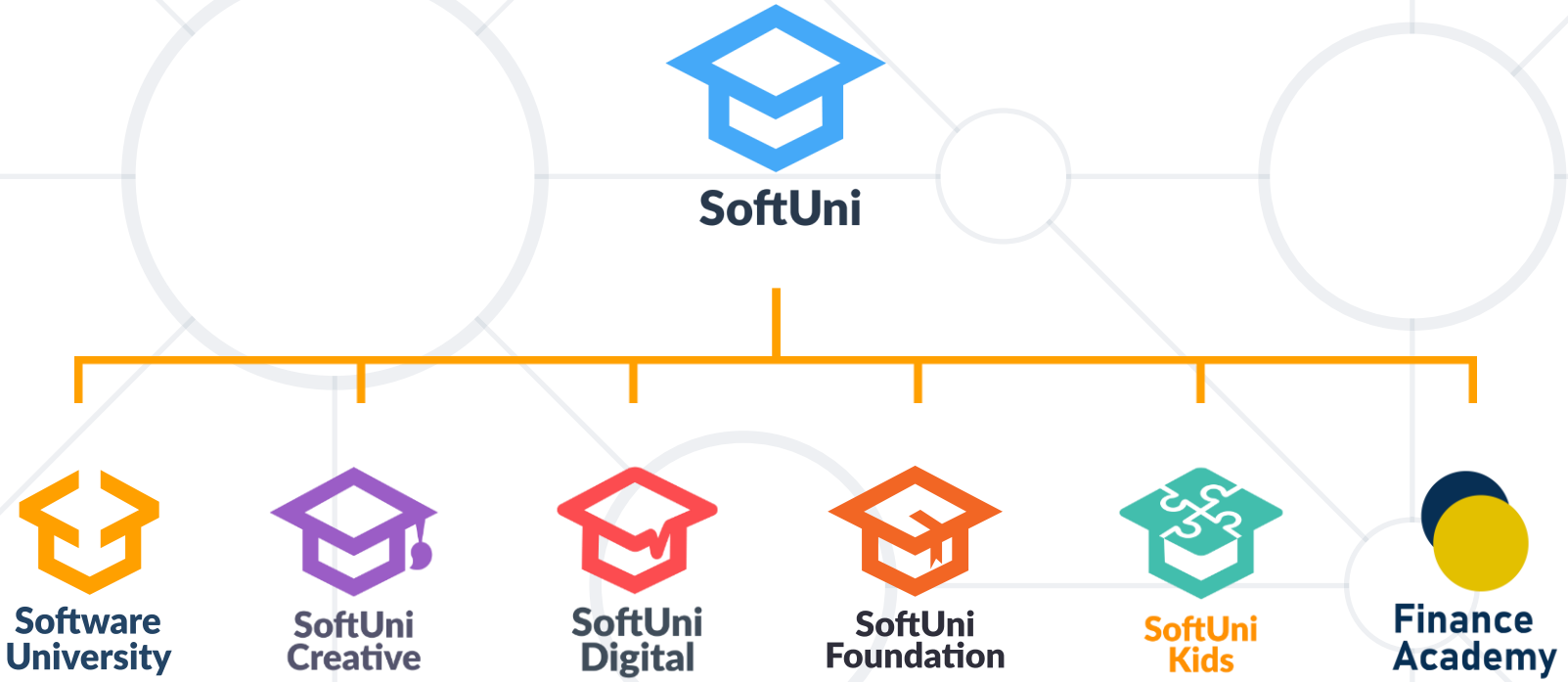
Cascading

- **CascadeType.REMOVE**: removes all related entities association with this setting when the owning entity is deleted
- **CascadeType.DETACH**: detaches all related entities if a "manual detach" occurs
- **CascadeType.ALL**: is shorthand for all of the above cascade operations

Summary

- Relational databases don't support inheritance
- It is implemented by JPA:
  - SINGLE_TABLE
  - TABLE_PER_CLASS
  - JOINED
- Table relations are Un/Bidirectional
  - One-to-One
  - Many-to-One
  - Many-to-Many

Questions?



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