

Inheritance vs Composition

What is Inheritance?

Inheritance is the process where one class acquires the properties (methods and fields) of another class. Inheritance is accomplished in Java using the **extends** keyword. With the use of inheritance, the information is manageable in a hierarchical order. Inheritance creates an “**IS-A**” relationship.

What is Composition?

Composition is the process of creating a *whole out of the parts*. Composition is accomplished in Java by having an *instance* of another class as a field of your class, instead of extending the class. In this way, the class holds a reference to another class. Composition creates a “**HAS-A**” relationship and uses the annotations **@OneToOne**, **@OneToMany** and **@ManyToOne**.

Example of Inheritance and Composition

Car **has a** Engine and Car **is a** Automobile

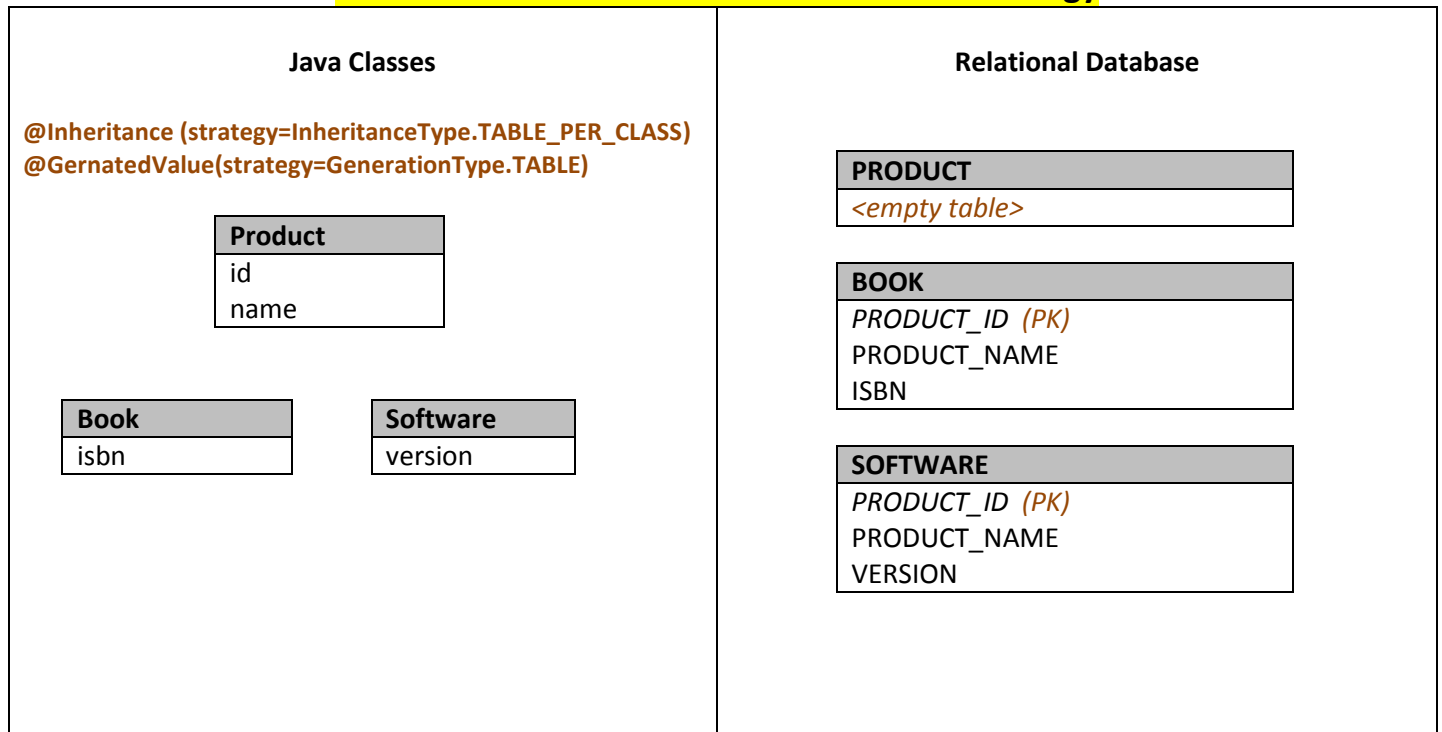
In programming this is represented as:

```
class Engine {} // The Engine class.

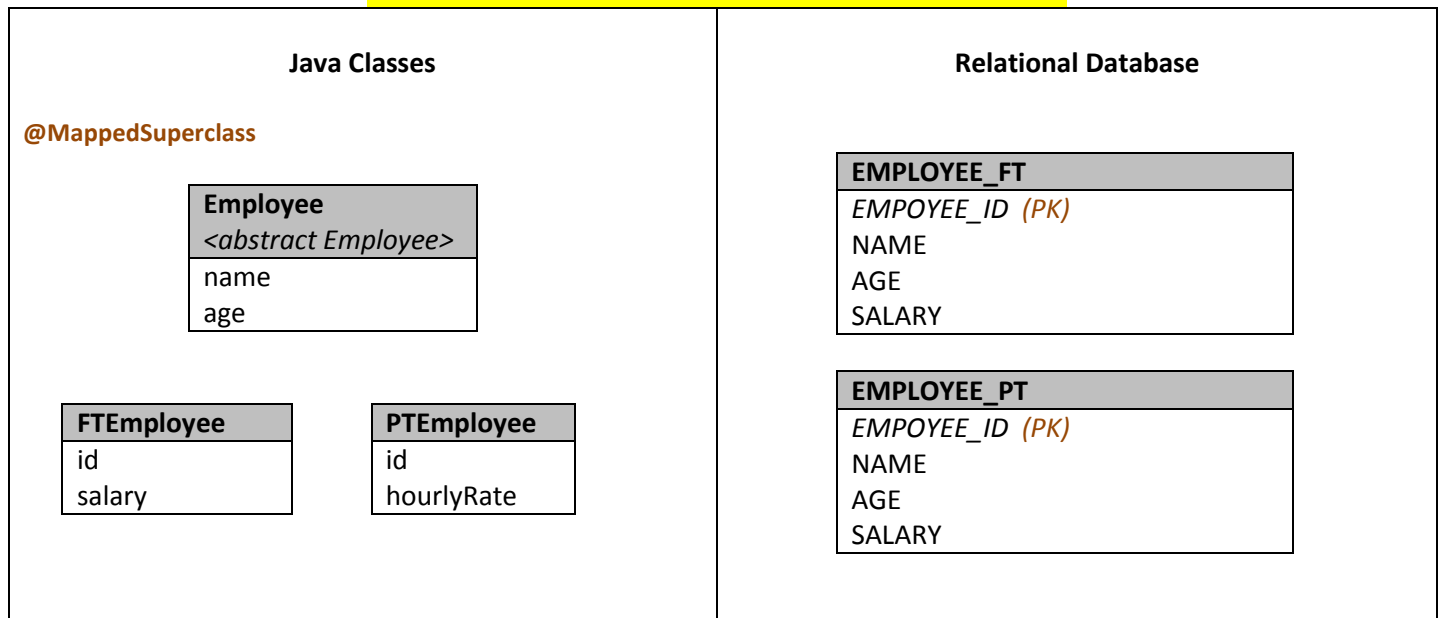
class Automobile {} // Automobile class which is parent to Car class.

class Car extends Automobile { // Car is an Automobile, so Car class extends Automobile class.
    private Engine engine; // Car has an Engine so, Car class has an instance of Engine class as its member.
}
```


Demo #3 Inheritance – TABLE PER CLASS Strategy



Demo #4 Inheritance – MAPPED SUPERCLASS



Demo #5 Composition – OneToOne Relationship (1:1)

Java Classes

Employee	Address
id	id
name	address
<i>@OneToOne</i>	city
<i>(mappedBy="employee")</i>	state
Address (object)	zip
	<i>@OneToOne</i>
	Employee (object)

*** Model assumes that 1 Employee may have 1 Address and that 1 Address may belong to only 1 Employee

Relational Database

EMPLOYEE
EMPLOYEE_ID (PK)
NAME
SOFTWARE
ADDRESS_ID (PK)
ADDRESS
CITY
STATE_CODE
ZIP_CODE
EMPLOYEE_EMPLOYEE_ID (FK)

Demo #6 Composition – OneToMany and ManyToOne Relationship (1:M)

Java Classes

University	Student
id	id
name	firstName
<i>@OneToMany</i>	lastName
<i>(mappedBy="university")</i>	<i>@ManyToOne</i>
List<Student> students	University (object)

The University Class MUST have a "helper" method when a 1:M relationship is implemented:

```
public void addStudent(Student student) {
    this.students.add(student);
}
```

*** Model assumes that 1 University may have 1 or more Students and that a Student may attend 1 University

Relational Database

UNIVERSITY
UNIVERSITY_ID (PK)
NAME
STUDENT
STUDENT_ID (PK)
FIRST_NAME
LAST_NAME
UNIVERSITY_UNIVERSITY_ID (FK)

Data Structures for Demo #1

```

C:\Windows\system32\cmd.exe - mysql -u demo_user -p
C:\Users\Denise Clark>mysql -u demo_user -p
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 35
Server version: 5.7.20-log MySQL Community Server (GPL)

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owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> use jpa_demo
Database changed
mysql>
mysql> status
-----
mysql Ver 14.14 Distrib 5.7.20, for win32 (AMD64)

Connection id:          35
Current database:       jpa_demo
Current user:           demo_user@localhost
SSL:                    Not in use
Using delimiter:        ;
Server version:         5.7.20-log MySQL Community Server (GPL)
Protocol version:       10
Connection:             localhost via TCP/IP
Server character set:   utf8
Db character set:       utf8
Client character set:   cp850
Conn. character set:    cp850
TCP port:               3306
Uptime:                 1 day 12 hours 32 min 12 sec

Threads: 1  Questions: 744  Slow queries: 0  Opens: 192  Flush tables: 1  Open tables: 149  Queries per second
g: 0.005
-----

mysql>
mysql> -- *****
mysql> -- *** Select All Products ***
mysql> -- *****
mysql> SELECT * FROM demo1_product;
+-----+-----+-----+-----+-----+
| PRODUCT_ID | PRODUCT_TYPE | PRODUCT_NAME | VERSION | ISBN |
+-----+-----+-----+-----+-----+
| 1 | B | Beginner Java | NULL | 123-456 |
| 2 | B | Advanced Java | NULL | 123-789 |
| 3 | S | Learn Java by Example | 1.0 | NULL |
| 4 | S | Learn Advanced Java by Example | 2.0 | NULL |
+-----+-----+-----+-----+-----+
4 rows in set (0.02 sec)

mysql>
mysql> -- *****
mysql> -- *** View the System Generated Sequence Table ***
mysql> -- *****
mysql> DESC sequence;
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| SEQ_NAME | varchar(50) | NO | PRI | NULL | |
| SEQ_COUNT | decimal(38,0) | YES | | NULL | |
+-----+-----+-----+-----+-----+-----+
2 rows in set (0.20 sec)

```

Data Structures for Demo #2

```

C:\Windows\system32\cmd.exe - mysql -u demo_user -p

C:\Users\Denise Clark>mysql -u demo_user -p
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 37
Server version: 5.7.20-log MySQL Community Server (GPL)

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Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> use jpa_demo;
Database changed
mysql> -- *****
mysql> -- *** select All Products ***
mysql> -- *****
mysql> SELECT * FROM demo2_product;
+-----+-----+-----+
| PRODUCT_ID | PRODUCT_TYPE | PRODUCT_NAME |
+-----+-----+-----+
|          51 | B             | Beginner Java |
|          52 | B             | Advanced Java |
|          53 | S             | Learn Java by Example |
|          54 | S             | Learn Advanced Java by Example |
+-----+-----+-----+
4 rows in set (0.00 sec)

mysql>
mysql> -- *****
mysql> -- *** select All Books ***
mysql> -- *****
mysql> SELECT * FROM demo2_book;
+-----+-----+
| PRODUCT_ID | ISBN |
+-----+-----+
|          51 | 123-456 |
|          52 | 123-789 |
+-----+-----+
2 rows in set (0.05 sec)

mysql>
mysql> -- *****
mysql> -- *** select All Software ***
mysql> -- *****
mysql> SELECT * FROM demo2_software;
+-----+-----+
| PRODUCT_ID | VERSION |
+-----+-----+
|          53 | 1.0 |
|          54 | 2.0 |
+-----+-----+
2 rows in set (0.01 sec)

```

Data Structures for Demo #2 (cont.)

```

C:\Windows\system32\cmd.exe - mysql -u demo_user -p

mysql>
mysql> -- *****
mysql> -- *** view Only Book Products ***
mysql> -- *****
mysql> SELECT p.*, b.*
-> FROM demo2_product p,
-> demo2_book
-> b
-> WHERE p.product_type = 'B'
-> AND p.product_id = b.product_id;
+-----+-----+-----+-----+-----+
| PRODUCT_ID | PRODUCT_TYPE | PRODUCT_NAME | PRODUCT_ID | ISBN |
+-----+-----+-----+-----+-----+
| 51 | B | Beginner Java | 51 | 123-456 |
| 52 | B | Advanced Java | 52 | 123-789 |
+-----+-----+-----+-----+-----+
2 rows in set (0.00 sec)

mysql>
mysql> -- *****
mysql> -- *** view Only Software Products ***
mysql> -- *****
mysql> SELECT p.*, s.*
-> FROM demo2_product p,
-> demo2_software s
-> WHERE p.product_type = 'S'
-> AND p.product_id = s.product_id;
+-----+-----+-----+-----+-----+
| PRODUCT_ID | PRODUCT_TYPE | PRODUCT_NAME | PRODUCT_ID | VERSION |
+-----+-----+-----+-----+-----+
| 53 | S | Learn Java by Example | 53 | 1.0 |
| 54 | S | Learn Advanced Java by Example | 54 | 2.0 |
+-----+-----+-----+-----+-----+
2 rows in set (0.00 sec)

mysql>
mysql> -- *****
mysql> -- *** view All Product Types and Product Specific Details ***
mysql> -- *****
mysql> SELECT p.*,
-> b.isbn,
-> s.version
-> FROM demo2_product AS p
-> LEFT OUTER JOIN demo2_book AS b ON p.product_id = b.product_id
-> LEFT OUTER JOIN demo2_software AS s ON p.product_id = s.product_id;

```


Data Structures for Demo #3

```
C:\Windows\system32\cmd.exe - mysql -u demo_user -p

C:\Users\Denise Clark>mysql -u demo_user -p
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 39
Server version: 5.7.20-log MySQL Community Server (GPL)

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Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql>
mysql> use jpa_demo;
Database changed
mysql>
mysql> -- *****
mysql> -- *** Select All Products ***
mysql> -- *****
mysql> SELECT * FROM demo3_product;
Empty set (0.00 sec)

mysql>
mysql> -- *****
mysql> -- *** Select All Books ***
mysql> -- *****
mysql> SELECT * FROM demo3_book;
+-----+-----+-----+
| PRODUCT_ID | ISBN   | PRODUCT_NAME |
+-----+-----+-----+
|          1 | 123-456 | Beginner Java |
|          2 | 123-789 | Advanced Java |
+-----+-----+-----+
2 rows in set (0.00 sec)

mysql>
mysql> -- *****
mysql> -- *** select All Software ***
mysql> -- *****
mysql> SELECT * FROM demo3_software;
+-----+-----+-----+
| PRODUCT_ID | PRODUCT_NAME                     | VERSION |
+-----+-----+-----+
|          3 | Learn Java by Example            | 1.0     |
|          4 | Learn Advanced Java by Example   | 2.0     |
+-----+-----+-----+
2 rows in set (0.00 sec)

mysql>
```

Data Structures for Demo #4

```
C:\Windows\system32\cmd.exe - mysql -u demo_user -p
C:\Users\Denise Clark>mysql -u demo_user -p
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 40
Server version: 5.7.20-log MySQL Community Server (GPL)

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Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> use jpa_demo;
Database changed
mysql> -- *****
mysql> -- *** Select All Full Time Employees (Salary) ***
mysql> -- *****
mysql> SELECT * FROM demo4_employee_ft;
+-----+-----+-----+-----+
| EMPLOYEE_ID | AGE | NAME | ANNUAL_SALARY |
+-----+-----+-----+-----+
|          101 |  39 | Mary |         125000 |
|          102 |  41 | John |          92800 |
|          151 |  39 | Mary |         125000 |
|          152 |  41 | John |          92800 |
+-----+-----+-----+-----+
4 rows in set (0.05 sec)

mysql> -- *****
mysql> -- *** Select All Part Time Employees (Hourly) ***
mysql> -- *****
mysql> SELECT * FROM demo4_employee_pt;
+-----+-----+-----+-----+
| EMPLOYEE_ID | AGE | HOURLY_RATE | NAME |
+-----+-----+-----+-----+
|          103 |  25 |         50.75 | Charlie |
|          104 |  29 |         42.5 | Lucy |
|          153 |  25 |         50.75 | Charlie |
|          154 |  29 |         42.5 | Lucy |
+-----+-----+-----+-----+
4 rows in set (0.00 sec)

mysql>
mysql>
```

Data Structures for Demo #5

```
C:\Windows\system32\cmd.exe - mysql -u demo_user -p
C:\Users\Denise Clark>mysql -u demo_user -p
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 41
Server version: 5.7.20-log MySQL Community Server (GPL)

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Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> use jpa_demo;
Database changed
mysql>
mysql> -- *****
mysql> -- *** select All Employees ***
mysql> -- *****
mysql> SELECT * FROM demo5_employee;
+-----+-----+
| EMPLOYEE_ID | NAME          |
+-----+-----+
|          201 | Sean Blessing |
|          203 | Greg Doud     |
|          205 | Lisa Slutsky  |
+-----+-----+
3 rows in set (0.02 sec)

mysql>
mysql> -- *****
mysql> -- *** select all Addresses ***
mysql> -- *****
mysql> SELECT * FROM demo5_address;
+-----+-----+-----+-----+-----+-----+
| ADDRESS_ID | ADDRESS                                | CITY   | STATE_CODE | ZIP_CODE | EMPLOYEE_EMPLOYEE_ID |
+-----+-----+-----+-----+-----+-----+
|          202 | 100 Java Happy-Path Lane              | Mason  | OH         | 45040    |                      201 |
|          204 | 999 Bootcamper Counseling St          | Mason  | OH         | 45040    |                      203 |
|          206 | 911 Triage-It Blvd                    | Mason  | OH         | 45040    |                      205 |
+-----+-----+-----+-----+-----+-----+
3 rows in set (0.06 sec)

mysql>
```

Data Structures for Demo #6

```

C:\Windows\system32\cmd.exe - mysql -u demo_user -p
C:\Users\Denise Clark>mysql -u demo_user -p
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 42
Server version: 5.7.20-log MySQL Community Server (GPL)

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Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> use jpa_demo;
Database changed
mysql>
mysql> -- *****
mysql> -- *** select All universities ***
mysql> -- *****
mysql> SELECT * FROM demo6_university;
+-----+-----+
| UNIVERSITY_ID | NAME                |
+-----+-----+
| 551 | University of Cincinnati |
| 555 | University of Dayton    |
+-----+-----+
2 rows in set (0.06 sec)

mysql>
mysql> -- *****
mysql> -- *** Select all Students ***
mysql> -- *****
mysql> SELECT * FROM demo6_student;
+-----+-----+-----+-----+
| STUDENT_ID | FIRST_NAME | LAST_NAME | UNIVERSITY_ID |
+-----+-----+-----+-----+
| 552 | John | Doe | 551 |
| 553 | Mary | Smith | 551 |
| 554 | James | Anderson | 551 |
| 556 | Lisa | Williams | 555 |
| 557 | Mike | Clark | 555 |
| 558 | Shannon | Baker | 555 |
+-----+-----+-----+-----+
6 rows in set (0.02 sec)

mysql>
mysql> -- *****
mysql> -- *** select all students and thier corresponding University ***
mysql> -- *** (See Notes on FK Column Name) ***
mysql> -- *****
mysql> SELECT u.name, s.first_name, s.last_name, s.student_id, u.university_id
-> FROM demo6_university u,
-> demo6_student s
-> WHERE s.university_university_id = u.university_id
-> ORDER by u.name, s.last_name;
+-----+-----+-----+-----+-----+
| name | first_name | last_name | student_id | university_id |
+-----+-----+-----+-----+-----+
| University of Cincinnati | James | Anderson | 554 | 551 |
| University of Cincinnati | John | Doe | 552 | 551 |
| University of Cincinnati | Mary | Smith | 553 | 551 |
| University of Dayton | Shannon | Baker | 558 | 555 |
| University of Dayton | Mike | Clark | 557 | 555 |
| University of Dayton | Lisa | Williams | 556 | 555 |
+-----+-----+-----+-----+-----+
6 rows in set (0.03 sec)

```