《数据库系统原理》实验报告（六）

题目：SQL 综合实验

学号		姓名		日期	12/01/2023

实验环境：

Windows 10 Docker MiniOB

实验步骤及结果截图：

1. 建立数据库、建表、插入数据

```
MariaDB [(none)]> create database library_sys
    -> ;
Query OK, 1 row affected (0.000 sec)

MariaDB [(none)]> show databases
    -> ;
+--------------------+
| Database           |
+--------------------+
| db_1024            |
| information_schema |
| library_sys        |
| mysql              |
| performance_schema |
| school_management  |
| sys                |
+--------------------+
7 rows in set (0.000 sec)

MariaDB [(none)]> use library_sys
Database changed
```

```
MariaDB [library_sys]> create table Book (
    ->     bno varchar(10) primary key,
    ->     bname varchar(30),
    ->     author varchar(30),
    ->     price float
    -> );
Query OK, 0 rows affected (0.013 sec)

MariaDB [library_sys]>
MariaDB [library_sys]> create table Student (
    ->     sno varchar(10) primary key,
    ->     sname varchar(30),
    ->     grade varchar(5)
    -> );
Query OK, 0 rows affected (0.010 sec)

MariaDB [library_sys]>
MariaDB [library_sys]> create table Borrow (
    ->     sno varchar(10),
    ->     bno varchar(10),
    ->     rdate datetime,
    ->     primary key(sno, bno),
    ->     foreign key(sno) references Student(sno) on delete cascade,
    ->     foreign key(bno) references Book(bno) on delete cascade
    -> );
Query OK, 0 rows affected (0.013 sec)
```

图 1：创建数据库、添加表

```
MariaDB [library_sys]> create table Borrow (
    ->     sno varchar(10),
    ->     bno varchar(10),
    ->     rdate datetime,
    ->     primary key(sno, bno),
    ->     foreign key(sno) references Student(sno) on delete cascade,
    ->     foreign key(bno) references Book(bno) on delete cascade
    -> );
Query OK, 0 rows affected (0.013 sec)

MariaDB [library_sys]> insert into Book values
    ->     ('T1001','Java 程序设计','李新民',23.5),
    ->     ('T1002','数据库原理及应用' ,'王珊',27),
    ->     ('T1003','Java 高级编程','陈海',23.5),
    ->     ('T1004','大学英语','张宁',18.5),
    ->     ('T1005','C++程序设计','马品三',33.5),
    ->     ('T1006','数据结构','刘子单',35);
Query OK, 6 rows affected (0.003 sec)
Records: 6  Duplicates: 0  Warnings: 0

MariaDB [library_sys]> insert into Student values
    ->     ('K001','张三','大一'),
    ->     ('K002','李四','大二'),
    ->     ('K003','王五','大三'),
    ->     ('K004','赵六','大四'),
    ->     ('K005','刘七','大四');
Query OK, 5 rows affected (0.003 sec)
Records: 5  Duplicates: 0  Warnings: 0

MariaDB [library_sys]> insert into Borrow values
    ->     ('K001','T1006','2022-10-9'),
    ->     ('K001','T1001','2022-3-1'),
    ->     ('K001','T1004','2022-5-7'),
    ->     ('K002','T1002','2022-6-9'),
    ->     ('K002','T1003','2022-12-5'),
    ->     ('K002','T1001','2022-11-3'),
    ->     ('K003','T1005','2022-9-4'),
    ->     ('K004','T1002','2022-2-5');
Query OK, 8 rows affected (0.002 sec)
Records: 8  Duplicates: 0  Warnings: 0
```

```
MariaDB [library_sys]> show tables
    -> ;
+----------------------+
| Tables_in_library_sys |
+----------------------+
| Book                 |
| Borrow               |
| Student              |
+----------------------+
3 rows in set (0.000 sec)
```

图 2：插入表项

2. 查询书名中包含 “程序设计” 的图书信息，输出所有信息（包括书名、书号、作者、单价），并按照单价降序排列

```
MariaDB [library_sys]> select bname as '书名', bno as '书号', author as '作者', price as '单价'
    -> from Book
    -> where bname like '%程序设计%'
    -> order by price desc;
+------------------+--------+-----------+--------+
| 书名             | 书号   | 作者      | 单价   |
+------------------+--------+-----------+--------+
| C++程序设计      | T1005  | 马品三    |   33.5 |
| Java 程序设计    | T1001  | 李新民    |   23.5 |
+------------------+--------+-----------+--------+
2 rows in set (0.001 sec)
```

图 3：程序设计图书信息

3. 查询借阅了书名为”数据库原理及应用”的学生信息，输出该学生的学号、姓名和年级

```
MariaDB [library_sys]> select stu.sno as '学号', stu.sname as '姓名', stu.grade as '年级'
    -> from Student as stu join Borrow as bor on stu.sno = bor.sno
    ->                     join Book as bok on bor.bno = bok.bno
    -> where bok.bname = '数据库原理及应用';
+--------+--------+--------+
| 学号   | 姓名   | 年级   |
+--------+--------+--------+
| K002   | 李四   | 大二   |
| K004   | 赵六   | 大四   |
+--------+--------+--------+
2 rows in set (0.003 sec)
```

图 4：查询借阅了书名为”数据库原理及应用”的学生信息

4. 统计每个学生借书信息，输出每个学生的学号、借书书名和还书日期；

```
MariaDB [library_sys]> select stu.sno as '学号', bok.bname as '借书书名', bor.rdate as '还书日期'
    -> from Borrow as bor join Book as bok on bor.bno = bok.bno
    ->                    join Student as stu on bor.sno = stu.sno;
+--------+--------------------------+---------------------+
| 学号   | 借书书名                 | 还书日期            |
+--------+--------------------------+---------------------+
| K001   | Java 程序设计            | 2022-03-01 00:00:00 |
| K001   | 大学英语                 | 2022-05-07 00:00:00 |
| K001   | 数据结构                 | 2022-10-09 00:00:00 |
| K002   | Java 程序设计            | 2022-11-03 00:00:00 |
| K002   | 数据库原理及应用         | 2022-06-09 00:00:00 |
| K002   | Java 高级编程            | 2022-12-05 00:00:00 |
| K003   | C++程序设计              | 2022-09-04 00:00:00 |
| K004   | 数据库原理及应用         | 2022-02-05 00:00:00 |
+--------+--------------------------+---------------------+
8 rows in set (0.001 sec)
```

图 5：统计学生信息

5. 查询所有借阅已过期图书的信息，输出学生姓名、书名和还书日期 （当前日期假设为 2022-11-8）

```
MariaDB [library_sys]> select stu.sname as '学生姓名', bok.bname as '书名', bor.rdate as '还书日期'
    -> from Borrow as bor join Book as bok on bor.bno = bok.bno
    ->                    join Student as stu on bor.sno = stu.sno
    -> where bor.rdate < '2022-11-8';
+--------------+--------------------------+---------------------+
| 学生姓名     | 书名                     | 还书日期            |
+--------------+--------------------------+---------------------+
| 张三         | Java 程序设计            | 2022-03-01 00:00:00 |
| 张三         | 大学英语                 | 2022-05-07 00:00:00 |
| 张三         | 数据结构                 | 2022-10-09 00:00:00 |
| 李四         | Java 程序设计            | 2022-11-03 00:00:00 |
| 李四         | 数据库原理及应用         | 2022-06-09 00:00:00 |
| 王五         | C++程序设计              | 2022-09-04 00:00:00 |
| 赵六         | 数据库原理及应用         | 2022-02-05 00:00:00 |
+--------------+--------------------------+---------------------+
7 rows in set (0.001 sec)
```

图 6：统计借阅已过期图书的信息

6. 查询没有借阅过书的学生信息，输出学生姓名和学号

```
MariaDB [library_sys]> select stu.sname as '学生姓名', stu.sno as '学号'
    -> from Student as stu left join Borrow as bor on stu.sno = bor.sno
    -> where bor.sno is null;
+--------------+--------+
| 学生姓名     | 学号   |
+--------------+--------+
| 刘七         | K005   |
+--------------+--------+
1 row in set (0.001 sec)
```

图 7：查询没有借阅过书的学生信息

7. 查询借了"Java 程序设计"但没有借"数据库原理及应用"的读者信息，输出这些学生的学号，并按照学号升序排列

```
    -> from Student as stu
    -> where exists (
    ->     (
    ->         select *
    ->         from Borrow as bor join Book as bok on bor.bno = bok.bno
    ->         where bor.sno = stu.sno and bok.bname = 'Java 程序设计'
    ->     )
    ->     except
    ->     (
    ->         select *
    ->         from Borrow as bor join Book as bok on bor.bno = bok.bno
    ->         where bor.sno = stu.sno and bok.bname = '数据库原理及应用'
    ->     )
    -> )
    -> order by stu.sno;
+--------+
| 学号   |
+--------+
| K001   |
+--------+
1 row in set (0.001 sec)
```

图 8：查询没有借阅过书的学生信息

8. 创建一个过程，使之能够实现如下功能：修改借阅表，增加字段”借阅状态”（字段名为”bstate”，数据类型可自行定义），字段含义为表示图书的借阅状态是否已经过期； 并根据表中已有数据为该字段赋值（所赋的值与表定义时的数据类型保持一致即可，比如可以定义已到期图书的”借阅状态”为 True，未到期图书的”借阅状态”为 False），要求使用 if 语句进行条件判断。（当前日期假设为 2022-11-8）

```
MariaDB [library_sys]> delimiter $$
MariaDB [library_sys]>
MariaDB [library_sys]> create procedure update_bstate()
    -> begin
    ->     -- add field bstate
    ->     alter table Borrow add column bstate boolean;
    ->
    ->     -- update bstate field based on rdate field
    ->     update Borrow
    ->     set bstate = if (rdate < '2022-11-08', false, true);
    ->
    -> end$$
Query OK, 0 rows affected (0.023 sec)

MariaDB [library_sys]>
MariaDB [library_sys]> delimiter ;
MariaDB [library_sys]>
MariaDB [library_sys]> call update_bstate();
Query OK, 8 rows affected (0.047 sec)

MariaDB [library_sys]>
MariaDB [library_sys]> select * from Borrow;
+------+-------+---------------------+--------+
| sno  | bno   | rdate               | bstate |
+------+-------+---------------------+--------+
| K001 | T1001 | 2022-03-01 00:00:00 |      0 |
| K001 | T1004 | 2022-05-07 00:00:00 |      0 |
| K001 | T1006 | 2022-10-09 00:00:00 |      0 |
| K002 | T1001 | 2022-11-03 00:00:00 |      0 |
| K002 | T1002 | 2022-06-09 00:00:00 |      0 |
| K002 | T1003 | 2022-12-05 00:00:00 |      1 |
| K003 | T1005 | 2022-09-04 00:00:00 |      0 |
| K004 | T1002 | 2022-02-05 00:00:00 |      0 |
+------+-------+---------------------+--------+
8 rows in set (0.000 sec)
```

图 9：添加 procedure

其中添加的 bstate 字段意义为：逾期未还的 Borrow 记录为 0， 尚在截至日期前的 Borrow 记录为 1（当前日期假设为 **2022-11-8**）

9. 修改图书表，在 bname 列上增加唯一性索引 bname_index，并按 bname 降序排列

```
MariaDB [library_sys]> alter table Book
    -> add unique index bname_index (bname desc);
Query OK, 0 rows affected (0.025 sec)
Records: 0  Duplicates: 0  Warnings: 0

MariaDB [library_sys]>
MariaDB [library_sys]> select * from Book;
+-------+--------------------------+----------+-------+
| bno   | bname                    | author   | price |
+-------+--------------------------+----------+-------+
| T1001 | Java 程序设计            | 李新民   |  23.5 |
| T1002 | 数据库原理及应用         | 王珊     |    27 |
| T1003 | Java 高级编程            | 陈海     |  23.5 |
| T1004 | 大学英语                 | 张宁     |  18.5 |
| T1005 | C++程序设计              | 马品三   |  33.5 |
| T1006 | 数据结构                 | 刘子单   |    35 |
+-------+--------------------------+----------+-------+
6 rows in set (0.001 sec)

MariaDB [library_sys]>
MariaDB [library_sys]> show index from Book;
+-------+------------+------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+
| Table | Non_unique | Key_name   | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Ignored |
+-------+------------+------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+
| Book  |          0 | PRIMARY    |            1 | bno         | A         |           6 |     NULL | NULL   |      | BTREE      |         |               | NO      |
| Book  |          0 | bname_index |           1 | bname       | D         |           6 |     NULL | NULL   | YES  | BTREE      |         |               | NO      |
+-------+------------+------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+
2 rows in set (0.000 sec)
```

出现的问题：

1. 不清楚如何进行日期比较，建表未仔细观察字段数据类型

解决方案：

1. 观察到建表时，日期段的数据类型为下图所示，DATETIME 类型的数据表示一个特定的日期和时间，包括年、月、日、时、分和秒，格式为 'YYYY-MM-DD HH:MI:SS'

```
rdate datetime,
```

在数据库表单中呈现为：

sno	bno	rdate
K001	T1001	2022-03-01 00:00:00
K001	T1004	2022-05-07 00:00:00
K001	T1006	2022-10-09 00:00:00
K002	T1001	2022-11-03 00:00:00
K002	T1002	2022-06-09 00:00:00
K002	T1003	2022-12-05 00:00:00
K003	T1005	2022-09-04 00:00:00
K004	T1002	2022-02-05 00:00:00

图 10：rdate 字段

比较时直接使用对应格式的字符串进行比较即可：

```
MariaDB [library_sys]> select stu.sname as '学生姓名', bok.bname as '书名', bor.rdate as '还书日期'
    -> from Borrow as bor join Book as bok on bor.bno = bok.bno
    ->                     join Student as stu on bor.sno = stu.sno
    -> where bor.rdate < '2022-11-8';
+--------------+------------------------+---------------------+
| 学生姓名     | 书名                   | 还书日期            |
+--------------+------------------------+---------------------+
| 张三         | Java 程序设计          | 2022-03-01 00:00:00 |
| 张三         | 大学英语               | 2022-05-07 00:00:00 |
| 张三         | 数据结构               | 2022-10-09 00:00:00 |
| 李四         | Java 程序设计          | 2022-11-03 00:00:00 |
| 李四         | 数据库原理及应用       | 2022-06-09 00:00:00 |
| 王五         | C++程序设计            | 2022-09-04 00:00:00 |
| 赵六         | 数据库原理及应用       | 2022-02-05 00:00:00 |
+--------------+------------------------+---------------------+
7 rows in set (0.001 sec)
```

图 11：datetime 比较方式