《数据库系统原理》实验报告（6）					
题目：SQL 综合实验					
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实验环境：

硬件配置：联想小新 Pro 14ACH 2021

CPU：AMD Ryzen 7 5800H with Radeon Graphics

操作系统：Windows11

数据库：MariaDB

实验步骤及结果截图：

1. 在数据库中仿照附录一建表，同时建立各表的主键约束和表间的外键约束。建表后，查看三个表都已经在数据库中建立成功：

2. 仿照附录 **2** 在表中插入样例数据：

```
MariaDB [lab6]> 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 (0.007 sec)
Records: 6  Duplicates: 0  Warnings: 0

MariaDB [lab6]> 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 (0.007 sec)
Records: 5  Duplicates: 0  Warnings: 0

MariaDB [lab6]> 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 (0.007 sec)
Records: 8  Duplicates: 0  Warnings: 0
```

3. 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 [lab6]> SELECT bname, bno, author, price
    -> FROM Book
    -> WHERE bname LIKE '%程序设计%'
    -> ORDER BY price DESC;
+-------------------+-------+-----------+-------+
| bname             | bno   | author    | price |
+-------------------+-------+-----------+-------+
| 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)
```

4. 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 [lab6]> SELECT sno, sname, grade
    -> FROM Student
    -> WHERE sno IN (
    -> SELECT sno
    -> FROM Book NATURAL INNER JOIN Borrow
    -> WHERE bname = '数据库原理及应用'
    -> );
+------+--------+--------+
| sno  | sname  | grade  |
+------+--------+--------+
| K002 | 李四   | 大二    |
| K004 | 赵六   | 大四    |
+------+--------+--------+
2 rows in set (0.001 sec)
```

5. 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 [lab6]> SELECT sno, bname, rdate
    -> FROM Student NATURAL INNER JOIN Borrow NATURAL INNER JOIN Book;
+------+----------------------+---------------------+
| sno  | bname                | rdate               |
+------+----------------------+---------------------+
| 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 (0.000 sec)
```

6. 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：

```
MariaDB [lab6]> SELECT sname, bname, rdate
    -> FROM Student NATURAL INNER JOIN Book NATURAL INNER JOIN Borrow
    -> WHERE rdate < '2022-11-8';
+--------+----------------------+---------------------+
| sname  | bname                | rdate               |
+--------+----------------------+---------------------+
| 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 (0.009 sec)
```

7. 查询没有借阅过书的学生信息，输出学生姓名和学号：

```
MariaDB [lab6]> SELECT sname, sno
    -> FROM Student
    -> WHERE sno NOT IN(
    -> SELECT sno
    -> FROM Borrow
    -> );
+--------+------+
| sname  | sno  |
+--------+------+
| 刘七    | K005 |
+--------+------+
1 row in set (0.012 sec)
```

8. 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：

```
MariaDB [lab6]> SELECT sno
    -> FROM Borrow NATURAL INNER JOIN Book
    -> WHERE bname = 'Java 程序设计'
    -> AND sno NOT IN(
    -> SELECT sno
    -> FROM Borrow NATURAL INNER JOIN Book
    -> WHERE bname = '数据库原理及应用'
    -> )
    -> ORDER BY sno ASC;
+------+
| sno  |
+------+
| K001 |
+------+
1 row in set (0.001 sec)
```

9.   创建一个过程，使之能够实现如下功能：

a) 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；

b) 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，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：

```
MariaDB [lab6]> DELIMITER $$
MariaDB [lab6]>
MariaDB [lab6]> CREATE PROCEDURE UpdateBorrowState()
    -> BEGIN
    -> ALTER TABLE Borrow
    -> ADD COLUMN bstate BOOLEAN;
    ->
    -> UPDATE Borrow
    -> SET bstate = IF(rdate < '2022-11-08', TRUE, FALSE);
    -> END $$
Query OK, 0 rows affected (0.024 sec)

MariaDB [lab6]>
MariaDB [lab6]> DELIMITER ;
MariaDB [lab6]>
MariaDB [lab6]> CALL UpdateBorrowState();
Query OK, 8 rows affected (0.032 sec)

MariaDB [lab6]> select * from Borrow;
+------+-------+---------------------+--------+
| sno  | bno   | rdate               | bstate |
+------+-------+---------------------+--------+
| K001 | T1001 | 2022-03-01 00:00:00 |      1 |
| K001 | T1004 | 2022-05-07 00:00:00 |      1 |
| K001 | T1006 | 2022-10-09 00:00:00 |      1 |
| K002 | T1001 | 2022-11-03 00:00:00 |      1 |
| K002 | T1002 | 2022-06-09 00:00:00 |      1 |
| K002 | T1003 | 2022-12-05 00:00:00 |      0 |
| K003 | T1005 | 2022-09-04 00:00:00 |      1 |
| K004 | T1002 | 2022-02-05 00:00:00 |      1 |
+------+-------+---------------------+--------+
8 rows in set (0.000 sec)
```

10.(*)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 [lab6]> CREATE INDEX bname_index
    -> ON Book(bname DESC);
Query OK, 0 rows affected (0.027 sec)
Records: 0  Duplicates: 0  Warnings: 0
```

查询增加的唯一性索引：

```
MariaDB [lab6]> 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   |          1 | bname_index |            1 | bname       | D         |           6 | NULL     | NULL   | YES  | BTREE      |         |               | NO      |
+--------+------------+-------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+
2 rows in set (0.000 sec)
```

出现的问题：

1.   在使用 CREATE INDEX 语句时，忘记在指定的表和列名前加 ON，导致语法错误：

```
MariaDB [lab6]> CREATE INDEX bname_index Book(bname DESC)
    -> ;
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version for the right syntax to use near 'Book(bname DESC)' at line 1
```

解决方案：

1. 使用 CREATE INDEX 的语法应该为"CREATE INDEX 索引名 ON 表名（列名 [升降序]）"。