



华中科技大学

数据库系统概论实验检查

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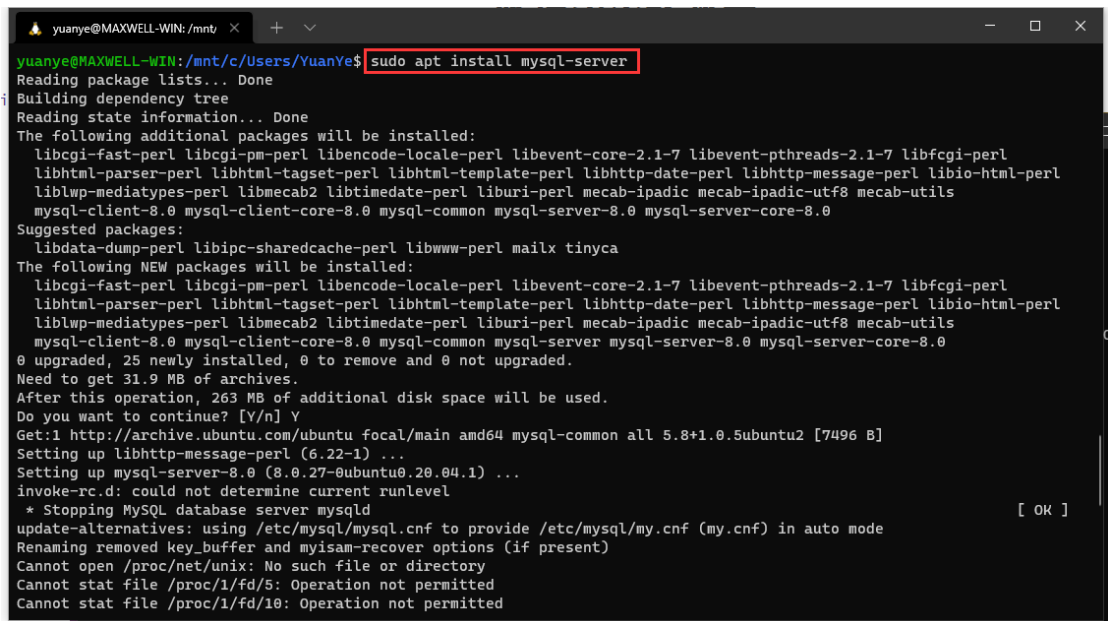
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2 数据库定义与基本操作

2.2 完成过程

2.2.1 安装数据库

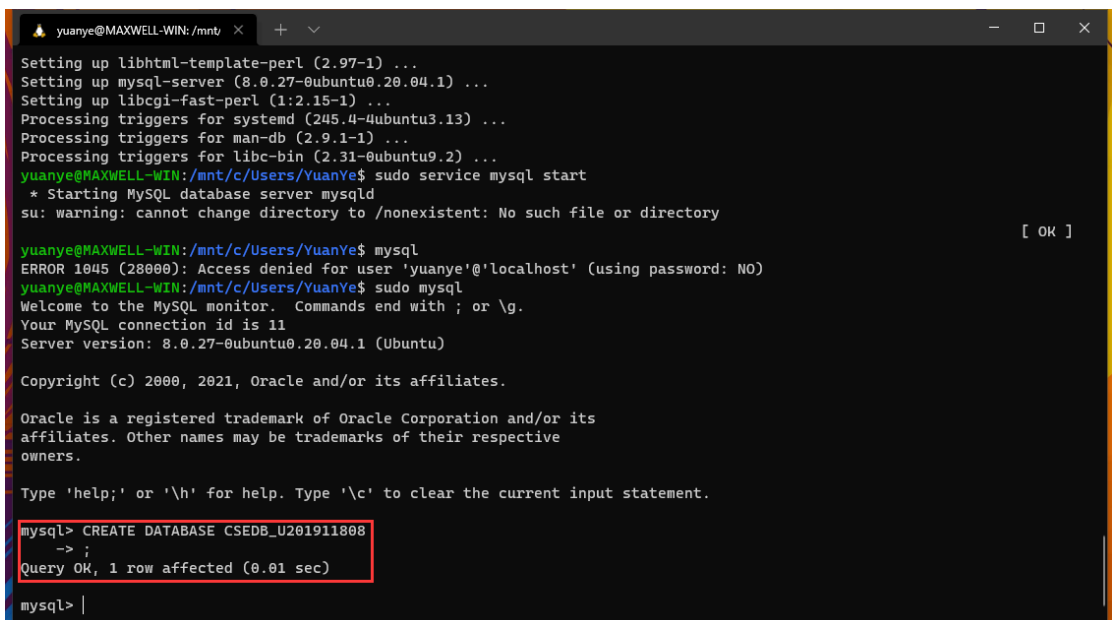
1) 安装并启动数据库，如图 2.1 所示：



```
yuanye@MAXWELL-WIN: /mnt/ x + v
yuanye@MAXWELL-WIN: /mnt/c/Users/YuanYe$ sudo apt install mysql-server
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  libbgi-fast-perl libbgi-pm-perl libencode-locale-perl libevent-core-2.1-7 libevent-pthreads-2.1-7 libfcgi-perl
  libhtml-parser-perl libhtml-tagset-perl libhtml-template-perl libhttp-date-perl libhttp-message-perl libio-html-perl
  liblwp-mediatypes-perl libmecab2 libtimedate-perl liburi-perl mecab-ipadic mecab-ipadic-utf8 mecab-utils
  mysql-client-8.0 mysql-client-core-8.0 mysql-common mysql-server-8.0 mysql-server-core-8.0
Suggested packages:
  libdata-dump-perl libipc-sharedcache-perl libwww-perl mailx tinymc
The following NEW packages will be installed:
  libbgi-fast-perl libbgi-pm-perl libencode-locale-perl libevent-core-2.1-7 libevent-pthreads-2.1-7 libfcgi-perl
  libhtml-parser-perl libhtml-tagset-perl libhtml-template-perl libhttp-date-perl libhttp-message-perl libio-html-perl
  liblwp-mediatypes-perl libmecab2 libtimedate-perl liburi-perl mecab-ipadic mecab-ipadic-utf8 mecab-utils
  mysql-client-8.0 mysql-client-core-8.0 mysql-common mysql-server mysql-server-8.0 mysql-server-core-8.0
0 upgraded, 25 newly installed, 0 to remove and 0 not upgraded.
Need to get 31.9 MB of archives.
After this operation, 263 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://archive.ubuntu.com/ubuntu focal/main amd64 mysql-common all 5.8+1.0.5ubuntu2 [7496 B]
Setting up libhttp-message-perl (6.22-1) ...
Setting up mysql-server-8.0 (8.0.27-0ubuntu0.20.04.1) ...
invoke-rc.d: could not determine current runlevel
* Stopping MySQL database server mysqld
update-alternatives: using /etc/mysql/mysql.cnf to provide /etc/mysql/my.cnf (my.cnf) in auto mode
Renaming removed key_buffer and myisam-recover options (if present)
Cannot open /proc/net/unix: No such file or directory
Cannot stat file /proc/1/fd/5: Operation not permitted
Cannot stat file /proc/1/fd/10: Operation not permitted
[ OK ]
```

图 2.1 安装并启动数据库

2) 创建名为 CSEDB_U201911808 的数据库，如图 2.2 所示：



```
yuanye@MAXWELL-WIN: /mnt/ x + v
Setting up libhtml-template-perl (2.97-1) ...
Setting up mysql-server (8.0.27-0ubuntu0.20.04.1) ...
Setting up libbgi-fast-perl (1:2.15-1) ...
Processing triggers for systemd (245.4-4ubuntu3.13) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for libc-bin (2.31-0ubuntu9.2) ...
yuanye@MAXWELL-WIN: /mnt/c/Users/YuanYe$ sudo service mysql start
* Starting MySQL database server mysqld
su: warning: cannot change directory to /nonexistent: No such file or directory
[ OK ]
yuanye@MAXWELL-WIN: /mnt/c/Users/YuanYe$ mysql
ERROR 1045 (28000): Access denied for user 'yuanye'@'localhost' (using password: NO)
yuanye@MAXWELL-WIN: /mnt/c/Users/YuanYe$ sudo mysql
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 11
Server version: 8.0.27-0ubuntu0.20.04.1 (Ubuntu)

Copyright (c) 2000, 2021, Oracle and/or its affiliates.

Oracle is a registered trademark of Oracle Corporation and/or its
affiliates. Other names may be trademarks of their respective
owners.

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

mysql> CREATE DATABASE CSEDB_U201911808
-> ;
Query OK, 1 row affected (0.01 sec)

mysql>
```

图 2.2 创建数据库

2.2.2 基本表操作

3) 在数据库中按照要求创建三个表，如图 2.3 所示：

```
yuanye@MAXWELL-WIN: /mnt/
mysql> use CSEDB_U201911808
Database changed
mysql> CREATE TABLE Student
-> (Sno CHAR(5) NOT NULL UNIQUE,
-> Sname CHAR(20) UNIQUE,
-> Ssex CHAR(1),
-> Sage INT,
-> Sdept CHAR(15),
-> Scholarship CHAR(2));
Query OK, 0 rows affected (0.02 sec)

mysql> CREATE TABLE Course
-> (Cno CHAR(5) NOT NULL UNIQUE,
-> Cname CHAR(30) UNIQUE,
-> Cpno CHAR(20),
-> Ccredit FLOAT
-> );
Query OK, 0 rows affected (0.03 sec)

mysql> CREATE TABLE SC
-> (Sno CHAR(5),
-> Cno CHAR(5),
-> Grade INT,
-> PRIMARY KEY(Sno, Cno));
Query OK, 0 rows affected (0.02 sec)

mysql> show tables;
+-----+
| Tables_in_CSEDB_U201911808 |
+-----+
| Course                      |
| SC                          |
| Student                     |
+-----+
3 rows in set (0.00 sec)
```

图 2.3 创建三个表

- 4) 使用 DROP 语句删除表，如图 2.4 所示：

```
mysql> DROP TABLE Student;
Query OK, 0 rows affected (0.01 sec)
```

图 2.4 删除表

- 5) 练习创建和删除索引操作，如图 2.5 所示：

```
mysql> CREATE UNIQUE INDEX CourseNo ON Course(Cno);
Query OK, 0 rows affected, 1 warning (0.02 sec)
Records: 0 Duplicates: 0 Warnings: 1

mysql> DROP INDEX CourseNo;
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MySQL server version for the right syntax to use near '' at line 1
```

图 2.5 创建和删除索引

- 6) 使用 ALTER 指令，在表格中增加一列，如图 2.6 所示：

```
mysql> ALTER TABLE Course ADD Cstart DATETIME;
Query OK, 0 rows affected (0.02 sec)
Records: 0 Duplicates: 0 Warnings: 0
```

图 2.6 表格增加一列

2.2.3 删除数据库

- 7) 使用 DROP 语句删除数据库，如图 2.7 所示：

```
mysql> DROP DATABASE CSEDB_U201911808
-> ;
Query OK, 1 row affected (0.01 sec)

mysql> SHOW DATABASES;
+-----+
| Database |
+-----+
| information_schema |
| mysql |
| performance_schema |
| sys |
+-----+
4 rows in set (0.00 sec)

mysql>
```

图 2.7 删除数据库

完成上述联系后，重新创建新的数据库，为接下来的实验做准备。

2.2.4 创建示例数据库

1) 创建新的数据库 S_T_U201911808，并在其中定义三个基本表，Student, Course, SC. 如图 2.8 所示：

```
mysql> CREATE DATABASE S_T_U201911808;
Query OK, 1 row affected (0.01 sec)

mysql> USE S_T_U201911808;
Database changed
mysql> CREATE TABLE Student
-> (Sno CHAR(9) PRIMARY KEY,
-> Sname CHAR(20) UNIQUE,
-> Ssex CHAR(2),
-> Sage SMALLINT,
-> Sdept CHAR(20),
-> Scholarship CHAR(2));
Query OK, 0 rows affected (0.02 sec)

mysql> CREATE TABLE Course
-> (Cno CHAR(4) PRIMARY KEY,
-> Cname CHAR(40),
-> Cpno CHAR(4),
-> Ccredit SMALLINT,
-> FOREIGN KEY (Cpno) REFERENCES Course(Cno));
Query OK, 0 rows affected (0.02 sec)

mysql> CREATE TABLE SC
-> (Sno CHAR(9),
-> Cno CHAR(4),
-> Grade SMALLINT,
-> PRIMARY KEY (Sno, Cno),
-> FOREIGN KEY (Sno) REFERENCES Student(Sno),
-> FOREIGN KEY (Cno) REFERENCES Course(Cno));
Query OK, 0 rows affected (0.02 sec)
```

图 2.8 创建数据库并定义三个基本表

2.2.5 创建基本表并添加数据

2) 使用可视化数据库管理软件——NaviCat 向刚刚定义的三个基本表中添加数据，如图 2.9 所示：

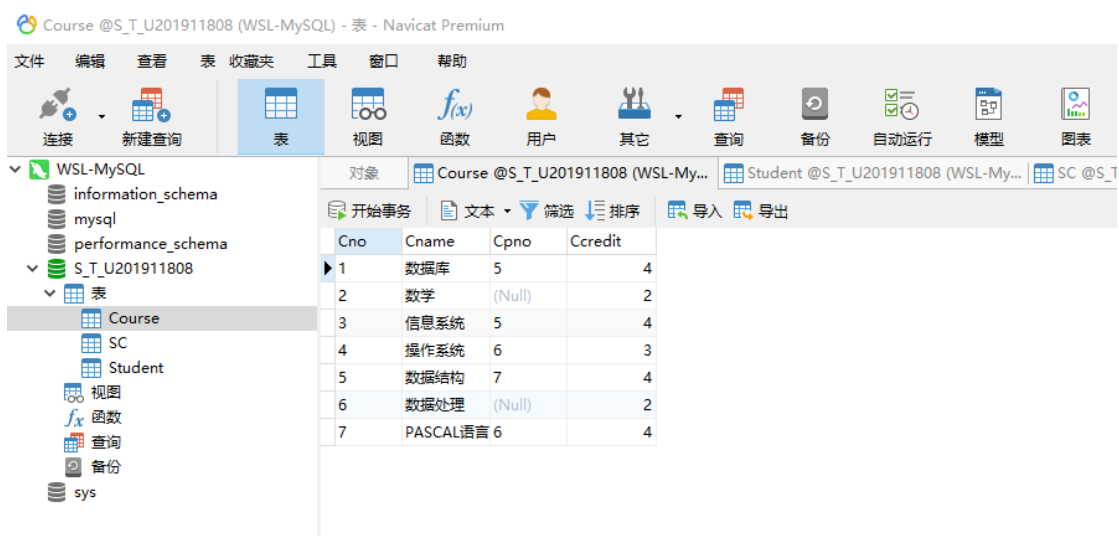


图 2.9 使用可视化软件添加数据

3) 回到命令行界面，使用指令查看并当前表格中现有的数据，如图 2.10 所示：

```

mysql> show tables;
+-----+
| Tables_in_S_T_U201911808 |
+-----+
| Course                     |
| SC                         |
| Student                   |
+-----+
3 rows in set (0.01 sec)

mysql> SELECT * FROM Course;
+-----+-----+-----+-----+
| Cno | Cname      | Cpno | Ccredit |
+-----+-----+-----+-----+
| 1   | 数据库    | 5    | 4       |
| 2   | 数学      | NULL | 2       |
| 3   | 信息系统  | 5    | 4       |
| 4   | 操作系统  | 6    | 3       |
| 5   | 数据结构  | 7    | 4       |
| 6   | 数据处理  | NULL | 2       |
| 7   | PASCAL语言 | 6    | 4       |
+-----+-----+-----+-----+
7 rows in set (0.00 sec)

mysql> SELECT * FROM SC;
+-----+-----+-----+
| Sno      | Cno | Grade |
+-----+-----+-----+
| 200215121 | 1   | 92    |
| 200215121 | 2   | 85    |
| 200215121 | 3   | 88    |
| 200215122 | 2   | 90    |
| 200215122 | 3   | 80    |
+-----+-----+-----+
5 rows in set (0.00 sec)

mysql> SELECT * FROM Student;
+-----+-----+-----+-----+-----+-----+
| Sno      | Sname | Ssex | Sage | Sdept | Scholarship |
+-----+-----+-----+-----+-----+-----+
| 200215121 | 李勇  | 男   | 20   | CS    | 否          |
| 200215122 | 刘晨  | 女   | 19   | CS    | 否          |
| 200215123 | 王敏  | 女   | 18   | MA    | 否          |
| 200215125 | 张立  | 男   | 19   | IS    | 否          |
+-----+-----+-----+-----+-----+-----+
4 rows in set (0.00 sec)

```

图 2.10 查看当前表格中全部数据

2.2.6 对基本表进行查询

4) 练习使用 SELECT 语句查询，如图 2.11 所示的是查询 student 表格中的全部学生信息，如图 2.11 所示：

```
yuanye@MAXWELL-WIN: /mnt/

mysql> show tables;
+-----+
| Tables_in_S_T_U201911808 |
+-----+
| Course                    |
| SC                        |
| Student                   |
+-----+
3 rows in set (0.00 sec)

mysql> SELECT Sno,Sname,Ssex,Sage,Sdept FROM Student;
+-----+-----+-----+-----+-----+
| Sno      | Sname | Ssex | Sage | Sdept |
+-----+-----+-----+-----+-----+
| 200215121 | 李勇  | 男   | 20   | CS    |
| 200215122 | 刘晨  | 女   | 19   | CS    |
| 200215123 | 王敏  | 女   | 18   | MA    |
| 200215125 | 张立  | 男   | 19   | IS    |
+-----+-----+-----+-----+-----+
4 rows in set (0.00 sec)

mysql> |
```

图 2.11 查询 srudent 表信息

5) 接下来，使用可视化界面查询选修 2 号课程并且成绩在 90 分以上的全部同学学号、姓名，查询结果为空，如图 2.12 所示：

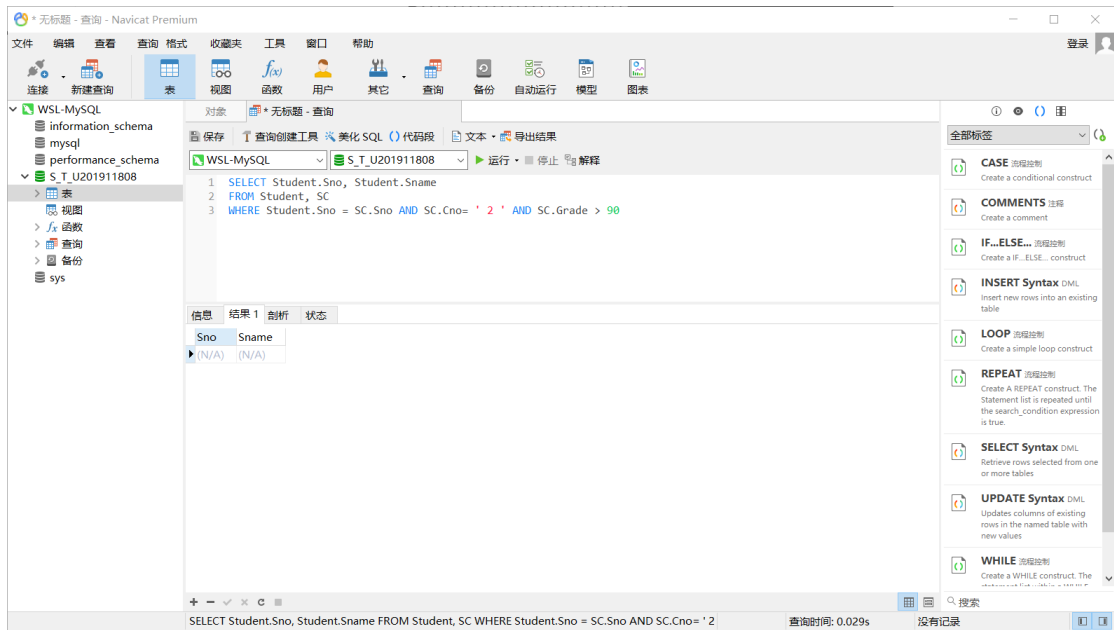


图 2.12 使用可视化管理软件查询信息

6) 接下来，依然利用可视化软件练习谓词查询操作，如图 2.13 所

示：

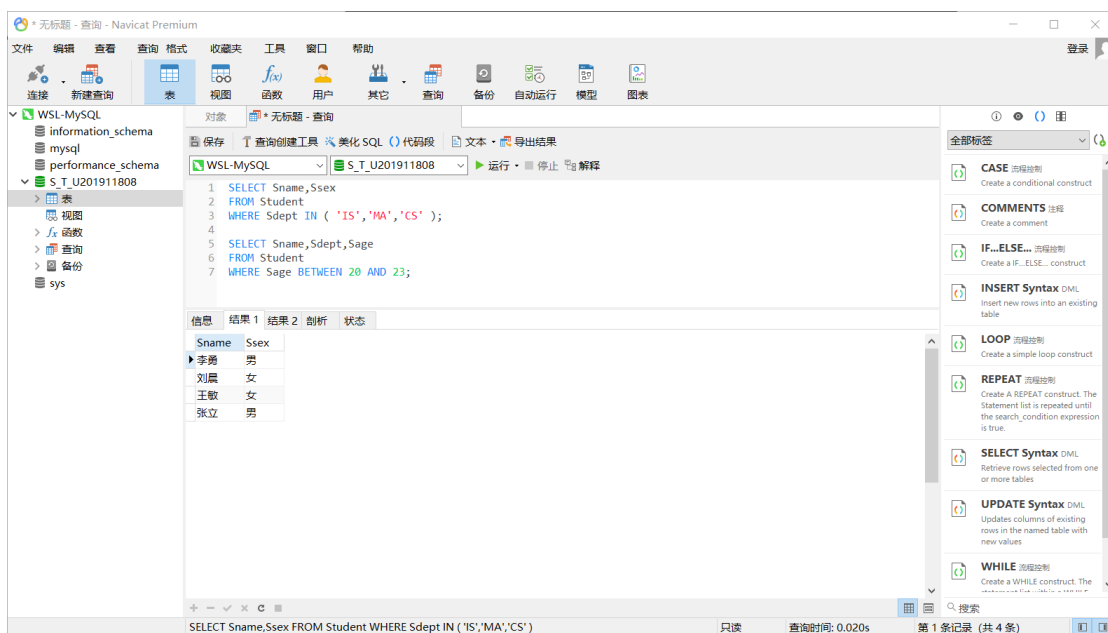


图 2.13 利用可视化软件进行谓词查询

7) 练习模糊查询，利用 LIKE 子句实现模糊查询。例如：查询所有姓刘学生的姓名、学号和性别，其结果如图 2.14 所示：

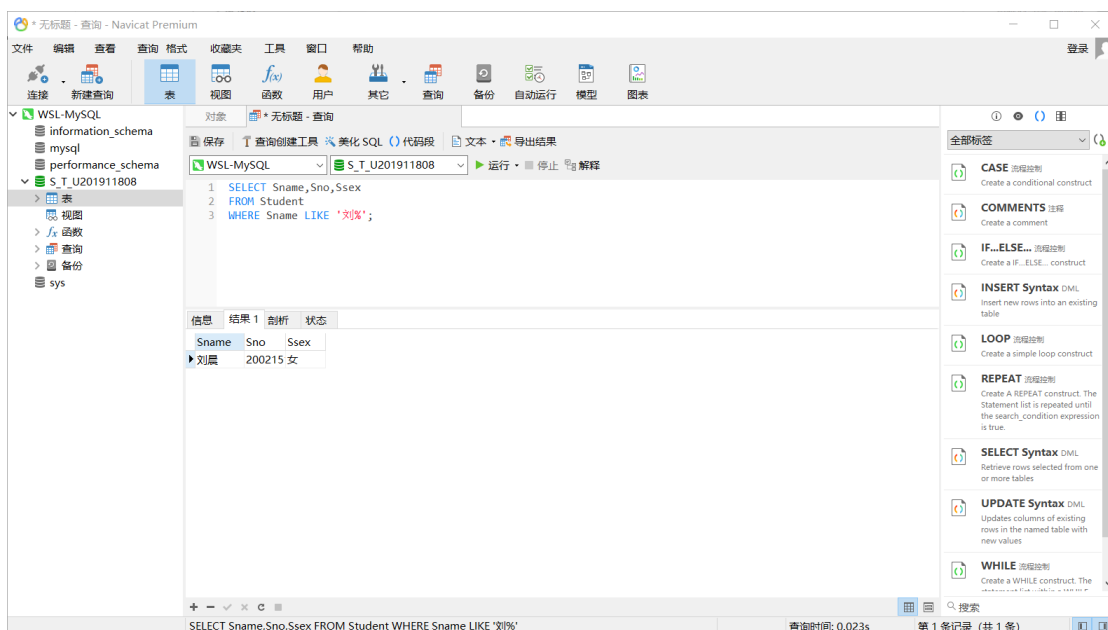


图 2.14 模糊查询练习

8) 利用 ORDER 子句为结果排序，例如：查询选修了 3 号课程的学生学号及其成绩，查询结果按分数降序排列，结果如图 2.15 所示：

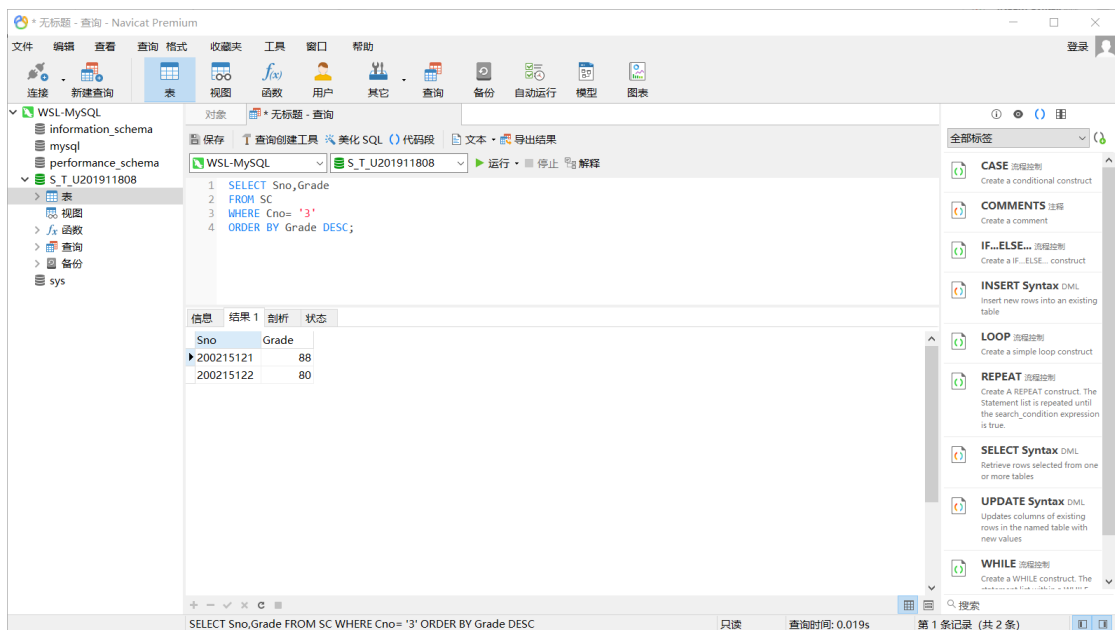


图 2.15 排序查询练习

9) 用 SQL Server 的统计函数进行统计计算，例如：计算 1 号课程的学生平均成绩，其结果如图 2.16 所示：

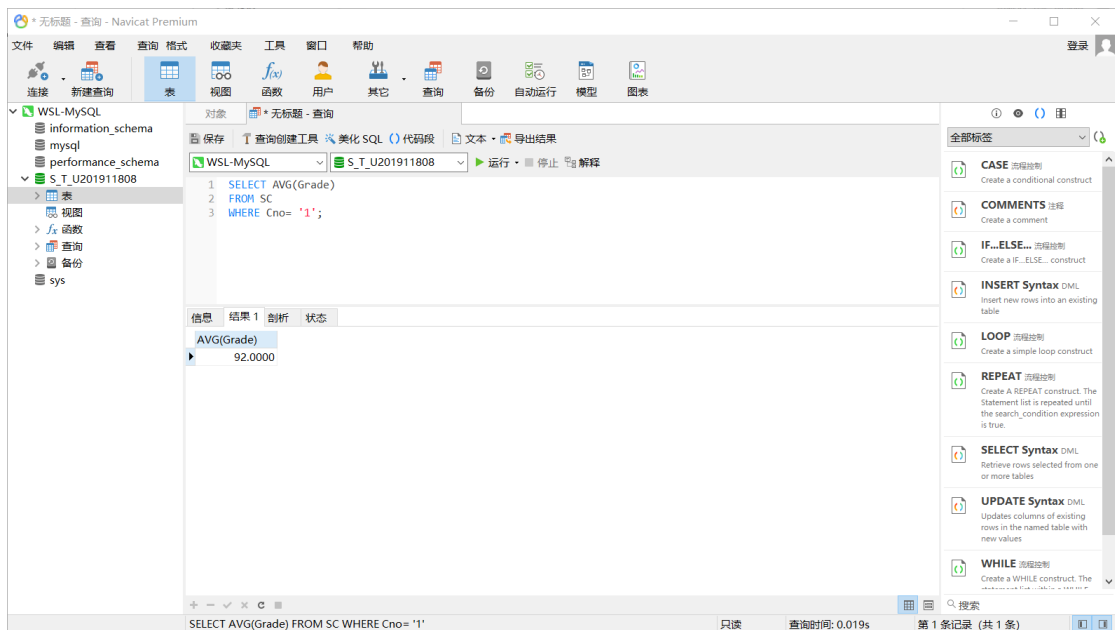


图 2.16 统计计算函数

10) 使用 Group By 子句查询选修了 3 门课以上课程的学生学号，查询结果为空，如图 2.17 所示：

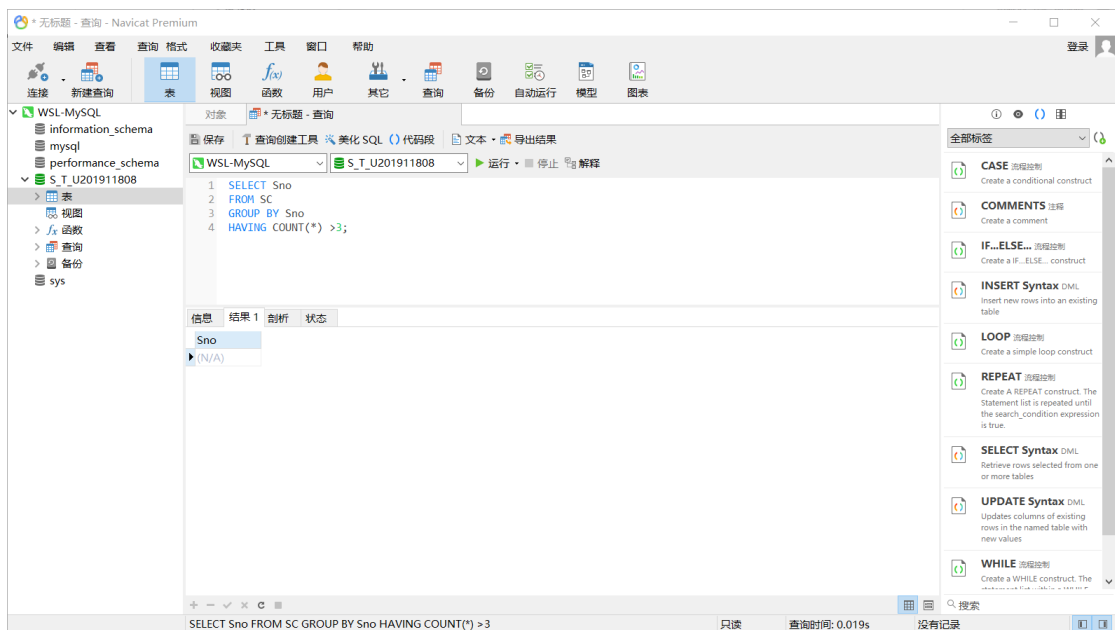


图 2.17 分组查询练习

2.2.7 扩展练习

(1) 查询全体学生的学号、姓名和年龄，如图 2.18 所示：

```
1 SELECT Sno, Sname, Sage
2 FROM Student;
```

| Sno | Sname | Sage |
|-----------|-------|------|
| 200215121 | 李勇 | 20 |
| 200215122 | 刘晨 | 19 |
| 200215123 | 王敏 | 18 |
| 200215125 | 张立 | 19 |

图 2.18 查询信息

(2) 查询所有计算机系学生的详细记录，如图 2.19 所示：

```
1 SELECT *
2 FROM Student
3 WHERE Sdept = 'CS';
```

| Sno | Sname | Ssex | Sage | Sdept | Scholarship |
|-----------|-------|------|------|-------|-------------|
| 200215121 | 李勇 | 男 | 20 | CS | 否 |
| 200215122 | 刘晨 | 女 | 19 | CS | 否 |

图 2.19 查询计算机系信息

(3) 找出考试成绩为优秀（90 分及以上）或不及格的学生的学号、课程号及成绩，如图 2.20 所示：

| | |
|---|----------------------------------|
| 1 | SELECT Sno, Cno, Grade |
| 2 | FROM SC |
| 3 | WHERE Grade >= 90 OR Grade < 60; |
| 4 | |

| 信息 | 结果 1 | 剖析 | 状态 |
|-------------|------|-------|----|
| Sno | Cno | Grade | |
| ▶ 200215121 | 1 | 92 | |
| 200215122 | 2 | 90 | |

图 2.20 查询优秀信息

(4) 查询年龄不在 19~20 岁之间的学生姓名、性别和年龄，如图 2.21 所示：

| | |
|---|-----------------------------------|
| 1 | SELECT Sname, Ssex, Sage |
| 2 | FROM Student |
| 3 | WHERE Sage NOT BETWEEN 19 AND 20; |
| 4 | |

| 信息 | 结果 1 | 剖析 | 状态 |
|-------|------|------|----|
| Sname | Ssex | Sage | |
| ▶ 王敏 | 女 | 18 | |

图 2.21 年龄筛选查询

(5) 查询数学系（MA）、信息系（IS）的学生的姓名和所在系，如图 2.22 所示：

| | |
|---|--------------------------------|
| 1 | SELECT Sname, Sdept |
| 2 | FROM Student |
| 3 | WHERE Sdept IN ('MA', 'IS'); |

| 信息 | 结果 1 | 剖析 | 状态 |
|-------|-------|----|----|
| Sname | Sdept | | |
| ▶ 王敏 | MA | | |
| 张立 | IS | | |

图 2.22 按系别筛选查询

(6) 查询名称中包含“数据”的所有课程的课程号、课程名及其学分，如图 2.23 所示：

| | |
|---|----------------------------|
| 1 | SELECT Cno, Cname, Ccredit |
| 2 | FROM Course |
| 3 | WHERE Cname LIKE '%数据%'; |

| 信息 | 结果 1 | 剖析 | 状态 |
|----|------|-------|---------|
| | Cno | Cname | Ccredit |
| ▶ | 1 | 数据库 | 4 |
| | 5 | 数据结构 | 4 |
| | 6 | 数据处理 | 2 |

图 2.23 模糊查询实现

(7) 找出所有没有选修课成绩的学生学号和课程号，如图 2.24 所示：

| | |
|---|----------------------|
| 1 | SELECT Sno, Cno |
| 2 | FROM SC |
| 3 | WHERE Grade IS NULL; |
| 4 | |

| 信息 | 结果 1 | 剖析 | 状态 |
|----|-------|-------|----|
| | Sno | Cno | |
| ▶ | (N/A) | (N/A) | |

图 2.24 筛选空置的信息

(8) 查询学生 200215121 选修课的最高分、最低分以及平均成绩，如图 2.25 所示：

| | |
|---|---|
| 1 | SELECT MAX(Grade), MIN(Grade), AVG(Grade) |
| 2 | FROM SC |
| 3 | WHERE Sno = '200215121'; |

| 信息 | 结果 1 | 剖析 | 状态 |
|----|------------|------------|------------|
| | MAX(Grade) | MIN(Grade) | AVG(Grade) |
| ▶ | 92 | 85 | 88.3333 |

图 2.25 按照学号筛选查询

(9) 查询选修了 2 号课程的学生学号及其成绩，查询结果按成绩升序排列，如图 2.26 所示：

```

1  SELECT Sno, Grade
2  FROM SC
3  WHERE Cno = '2'
4  ORDER BY Grade;

```

| 信息 | 结果 1 | 剖析 | 状态 |
|----|-----------|-------|----|
| | Sno | Grade | |
| ▶ | 200215121 | 85 | |
| | 200215122 | 90 | |

图 2.26 查询特定课程学生信息并排序

(10) 查询每个系名及其学生的平均年龄，如图 2.27 所示：

```

1  SELECT Sdept, AVG(Sage)
2  FROM Student
3  GROUP BY Sdept;

```

| 信息 | 结果 1 | 剖析 | 状态 |
|----|-------|-----------|----|
| | Sdept | AVG(Sage) | |
| ▶ | CS | 19.5000 | |
| | MA | 18.0000 | |
| | IS | 19.0000 | |

图 2.27 查询综合函数

(思考：如何查询学生平均年龄在 19 岁以下（含 19 岁）的系别及其学生的平均年龄？)，如图 2.28 所示：

```

1  SELECT Sdept, AVG(Sage)
2  FROM Student
3  GROUP BY Sdept
4  HAVING AVG(Sage) <= 19;
5

```

| 信息 | 结果 1 | 剖析 | 状态 |
|----|-------|-----------|----|
| | Sdept | AVG(Sage) | |
| ▶ | MA | 18.0000 | |
| | IS | 19.0000 | |

图 2.28 思考题

3 SQL 的复杂操作

3.2 完成过程

3.2.1 扩展练习

(1) 查询每门课程及其被选情况（输出所有课程中每门课的课程号、课程名称、选修该课程的学生学号及成绩--如果没有学生选择该课，则相应的学生学号及成绩为空值）。

```
1 SELECT Course.Cno, Cname, Sno, Grade
2 FROM SC RIGHT JOIN Course ON (Course.Cno = SC.Cno);
```

| 信息 | 结果 1 | 剖析 | 状态 |
|-----|----------|-----------|--------|
| Cno | Cname | Sno | Grade |
| 1 | 数据库 | 200215121 | 92 |
| 2 | 数学 | 200215122 | 90 |
| 2 | 数学 | 200215121 | 85 |
| 3 | 信息系统 | 200215122 | 80 |
| 3 | 信息系统 | 200215121 | 88 |
| 4 | 操作系统 | (Null) | (Null) |
| 5 | 数据结构 | (Null) | (Null) |
| 6 | 数据处理 | (Null) | (Null) |
| 7 | PASCAL语言 | (Null) | (Null) |

图 3.1 查询 1

(2) 查询与“张立”同岁的学生的学号、姓名和年龄。（要求使用至少 3 种方法求解）

方法 1：嵌套搜索

```
1 SELECT Sno, Sname, Sage
2 FROM Student
3 WHERE Sage = (SELECT Sage FROM Student WHERE Sname='张立');
```

| 信息 | 结果 1 | 剖析 | 状态 |
|-----------|-------|------|----|
| Sno | Sname | Sage | |
| 200215122 | 刘晨 | 19 | |
| 200215125 | 张立 | 19 | |

图 3.2 嵌套搜索

方法 2：自连接

```

1  SELECT S1.Sno, S1.Sname, S1.Sage
2  FROM Student S1, Student S2
3  WHERE S2.Sname = '张立' AND S1.Sage = S2.Sage;

```

| 信息 | 结果 1 | 剖析 | 状态 |
|----|-----------|-------|------|
| | Sno | Sname | Sage |
| ▶ | 200215122 | 刘晨 | 19 |
| | 200215125 | 张立 | 19 |

图 3.3 自连接

方法 3: EXIST 子句

```

1  SELECT Sno, Sname, Sage
2  FROM Student S1
3  WHERE EXISTS ( SELECT * FROM Student S2 WHERE S2.Sage = S1.Sage AND S2.Sname = '张立' );

```

| 信息 | 结果 1 | 剖析 | 状态 |
|----|-----------|-------|------|
| | Sno | Sname | Sage |
| ▶ | 200215122 | 刘晨 | 19 |
| | 200215125 | 张立 | 19 |

图 3.4 EXIST 子句

(3) 查询选修了 3 号课程而且成绩为良好（80~89 分）的所有学生的学号和姓名。

```

1  SELECT Student.Sno, Sname
2  FROM Student, SC
3  WHERE Student.Sno = SC.Sno AND Cno = 3 AND Grade BETWEEN 80 AND 89;

```

| 信息 | 结果 1 | 剖析 | 状态 |
|----|-----------|-------|----|
| | Sno | Sname | |
| ▶ | 200215121 | 李勇 | |
| | 200215122 | 刘晨 | |

图 3.5 查询 2

(4) 查询学生 200215122 选修的课程号、课程名


```

1  SELECT Course.Cno, Cname
2  FROM SC, Course
3  WHERE SC.Cno = Course.Cno AND Sno = '200215122';
4

```

| 信息 | 结果 1 | 剖析 | 状态 |
|-----|-------|----|----|
| Cno | Cname | | |
| 2 | 数学 | | |
| 3 | 信息系统 | | |

图 3.6 查询 3

（思考：如何查询学生 200215122 选修的课程号、课程名及成绩？）

```

1  SELECT Course.Cno, Cname, Grade
2  FROM SC, Course
3  WHERE SC.Cno = Course.Cno AND Sno = '200215122';
4

```

| 信息 | 结果 1 | 剖析 | 状态 |
|-----|-------|-------|----|
| Cno | Cname | Grade | |
| 2 | 数学 | 90 | |
| 3 | 信息系统 | 80 | |

图 3.7 查询 4

（5）找出每个学生低于他所选修课程平均成绩 5 分以上的课程号。（输出学号和课程号）

```

1  SELECT Sno, Cno
2  FROM SC SC1
3  WHERE Grade - ( SELECT AVG(Grade) FROM SC SC2 GROUP BY Sno HAVING SC1.Sno = SC2.Sno ) < - 5;
4

```

| 信息 | 结果 1 | 剖析 | 状态 |
|-------|-------|----|----|
| Sno | Cno | | |
| (N/A) | (N/A) | | |

图 3.8 查询 5

（6）查询比所有男生年龄都小的女生的学号、姓名和年龄。

```

1  SELECT Sno, Sname, Sage
2  FROM Student
3  WHERE Ssex = '女' AND Sage < ALL ( SELECT Sage FROM Student WHERE Ssex = '男' );

```

| 信息 | 结果 1 | 剖析 | 状态 |
|-----------|-------|------|----|
| Sno | Sname | Sage | |
| 200215123 | 王敏 | 18 | |

图 3.9 查询 ALL

（7）查询所有选修了 2 号课程的学生姓名及所在系。

| | |
|---|---|
| 1 | SELECT Sname, Sdept |
| 2 | FROM Student, SC |
| 3 | WHERE Student.Sno = SC.Sno AND Cno = 2; |

| 信息 | 结果 1 | 剖析 | 状态 |
|----|-------|-------|----|
| | Sname | Sdept | |
| ▶ | 李勇 | CS | |
| | 刘晨 | CS | |

图 3.10 查询 AND

(8) 使用 update 语句把成绩为良的学生的年龄增加 2 岁，并查询出来。

```

1 UPDATE Student
2 SET Sage = Sage + 2
3 WHERE
4     Sno IN (
5         SELECT
6             temp.Sno
7         FROM
8             ( SELECT DISTINCT Student.Sno FROM SC, Student WHERE Student.Sno = SC.Sno AND Grade BETWEEN 80 AND 89 ) temp
9         );
10
11 SELECT *
12 FROM Student;

```

| 信息 | 结果 1 | 剖析 | 状态 | | | |
|----|-----------|-------|------|------|-------|-------------|
| | Sno | Sname | Ssex | Sage | Sdept | Scholarship |
| ▶ | 200215121 | 李勇 | 男 | 22 | CS | 否 |
| | 200215122 | 刘晨 | 女 | 21 | CS | 否 |
| | 200215123 | 王敏 | 女 | 18 | MA | 否 |
| | 200215125 | 张立 | 男 | 19 | IS | 否 |

图 3.11 查询嵌套 IN

(9) 使用 insert 语句增加两门课程：C 语言和人工智能，并查询出来

```

1  INSERT
2  INTO Course
3  VALUES
4      (8, 'C语言', NULL, 4),
5      (9, '人工智能', 2, 2);
6
7  SELECT *
8  FROM Course;

```

| 信息 | 结果 1 | 剖析 | 状态 |
|----|------|----|----|
|----|------|----|----|

| Cno | Cname | Cpno | Ccredit |
|-----|----------|--------|---------|
| ▶ 1 | 数据库 | 5 | 4 |
| 2 | 数学 | (Null) | 2 |
| 3 | 信息系统 | 5 | 4 |
| 4 | 操作系统 | 6 | 3 |
| 5 | 数据结构 | 7 | 4 |
| 6 | 数据处理 | (Null) | 2 |
| 7 | PASCAL语言 | 6 | 4 |
| 8 | C语言 | (Null) | 4 |
| 9 | 人工智能 | 2 | 2 |

图 3.12 使用 INSERT 插入课程

(10) 使用 delete 语句把人工智能课程删除，并查询出来。

```
1 DELETE
2 FROM Course
3 WHERE Cname = '人工智能';
```

信息

剖析

状态

```
DELETE
FROM Course
WHERE Cname = '人工智能'
> Affected rows: 1
> 时间: 0.004s
```

图 3.13 首先执行删除操作

| | Cno | Cname | Cpno | Ccredit |
|---|-----|----------|--------|---------|
| ▶ | 1 | 数据库 | 5 | 4 |
| | 2 | 数学 | (Null) | 2 |
| | 3 | 信息系统 | 5 | 4 |
| | 4 | 操作系统 | 6 | 3 |
| | 5 | 数据结构 | 7 | 4 |
| | 6 | 数据处理 | (Null) | 2 |
| | 7 | PASCAL语言 | 6 | 4 |
| | 8 | C语言 | (Null) | 4 |

图 3.14 然后再次查询表，发现已经被删除

4 SQL 的高级实验

4.2 完成过程

4.2.1 扩展练习

(1) 创建 CS 系的视图 CS_View

```
1 CREATE VIEW CS_View AS SELECT
2 *
3 FROM
4 Student
5 WHERE
6 Sdept = 'CS';
7
8 SELECT *
9 FROM CS_View;
```

图 4.1 创建视图操作

| | Sno | Sname | Ssex | Sage | Sdept | Scholarship |
|---|-----------|-------|------|------|-------|-------------|
| ▶ | 200215121 | 李勇 | 男 | 22 | CS | 否 |
| | 200215122 | 刘晨 | 女 | 21 | CS | 否 |

图 4.2 查询视图查看创建结果

(2) 在视图 CS_View 上查询 CS 系选修了 1 号课程的学生

```
1 SELECT CS_View.Sno, Sname, Ssex, Sage, Sdept, Scholarship
2 FROM CS_View, SC
3 WHERE CS_View.Sno = SC.Sno AND Cno = 1;
4
```

| 信息 | 结果 1 | 剖析 | 状态 | | |
|-------------|-------|------|------|-------|-------------|
| Sno | Sname | Ssex | Sage | Sdept | Scholarship |
| ▶ 200215121 | 李勇 | 男 | 22 | CS | 否 |

图 4.3 在视图上进行查询

(3) 创建 IS 系成绩大于 80 的学生的视图 IS_View

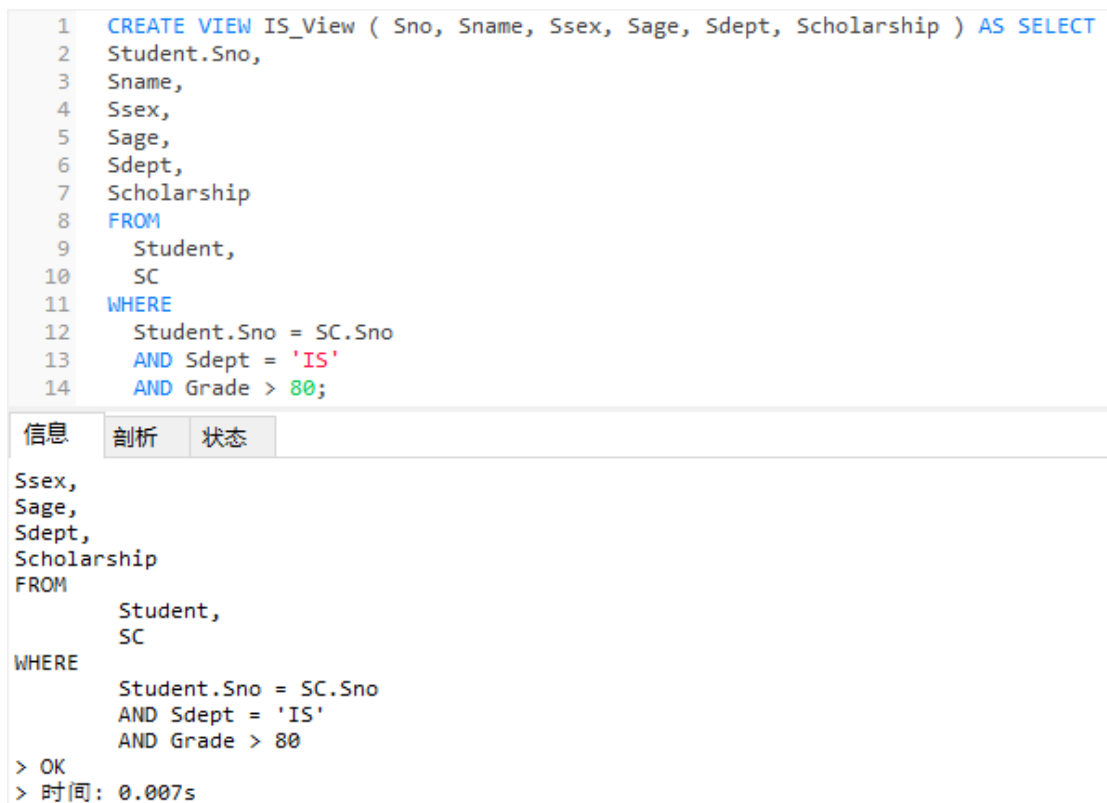


图 4.4 新建关于 IS 系得视图

(4) 在视图 IS_View 查询 IS 系成绩大于 80 的学生

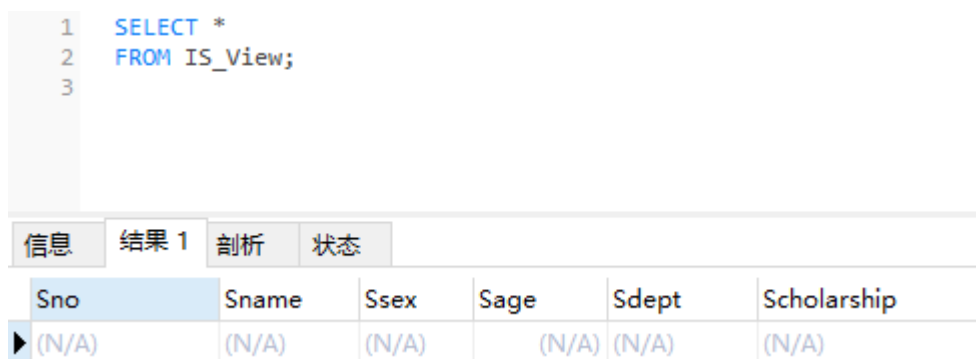


图 4.5 查询视图，无结果

(5) 删除视图 IS_View



图 4.6 删除视图

(6) 利用可视化窗口创建 2 个不同的用户 U1 和 U2,利用系统管理员给 U1 授

予 Student 表的查询和更新的权限，给 U2 对 SC 表授予插入的权限。

```
mysql> show grants for 'U1'@'localhost';
+-----+
| Grants for U1@localhost |
+-----+
| GRANT USAGE ON *.* TO 'U1'@'localhost' |
| GRANT SELECT, UPDATE, ALTER ON 'S_T_U201911808'.'Student' TO 'U1'@'localhost' |
+-----+
2 rows in set (0.01 sec)

mysql> show grants for 'U2'@'localhost';
+-----+
| Grants for U2@localhost |
+-----+
| GRANT USAGE ON *.* TO 'U2'@'localhost' |
| GRANT INSERT ON 'S_T_U201911808'.'SC' TO 'U2'@'localhost' |
+-----+
2 rows in set (0.00 sec)
```

图 4.7 在命令行中检查权限授予情况

然后用 U1 登录，分别

1) 查询学生表的信息；

```
1 SELECT *
2 FROM Student;
```

| 信息 | 结果 1 | 剖析 | 状态 | | |
|-----------|-------|------|------|-------|-------------|
| Sno | Sname | Ssex | Sage | Sdept | Scholarship |
| 200215121 | 李勇 | 男 | 22 | CS | 否 |
| 200215122 | 刘晨 | 女 | 21 | CS | 否 |
| 200215123 | 王敏 | 女 | 18 | MA | 否 |
| 200215125 | 张立 | 男 | 19 | IS | 否 |

图 4.8 使用 U1 查询 Student 表

2) 把所有学生的年龄增加 1 岁，然后查询；

```
1 UPDATE Student
2 SET Sage = Sage + 1;
3
4 SELECT *
5 FROM Student;
```

| 信息 | 结果 1 | 剖析 | 状态 | | |
|-----------|-------|------|------|-------|-------------|
| Sno | Sname | Ssex | Sage | Sdept | Scholarship |
| 200215121 | 李勇 | 男 | 23 | CS | 否 |
| 200215122 | 刘晨 | 女 | 22 | CS | 否 |
| 200215123 | 王敏 | 女 | 19 | MA | 否 |
| 200215125 | 张立 | 男 | 20 | IS | 否 |

图 4.9 修改年龄并查询

3) 删除 IS 系的学生；

```
1 DELETE
2 FROM Student
3 WHERE Sdept = 'IS';
4
```

| 信息 | 状态 |
|---|----|
| DELETE FROM Student WHERE Sdept = 'IS' > 1142 - DELETE command denied to user 'U1'@'localhost' for table 'Student' > 时间: 0s | |

图 4.10 无权限删除

4) 查询 CS 系的选课信息。

```
1 SELECT Student.Sno, Sname, Cno, Cname
2 FROM Student, SC
3 WHERE Student.Sno = SC.Sno AND Student.Sdept = 'CS';
4
```

| 信息 | 状态 |
|--|----|
| SELECT Student.Sno, Sname, Cno, Cname FROM Student, SC WHERE Student.Sno = SC.Sno AND Student.Sdept = 'CS' > 1142 - SELECT command denied to user 'U1'@'localhost' for table 'SC' > 时间: 0s | |

图 4.11 无权查询 CS 系选课信息

用 U2 登录，分别

1) 在 SC 表中插入 1 条记录（'200215122'，'1'，75）；

```
1 INSERT INTO SC
2 VALUES ('200215122', '1', 75);
3
```

| 信息 | 剖析 | 状态 |
|---|----|----|
| INSERT INTO SC VALUES ('200215122', '1', 75) > Affected rows: 1 > 时间: 0.002s | | |

图 4.12 U2 可以向 SC 中插入数据

2) 查询 SC 表的信息，



图 4.13 U2 无权查询 SC 表得信息

3) 查询视图 CS_View 的信息。



图 4.14 U2 无权查询 CS 视图

(7) 用系统管理员登录，收回 U1 的所有权限

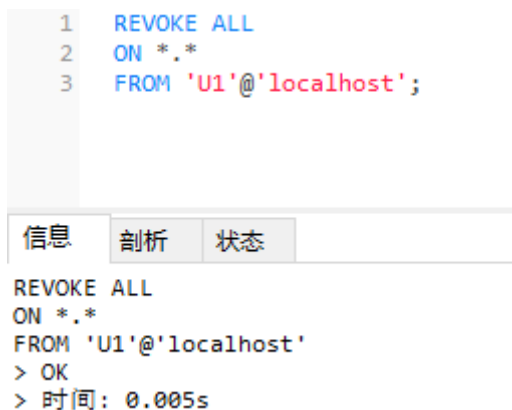


图 4.15 撤销权限

(8) 用 U1 登录，查询学生表的信息

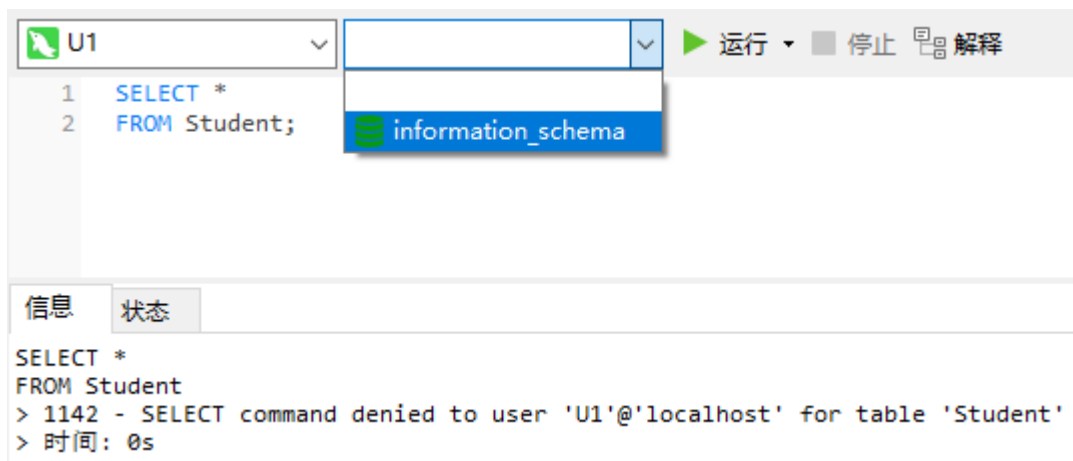


图 4.16 U1 已经无权限

(9) 用系统管理员登录

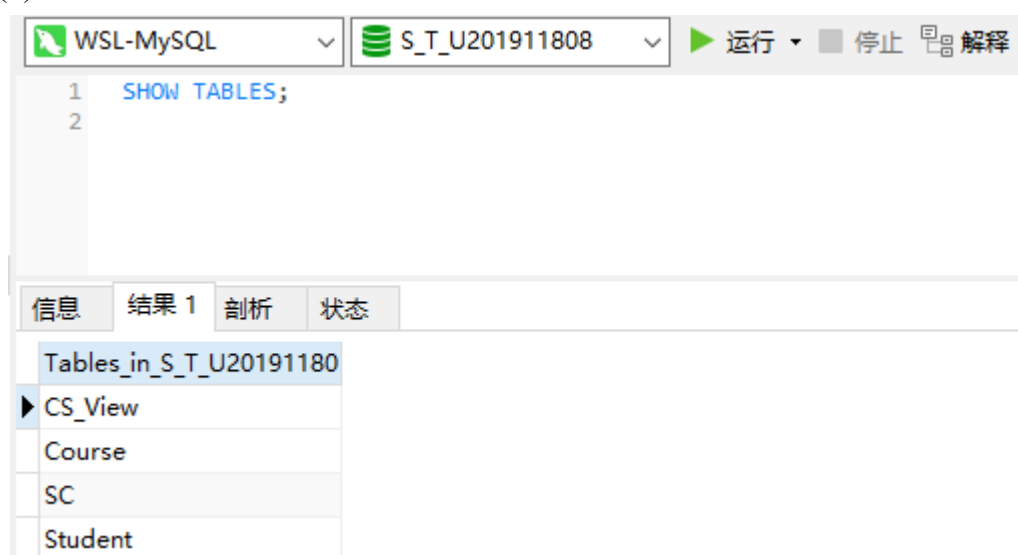


图 4.17 重新用系统管理员登录

(10) 对 SC 表建立一个更新触发器，当更新了 SC 表的成绩时，如果更新后的成绩大于等于 95，则检查该成绩的学生是否有奖学金，如果奖学金是“否”，则修改为“是”。如果修改后的成绩小于 95，则检查该学生的其他成绩是不是有大于 95 的，如果都没有，且修改前的成绩是大于 95 时，则把其奖学金修改为“否”。

```

1 CREATE TRIGGER SCHO_JDG AFTER UPDATE ON SC FOR EACH ROW
2 BEGIN
3 IF
4 NEW.Grade >= 95 THEN
5 UPDATE Student
6 SET Scholarship = '是'
7 WHERE
8 Scholarship = '否' AND NEW.Sno = Student.Sno;
9
10 ELSEIF NEW.Grade < 95 AND NOT EXISTS ( SELECT * FROM SC WHERE NEW.Sno = SC.Sno AND SC.Grade >= 95
11 )
12 AND OLD.Grade >= 95 THEN
13 UPDATE Student
14 SET Scholarship = '否';
15
16 END IF;
17 END;
18

```

信息 剖析 状态

```

ELSEIF NEW.Grade < 95 AND NOT EXISTS ( SELECT * FROM SC WHERE NEW.Sno = SC.Sno AND SC.Grade >= 95
)
AND OLD.Grade >= 95 THEN
UPDATE Student
SET Scholarship = '否';

END IF;

END
> Affected rows: 0
> 时间: 0.004s

```

图 4.18 定义触发器

然后进行成绩修改，并进行验证是否触发器正确执行。

- 1) 首先把某个学生成绩修改为 98，查询其奖学金。

```

1 UPDATE SC
2 SET Grade = 98
3 WHERE Sno = '200215121' AND Cno = '1';
4
5 SELECT Sno, Sname, Scholarship
6 FROM Student
7 WHERE Sno = '200215121';

```

信息 结果 1 剖析 状态

| Sno | Sname | Scholarship |
|-----------|-------|-------------|
| 200215121 | 李勇 | 是 |

图 4.19 查看触发器效果

- 2) 再把刚才的成绩修改为 80，再查询其奖学金。

```

1 UPDATE SC
2 SET Grade = 80
3 WHERE Sno = '200215121' AND Cno = '1';
4
5 SELECT Sno, Sname, Scholarship
6 FROM Student
7 WHERE Sno = '200215121';

```

信息 结果 1 剖析 状态

| Sno | Sname | Scholarship |
|-----------|-------|-------------|
| 200215121 | 李勇 | 否 |

图 4.20 查看触发器效果

- (11) 删除刚定义的触发器



图 4.21 删除触发器

(12) 定义一个存储过程计算 CS 系的课程的平均成绩和最高成绩，在查询分析器或查询编辑器中执行存储过程，查看结果。

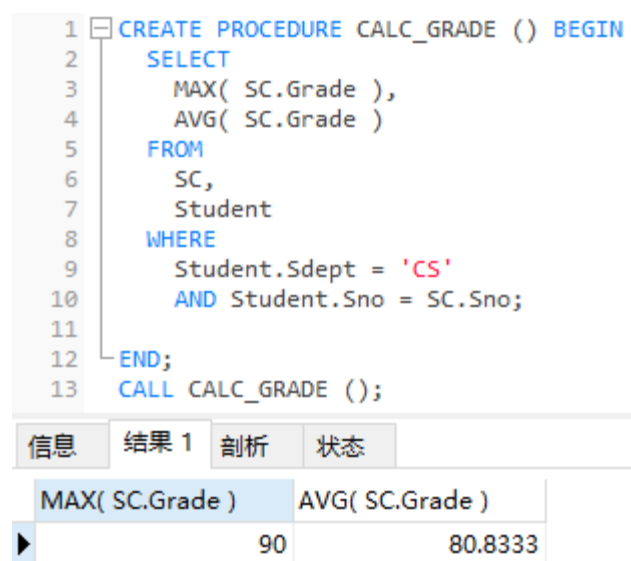


图 4.22 定义存储过程

(13) 定义一个带学号为参数的查看某个学号的所有课程的成绩，查询结果要包含学生姓名。进行验证。

```

1  CREATE PROCEDURE SNO_GRADE (
2      IN SID CHAR ( 9 )) BEGIN
3      SELECT
4          Student.Sno,
5          Student.Sname,
6          Course.Cname,
7          SC.Grade
8      FROM
9          Student,
10         SC,
11         Course
12     WHERE
13         Student.Sno = SID
14         AND Student.Sno = SC.Sno
15         AND SC.Cno = Course.Cno;
16
17 END;
18 CALL SNO_GRADE ( '200215121' );

```

| 信息 | 结果 1 | 剖析 | 状态 |
|-----------|-------|-------|-------|
| Sno | Sname | Cname | Grade |
| 200215121 | 李勇 | 数据库 | 80 |
| 200215121 | 李勇 | 数学 | 80 |
| 200215121 | 李勇 | 信息系统 | 80 |

图 4.23 利用存储过程进行查询

(14) 把上一题改成函数。再进行验证。

本题在 MySQL 中无法实现

(15) 在 SC 表上定义一个完整性约束，要求成绩再 0-100 之间。定义约束前，先把某个学生的成绩修改成 120，进行查询，再修改回来。定义约束后，再把该学生成绩修改为 120，然后进行查询。

在定义完整性约束前，先修改学号为 200215122 同学 1 号课程的成绩为 120 分，操作过程及修改后的结果如下：

| | |
|---|-------------------|
| 1 | UPDATE SC |
| 2 | SET Grade = 120 |
| 3 | WHERE |
| 4 | Sno = '200215122' |
| 5 | AND Cno = '1'; |
| 6 | SELECT |
| 7 | * |
| 8 | FROM |
| 9 | SC; |

| 信息 | 结果 1 | 剖析 | 状态 |
|----|-----------|-----|-------|
| | Sno | Cno | Grade |
| ▶ | 200215121 | 1 | 80 |
| | 200215121 | 2 | 80 |
| | 200215121 | 3 | 80 |
| | 200215122 | 1 | 120 |
| | 200215122 | 2 | 90 |
| | 200215122 | 3 | 80 |

图 4.24 添加完整性约束

新增约束条件，如下图所示：

| | |
|---|----------------------------------|
| 1 | ALTER TABLE SC |
| 2 | ADD CONSTRAINT CON_GRADE |
| 3 | CHECK (Grade BETWEEN 0 AND 100); |

| 信息 | 剖析 | 状态 |
|---|----|----|
| ALTER TABLE SC ADD CONSTRAINT CON_GRADE CHECK (Grade BETWEEN 0 AND 100) > OK > 时间: 0.085s | | |

图 4.25 向 SC 表中新增完整性约束条件

之后，再次尝试修改学生成绩为 120 分，报错，如下图所示：

| | |
|---|-------------------|
| 1 | UPDATE SC |
| 2 | SET Grade = 120 |
| 3 | WHERE |
| 4 | Sno = '200215122' |
| 5 | AND Cno = '1'; |
| 6 | SELECT |
| 7 | * |
| 8 | FROM |
| 9 | SC; |

| 信息 | 状态 |
|---|----|
| UPDATE SC SET Grade = 120 WHERE Sno = '200215122' AND Cno = '1' > 3819 - Check constraint 'CON_GRADE' is violated. > 时间: 0s | |

图 4.26 增加完整性约束条件后，不合法数据修改将会报错

5 数据库设计

5.2.8 系统测试

测试环境：操作系统：Windows 10；数据库版本：8.0.27-0ubuntu0.20.04.1

1. 应用程序启动与连接数据库测试

首先按回车采取默认值，当然如果需要连接其他数据库，也可以输入相应的值，如图 5.6 所示。

```
D:\Anaconda\python.exe C:/Users/YuanYe/Desktop/数据库/expr4.py
Input the IP Address (default: localhost):
Username (default: yuanye):
Password (default: yuanye):
Select one database to operate (default: S_T_U201911808): |
```

图 5.6

然后会显示登录信息、数据库版本信息以及初始主菜单界面，如图 5.7 所示。

```
... Connecting to the Database ...
----- Student Management System -----
      Author: 网安1902班 袁也  U201911808
      MySQL Version: 8.0.27-0ubuntu0.20.04.1
User: yuanye@localhost  Database: S_T_U201911808

***** Menu *****
1. Insert New Student Info      2. Modify Existing Student Info
3. Insert New Course Info      4. Modify Existing Course Info
5. Delete Existing Course Info 6. Record Student Grade
7. Modify Student Grade        8. Print Analytical Info by Dept
9. Print Grade Rank by Dept    10. Print Student Info

                                0. Exit

*****
Choose what you want (0~10):
```

2. 测试插入学生信息

选择操作 1，并输入相应的插入数据，如图 5.8 所示。

```

Choose what you want (0~10): 1
===== Mode 1: Insert New Student Info =====
Please input the following information!
Student ID: 200215129
Name: 张三
Gender: 男
Age: 21
Student's Department: EE
Have Scholarship? (y/n)n
Re-check the student's information below:
+---+-----+-----+-----+-----+-----+-----+
|  |      sno | sname  | sex   | age  | dept  | scholarship |
+---+-----+-----+-----+-----+-----+-----+
| 0 | 200215129 | 张三   | 男    | 21   | EE    | 否          |
+---+-----+-----+-----+-----+-----+
ARE YOU SURE TO INSERT THE NEW INFORMATION? (y/n)y
Successfully Inserted!

```

在 navicat 中查询 student 表的信息，如图 5.9 所示，可以看到已经能够查询到相应的学生信息。

| Sno | Sname | Ssex | Sage | Sdept | Scholarship |
|-----------|-------|------|------|-------|-------------|
| 200215121 | 李勇 | 男 | 23 | CS | 否 |
| 200215122 | 刘晨 | 男 | 20 | CS | 是 |
| 200215123 | 王敏 | 女 | 19 | MA | 否 |
| 200215125 | 张立 | 男 | 20 | IS | 否 |
| 200215129 | 张三 | 男 | 21 | EE | 否 |

3. 测试修改学生信息

选择操作 2，进行修改操作，如图 5.10 所示。

```

Choose what you want (0~10): 2
===== Mode 2: Modify Existing Student Info =====
Please input the Student ID to search the student!
Student ID: 200215129
Student founded! Here is the information of this person:
+---+-----+-----+-----+-----+-----+-----+
|  |      sno | sname  | sex   | age  | dept  | scholarship |
+---+-----+-----+-----+-----+-----+-----+
| 0 | 200215129 | 张三   | 男    | 21   | EE    | 否          |
+---+-----+-----+-----+-----+-----+
Select column 1~6 to modify, select 0 to exit: 4
Input the new data: 24
Successfully Updated!
Select column 1~6 to modify, select 0 to exit: 6
Input the new data: 是
Successfully Updated!
Select column 1~6 to modify, select 0 to exit: 0

```

Student 表如图 5.11 所示：

| Sno | Sname | Ssex | Sage | Sdept | Scholarship |
|-----------|-------|------|------|-------|-------------|
| 200215121 | 李勇 | 男 | 23 | CS | 否 |
| 200215122 | 刘晨 | 男 | 20 | CS | 是 |
| 200215123 | 王敏 | 女 | 19 | MA | 否 |
| 200215125 | 张立 | 男 | 20 | IS | 否 |
| 200215129 | 张三 | 男 | 24 | EE | 是 |

4. 插入课程信息

选择模式 3，输入相应的数据，如图 5.12 所示：

```

Choose what you want (0~10): 3
===== Mode 3: Insert New Course Info =====
Please input the following information!
Course ID: 10
Course Name: 大学物理
Previous Course ID: 2
Credits: 5
Re-check the course's information below:
+---+-----+-----+-----+-----+
|   | cno | cname   | cpno | ccredit |
+---+-----+-----+-----+-----+
| 0 | 10 | 大学物理 | 2    | 5       |
+---+-----+-----+-----+-----+
ARE YOU SURE TO INSERT THE NEW INFORMATION? (y/n)y
Successfully Inserted!

```

查询 course 表，如图 5.13 所示。

| Cno | Cname | Cpno | Ccredit |
|-----|----------|--------|---------|
| 0 | 入学考试 | (Null) | 5 |
| 1 | 数据库 | 5 | 4 |
| 10 | 大学物理 | 2 | 5 |
| 2 | 数学 | (Null) | 2 |
| 3 | 信息系统 | 5 | 4 |
| 4 | 操作系统 | 6 | 3 |
| 5 | 数据结构 | 7 | 4 |
| 6 | 数据处理 | (Null) | 2 |
| 7 | PASCAL语言 | 6 | 4 |
| 8 | C语言 | (Null) | 4 |
| 9 | Py语言 | 0 | 2 |

5. 修改课程信息

选择模式 4，输入修改的信息，如图 5.14 所示。

```

Choose what you want (0~10): 4
===== Mode 4: Modify Existing Course Info =====
Please input the Course ID to search the course!
Course ID: 10
Course founded! Here is the information of this course:
+----+-----+-----+-----+-----+
|  |  cno | cname  |  cpno |  ccredit |
+----+-----+-----+-----+-----+
| 0 |   10 | 大学物理 |    2 |        5 |
+----+-----+-----+-----+-----+
Select column 1~4 to modify, select 0 to exit: 4
Input the new data: 3
Successfully Updated!
Select column 1~4 to modify, select 0 to exit: 0

```

修改后的 course 表如图 5.15 所示：

| | Cno | Cname | Cpno | Ccredit |
|---|-----|----------|--------|---------|
| ▶ | 0 | 入学考试 | (Null) | 5 |
| | 1 | 数据库 | 5 | 4 |
| | 10 | 大学物理 | 2 | 3 |
| | 2 | 数学 | (Null) | 2 |
| | 3 | 信息系统 | 5 | 4 |
| | 4 | 操作系统 | 6 | 3 |
| | 5 | 数据结构 | 7 | 4 |
| | 6 | 数据处理 | (Null) | 2 |
| | 7 | PASCAL语言 | 6 | 4 |
| | 8 | C语言 | (Null) | 4 |
| | 9 | Py语言 | 0 | 2 |

6. 删除课程信息

选择模式 5，删除大学物理课程信息，如图 5.16 所示。

```

Choose what you want (0~10): 5
===== Mode 5: Delete Existing Course Info =====
Please input the Course ID to search the course!
Course ID: 10
Course founded! Here is the information of this course:
+----+-----+-----+-----+-----+
|  |  cno | cname  |  cpno |  ccredit |
+----+-----+-----+-----+-----+
| 0 |   10 | 大学物理 |    2 |        3 |
+----+-----+-----+-----+-----+
ARE YOU SURE TO DELETE THIS COURSE? (y/n): y
Successfully Deleted!

```

删除后的 course 表如图 5.17 所示。

| Cno | Cname | Cpno | Ccredit |
|-----|----------|--------|---------|
| 0 | 入学考试 | (Null) | 5 |
| 1 | 数据库 | 5 | 4 |
| 2 | 数学 | (Null) | 2 |
| 3 | 信息系统 | 5 | 4 |
| 4 | 操作系统 | 6 | 3 |
| 5 | 数据结构 | 7 | 4 |
| 6 | 数据处理 | (Null) | 2 |
| 7 | PASCAL语言 | 6 | 4 |
| 8 | C语言 | (Null) | 4 |
| 9 | Py语言 | 0 | 2 |

7. 登记学生成绩

选择模式 6，输入相应的数据，如图 5.18 所示。

```
Choose what you want (0~10): 6
===== Mode 6: Record Student's Grade =====
Please input the following information!
Student ID: 200215129
Course ID: 9
Student's Grade: 76
Re-check the information below:
+---+-----+-----+-----+
|   |      sno |   cno |  grade |
|---+-----+-----+-----|
| 0 | 200215129 |    9 |    76 |
+---+-----+-----+-----+
ARE YOU SURE TO INSERT THE NEW INFORMATION? (y/n)y
Successfully Inserted!
```

添加后的 SC 表如图 5.19 所示。

| Sno | Cno | Grade |
|-----------|-----|-------|
| 200215121 | 1 | 80 |
| 200215121 | 2 | 80 |
| 200215121 | 3 | 80 |
| 200215122 | 1 | 80 |
| 200215122 | 2 | 90 |
| 200215122 | 3 | 80 |
| 200215122 | 5 | 96 |
| 200215123 | 9 | 98 |
| 200215129 | 9 | 76 |

8. 修改学生成绩

选择模式 7，输入相应的信息查询并修改学生成绩，如图 5.20 所示。

```
Choose what you want (0~10): 7
===== Mode 7: Modify Student's Grade =====
Please input the Student ID and Course ID to search the grade record!
Student ID: 200215129
Course ID: 9
Course founded! Here is the information of this course:
+---+-----+-----+-----+
|   |      sno |   cno |  grade |
+---+-----+-----+-----+
| 0 | 200215129 |     9 |     76 |
+---+-----+-----+-----+
Are you sure to modify this score? (y/n): y
Input the new grade: 87
Successfully Updated!
```

修改后的 SC 表如图 5.21 所示。

| Sno | Cno | Grade |
|-----------|-----|-------|
| 200215121 | 1 | 80 |
| 200215121 | 2 | 80 |
| 200215121 | 3 | 80 |
| 200215122 | 1 | 80 |
| 200215122 | 2 | 90 |
| 200215122 | 3 | 80 |
| 200215122 | 5 | 96 |
| 200215123 | 9 | 98 |
| 200215129 | 9 | 87 |

9. 按系打印统计信息

选择模式 8，可以看到统计信息如图 5.22 所示。

```
Choose what you want (0~10): 8
===== Mode 8: Print Analytical Info by Dept =====
Department List: CS,EE,IS,MA
Here is the information for your inquire:
+---+-----+-----+-----+-----+-----+
|   | dept |   avg |   max |   min | a_rate | f_num |
+---+-----+-----+-----+-----+-----+
| 0 | CS   | 83.7143 | 96 | 80 | 0.285714 | 0 |
| 1 | EE   | 87 | 87 | 87 | 0 | 0 |
| 2 | IS   | | nan | nan | 0 | 0 |
| 3 | MA   | 98 | 98 | 98 | 1 | 0 |
+---+-----+-----+-----+-----+-----+
Press Enter to continue...
```

10. 学生成绩排名

选择模式 9，输入项查询的院系信息，查询结果如图 5.23 所示。

```

Choose what you want (0~10): 9
===== Mode 9: Print Department Student Ranking =====
Department List: CS,EE,IS,MA
Please select one department to inquire the student's ranking: CS
Here is the ranking of CS department:
+-----+-----+-----+-----+-----+-----+
|      |      | sno | sname |      | avg |      | c_num |      | credits |
|-----+-----+-----+-----+-----+-----+-----+
| 0 | 200215122 | 刘晨 | 86.5 | 4 | 14 |
| 1 | 200215121 | 李勇 | 80 | 3 | 10 |
+-----+-----+-----+-----+-----+-----+
Do you want to search other department's rank? (y/n)y
Department List: CS,EE,IS,MA
Please select one department to inquire the student's ranking: IS
Here is the ranking of IS department:
+-----+-----+-----+-----+-----+
| sno | sname | avg | c_num | credits |

```

11. 查询学生信息

选择模式 10，输入需要查询的学生学号，查询结果如图 5.24 所示。

```

Choose what you want (0~10): 10
===== Mode 10: Lookup Student Basic Info =====
Please input the Student ID to search the student!
Student ID: 200215129
Student founded! Here is the information of this person:
+-----+-----+-----+-----+-----+-----+
|      |      | sno | sname | sex | age | dept | scholarship |
|-----+-----+-----+-----+-----+-----+
| 0 | 200215129 | 张三 | 男 | 24 | EE | 是 |
+-----+-----+-----+-----+-----+-----+
Student's Course Info:
+-----+-----+-----+-----+-----+
|      |      | cno | cname |      | grade |      | credits |      | cpno |
|-----+-----+-----+-----+-----+-----+
| 0 | 9 | Py语言 | 87 | 2 | 0 |
+-----+-----+-----+-----+-----+
Press Enter to continue ...

```

A 附录

A.1 数据库管理系统源码

```
#!/usr/bin/python
# -*- coding: UTF-8 -*-

import os
import pymysql
import pandas as pd
from tabulate import tabulate

def print_menu():
    print(''''
    ***** Menu
    *****
    1. Insert New Student Info          2. Modify Existing Student
Info
    3. Insert New Course Info          4. Modify Existing Course
Info
    5. Delete Existing Course Info      6. Record Student Grade
    7. Modify Student Grade             8. Print Analytical Info by
Dept
    9. Print Grade Rank by Dept         10. Print Student Info

                                0. Exit

    *****
    ''')
    return

def insert_student(db):
    cursor = db.cursor()
    dic_student = {'sno': [], 'sname': [], 'sex': [], 'age': [], 'dept':
[], 'scholarship': []}
    print("===== Mode 1: Insert New Student Info
=====")
    print("Please input the following information! ")

    dic_student['sno'].append(input("Student ID: "))
    dic_student['sname'].append(input("Name: "))
    dic_student['sex'].append(input("Gender: "))
    dic_student['age'].append(input("Age: "))
    dic_student['dept'].append(input("Student's Department: "))
    dic_student['scholarship'].append("是" if input("Have Scholarship?
(y/n)") == 'y' else "否")

    df = pd.DataFrame(dic_student)

    print("Re-check the student's information below: ")
    print(tabulate(df, headers='keys', tablefmt='psql'))

    op = input("ARE YOU SURE TO INSERT THE NEW INFORMATION? (y/n)")
    if op == 'n':
        print("rollback successfully! ")
        return
```

```

else:
    pass

sql = "INSERT INTO Student " \
      "VALUES('%s', '%s', '%s', %s, '%s', '%s')" % (
          dic_student['sno'][0], dic_student['sname'][0],
dic_student['sex'][0], dic_student['age'][0],
          dic_student['dept'][0],
          dic_student['scholarship'][0])

try:
    cursor.execute(sql)
    db.commit()
    print("Successfully Inserted! ")
except:
    print("An unexpected error occurred and we rollback all the changes.
")
    db.rollback()

return

def update_student(db):
    cursor = db.cursor()
    dic_student = {'sno': [], 'sname': [], 'sex': [], 'age': [], 'dept':
[], 'scholarship': []}
    print("===== Mode 2: Modify Existing Student Info
=====")
    print("Please input the Student ID to search the student! ")

    dic_student['sno'].append(input("Student ID: "))

    sql = "SELECT * FROM Student WHERE Sno = '%s'" % dic_student['sno'][0]

    try:
        cursor.execute(sql)
        results = cursor.fetchall()
        for index, row in enumerate(results):
            # dic_student['sno'].append(row[0])
            dic_student['sname'].append(row[1])
            dic_student['sex'].append(row[2])
            dic_student['age'].append(row[3])
            dic_student['dept'].append(row[4])
            dic_student['scholarship'].append(row[5])

        print("Student founded! Here is the information of this person:
")
        df = pd.DataFrame(dic_student)
        print(tabulate(df, headers='keys', tablefmt='psql'))
    except:
        print("Error: unable to fetch data")
        return

    header_list = ['', 'Sno', 'Sname', 'Ssex', 'Sage', 'Sdept',
'Scholarship']

    while True:
        modify_op = input("Select column 1~6 to modify, select 0 to exit:
")
        if modify_op == '0':
            break

```

```

        else:
            pass
        new_data = input("Input the new data: ")

        sql = "UPDATE Student SET %s = " % header_list[int(modify_op)]
        if modify_op != 4:
            sql += "'"
            sql += new_data
            if modify_op != 4:
                sql += "'"
            sql += "WHERE Sno = '%s'" % dic_student['sno'][0]

        try:
            print("Successfully Updated! ")
            cursor.execute(sql)
            db.commit()
        except:
            print("update error! ")
            db.rollback()
            return

    return

def insert_course(db):
    cursor = db.cursor()
    dic_course = {'cno': [], 'cname': [], 'cpno': [], 'ccredit': []}
    print("===== Mode 3: Insert New Course Info =====")
    print("Please input the following information! ")

    dic_course['cno'].append(input("Course ID: "))
    dic_course['cname'].append(input("Course Name: "))
    dic_course['cpno'].append(input("Previous Course ID: "))
    dic_course['ccredit'].append(input("Credits: "))

    df = pd.DataFrame(dic_course)

    print("Re-check the course's information below: ")
    print(tabulate(df, headers='keys', tablefmt='psql'))

    op = input("ARE YOU SURE TO INSERT THE NEW INFORMATION? (y/n)")
    if op == 'n':
        print("rollback successfully! ")
        return
    else:
        pass

    sql = "INSERT INTO Course " \
          "VALUES('%s', '%s', '%s', %s)" % (
            dic_course['cno'][0], dic_course['cname'][0],
            dic_course['cpno'][0], dic_course['ccredit'][0])

    try:
        cursor.execute(sql)
        db.commit()
        print("Successfully Inserted! ")
    except:
        print("An unexpected error occurred and we rollback all the changes. ")
        db.rollback()

```



```

return

def modify_course(db):
    cursor = db.cursor()
    dic_course = {'cno': [], 'cname': [], 'cpno': [], 'ccredit': []}
    print("===== Mode 4: Modify Existing Course Info =====")
    print("Please input the Course ID to search the course! ")

    dic_course['cno'].append(input("Course ID: "))

    sql = "SELECT * FROM Course WHERE Cno = '%s'" % dic_course['cno'][0]

    try:
        cursor.execute(sql)
        results = cursor.fetchall()
        for index, row in enumerate(results):
            # dic_course['cno'].append(row[0])
            dic_course['cname'].append(row[1])
            dic_course['cpno'].append(row[2])
            dic_course['ccredit'].append(row[3])

        print("Course founded! Here is the information of this course: ")
        df = pd.DataFrame(dic_course)
        print(tabulate(df, headers='keys', tablefmt='psql'))
    except:
        print("Error: unable to fetch data")
        return

    header_list = ['', 'Cno', 'Cname', 'Cpno', 'Ccredit']

    while True:
        modify_op = input("Select column 1~4 to modify, select 0 to exit: ")

        if modify_op == '0':
            break
        else:
            pass
        new_data = input("Input the new data: ")

        sql = "UPDATE Course SET %s = " % header_list[int(modify_op)]
        if modify_op != 4:
            sql += "'"
            sql += new_data
        if modify_op != 4:
            sql += "'"
        sql += "WHERE Cno = '%s'" % dic_course['cno'][0]

        try:
            print("Successfully Updated! ")
            cursor.execute(sql)
            db.commit()
        except:
            print("update error! ")
            db.rollback()
            return

    return

```

```

def delete_course(db):
    cursor = db.cursor()
    dic_course = {'cno': [], 'cname': [], 'cpno': [], 'ccredit': []}
    print("===== Mode 5: Delete Existing Course Info =====")
    print("Please input the Course ID to search the course! ")

    dic_course['cno'].append(input("Course ID: "))

    sql = "SELECT * FROM Course WHERE Cno = '%s'" % dic_course['cno'][0]

    try:
        cursor.execute(sql)
        results = cursor.fetchall()
        for index, row in enumerate(results):
            # dic_course['cno'].append(row[0])
            dic_course['cname'].append(row[1])
            dic_course['cpno'].append(row[2])
            dic_course['ccredit'].append(row[3])

        print("Course founded! Here is the information of this course: ")
        df = pd.DataFrame(dic_course)
        print(tabulate(df, headers='keys', tablefmt='psql'))
    except:
        print("Error: unable to fetch data")
        return

    header_list = ['', 'Cno', 'Cname', 'Cpno', 'Ccredit']

    confirm_op = input("ARE YOU SURE TO DELETE THIS COURSE? (y/n): ")
    if confirm_op == 'n':
        return
    else:
        pass

    sql = "DELETE FROM Course WHERE Cno = '%s'" % dic_course['cno'][0]

    try:
        print("Successfully Deleted! ")
        cursor.execute(sql)
        db.commit()
    except:
        print("delete error! ")
        db.rollback()
        return

    return

def record_grade(db):
    cursor = db.cursor()
    dic_sc = {'sno': [], 'cno': [], 'grade': []}
    print("===== Mode 6: Record Student's Grade =====")
    print("Please input the following information! ")

    dic_sc['sno'].append(input("Student ID: "))
    dic_sc['cno'].append(input("Course ID: "))
    dic_sc['grade'].append(input("Student's Grade: "))

```

```

df = pd.DataFrame(dic_sc)

print("Re-check the information below: ")
print(tabulate(df, headers='keys', tablefmt='psql'))

op = input("ARE YOU SURE TO INSERT THE NEW INFORMATION? (y/n)")
if op == 'n':
    print("rollback successfully! ")
    return
else:
    pass

sql = "INSERT INTO SC " \
      "VALUES('%s', '%s', %s)" % (
          dic_sc['sno'][0], dic_sc['cno'][0], dic_sc['grade'][0])

try:
    cursor.execute(sql)
    db.commit()
    print("Successfully Inserted! ")
except:
    print("An unexpected error occurred and we rollback all the changes.
")
    db.rollback()

return

def modify_grade(db):
    cursor = db.cursor()
    dic_sc = {'sno': [], 'cno': [], 'grade': []}
    print("===== Mode 7: Modify Student's Grade
=====")
    print("Please input the Student ID and Course ID to search the grade
record! ")

    dic_sc['sno'].append(input("Student ID: "))
    dic_sc['cno'].append(input("Course ID: "))

    sql = "SELECT * FROM SC WHERE Sno = '%s' AND Cno = '%s'" %
(dic_sc['sno'][0], dic_sc['cno'][0])

    try:
        cursor.execute(sql)
        results = cursor.fetchall()
        for index, row in enumerate(results):
            # dic_sc['sno'].append(row[0])
            # dic_sc['cno'].append(row[1])
            dic_sc['grade'].append(row[2])

        print("Course founded! Here is the information of this course: ")
        df = pd.DataFrame(dic_sc)
        print(tabulate(df, headers='keys', tablefmt='psql'))
    except:
        print("Error: unable to fetch data")
        return

header_list = ['', 'Sno', 'Cno', 'Grade']

modify_op = input("Are you sure to modify this score? (y/n): ")
if modify_op == 'n':

```

```

        return
    else:
        pass
    new_data = input("Input the new grade: ")

    sql = "UPDATE SC SET Grade = %s WHERE Sno = '%s' AND Cno = '%s'" %
(new_data, dic_sc['sno'][0], dic_sc['cno'][0])

    try:
        print("Successfully Updated! ")
        cursor.execute(sql)
        db.commit()
    except:
        print("update error! ")
        db.rollback()
        return

    return

def analyze_grade(db):
    cursor = db.cursor()
    dic_sc = {'dept': [], 'avg': [], 'max': [], 'min': [], 'a_rate': [],
'f_num': []}
    l_dept = []
    print("===== Mode 8: Print Analytical Info by Dept
=====")
    # print("Please input the Student ID and Course ID to search the grade
record! ")

    # Step 1. acquire all of the dept names
    sql = "SELECT DISTINCT Sdept FROM Student ORDER BY Sdept"
    try:
        cursor.execute(sql)
        results = cursor.fetchall()
        for row in results:
            l_dept.append(row[0])
    except:
        print("Error: unable to fetch department data")
        return

    print("Department List: " + ",".join(str(x) for x in l_dept))

    # Step 2. get the data of each dept
    for dept in l_dept:
        dic_sc['dept'].append(dept)

        # fetch the avg, max, min number
        sql = "SELECT AVG(SC.Grade), MAX(SC.Grade), MIN(SC.Grade) FROM
Student, SC WHERE Student.Sdept = '%s' AND " \
            "Student.Sno = SC.Sno" % dept
        try:
            cursor.execute(sql)
            results = cursor.fetchall()
            for row in results:
                dic_sc['avg'].append(row[0])
                dic_sc['max'].append(row[1])
                dic_sc['min'].append(row[2])
        except:
            print("Error: unable to fetch avg/max/min data")
            return

```

```

a_number = 0
total_number = 0

# fetch the A number
sql = "SELECT COUNT(*) FROM Student, SC WHERE Student.Sdept = '%s'
AND Student.Sno = SC.Sno AND SC.Grade >= 90" % dept
try:
    cursor.execute(sql)
    results = cursor.fetchall()
    for row in results:
        a_number = row[0]
except:
    print("Error: unable to fetch avg/max/min data")
    return

# fetch all dept student number
sql = "SELECT COUNT(*) FROM Student, SC WHERE Student.Sdept = '%s'
AND Student.Sno = SC.Sno" % dept
try:
    cursor.execute(sql)
    results = cursor.fetchall()
    for row in results:
        total_number = row[0]
except:
    print("Error: unable to fetch total student number data")
    return

if total_number != 0:
    a_rate = a_number / total_number
else:
    a_rate = 0.0
dic_sc['a_rate'].append(a_rate)

fail_num = 0

# fetch the failed students number
sql = "SELECT COUNT(*) FROM Student, SC WHERE Student.Sdept = '%s'
AND Student.Sno = SC.Sno AND SC.Grade < 60" % dept
try:
    cursor.execute(sql)
    results = cursor.fetchall()
    for row in results:
        fail_num = row[0]
except:
    print("Error: unable to fetch avg/max/min data")
    return

dic_sc['f_num'].append(fail_num)

# Step 3. display the information
print("Here is the information for your inquire: ")
df = pd.DataFrame(dic_sc)
print(tabulate(df, headers='keys', tablefmt='psql'))
input("Press Enter to continue...")
return

def rank_student(db):
    cursor = db.cursor()
    l_dept = []

```

```

print("===== Mode 9: Print Department Student Ranking
=====")
# print("Please input the Student ID and Course ID to search the grade
record! ")

# Step 1. acquire all of the dept names
sql = "SELECT DISTINCT Sdept FROM Student ORDER BY Sdept"
try:
    cursor.execute(sql)
    results = cursor.fetchall()
    for row in results:
        l_dept.append(row[0])
except:
    print("Error: unable to fetch department data")
    return

while True:
    dic_sc = {'sno': [], 'sname': [], 'avg': [], 'c_num': [], 'credits':
[]}]
    print("Department List: " + ",".join(str(x) for x in l_dept))
    while True:
        sel_dept = input("Please select one department to inquire the
student's ranking: ")
        if sel_dept in l_dept:
            break
        else:
            print('Department %s not found! ' % sel_dept)

    # dic_sc = {'sno': [], 'sname': [], 'avg': [], 'c_num': [], 'credits':
[]}]

    # Step 2. get the data of the chosen dept
    sql = "SELECT Student.Sno, Student.Sname, AVG(SC.Grade),
COUNT(SC.Grade), SUM(Course.Ccredit) FROM Student, SC, " \
        "Course WHERE Student.Sdept = '%s' AND SC.Sno = Student.Sno
AND Course.Cno = SC.Cno GROUP BY Student.Sno " \
        "ORDER BY AVG(SC.Grade) DESC" % sel_dept
    try:
        cursor.execute(sql)
        results = cursor.fetchall()
        for row in results:
            dic_sc['sno'].append(row[0])
            dic_sc['sname'].append(row[1])
            dic_sc['avg'].append(row[2])
            dic_sc['c_num'].append(row[3])
            dic_sc['credits'].append(row[4])
    except:
        print("Error: unable to fetch student's data")
        return

    # Step 3. display the information
    print("Here is the ranking of %s department: " % sel_dept)
    df = pd.DataFrame(dic_sc)
    print(tabulate(df, headers='keys', tablefmt='psql'))
    sel_op = input("Do you want to search other department's rank?
(y/n) ")
    if sel_op == 'n':
        break
    else:
        pass

return

```

```

def show_stu_info(db):
    cursor = db.cursor()
    dic_student = {'sno': [], 'sname': [], 'sex': [], 'age': [], 'dept':
[], 'scholarship': []}
    dic_course = {'cno': [], 'cname': [], 'grade': [], 'credits': [],
'cpno': []}
    print("===== Mode 10: Lookup Student Basic Info
=====")
    print("Please input the Student ID to search the student! ")

    dic_student['sno'].append(input("Student ID: "))

    sql = "SELECT * FROM Student WHERE Sno = '%s'" % dic_student['sno'][0]

    try:
        cursor.execute(sql)
        results = cursor.fetchall()
        for index, row in enumerate(results):
            # dic_student['sno'].append(row[0])
            dic_student['sname'].append(row[1])
            dic_student['sex'].append(row[2])
            dic_student['age'].append(row[3])
            dic_student['dept'].append(row[4])
            dic_student['scholarship'].append(row[5])

        print("Student founded! Here is the information of this person:
")

        df = pd.DataFrame(dic_student)
        print(tabulate(df, headers='keys', tablefmt='psql'))
    except:
        print("Error: unable to fetch data")
        return

    # definition: dic_course = {'cno': [], 'cname': [], 'grade': [],
'credits': [], 'cpno': []}
    sql = "SELECT SC.Cno, Course.Cname, SC.Grade, Course.Ccredit,
Course.Cpno FROM SC, Course WHERE SC.Sno = '%s' AND " \
        "SC.Cno = Course.Cno" % dic_student['sno'][0]

    try:
        cursor.execute(sql)
        results = cursor.fetchall()
        for index, row in enumerate(results):
            dic_course['cno'].append(row[0])
            dic_course['cname'].append(row[1])
            dic_course['grade'].append(row[2])
            dic_course['credits'].append(row[3])
            dic_course['cpno'].append(row[4])

        print("Student's Course Info: ")
        df = pd.DataFrame(dic_course)
        print(tabulate(df, headers='keys', tablefmt='psql'))
        input("Press Enter to continue ... ")
    except:
        print("Error: unable to fetch course data")
        return

    return

```

```

def main():
    ip_addr = input("Input the IP Address (default: localhost): ") or "localhost"
    usr = input("Username (default: yuanye): ") or "yuanye"
    passwd = input("Password (default: yuanye): ") or "yuanye"
    select_db = input("Select one database to operate (default: S_T_U201911808): ") or "S_T_U201911808"

    print(" ... Connecting to the Database ... ")

    db = pymysql.connect(
        host=ip_addr,
        user=usr,
        password=passwd,
        database=select_db
    )

    cursor = db.cursor()

    cursor.execute("SELECT VERSION()")

    db_version = cursor.fetchone()

    print("----- Student Management System -----")
    print("          Author: 网安1902班 袁也  U201911808")
    print("          MySQL Version: {}".format(db_version[0]))
    print("   User: {}@{}   Database: {}".format(usr, ip_addr, select_db))

    while True:
        print_menu()
        op = input("Choose what you want (0~10): ")
        if op == '0':
            break
        elif op == '1':
            insert_student(db)
        elif op == '2':
            update_student(db)
        elif op == '3':
            insert_course(db)
        elif op == '4':
            modify_course(db)
        elif op == '5':
            delete_course(db)
        elif op == '6':
            record_grade(db)
        elif op == '7':
            modify_grade(db)
        elif op == '8':
            analyze_grade(db)
        elif op == '9':
            rank_student(db)
        elif op == '10':
            show_stu_info(db)
        else:
            print("Wrong Input! ")

    db.close()
    print("Thanks for using this database! Bye!")

```

```
if __name__ == '__main__':  
    main()
```