

深 圳 大 学

实 验 报 告

课程名称： 数据库系统

实验序号： 实验 1

实验名称： SQL的DDL语言和单表查询

学 号： 2022280310

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实验完成日期： 2024 年 9 月 24 日

一、实验目的：

- 1、了解 DBMS 系统的功能、软件组成；
- 2、掌握利用 SQL 语句定义、和简单操纵数据库的方法。

二、实验要求：

- 1、在课外安装相关软件并浏览软件自带的帮助文件和功能菜单，了解 DBMS 的功能、结构；
- 2、创建一个有两个关系表的数据库；（建议采用 ORACLE ISQLPLUS）
- 3、数据库、关系表定义；
- 4、学习定义关系表的约束(主键、外键、自定义)；
- 5、了解 SQL 的数据定义功能；
- 6、了解 SQL 的操纵基本功能；
- 8、了解视图的概念；

三、实验设备：

计算机、数据库管理系统如 DB2，Oracle 等软件。

四、实验内容

1、使用 SQL DDL 语句建立关系数据库模式，并用 DML 数据如下：

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO
7369	SMITH	CLERK	7902	17-Dec-90	13750		20
7499	ALLEN	SALESMAN	7698	20-FEB-89	19000	6400	30
7521	WARD	SALESMAN	7698	22-FEB-93	18500	4250	30
7566	JONES	MANAGER	7839	02-APR-89	26850		20
7654	MARTIN	SALESMAN	7698	28-SEP-97	15675	3500	30
7698	BLAKE	MANAGER	7839	01-MAY-90	24000		30
7782	CLARK	MANAGER	7839	09-JUN-88	27500		10
7788	SCOTT	ANALYST	7566	19-APR-87	19500		20
7839	KING	PRESIDENT		17-NOV-83	82500		10
7844	TURNER	SALESMAN	7698	08-SEP-92	18500	6250	30
7876	ADAMS	CLERK	7788	23-MAY-96	11900		20
7900	JAMES	CLERK	7698	03-DEC-95	12500		30
7902	FORD	ANALYST	7566	03-DEC-91	21500		20
7934	MILLER	CLERK	7782	23-JAN-95	13250		10
3258	GREEN	SALESMAN	4422	24-Jul-95	18500	2750	50
4422	STEVENS	MANAGER	7839	14-Jan-94	24750		50

DEPT+(学生自己的学号):

DEPTNO	DNAME	LOC
10	ACCOUNTING	LONDON
20	RESEARCH	PRESTON
30	SALES	LIVERPOOL
40	OPERATIONS	STAFFORD
50	MARKETING	LUTON

以下为学生实验填写部分:

1. 参考课件约束方式, 创建 emp 和 dept 的 DDL 语句 (要有语句和运行结果截屏)

1.1 由于 EMP 表中有 DEPT 表中的外键约束, 因此先创建 DEPT 表, 如下

```
mysql> CREATE TABLE DEPT2022280310(
-> DEPTNO NUMERIC NOT NULL,
-> DNAME VARCHAR(10) NOT NULL,
-> LOC VARCHAR(10) NOT NULL,
-> PRIMARY KEY(DEPTNO));
Query OK, 0 rows affected (0.01 sec)
```

语句如下:

```
CREATE TABLE DEPT2022280310(
  DEPTNO NUMERIC NOT NULL,
  DNAME VARCHAR(10) NOT NULL,
  LOC VARCHAR(10) NOT NULL,
  PRIMARY KEY(DEPTNO)
);
```

1.2 再创建 EMP 表;

```
mysql> CREATE TABLE emp (
-> empno DECIMAL(10,0) NOT NULL,
-> ename VARCHAR(10) NOT NULL CHECK(ename = UPPER(ename)),
-> job VARCHAR(9),
-> mgr DECIMAL(10,0) REFERENCES emp(empno),
-> hiredate DATE CHECK (hiredate <= SYSDATE),
-> sal DECIMAL(10,2) CHECK (sal > 500),
-> comm DECIMAL(9,0) DEFAULT NULL,
-> deptno DECIMAL(2,0) NOT NULL,
-> PRIMARY KEY (empno),
-> FOREIGN KEY (deptno) REFERENCES dept2022280310(deptno)
-> );
Query OK, 0 rows affected (0.01 sec)
```

语句如下:

```
CREATE TABLE emp (
  empno DECIMAL(10,0) NOT NULL,
  ename VARCHAR(10) NOT NULL CHECK(ename = UPPER(ename)),
  job VARCHAR(9),
```

```

mgr      DECIMAL(10,0)  REFERENCES emp(empno),
hiredate DATE          CHECK (hiredate <= SYSDATE),
sal      DECIMAL(10,2)  CHECK (sal > 500),
comm     DECIMAL(9,0)   DEFAULT NULL,
deptno   DECIMAL(2,0)   NOT NULL,
PRIMARY KEY (empno),
FOREIGN KEY (deptno) REFERENCES dept2022280310(deptno)
);

```

在 phpMyAdmin 中可以看到两个表成功创建了。



2. 插入 emp 和 dept 数据的 DML 语句 （要有语句和运行结果截屏）

2.1 向 DEPT 中插入数据，如下

```

mysql> INSERT INTO DEPT2022280310 VALUES
-> (10, 'ACCOUNTING', 'LONDON'),
-> (20, 'RESEARCH', 'PRESTON'),
-> (30, 'SALES', 'LIVERPOOL'),
-> (40, 'OPERATIONS', 'STAFFORD'),
-> (50, 'MARKETING', 'LUTON');
Query OK, 5 rows affected (0.00 sec)
Records: 5  Duplicates: 0  Warnings: 0

```

语句如下：

```

INSERT INTO DEPT2022280310 VALUES
(10, 'ACCOUNTING', 'LONDON'),
(20, 'RESEARCH', 'PRESTON'),
(30, 'SALES', 'LIVERPOOL'),
(40, 'OPERATIONS', 'STAFFORD'),
(50, 'MARKETING', 'LUTON');

```

在 phpMyAdmin 中也可以看到数据成功插入；

正在显示第 0 - 4 行 (共 5 行, 查询花费 0.0003 秒。)

SELECT * FROM `dept2022280310`

☐ 显示全部

行数: 25

过滤行: 在表中搜索

按索引排序: 无

+ 选项

←T→

DEPTNO

DNAME

LOC

<input type="checkbox"/>	编辑	复制	删除	10	ACCOUNTING	LONDON
<input type="checkbox"/>	编辑	复制	删除	20	RESEARCH	PRESTON
<input type="checkbox"/>	编辑	复制	删除	30	SALES	LIVERPOOL
<input type="checkbox"/>	编辑	复制	删除	40	OPERATIONS	STAFFORD
<input type="checkbox"/>	编辑	复制	删除	50	MARKETING	LUTON

同时在控制台可以使用语句：

```
SELECT * FROM `dept2022280310`;
```

查看是否插入成功。

```
mysql> SELECT * FROM `dept2022280310` ;
+-----+-----+-----+
| DEPTNO | DNAME      | LOC      |
+-----+-----+-----+
| 10     | ACCOUNTING | LONDON   |
| 20     | RESEARCH   | PRESTON  |
| 30     | SALES      | LIVERPOOL |
| 40     | OPERATIONS | STAFFORD |
| 50     | MARKETING  | LUTON    |
+-----+-----+-----+
5 rows in set (0.00 sec)
```

2.2 在 EMP 中插入数据，如下

```
mysql> INSERT INTO EMP VALUES
-> (7369, 'SMITH', 'CLERK', 7902, '1990-12-17', 13750, NULL, 20),
-> (7499, 'ALLEN', 'SALESMAN', 7698, '1989-02-20', 19000, 6400, 30),
-> (7521, 'WARD', 'SALESMAN', 7698, '1993-02-22', 18500, 4250, 30),
-> (7566, 'JONES', 'MANAGER', 7839, '1989-04-02', 26850, NULL, 20),
-> (7654, 'MARTIN', 'SALESMAN', 7698, '1997-09-28', 15675, 3500, 30),
-> (7698, 'BLAKE', 'MANAGER', 7839, '1990-05-01', 24000, NULL, 30),
-> (7782, 'CLARK', 'MANAGER', 7839, '1988-06-09', 27500, NULL, 10),
-> (7788, 'SCOTT', 'ANALYST', 7566, '1987-04-19', 19500, NULL, 20),
-> (7839, 'KING', 'PRESIDENT', NULL, '1983-11-17', 82500, NULL, 10),
-> (7844, 'TURNER', 'SALESMAN', 7698, '1992-09-08', 18500, 6250, 30),
-> (7876, 'ADAMS', 'CLERK', 7788, '1996-05-23', 11900, NULL, 20),
-> (7900, 'JAMES', 'CLERK', 7698, '1995-12-03', 12500, NULL, 30),
-> (7902, 'FORD', 'ANALYST', 7566, '1991-12-03', 21500, NULL, 20),
-> (7934, 'MILLER', 'CLERK', 7782, '1995-01-23', 13250, NULL, 10),
-> (3258, 'GREEN', 'SALESMAN', 4422, '1995-06-24', 18500, 2750, 50),
-> (4422, 'STEVENS', 'MANAGER', 7839, '1994-01-14', 24750, NULL, 50),
-> (6548, 'BARNES', 'CLERK', 4422, '1995-01-16', 11950, NULL, 50);
Query OK, 17 rows affected (0.00 sec)
Records: 17  Duplicates: 0  Warnings: 0
```

语句如下：

```
INSERT INTO EMP VALUES
(7369, 'SMITH', 'CLERK', 7902, '1990-12-17', 13750, NULL, 20),
(7499, 'ALLEN', 'SALESMAN', 7698, '1989-02-20', 19000, 6400, 30),
(7521, 'WARD', 'SALESMAN', 7698, '1993-02-22', 18500, 4250, 30),
(7566, 'JONES', 'MANAGER', 7839, '1989-04-02', 26850, NULL, 20),
(7654, 'MARTIN', 'SALESMAN', 7698, '1997-09-28', 15675, 3500, 30),
(7698, 'BLAKE', 'MANAGER', 7839, '1990-05-01', 24000, NULL, 30),
(7782, 'CLARK', 'MANAGER', 7839, '1988-06-09', 27500, NULL, 10),
(7788, 'SCOTT', 'ANALYST', 7566, '1987-04-19', 19500, NULL, 20),
(7839, 'KING', 'PRESIDENT', NULL, '1983-11-17', 82500, NULL, 10),
(7844, 'TURNER', 'SALESMAN', 7698, '1992-09-08', 18500, 6250, 30),
(7876, 'ADAMS', 'CLERK', 7788, '1996-05-23', 11900, NULL, 20),
(7900, 'JAMES', 'CLERK', 7698, '1995-12-03', 12500, NULL, 30),
(7902, 'FORD', 'ANALYST', 7566, '1991-12-03', 21500, NULL, 20),
(7934, 'MILLER', 'CLERK', 7782, '1995-01-23', 13250, NULL, 10),
(3258, 'GREEN', 'SALESMAN', 4422, '1995-06-24', 18500, 2750, 50),
(4422, 'STEVENS', 'MANAGER', 7839, '1994-01-14', 24750, NULL, 50),
(6548, 'BARNES', 'CLERK', 4422, '1995-01-16', 11950, NULL, 50);
```

在 phpMyAdmin 中可以看到数据插入成功：

新建

deptno

expfirst

新建

dept2022280310

emp

information_schema

mysql

performance_schema

sys

SELECT * FROM `emp`

☐ 显示全部

行数: 25

过滤行: 在表中搜索

按索引排序: 无

+ 选项

empno

ename

job

mgr

hiredate

sal

comm

deptno

<input type="checkbox"/>				7369	SMITH	CLERK	7902	1990-12-17	13750.00	NULL	20
<input type="checkbox"/>				7499	ALLEN	SALESMAN	7698	1989-02-20	19000.00	6400	30
<input type="checkbox"/>				7521	WARD	SALESMAN	7698	1993-02-22	18500.00	4250	30
<input type="checkbox"/>				7566	JONES	MANAGER	7839	1989-04-02	26850.00	NULL	20
<input type="checkbox"/>				7654	MARTIN	SALESMAN	7698	1997-09-28	15675.00	3500	30
<input type="checkbox"/>				7698	BLAKE	MANAGER	7839	1990-05-01	24000.00	NULL	30
<input type="checkbox"/>				7782	CLARK	MANAGER	7839	1988-06-09	27500.00	NULL	10
<input type="checkbox"/>				7788	SCOTT	ANALYST	7566	1987-04-19	19500.00	NULL	20
<input type="checkbox"/>				7839	KING	PRESIDENT	NULL	1983-11-17	82500.00	NULL	10
<input type="checkbox"/>				7844	TURNER	SALESMAN	7698	1992-09-08	18500.00	6250	30
<input type="checkbox"/>				7876	ADAMS	CLERK	7788	1996-05-23	11900.00	NULL	20
<input type="checkbox"/>				7900	JAMES	CLERK	7698	1995-12-03	12500.00	NULL	30
<input type="checkbox"/>				7902	FORD	ANALYST	7566	1991-12-03	21500.00	NULL	20
<input type="checkbox"/>				7934	MILLER	CLERK	7782	1995-01-23	13250.00	NULL	10
<input type="checkbox"/>				3258	GREEN	SALESMAN	4422	1995-06-24	18500.00	2750	50
<input type="checkbox"/>				4422	STEVENS	MANAGER	7839	1994-01-14	24750.00	NULL	50
<input type="checkbox"/>				6548	BARNES	CLERK	4422	1995-01-16	11950.00	NULL	50

控制台中也可以用语句

SELECT * FROM `emp`;

查看数据是否插入成功。

mysql> SELECT * FROM `emp` ;

empno	ename	job	mgr	hiredate	sal	comm	deptno
7369	SMITH	CLERK	7902	1990-12-17	13750.00	NULL	20
7499	ALLEN	SALESMAN	7698	1989-02-20	19000.00	6400	30
7521	WARD	SALESMAN	7698	1993-02-22	18500.00	4250	30
7566	JONES	MANAGER	7839	1989-04-02	26850.00	NULL	20
7654	MARTIN	SALESMAN	7698	1997-09-28	15675.00	3500	30
7698	BLAKE	MANAGER	7839	1990-05-01	24000.00	NULL	30
7782	CLARK	MANAGER	7839	1988-06-09	27500.00	NULL	10
7788	SCOTT	ANALYST	7566	1987-04-19	19500.00	NULL	20
7839	KING	PRESIDENT	NULL	1983-11-17	82500.00	NULL	10
7844	TURNER	SALESMAN	7698	1992-09-08	18500.00	6250	30
7876	ADAMS	CLERK	7788	1996-05-23	11900.00	NULL	20
7900	JAMES	CLERK	7698	1995-12-03	12500.00	NULL	30
7902	FORD	ANALYST	7566	1991-12-03	21500.00	NULL	20
7934	MILLER	CLERK	7782	1995-01-23	13250.00	NULL	10
3258	GREEN	SALESMAN	4422	1995-06-24	18500.00	2750	50
4422	STEVENS	MANAGER	7839	1994-01-14	24750.00	NULL	50
6548	BARNES	CLERK	4422	1995-01-16	11950.00	NULL	50

17 rows in set (0.00 sec)

2.3 最后检查外键约束是否有效

如果外键约束有效，那么向 EMP 表中插入一个 DEPTNO 在 DEPT 表中不存在的数据时会发生错误。

用下面的指令检查

```
INSERT INTO EMP VALUES
(66,'SZU','SCHOOL', 6666, '1983-09-27', 88888.88, NULL, 00);
```

```
mysql> INSERT INTO EMP VALUES
-> (66,'SZU','SCHOOL', 6666, '1983-09-27', 88888.88, NULL, 00);
Query OK, 1 row affected (0.00 sec)
```

发现成功插入，表明外键约束无效。

将 DEPT 表和 EMP 表的引擎改为 InnoDB;

```
ALTER TABLE DEPT2022280310 ENGINE=InnoDB;
```

```
ALTER TABLE EMP ENGINE=InnoDB;
```

```
mysql> ALTER TABLE DEPT2022280310 ENGINE=InnoDB;
Query OK, 5 rows affected (0.01 sec)
Records: 5 Duplicates: 0 Warnings: 0

mysql> ALTER TABLE EMP ENGINE=InnoDB;
Query OK, 18 rows affected (0.01 sec)
Records: 18 Duplicates: 0 Warnings: 0
```

再删除刚刚插入的语句，

按索引排序: 无

+ 选项									
← T →		empno	ename	job	mgr	hiredate	sal	comm	deptno
<input type="checkbox"/>	编辑 复制 删除	66	SZU	SCHOOL	6666	1983-09-27	88888.88	NULL	0
<input type="checkbox"/>	编辑 复制 删除	3258	GREEN	SALESMAN	4422	1995-06-24	18500.00	2750	50
<input type="checkbox"/>	编辑 复制 删除	4422	STEVENS	MANAGER	7839	1994-01-14	24750.00	NULL	50

将 DEPT 设置为 EMP 的外键，

```
mysql> ALTER TABLE EMP ADD FOREIGN KEY(DEPTNO) REFERENCES DEPT2022280310(DEPTNO);
Query OK, 17 rows affected (0.02 sec)
Records: 17 Duplicates: 0 Warnings: 0
```

再次添加检查语句，发现插入失败，说明外键约束有效。

```
mysql> INSERT INTO EMP VALUES
-> (66,'SZU','SCHOOL', 6666, '1983-09-27', 88888.88, NULL, 00);
ERROR 1452 (23000): Cannot add or update a child row: a foreign key constraint fails (
expfirst.`emp`, CONSTRAINT `emp_ibfk_1` FOREIGN KEY (`deptno`) REFERENCES `dept2022280
310` (`DEPTNO`))
mysql>
```


3. 老师实验课上选取单表查询的难度较高的题目（要有题目语句和运行结果截屏）

①1.13 Find all the employees whose last names end with S

```
mysql> SELECT * FROM EMP WHERE ENAME LIKE '%S'
-> ;
```

empno	ename	job	mgr	hiredate	sal	comm	deptno
4422	STEVENS	MANAGER	7839	1994-01-14	24750.00	NULL	50
6548	BARNES	CLERK	4422	1995-01-16	11950.00	NULL	50
7566	JONES	MANAGER	7839	1989-04-02	26850.00	NULL	20
7876	ADAMS	CLERK	7788	1996-05-23	11900.00	NULL	20
7900	JAMES	CLERK	7698	1995-12-03	12500.00	NULL	30

5 rows in set (0.00 sec)

②7.9 Create a view for use by personnel in department 30 showing employee name, number, job and hiredate

SELECT 后面跟 employee name, number, job and hiredate, 设置 view 的列, where 设置查找条件

```
mysql> CREATE VIEW DEPT30_EMPLOYEES AS SELECT ename, empno, job, hiredate FROM
-> EMP WHERE deptno=30;
Query OK, 0 rows affected (0.00 sec)
```

由代码所建视图如下：

The screenshot shows a database management interface. On the left, a tree view displays the database structure, including a view named 'dept30_employees'. On the right, the SQL query 'SELECT * FROM `dept30_employees`' is entered. Below the query, there are controls for displaying all rows (25 rows shown) and a search filter. The data table below shows the following records:

	ename	empno	job	hiredate
<input type="checkbox"/>	ALLEN	7499	SALESMAN	1989-02-20
<input type="checkbox"/>	WARD	7521	SALESMAN	1993-02-22
<input type="checkbox"/>	MARTIN	7654	SALESMAN	1997-09-28
<input type="checkbox"/>	BLAKE	7698	MANAGER	1990-05-01
<input type="checkbox"/>	TURNER	7844	SALESMAN	1992-09-08
<input type="checkbox"/>	JAMES	7900	CLERK	1995-12-03

③5.4 List the average annual salary for all job groups having more than 2 employees in the group.

由于表中的 SAL 属性表示的是月薪，需要乘以 12 才是年薪。

```
mysql> SELECT JOB, AVG(SAL*12) AS AVER_ANNUAL_SAL FROM EMP GROUP BY JOB
-> HAVING COUNT(EMPNO)>2;
```

JOB	AVER_ANNUAL_SAL
CLERK	152040.000000
MANAGER	309300.000000
SALESMAN	216420.000000

```
3 rows in set (0.00 sec)
```

- ④5.5 Find all departments with an average commission greater than 25% of average salary.

需要用 having 设置条件 $AVG(COMM) > 0.25 * AVG(SAL)$

```
mysql> SELECT DEPTNO, AVG(SAL) AS AVER_SAL, AVG(COMM) AS AVER_COMM FROM EMP
-> GROUP BY DEPTNO HAVING AVG(COMM) > 0.25 * AVG(SAL);
```

DEPTNO	AVER_SAL	AVER_COMM
30	18029.166667	5100.0000

```
1 row in set (0.00 sec)
```

- ⑤5.6 Find each department's average annual salary for all its employees except the managers and the president.

用 WHERE 排除两个职业，再根据 department 的编号分组

```
mysql> SELECT DEPTNO, AVG(SAL) AS AVER_SAL FROM EMP
-> WHERE JOB NOT IN('MANAGER', 'PRESIDENT') GROUP BY DEPTNO
-> ;
```

DEPTNO	AVER_SAL
10	13250.000000
20	16662.500000
30	16835.000000
50	15225.000000

```
4 rows in set (0.00 sec)
```

- ⑥ Compute the daily and hourly salary for employees in department 30, round to the nearest penny. Assume there are 22 working days in a month and 8 working hours in a day.

四舍五入使用 ROUND 函数，日工资： $sal/22$ 小时工资： $(sal/22)/8$

员工有两个属性：编号和名字

```
mysql> SELECT EMPNO, ENAME, ROUND(SAL/22, 2) AS DAILY_SAL, ROUND((SAL/22)/8)
-> AS HOURLY_SAL FROM EMP WHERE DEPTNO=30;
```

EMPNO	ENAME	DAILY_SAL	HOURLY_SAL
7499	ALLEN	863.64	108
7521	WARD	840.91	105
7654	MARTIN	712.50	89
7698	BLAKE	1090.91	136
7844	TURNER	840.91	105
7900	JAMES	568.18	71

```
6 rows in set (0.00 sec)
```

五. 实验心得

本次实验较为成功，成功建立了目标数据库。同时遇到了一些问题并加以解决。

1. 在建好表后重新打开控制台，需要选择数据库才能对目标数据库进行插入等操作

```
mysql> use expfirst
Database changed
```

否则直接插入会报错

```
mysql> insert into dept2022280310 values
-> (10, 'ACCOUNTING', 'LONDON'),
-> (20, 'RESEARCH', 'PRESTON'),
-> (30, 'SALES', 'LIVERPOOL'),
-> (40, 'OPERATIONS', 'STAFFORD'),
-> (50, 'MARKETING', 'LUTON');
ERROR 1046 (3D000): No database selected
```

2. 给关系表添加外键时需要保证外键和其引用的列的数据类型必须完全匹配，包括精度。而我设计表时，EMP 表中的 deptno 列类型是 decimal(2,0)，而 dept2022280310 表中的 DEPTNO 列类型是 decimal(10,0)，精度不匹配，因此报错。

```
mysql> ALTER TABLE EMP ADD FOREIGN KEY(DEPTNO) REFERENCES DEPT2022280310(DEPTNO);
ERROR 1452 (23000): Cannot add or update a child row: a foreign key constraint fails (`expfirst`.`#sql-1468_c`, CONSTRAINT `#sql-1468_c_ibfk_1` FOREIGN KEY (`deptno`) REFEREN
CES `dept2022280310` (`DEPTNO`))
```

后来将 EMP 表中的 deptno 列类型改为 decimal(10,0)才解决。

```
mysql> ALTER TABLE EMP MODIFY deptno decimal(10,0);
Query OK, 17 rows affected (0.02 sec)
Records: 17 Duplicates: 0 Warnings: 0
```

六. 诚信承诺

本人郑重承诺在 SQL 实验的实施的过程中不发生任何不诚信现象，一切不诚信所导致的后果均由本人承担。

签名（手签，不得打印）：

指导教师批阅意见：

成绩评定：

指导教师签字：
年 月 日

备注：