

哈尔滨工业大学

<<数据库系统>>

实验报告一

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实验一

一、实验目的

掌握 MySQL 关系数据库管理系统的基本命令，并熟练使用 SQL 语言管理 MySQL 数据库。掌握 SQL 语言的使用方法，学会使用 SQL 语言进行关系数据库查询，特别是聚集查询、连接查询和嵌套查询。

二、实验环境

Windows 11 操作系统，MySQL 8.0.40 版本，Navicat 16.1.4

三、实验过程及结果

3.1 数据准备

3.1.1 创建关系数据库 company

创建关系数据库 company，其模式如下（下划线表示关系的主键）：

(1) 关系 EMPLOYEE (ENAME, ESSN, ADDRESS, SALARY, SUPERSSN, DNO)

- ENAME: 工作人员名字，
- ESSN: 工作人员身份证号，
- ADDRESS: 工作人员住址，
- SALARY: 工作人员工资，
- SUPERSSN: 工作人员直接领导的身份证号，
- DNO: 所属部门号

(2) 关系 DEPARTMENT (DNAME, DNO, MGRSSN, MGRSTARTDATE)

- DNAME: 部门名，
- DNEMBER: 部门号，
- MGRSSN: 部门领导身份证号，
- MGRSTARTDATE: 部门领导开始领导工作的日期

(3) 关系 PROJECT (PNAME, PNO, PLOCATION, DNO)

- PNAME: 工程项目名，
- PNO: 工程项目号，
- PLOCATION: 工程项目所在地，

- DNO: 工程项目所属部门号

(4) 关系 WORKS_ON (ESSN, PNO, HOURS)

- ESSN: 工作人员身份证号,
- PNO: 工程项目号,
- HOURS: 工作小时数

在终端启动 MySQL, 使用 “create database company;” 创建关系数据库 company, 并通过 “show databases;” 检查是否创建成功。

```

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

C:\Users\KangGe>mysql -u root -p
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 24
Server version: 8.0.40 MySQL Community Server - GPL

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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 company;
Query OK, 1 row affected (0.01 sec)

mysql> show databases;
+-----+
| Database |
+-----+
| company  |
| information_schema |
| library  |
| mysql    |
| performance_schema |
| student  |
| sys      |
+-----+
7 rows in set (0.00 sec)

mysql>

```

3.1.2 创建关系模式 employee、department、project 和 works_on

切换到刚创建的 company 数据库, 使用 “create table employee();” 创建新表 (关系模式), 括号内规定字段名和数据数据类型, 并设置主键。之后通过 “show tables;” 检查是否创建成功, 并通过 “describe employee;” 查看创建的 employee 表的字段名、数据类型、是否为空值、主键、默认值、备注等属性。

```

C:\Windows\system32\cmd.exe - mysql --local-infile=1 -u root -p

mysql> use company
Database changed
mysql> use company;
Database changed
mysql> create table employee(
  ->  ename varchar(12),
  ->  essn char(18),
  ->  address text,
  ->  salary int,
  ->  superssn char(18),
  ->  dno char(3),
  ->  primary key(essn));
Query OK, 0 rows affected (0.02 sec)

mysql> describe employee;
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| ename | varchar(12) | YES |  | NULL |  |
| essn | char(18) | NO | PRI | NULL |  |
| address | text | YES |  | NULL |  |
| salary | int | YES |  | NULL |  |
| superssn | char(18) | YES |  | NULL |  |
| dno | char(3) | YES |  | NULL |  |
+-----+-----+-----+-----+-----+-----+
6 rows in set (0.00 sec)

mysql>

```

同理，继续创建关系模式 department、project 和 works_on。

```

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

mysql> create table department(
  -> dname varchar(15),
  -> dno char(3),
  -> mgrssn char(18),
  -> mgrstartdate date,
  -> primary key(dno));
Query OK, 0 rows affected (0.02 sec)

mysql> create table project(
  -> pname varchar(3),
  -> pno char(2),
  -> plocation text,
  -> dno char(3),
  -> primary key(pno));
Query OK, 0 rows affected (0.02 sec)

mysql> create table works_on(
  -> essn char(18),
  -> pno char(2),
  -> hours int,
  -> primary key(essn, pno));
Query OK, 0 rows affected (0.02 sec)

mysql> show tables;
+-----+
| Tables_in_company |
+-----+
| department         |
| employee           |
| project            |
| works_on           |
+-----+
4 rows in set (0.00 sec)

mysql>

```

3.1.3 添加数据

向创建的数据库 company 中添加数据，以备后续查询使用。

重新启动 MySQL，设置 local-infile 参数为 1，输入“set global local_infile=true”，以便可以从本地导入数据。

```

C:\Windows\system32\cmd.exe - mysql --local-infile=1 -u root -p

C:\Users\KangGe>mysql --local-infile=1 -u root -p
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 27
Server version: 8.0.40 MySQL Community Server - GPL

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owners.

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

mysql> show global variables like "local_infile";
+-----+
| Variable_name | Value |
+-----+
| local_infile  | OFF   |
+-----+
1 row in set, 1 warning (0.00 sec)

mysql> set global local_infile=true;
Query OK, 0 rows affected (0.01 sec)

mysql> show global variables like "local_infile";
+-----+
| Variable_name | Value |
+-----+
| local_infile  | ON    |
+-----+
1 row in set, 1 warning (0.00 sec)

mysql>

```

切换到 company 数据库，首先使用“delete from xxx;”清空表内数据，然后通过“load data local infile <path> into table xxx;”从本地导入数据到表中。

```

C:\Windows\system32\cmd.exe - mysql --local-infile=1 -u root -p

mysql> use company;
Database changed
mysql> delete from employee;
Query OK, 0 rows affected (0.00 sec)

mysql> delete from department;
Query OK, 0 rows affected (0.00 sec)

mysql> delete from project;
Query OK, 0 rows affected (0.00 sec)

mysql> delete from works_on;
Query OK, 0 rows affected (0.00 sec)

mysql> load data local infile "C:/Users/KangGe/Desktop/数据库/实验/实验一/employee.txt" into table employee;
Query OK, 50 rows affected (0.00 sec)
Records: 50 Deleted: 0 Skipped: 0 Warnings: 0

mysql> load data local infile "C:/Users/KangGe/Desktop/数据库/实验/实验一/department.txt" into table department;
Query OK, 5 rows affected, 4 warnings (0.00 sec)
Records: 5 Deleted: 0 Skipped: 0 Warnings: 4

mysql> load data local infile "C:/Users/KangGe/Desktop/数据库/实验/实验一/project.txt" into table project;
Query OK, 10 rows affected (0.01 sec)
Records: 10 Deleted: 0 Skipped: 0 Warnings: 0

mysql> load data local infile "C:/Users/KangGe/Desktop/数据库/实验/实验一/works_on.txt" into table works_on;
Query OK, 109 rows affected (0.01 sec)
Records: 109 Deleted: 0 Skipped: 0 Warnings: 0

mysql>

```

使用 Navicat 可以查看到已成功添加数据，下面开始完成查询操作。

对象 department @company (DBMS) - 表			
DNAME	DNO	MGRSSN	MGRSTARTDATE
甲类一车间	A01	131181199901012113	2020-10-10
甲类二车间	A02	131181199902102123	2023-01-25
乙类一车间	B01	131181199903012133	2022-05-06
乙类二车间	B02	131181199904022143	2021-09-11
研发部	C10	131181199905032153	2022-06-09

对象 employee @company (DBMS) - 表					
ENAME	ESSN	ADDRESS	SALARY	SUPERSSN	DNO
王大一	131181199901012113	王家村	7000.00	131181199901012113	A01
王小二	131181199901022113	王家村	5000.00	131181199901012113	A01
王三	131181199901032113	王家村	3000.00	131181199901012113	A01
王四	131181199901042113	王家村	3000.00	131181199901012113	A01
王五	131181199901052113	王家村	3000.00	131181199901012113	A01
王六	131181199901062113	王家村	3000.00	131181199901012113	A01
王七	131181199901072113	王家村	3000.00	131181199901012113	A01
王八	131181199901082113	王家村	3000.00	131181199901012113	A01
王九	131181199901092113	王家村	3000.00	131181199901012113	A01
王十	131181199901102113	王家村	3000.00	131181199901012113	A01
张大一	131181199902012123	张家村	5000.00	131181199902102123	A02
张小二	131181199902022123	张家村	3000.00	131181199902102123	A02
张三	131181199902032123	张家村	2000.00	131181199902102123	A02
张四	131181199902042123	张家村	2000.00	131181199902102123	A02
张五	131181199902052123	张家村	2000.00	131181199902102123	A02
张六	131181199902062123	张家村	2000.00	131181199902102123	A02

对象 project @company (DBMS) - 表			
PNAME	PNO	PLOCATION	DNO
SQL	P1	S市	A01
PPA	P2	S市	A01
D3T	P3	D市	B01
ABZ	P4	S市	A01
QC	P5	D市	B01
PG	P6	P市	A02
OT9	P7	D市	B01
5E	P8	D市	B01
SSP	P9	T市	B02
WW	PZ	W市	C10

对象 works_on @company (DBMS) - 表		
ESSN	PNO	HOURS
131181199901012113	P1	1
131181199901012113	P2	3
131181199901012113	P4	2
131181199901022113	P1	2
131181199901022113	P2	2
131181199901022113	P4	2
131181199901032113	P1	6
131181199901032113	P2	3
131181199901032113	P4	1
131181199901042113	P1	3
131181199901042113	P2	1
131181199901042113	P4	1
131181199901052113	P1	5
131181199901052113	P2	3
131181199901052113	P4	2
131181199901062113	P1	3
131181199901062113	P2	3
131181199901062113	P4	0
131181199901072113	P1	2
131181199901072113	P2	9
131181199901072113	P4	0
131181199901082113	P1	0
131181199901082113	P2	0
131181199901082113	P4	10
131181199901092113	P1	0
131181199901092113	P2	9
131181199901092113	P4	2
131181199901102113	P1	3
131181199901102113	P2	0
131181199901102113	P4	4
131181199902012123	P6	5
131181199902022123	P6	4
131181199902032123	P6	4
131181199902042123	P6	3
131181199902052123	P6	4

3.2 参加了项目名为“SQL Project”的员工名字

SQL 查询语句为 select ename from employee where essn in (select essn from project, works_on where project.pno=works_on.pno and pname='SQL' and hours>0);

```

C:\Windows\system32\cmd.exe - mysql ...
mysql>
mysql> select ename from employee
-> where essn in (
-> select essn from project, works_on
-> where project.pno=works_on.pno
-> and pname='SQL'
-> and hours>0);
+-----+
| ename |
+-----+
| 王大一 |
| 王小二 |
| 王三   |
| 王四   |
| 王五   |
| 王六   |
| 王七   |
| 王十   |
| 孙小二 |
+-----+
9 rows in set (0.00 sec)

mysql>

```

3.3 在“Research Department”工作且工资低于 3000 元的员工名字和地址

SQL 查询语句为 select ename , address from employee, department where employee.dno=department.dno and dname='研发部' and salary<3000;

```

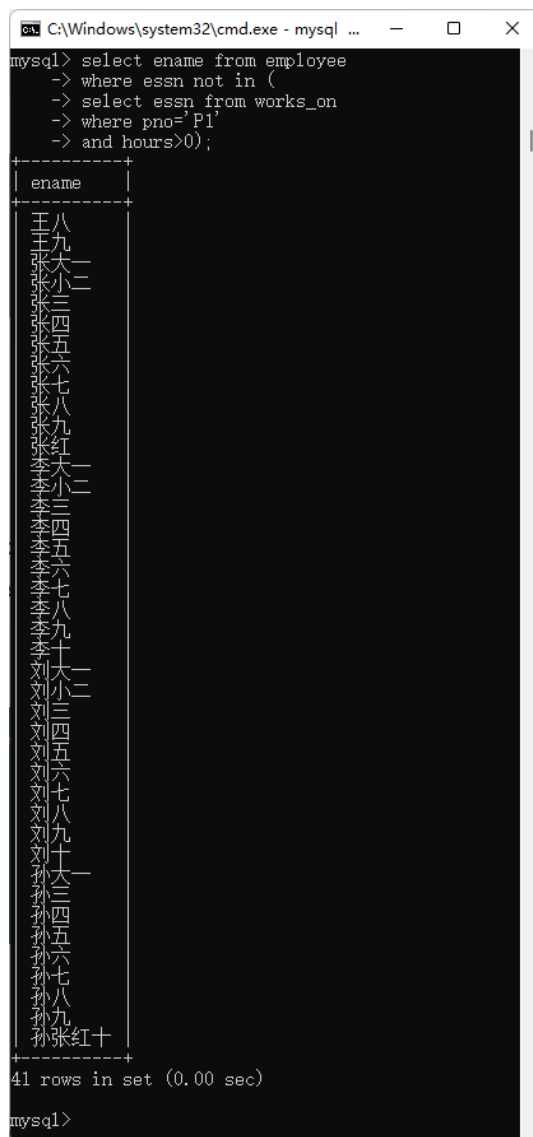
C:\Windows\system32\cmd.exe - mysql --local-infile...
mysql> select ename , address from employee, department
-> where employee.dno=department.dno
-> and dname='研发部'
-> and salary<3000;
+-----+-----+
| ename | address |
+-----+-----+
| 孙四   | 孙村   |
| 孙五   | 孙村   |
| 孙六   | 孙村   |
| 孙张红十 | 孙村   |
+-----+-----+
4 rows in set (0.00 sec)

mysql>

```

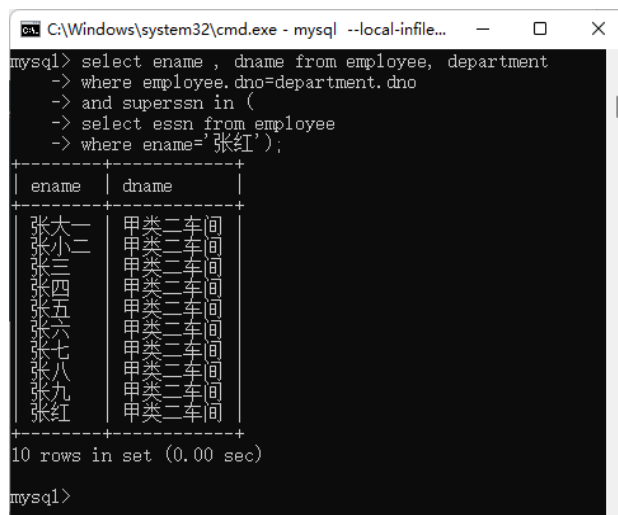
3.4 没有参加项目编号为 P1 的项目的员工姓名

SQL 查询语句为 select ename from employee where essn not in (select essn from works_on where pno='P1' and hours>0);



3.5 由张红领导的工作人员的姓名和所在部门的名字

SQL 查询语句为 select ename , dname from employee, department where employee.dno=department.dno and superssn in (select essn from employee where ename='张红');



3.6 至少参加了项目编号为 P1 和 P2 的项目的员工号

SQL 查询语句为 select essn from works_on where pno='P1' and hours>0 and essn in (select essn from works_on where pno='P2' and hours>0);

```
C:\Windows\system32\cmd.exe - mysql ...
mysql> select essn from works_on
-> where pno='P1'
-> and hours>0
-> and essn in (
-> select essn from works_on
-> where pno='P2'
-> and hours>0);
+-----+
| essn |
+-----+
| 131181199901012113 |
| 131181199901022113 |
| 131181199901032113 |
| 131181199901042113 |
| 131181199901052113 |
| 131181199901062113 |
| 131181199901072113 |
| 131181199905022153 |
+-----+
8 rows in set (0.00 sec)

mysql>
```

3.7 参加了全部项目的员工号码和姓名

SQL 查询语句为 select essn , ename from employee where not exists (select pno from project where not exists (select * from works_on where works_on.pno=project.pno and works_on.essn=employee.essn));

```
C:\Windows\system32\cmd.exe - mysql ...
mysql> select essn , ename from employee
-> where not exists (
-> select pno from project
-> where not exists (
-> select * from works_on
-> where works_on.pno=project.pno
-> and works_on.essn=employee.essn));
+-----+-----+
| essn | ename |
+-----+-----+
| 131181199905022153 | 孙小二 |
+-----+-----+
1 row in set (0.00 sec)

mysql> _
```

3.8 员工平均工资低于 3000 元的部门名称

SQL 查询语句为 select dname from department where dno in (select dno from employee group by dno having avg(salary)<3000);

```
C:\Windows\system32\cmd.exe - mysql ...
mysql> select dname from department
-> where dno in (
-> select dno from employee
-> group by dno having avg(salary)<3000);
+-----+
| dname |
+-----+
| 乙类二车间 |
+-----+
1 row in set (0.00 sec)

mysql> _
```


3.9 至少参与了 3 个项目且工作总时间不超过 8 小时的员工名字

SQL 查询语句为 select ename from employee where essn in (select essn from works_on group by essn having count(pno)>=3 and sum(hours)<=8);

```

mysql> select ename from employee
-> where essn in (
-> select essn from works_on
-> group by essn having count(pno)>=3
-> and sum(hours)<=8);
+-----+
| ename |
+-----+
| 王大一 |
| 王小二 |
| 王四   |
| 王六   |
| 王十一 |
| 李十一 |
| 李十一 |
| 李十一 |
| 李十一 |
+-----+
9 rows in set (0.01 sec)

mysql>

```

3.10 每个部门的员工小时平均工资

SQL 查询语句为 select sums.dno, sums.salary/sumhours as hoursavgsalary from (select dno , sum(salary) as sums.salary from employee group by dno) as sums, (select dno , sum(hours) as sumhours from works_on join employee on works_on.essn=employee.essn group by dno) as sumh where sums.dno=sumh.dno;

```

mysql> select sums.dno, sums.salary/sumhours as hoursavgsalary
-> from (select dno , sum(salary) as sums.salary from employee group by dno) as sums,
-> (select dno , sum(hours) as sumhours from works_on join employee on works_on.essn=employee.essn group by dno) as sumh
-> where sums.dno=sumh.dno;
+-----+-----+
| dno | hoursavgsalary |
+-----+-----+
| A01 | 439.0244       |
| A02 | 652.1739       |
| B01 | 685.3933       |
| B02 | 638.7097       |
| C10 | 858.9153       |
+-----+-----+
5 rows in set (0.00 sec)

mysql>

```

四、实验心得

(1) 掌握了 MySQL 关系数据库管理系统的基本命令，学会了 SQL 语言的使用方法，可以熟练使用 SQL 语言管理 MySQL 数据库。

(2) 学会了使用 SQL 语言进行聚集查询、连接查询和嵌套查询等关系数据库查询，对数据库管理系统、关系数据模型、关系代数和 SQL 查询有了更深入的理解。

(3) 查询参加了全部项目的员工时，SQL 不支持全称量词 \forall ，可以使用 not exists 间接实现全称量词 \forall 功能。