华东师范大学软件工程学院实验报告

实验课程：数据库系统及其应用实践	**年级**：2023 级	**实验成绩**：
实验名称：Lab-01	**姓名**：顾翌炜	
实验编号：Lab-01	**学号**：10235101527	**实验日期**：2025/03/06
指导教师：姚俊杰	**组号**：01	**实验时间**：2 课时

备注

在基于 college 的 task2 中，涉及到很多 name 相同，id 却不同的学生的问题，考虑到其中的 2000 个 id 无一重复，而 name 却有 432 个重复，显得有些不合理，所以相关问题我都用了两种方法来回答（一种是 **distinct ID**，一种是 **distinct name**）两种方法在我的报告里都会有展示

1 实验目标

学习和熟悉使用 SQL 查询语句

2 实验要求

1) 按照实验内容，依次完成每个实验步骤；
2) 操作实验步骤时，需要理解该操作步骤的目的，预判操作的结果；当操作结果与预判不符时，及时向任课教师和助教咨询；
3) 在实验报告中依次记录主要操作步骤的内容和结果（返回的消息或截图）；
4) 对实验中遇到的问题、解决方案及收获进行总结；
5) 确保实验报告整洁、美观（注意字体、字号、对齐、截图大小和分页等；）

3 实验过程记录

3.1 安装 sql 环境以及数据库的集成开发环境

按照老师提供的文档安装 sql 环境并配置，安装方法略

3.2 新建数据库并运行 sql 文件

在 DataGrip 中新建一个数据库并测试连接

图 1: 测试连接

运行 Lab-01 文件夹内的 **activity.sql** 和 **college.sql** 文件完成实验的环境创建。

3.3 Task 1 - based on database activity

通过观察 **activity.sql** 可以发现：

activity.sql

```sql
-- ----------------------------
-- Table structure for activity
-- ----------------------------
CREATE TABLE `activity`  (
`actid` int NOT NULL,
`activity_name` varchar(25) CHARACTER SET utf8mb4 COLLATE utf8mb4_0900_ai_ci
    NULL DEFAULT NULL,
PRIMARY KEY (`actid`) USING BTREE
) ENGINE = InnoDB CHARACTER SET = utf8mb4 COLLATE = utf8mb4_0900_ai_ci
    ROW_FORMAT = Dynamic;

-- ----------------------------
-- Table structure for faculty
-- ----------------------------
CREATE TABLE `faculty`  (
`FacID` int NOT NULL,
`Lname` varchar(15) CHARACTER SET utf8mb4 COLLATE utf8mb4_0900_ai_ci NULL
    DEFAULT NULL,
`Fname` varchar(15) CHARACTER SET utf8mb4 COLLATE utf8mb4_0900_ai_ci NULL
    DEFAULT NULL,
`_Rank` varchar(15) CHARACTER SET utf8mb4 COLLATE utf8mb4_0900_ai_ci NULL
    DEFAULT NULL,
```

```
18  `Sex` char(1) CHARACTER SET utf8mb4 COLLATE utf8mb4_0900_ai_ci NULL DEFAULT NULL
        ,
19  `Phone` int NULL DEFAULT NULL,
20  `Room` char(5) CHARACTER SET utf8mb4 COLLATE utf8mb4_0900_ai_ci NULL DEFAULT
        NULL,
21  `Building` varchar(13) CHARACTER SET utf8mb4 COLLATE utf8mb4_0900_ai_ci NULL
        DEFAULT NULL,
22  PRIMARY KEY (`FacID`) USING BTREE
23  ) ENGINE = InnoDB CHARACTER SET = utf8mb4 COLLATE = utf8mb4_0900_ai_ci
        ROW_FORMAT = Dynamic;
24
25
26  -- ----------------------------
27  -- 以下省略，共五张表格
28  -- ----------------------------
```

可以看出 **activity** 中表格的列如下所示：

activity 的表格

activity (actid, activity_name)
faculty (FacID, Lname, Fname, _Rank, Sex, Phone, Room, Building)
faculty_participate_in (FacID, actid)
participate_in (stuid, actid)
student (StuID, LName, Fname, Age, Sex, Major, Advisor, city_code)

为了更清晰的展现数据库中外键等关系，可以用下图形式展现：

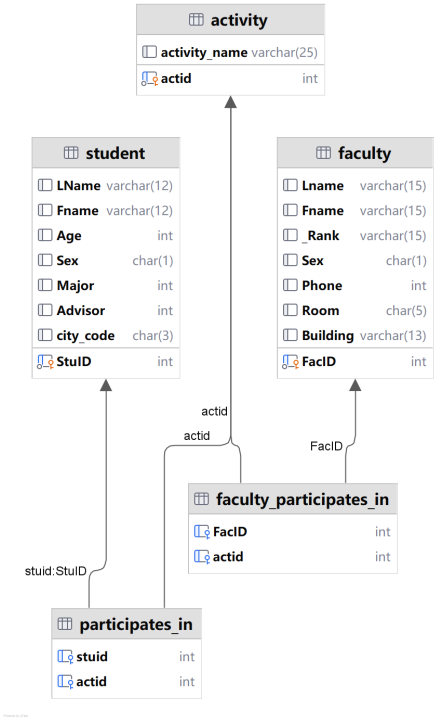


图 2: activity 关系

3.3.1 Queation 0

Give me the number of faculty members who participate in an activity (easy)

Queation 0

```
1    select count(distinct faculty.FacID)
2    from faculty,
3        faculty_participates_in
4    where faculty.FacID = faculty_participates_in.FacID;
```

运行结果入下图所示：

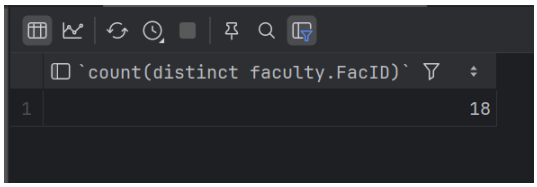


图 3: Question 0

得到的结果是：18

3.3.2 Queation 1

How many activities do we have? (easy)

Queation 1

```
1    select count(actid)
2    from activity;
```

运行结果入下图所示：

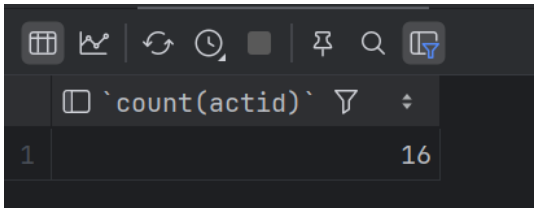


图 4: Question 1

得到的结果是：16

3.3.3 Question 2

How many faculty members does each building have? List the result with the name of the building. (medium)

Question 2

```
1    select Building, count(FacID)
2    from faculty
3    group by Building;
```

运行结果如下图所示：

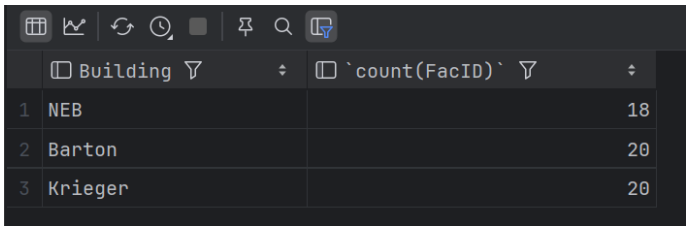


图 5: Question 2

得到的结果是：

- NEB, 18

- Barton, 20
- Krieger, 20

3.3.4 Question 3

How many activities does Mark Giuliano participate in? (medium)

Question 3

```
select count(faculty_participates_in.actid)
from faculty_participates_in,
     faculty
where faculty_participates_in.FacID = faculty.FacID
  and faculty.Fname = 'Mark'
  and faculty.Lname = 'Giuliano';
```

运行结果如下图所示：

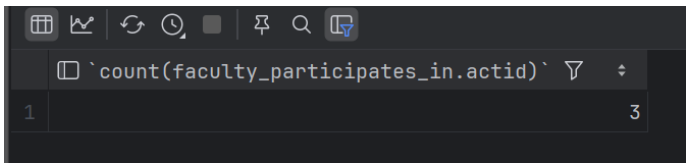


图 6: Question 3

得到的结果是：3

3.3.5 Question 4

Show the ids of the faculty who don't participate in any activity. (hard)

Question 4

```
select distinct faculty.FacID
from faculty,
faculty_participates_in
where faculty.FacID not in (select distinct faculty.FacID
                            from faculty,
                                 faculty_participates_in
                            where faculty.FacID = faculty_participates_in.
                                FacID);
```

运行结果如下图所示：

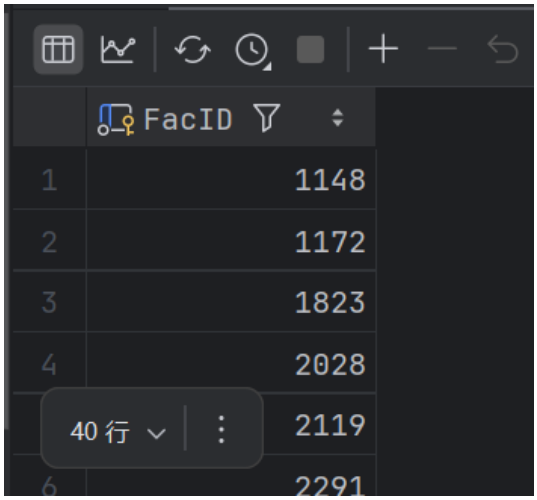


图 7: Question 4

得到的结果是：1148, 1172, 1823 等 40 个元组

3.3.6 Question 5

What are the ids of the faculty members who do not advise any student? (hard)

Question 5

```
1    select FacID
2    from faculty
3    where FacID not in (select distinct Advisor
4                        from student);
```

运行结果如下图所示：

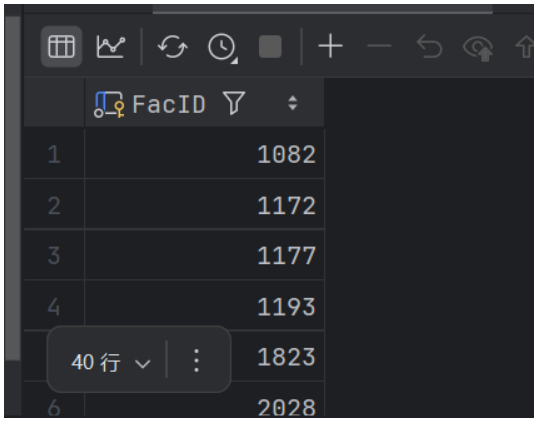


图 8: Question 5

得到的结果是：1082, 1172, 1177 等 40 个元组

3.3.7 Question 6

Find the name of the activity that has the largest number of student participants. (extra)

Question 6

```
select activity_name
from (select activity_name, count(activity.actid)
      from activity,
           participates_in
      where activity.actid = participates_in.actid
      group by activity_name
      order by count(activity.actid) desc
      limit 1) as activity_count;
```

运行结果如下图所示：

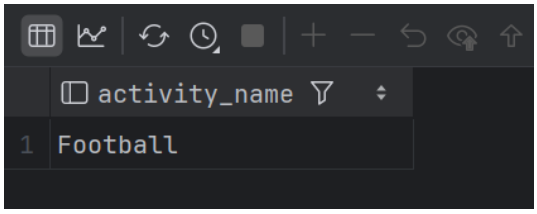


图 9: Question 6

得到的结果是：Football

3.3.8 Question 7

What are the first name and last name of Linda Smith's advisor? (extra)

Question 7

```
select faculty.Fname, faculty.LName
from faculty
where FacID = (select student.Advisor
               from student
               where Fname = 'Linda'
                 and LName = 'Smith');
```

运行结果如下图所示：

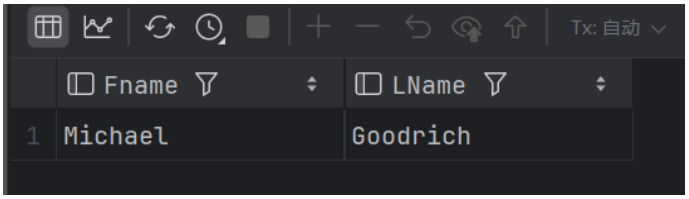


图 10: Question 7

得到的结果是：Michael, Goodrich

3.3.9 Question 8

Give me the first and last name of the faculty who advises the most students. (extra)

Question 8

```
1     select faculty.Fname, faculty.Lname
2     from faculty
3     where faculty.FacID = (select student.Advisor
4                            from student
5                            group by student.Advisor
6                            order by count(student.StuID) desc
7                            limit 1);
```

运行结果如下图所示：

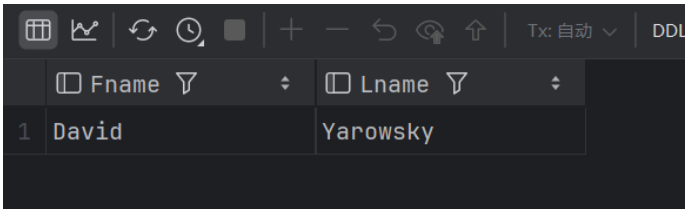


图 11: Question 8

得到的结果是：David, Yarowsky

3.3.10 Question 9

Find the ids of the students who participate in Canoeing and Kayaking. (extra)

Question 9

```
1     select distinct s.StuID
2     from student s
3     where s.StuID in (select s1.StuID
```

```
4                       from student s1,
5                            participates_in,
6                            activity
7                       where s1.StuID = participates_in.stuid
8                         and participates_in.actid = activity.actid
9                         and activity.activity_name = ('Canoeing'))
10                        and s.StuID in (select s2.StuID
11                      from student s2,
12                           participates_in,
13                           activity
14                      where s2.StuID = participates_in.stuid
15                        and participates_in.actid = activity.actid
16                        and activity.activity_name = ('Kayaking'))
```

运行结果如下图所示：

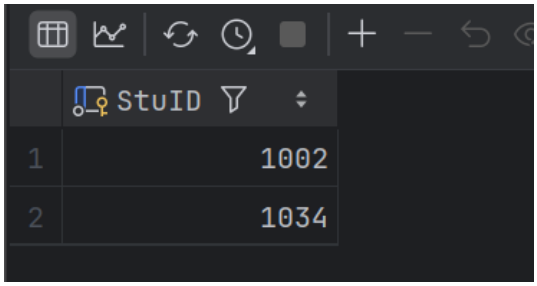


图 12: Question 9

得到的结果是：

- 1002
- 1034

3.4 Task 2 - based on database college

通过观察 **college.sql** 可以发现：

activity.sql

```
1       -- ----------------------------
2       -- Table structure for advisor
3       -- ----------------------------
4       DROP TABLE IF EXISTS `advisor`;
5       CREATE TABLE `advisor`  (
6       `s_ID` varchar(5) CHARACTER SET utf8mb4 COLLATE utf8mb4_0900_ai_ci NOT NULL,
7       `i_ID` varchar(5) CHARACTER SET utf8mb4 COLLATE utf8mb4_0900_ai_ci NULL
            DEFAULT NULL,
```

```
8     PRIMARY KEY (`s_ID`) USING BTREE,
9     INDEX `i_ID`(`i_ID` ASC) USING BTREE,
10    CONSTRAINT `advisor_ibfk_1` FOREIGN KEY (`i_ID`) REFERENCES `instructor` (`
          ID`) ON DELETE SET NULL ON UPDATE RESTRICT,
11    CONSTRAINT `advisor_ibfk_2` FOREIGN KEY (`s_ID`) REFERENCES `student` (`ID`)
           ON DELETE CASCADE ON UPDATE RESTRICT
12    ) ENGINE = InnoDB CHARACTER SET = utf8mb4 COLLATE = utf8mb4_0900_ai_ci
          ROW_FORMAT = Dynamic;
13
14
15    -- ----------------------------
16    -- 以下省略，共11张表格
17    -- ----------------------------
```

可以看出 **college** 中表格的列如下所示：

ER Diagram 表格

department (building, budget, dept_name)
course (course_id, title, dept_name, credits)
classroom (building, room_number, capacity)
prereq (course_id, prereq_id)
section (course_id, sec_id, semester, year, building, room_number, time_slot_id)
instructor (ID, name, dept_name, salary)
student (ID, name, dept_name, tot_cred)
time_slot (time_slot_id, day, start_hr, start_min, end_hr, end_min)
teaches (ID, course_id, sec_id, semester, year)
takes (ID, course_id, sec_id, semester, year, grade)
advisor (s_ID, i_ID)

为了更清晰的展现数据库中外键等关系，可以用下图形式展现：

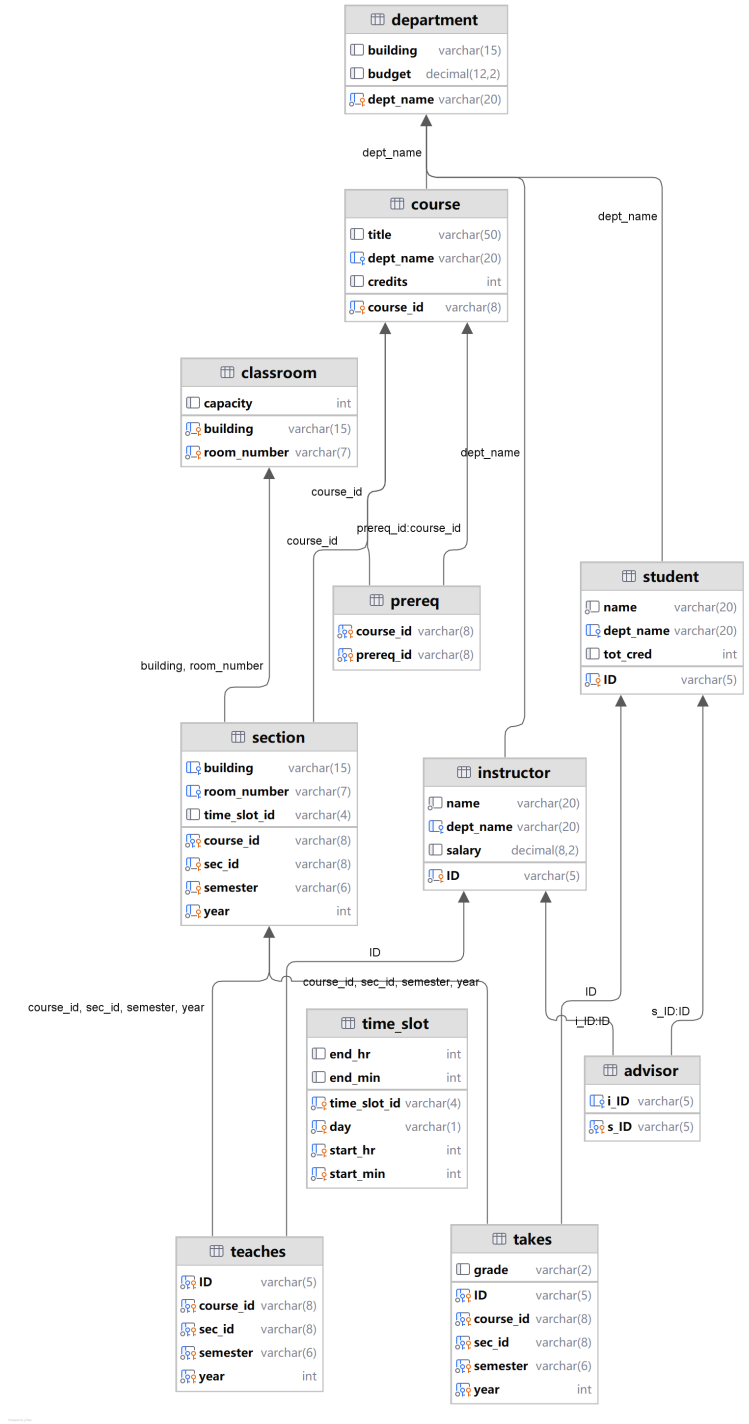


图 13: activity 关系

3.4.1 Question 10

List the names of all courses ordered by their titles and credits. (easy)

Question 10

```
1    select title
2    from course
3    order by title, credits;
```

运行结果如下图所示：

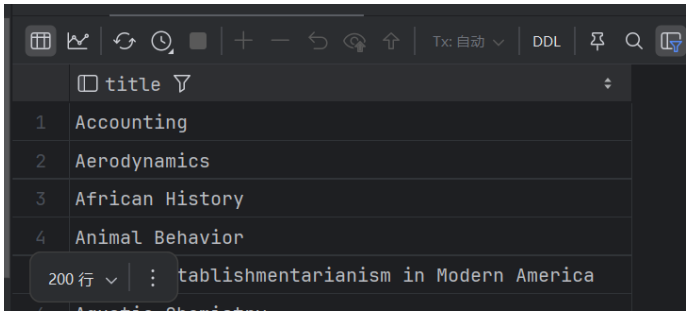


图 14: Question 10

得到的结果是：Accounting, Aerodynamics 等 200 个元组

3.4.2 Question 11

Count the number of students who have advisors. (easy)

答案 1：假设相同的 name 表示同一个学生

Question 11

```
1    select count(distinct student.name)
2    from student
3            join advisor
4                on student.ID = advisor.s_ID
5                    and i_ID is not null;
```

运行结果如下图所示：

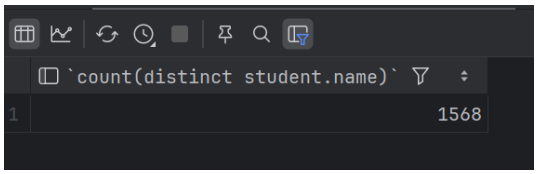


图 15: Question 11

得到的结果是：1568

备注：由于本题涉及到了 id 没有重复值，name 却有 432 个重复值的问题，所以本题上传第二种答案

答案 2：假设相同的 id 表示同一个学生

Question 11

```
1    select count(distinct student.ID)
2    from student
3            join advisor
4                on student.ID = advisor.s_ID
5                    and i_ID is not null;
```

运行结果如下图所示：

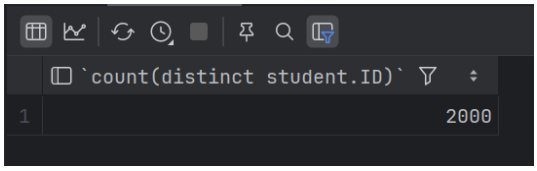


图 16: Question 11

得到的结果是：2000

3.4.3 Question 12

How many departments offer courses? (easy)

Question 12

```
1    select count(distinct course.dept_name)
2    from course;
```

运行结果如下图所示：

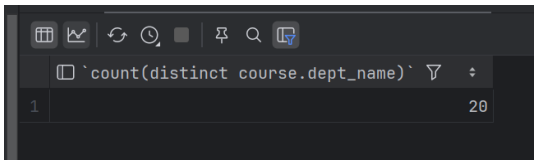


图 17: Question 12

得到的结果是：20

3.4.4 Question 13

List the information of all instructors ordered by their salary in ascending order. (easy)

Question 13

```
1    select *
2    from instructor
```

```
3       order by salary;
```

运行结果如下图所示：

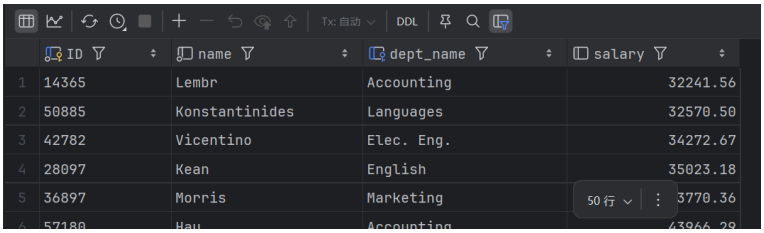


图 18: Question 13

得到的结果是：(14365, Lembr, Accounting, 32241.56) 等 50 个元组

3.4.5 Question 14

How many different courses offered by Physics department? (easy)

Question 14

```
1       select count(course.title)
2       from course
3       where dept_name = 'Physics';
```

运行结果如下图所示：

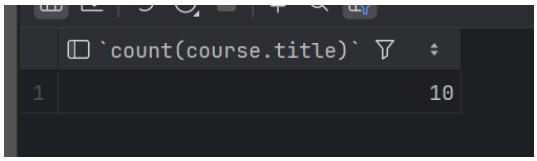


图 19: Question 14

得到的结果是：10

3.4.6 Question 15

What are the titles for courses with two prerequisites? (medium)

Question 15

```
1       select title
2       from course
3           join prereq
4               on course.course_id = prereq.course_id
```

```
5       group by course.course_id
6       having count(prereq_id) = 2;
```

运行结果如下图所示：

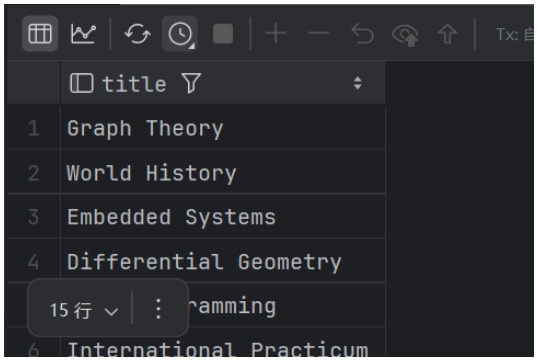


图 20: Question 15

得到的结果是：Graph Theory, World History 等 15 个元组

3.4.7 Question 16

What is the title, credit value, and department name for courses with more than one prerequisite? (medium)

Question 16

```
1       select title, credits, dept_name
2       from course
3               join prereq
4                   on course.course_id = prereq.course_id
5       group by title, credits, dept_name
6       having count(prereq_id) > 1;
```

运行结果如下图所示：

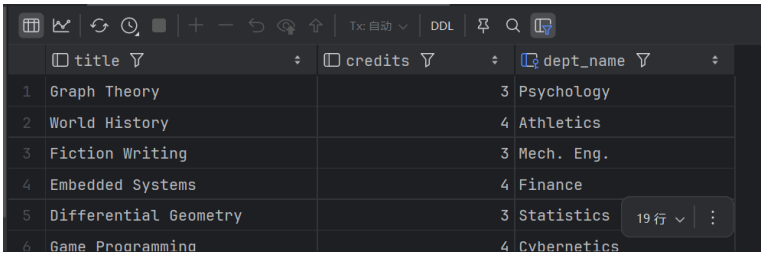


图 21: Question 16

得到的结果是：(Graph Theory,3,Psychology) 等 19 个元组

3.4.8 Question 17

Give the title of the course offered in Chandler during the Fall of 2010. (medium)

Question 17

```
select title
from course
        join section
            on course.course_id = section.course_id
where building = 'Chandler'
  and semester = 'Fall'
  and year = 2010;
```

运行结果如下图所示：

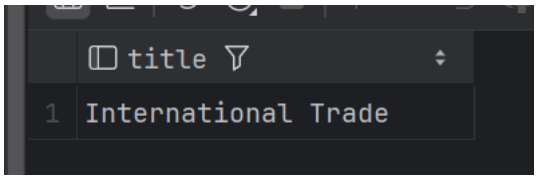


图 22: Question 17

得到的结果是：International Trade

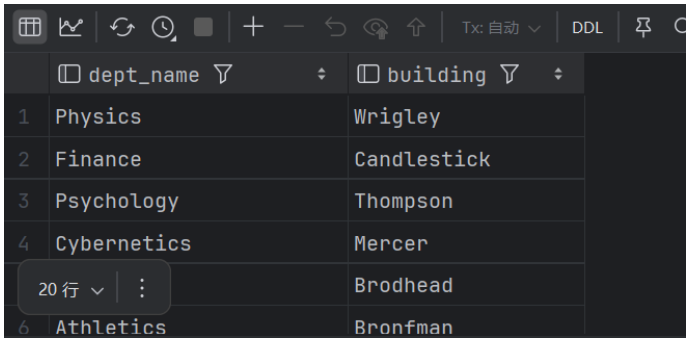
3.4.9 Question 18

List the names and buildings of all departments sorted by the budget from large to small. (medium)

Question 18

```
select dept_name, building
from department
order by budget desc;
```

运行结果如下图所示：



	dept_name	building
1	Physics	Wrigley
2	Finance	Candlestick
3	Psychology	Thompson
4	Cybernetics	Mercer
	20 行	Brodhead
6	Athletics	Bronfman

图 23: Question 18

得到的结果是：(Physics, Wrigley) 等 20 个元组

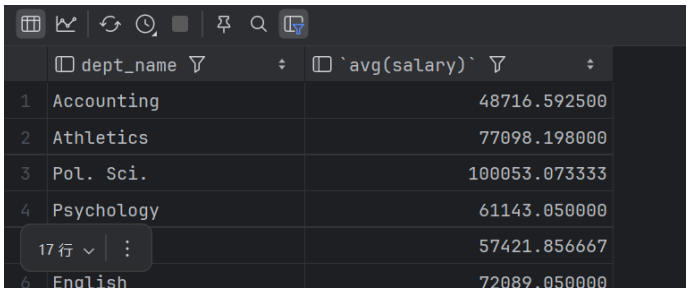
3.4.10 Question 19

Find the names and average salaries of all departments whose average salary is greater than 42000. (medium)

Question 19

```
1    select department.dept_name, avg(salary) as avg_salary
2    from department
3        join instructor
4        on department.dept_name = instructor.dept_name
5    group by department.dept_name
6    having avg_salary > 42000;
```

运行结果如下图所示：



	dept_name	`avg(salary)`
1	Accounting	48716.592500
2	Athletics	77098.198000
3	Pol. Sci.	100053.073333
4	Psychology	61143.050000
	17 行	57421.856667
6	English	72089.050000

图 24: Question 19

得到的结果是：(Accounting, 48716.592500) 等 17 个元组

3.4.11 Question 20

Find the number of rooms with more than 50 capacity for each building. (medium)

Question 20

```
1    select building, count(*) as num_rooms
2    from classroom
3    where capacity > 50
4    group by building;
```

运行结果如下图所示：

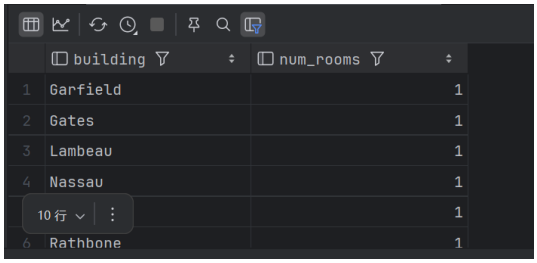


图 25: Question 20

得到的结果是：11

3.4.12 Question 21

Find the total number of students in each department. (medium)

Question 21

```
1    select department.dept_name, count(student.name) as students_number
2    from department
3             join student
4             on department.dept_name = student.dept_name
5    group by department.dept_name;
```

运行结果如下图所示：

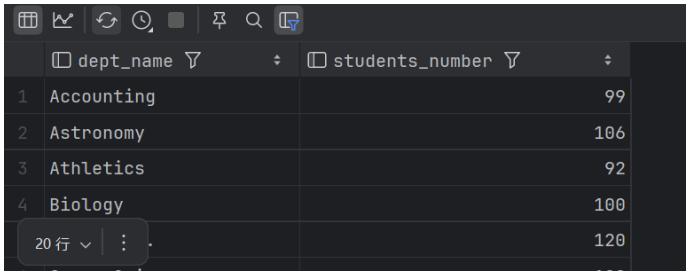


图 26: Question 21

得到的结果是：(Account, 99) 等 20 个元组

3.4.13 Question 22

How many rooms whose capacity is less than 50 does the Lamberton building have? (medium)

Question 22

```
1    select count(*)
2    from classroom
3    where capacity < 50
4      and building = 'Lamberton';
```

运行结果如下图所示：

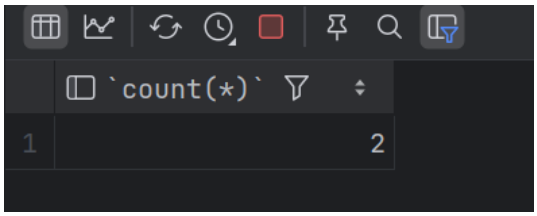


图 27: Question 22

得到的结果是：2

3.4.14 Question 23

What are the names of students who have more than one advisor? (medium)
答案 1：假设相同的 name 表示同一个学生

Question 23

```
1    select name
2    from student
3            join advisor
4                on student.ID = advisor.s_ID
5    group by name
6    having count(i_ID) > 1;
```

运行结果如下图所示：

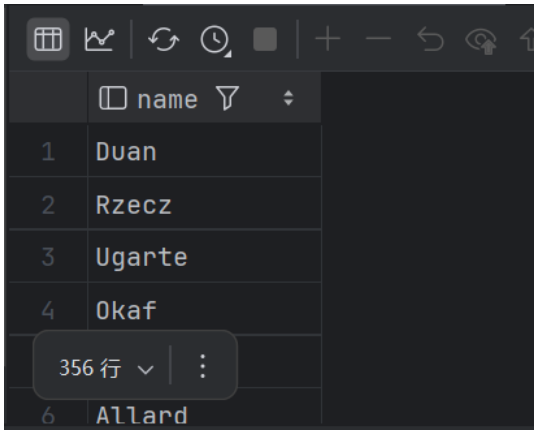


图 28: Question 23

得到的结果是：(Duan, 2), (Rzecz, 2) 等 356 个元组

备注：由于本题涉及到了 id 没有重复值，name 却有 432 个重复值的问题，所以本题上传第二种答案

答案 2：假设相同的 ID 表示同一个学生

Question 23

```
select ID
from student
        join advisor
            on student.ID = advisor.s_ID
group by ID
having count(i_ID) > 1;
```

运行结果如下图所示：

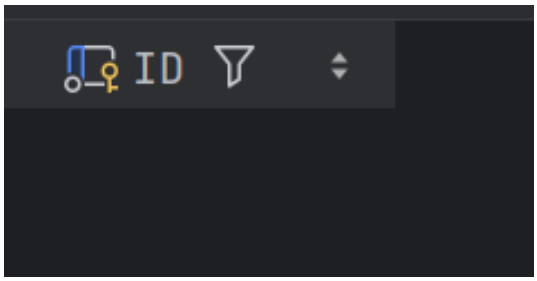


图 29: Question 23

得到的结果是：空

3.4.15 Question 24

Find the department name of the instructor whose name contains 'Soisalon'. (medium)

Question 24

```
SELECT dept_name
FROM instructor
WHERE name LIKE '%Soisalon%'
  OR name LIKE 'Soisalon%'
  OR name LIKE '%Soisalon'
  OR name = 'Soisalon';
```

运行结果如下图所示：

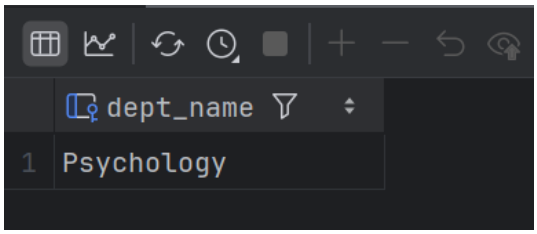


图 30: Question 24

得到的结果是：Psychology

3.4.16 Question 25

Give the name of the department with the lowest budget. (medium)

Question 25

```
select dept_name
from department
order by budget
limit 1;
```

运行结果如下图所示：

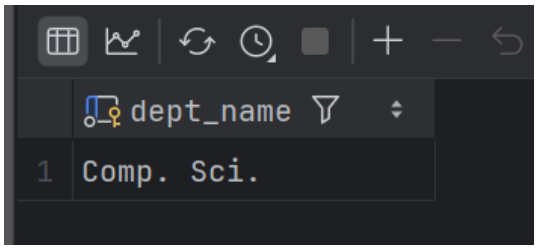


图 31: Question 25

得到的结果是：Comp. Sci.

3.4.17 Question 26

What is the title of the course that is a prerequisite for Mobile Computing? (hard)

Question 26

```
select title
from course
where course_id in (select prereq_id
                    from course
                             join prereq
                                 on course.course_id = prereq.course_id
                    where course.title = 'Mobile Computing');
```

运行结果如下图所示：

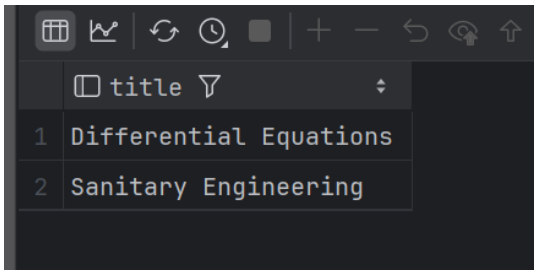


图 32: Question 26

得到的结果是：Differential Equations, Sanitary Engineering

3.4.18 Question 27

What are the names of the 3 departments with the most courses? (hard)

Question 27

```
select course.dept_name
from department
        join course
            on department.dept_name = course.dept_name
group by course.dept_name
order by count(course_id) desc
limit 3;
```

运行结果如下图所示：

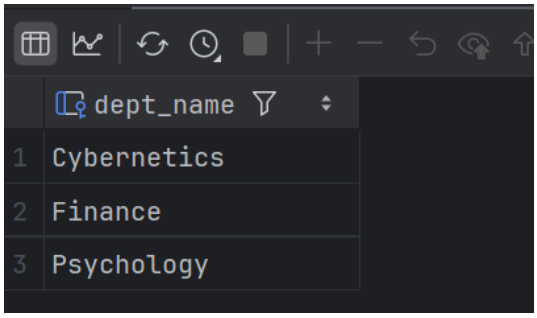


图 33: Question 27

得到的结果是：Cybernetics, Finance, Psychology

3.4.19 Question 28

Find the id of the courses that do not have any prerequisite? (hard)

Question 28

```
1     (select course.course_id
2      from course)
3     except
4     (select course.course_id
5      from course
6            join prereq
7                on course.course_id = prereq.course_id);
```

运行结果如下图所示：

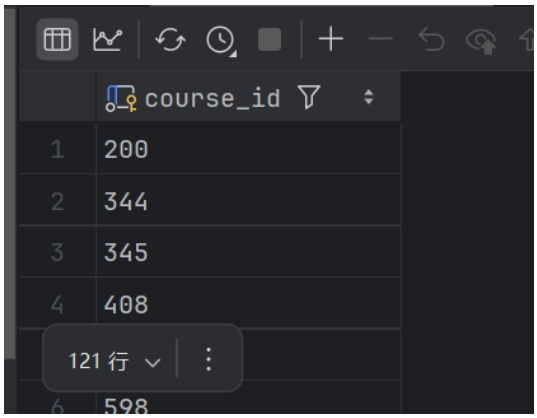


图 34: Question 28

得到的结果是：200, 344, 345 等 121 个元组

3.4.20 Question 29

What are the names of students who took a course in the Fall of 2003? (hard)

Question 29

```
1    select name
2    from student
3            join takes
4                on student.ID = takes.ID
5    where semester = 'Fall'
6      and year = 2003;
```

运行结果如下图所示：

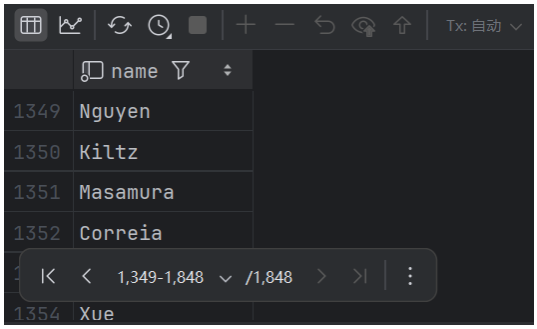


图 35: Question 29

得到的结果是：Milanic, lindner 等 1848 个元组

还是因为 name 相同指的是同名还是不同的人，我这里也运行了当作是不同的人的代码（即加上 distinct）

得到的另一个结果是：Milanic, lindner 等 1093 个元组

3.4.21 Question 30

Find the semester and year which has the least number of students taking any class. (hard)

Question 30

```
1    select semester, year
2    from takes
3    group by semester, year
4    order by count(*)
5    limit 1;
```

运行结果如下图所示：

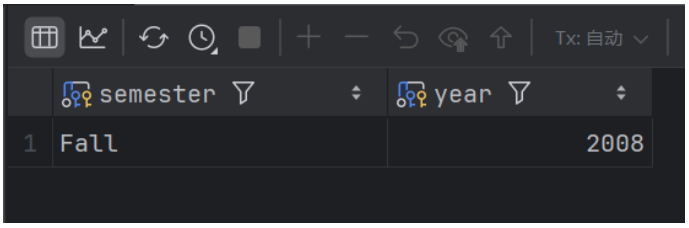


图 36: Question 30

得到的结果是：Fall, 2008

3.4.22 Question 31

Find the id of instructors who didn't teach any courses? (hard)

Question 31

```
1     (select distinct id
2      from instructor)
3     except
4     (select distinct instructor.ID
5      from instructor
6             join teaches
7                 on instructor.ID = teaches.ID);
```

运行结果如下图所示：

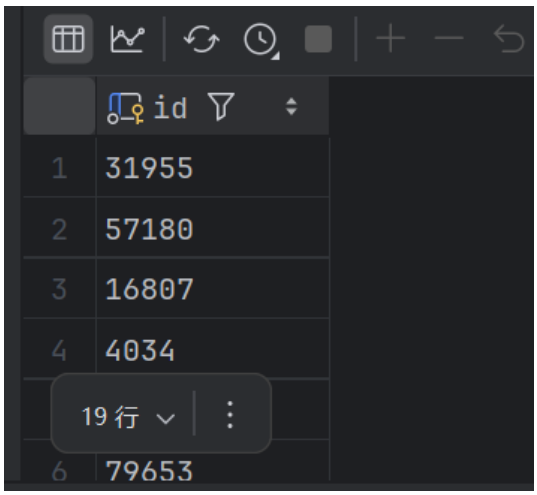


图 37: Question 31

得到的结果是：Yazdi, Moreira 等 19 个元组

3.4.23 Question 32

Find the name of students who took some course offered by Statistics department. (hard)

Question 32

```
select name
from student
        join takes
             on student.ID = takes.ID
        join section
             on takes.course_id = section.course_id
            and takes.sec_id = section.sec_id
            and takes.semester = section.semester and takes.year = section.
               year
        join course
             on section.course_id = course.course_id
where course.dept_name = 'Statistics';
```

运行结果如下图所示：

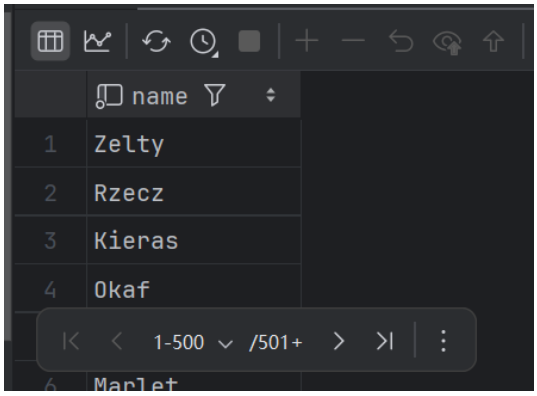


图 38: Question 32

得到的结果是：Zelty, Rzecz 等 606 个元组

还是因为 name 相同指的是同名还是不同的人，我这里也运行了当作是不同的人的代码（即加上 distinct）

得到的另一个结果是：Zelty, Rzecz 等 515 个元组

3.4.24 Question 33

What are the titles of courses without prerequisites? (hard)

Question 33

```
(select title
 from course)
```

```
3      except
4      (select title
5       from course
6              join prereq
7                   on course.course_id = prereq.course_id);
```

运行结果如下图所示：

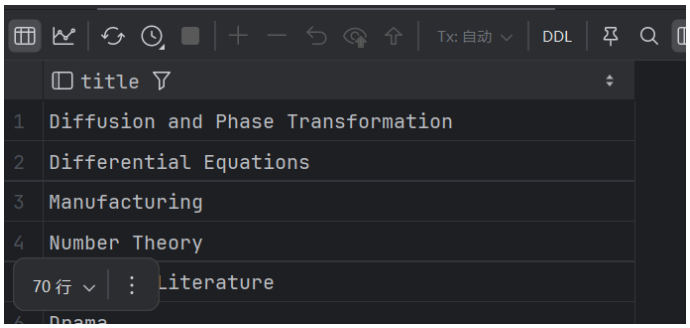


图 39: Question 33

得到的结果是：Diffusion and Phase Transformation 等 70 个元组

3.4.25 Question 34

Find names of instructors with salary greater than that of some (at least one) instructor in the Biology department. (hard)

Question 34

```
1      select name
2      from instructor
3      where salary > some (select salary
4                           from instructor
5                           where dept_name = 'Biology');
```

运行结果如下图所示：

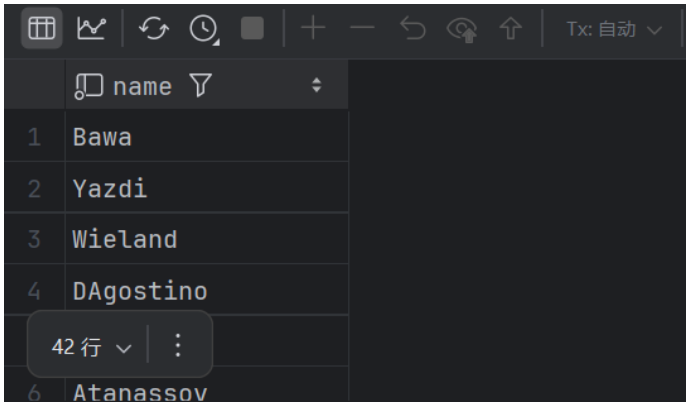


图 40: Question 34

得到的结果是：(Bawa, 72140.88) 等 42 个元组

3.4.26 Question 35

How many instructors are in the department with the highest budget, and what is their average salary? (hard)

Question 35-1

```
1     select count(*)
2     from instructor
3     where dept_name = (select department.dept_name
4                        from department
5                                 join instructor
6                                     on department.dept_name = instructor.
                                         dept_name
7                        order by budget desc
8                        limit 1);
```

运行结果如下图所示：

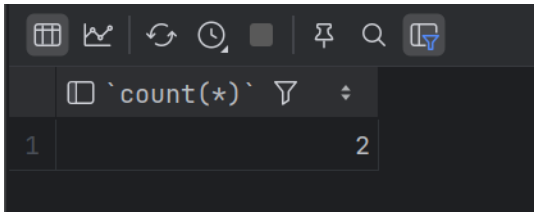


图 41: Question 35-1

Question 35-2

```
1      select avg(salary)
2      from instructor
3      where dept_name = (select department.dept_name
4                         from department
5                                  join instructor
6                                       on department.dept_name = instructor.
                                            dept_name
7                         order by budget desc
8                         limit 1);
```

运行结果如下图所示：

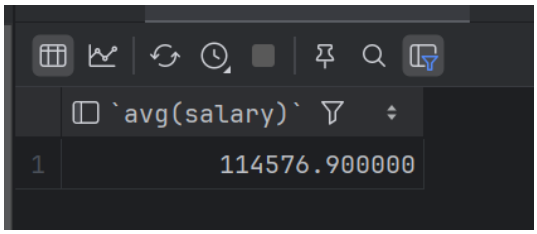


图 42: Question 35-2

得到的结果是：2 和 114576.900000

3.4.27 Question 36

What are the names of students who haven't taken any Biology courses? (hard)

Question 36

```
1      (select distinct name
2       from student)
3      except
4      (select distinct name
5       from student
6              join takes
7                   on student.ID = takes.ID
8       where dept_name = 'Biology');
```

运行结果如下图所示：

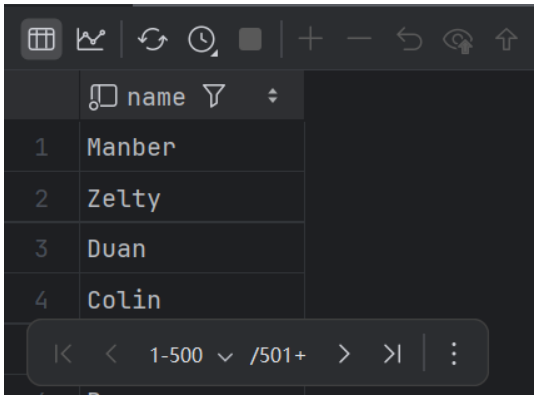


图 43: Question 36

得到的结果是：Manber, Zelty, Duan 等 1469 个元组

3.4.28 Question 37

Give the title of the prerequisite to the course International Finance. (hard)

Question 37

```
select title
from course
where course_id = (select prereq_id
                   from course
                            join prereq
                                 on course.course_id = prereq.course_id
                   where title = 'International Finance');
```

运行结果如下图所示：

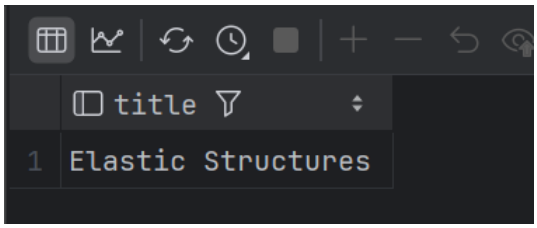


图 44: Question 37

得到的结果是：Elastic Structures

3.4.29 Question 38

What is the name of the department with the most credits? (hard)

Question 38

```
1      select department.dept_name
2      from department
3               join course
4                   on department.dept_name = course.dept_name
5      group by department.dept_name
6      order by sum(credits) desc
7      limit 1;
```

运行结果如下图所示：

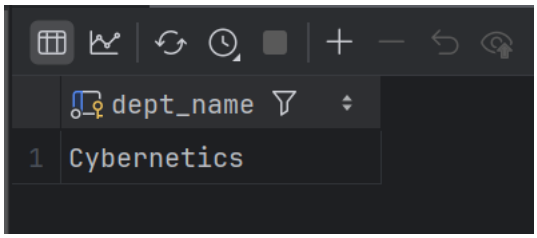


图 45: Question 38

得到的结果是：Cybernetics

3.4.30 Question 39

Give the name and building of the departments with greater than average budget. (extra)

Question 39

```
1      select dept_name, building
2      from department
3      where budget > (select avg(budget)
4      from department);
```

运行结果如下图所示：

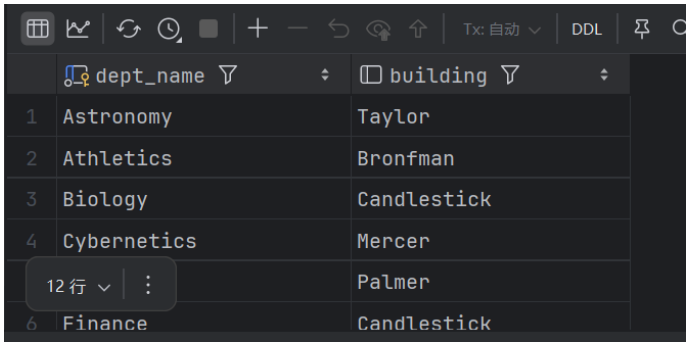


图 46: Question 39

得到的结果是：(Astronomy, Taylor) 等 12 个元组

4 存在的问题及解决方案

4.1 存在的问题：

在实验开始阶段，由于表格数量较多，且表格之间都有较强的关联性，一次性理解所有表格之间的关联有着一定的难度，为了防止在完成问题的时候需要很多次翻阅表格之间的关系和表格的内容，将表格之间的关系绘制成了关系图谱。

4.2 解决方案：

绘制了如图 2 和图 13 的两张关系图谱，且在两张表格之间的连接线上写出了连接的关系（实际上是 join 的时候 on 部分所需要验证的条件）这样可以用图形化界面清晰地展示表格之间的关系，方便解答问题。这样一来，在做题的方便程度和流畅度上都有了明显的提升。

5 实验小结

通过本次实验的完成，我对关系型数据库中的数据查询、表间关系操作等知识点有了更深入的理解。

- **深入理解表间关系的意义和操作**：实验过程中通过绘制关系图谱，进一步加深了对数据库表结构及其内在关联的理解，尤其在涉及多表查询及复杂条件筛选时，图谱极大降低了操作复杂性。
- **熟悉了 SQL 语句的高级运用**：本次实验中，利用了如 `JOIN`、`GROUP BY`、子查询、聚合函数等多种 SQL 语句和操作，解决了具有挑战性的复杂查询问题。
- **提高了效率与规范性**：通过提前梳理表结构，解决了实验初期因表格较多、关系复杂带来的效率问题，保证了实验的完整性和流畅性。
- **问题分析与解决能力的提升**：实验涉及多个难度不一的问题，通过将问题分解并逐步优化解决方案，比如将“大于平均值”拆分为“查询平均值”和“大于指定值”两个问题来解决，极大的简化了解题难度，不仅锻炼了解题能力，还积累了处理 SQL 问题的经验。

本次实验让我对关系型数据库及 SQL 查询操作的运用有了更加全面的认识和技能提升，为后续复杂数据库操作打下了良好的基础。