Contents

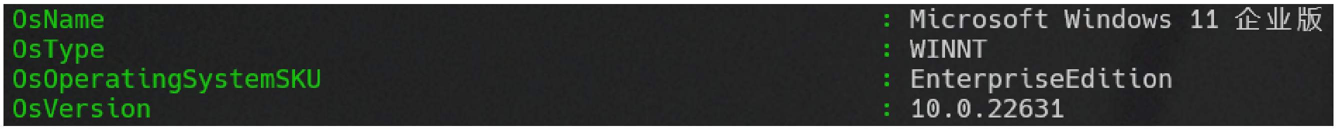
实验七 视图

实验目的

熟悉 SQL 语言支持的有关视图的操作，能够熟练使用 SQL 语句来创建需要的视图，对视图进行查询和取消视图。

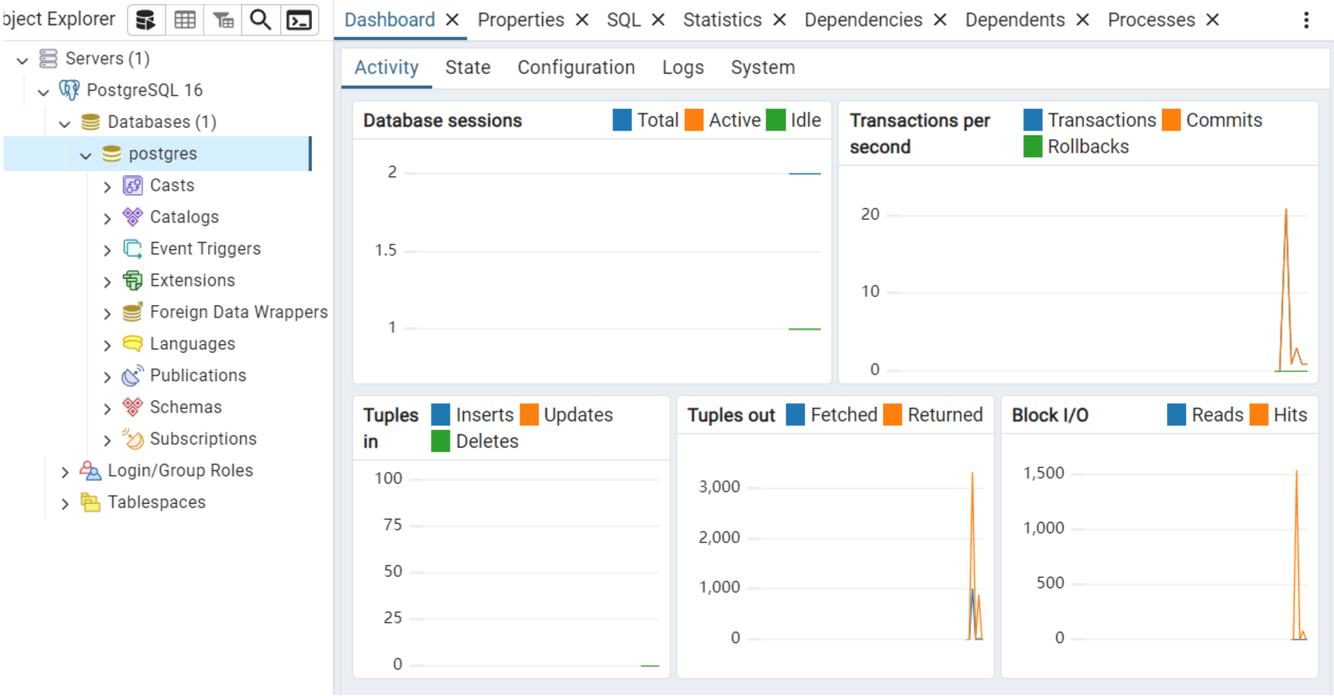
实验环境

- OS: Windows 11

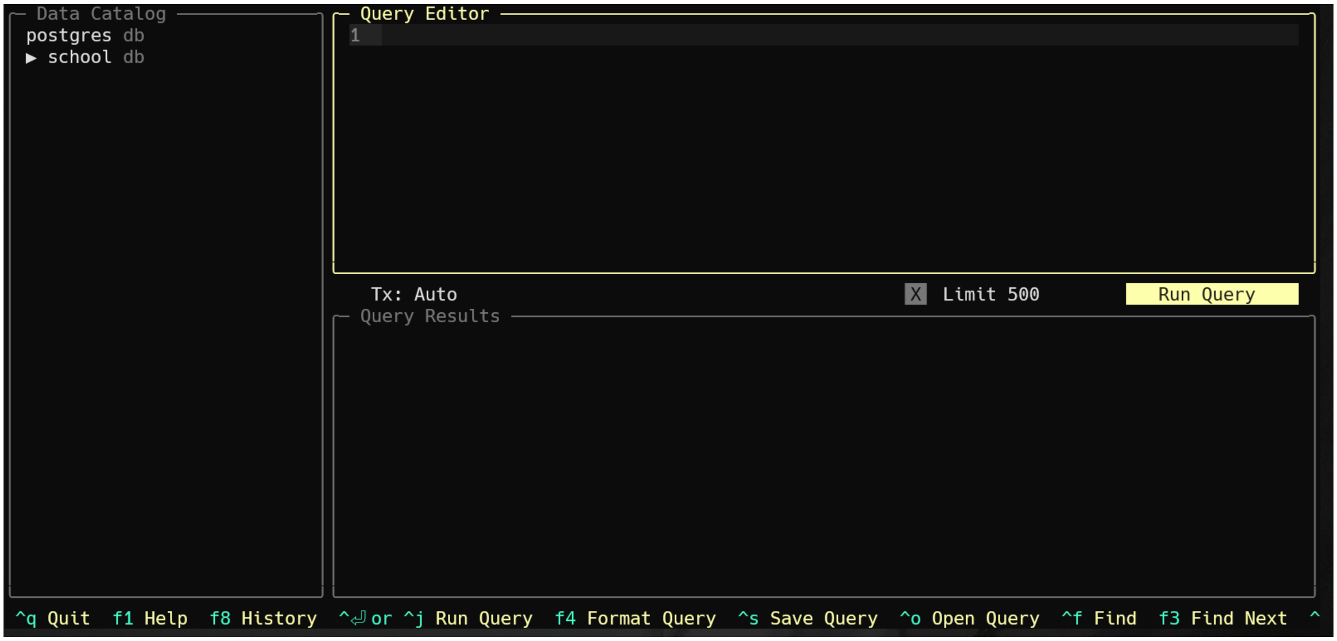


```
OsName                                      : Microsoft Windows 11 企业版
OsType                                      : WINNT
OsOperatingSystemSKU                        : EnterpriseEdition
OsVersion                                   : 10.0.22631
```

- Database: PostgreSQL 16



- UI: harlequin-postgres


Data Catalog
postgres db
▶ school db
Query Editor
1
Tx: Auto
☒ Limit 500
Run Query
Query Results
^q Quit f1 Help f8 History ^⏎ or ^j Run Query f4 Format Query ^s Save Query ^o Open Query ^f Find f3 Find Next ^

实验内容

1. 定义常见的视图形式，包括：

- 行列子集视图。
- WITH CHECK OPTION 的视图。
- 基于多个基表的视图。
- 基于视图的视图。
- 带表达式的视图。
- 分组视图。

2. 通过实验考察 WITH CHECK OPTION 这一语句在视图定义后产生的影响，包括对修改操作、删除操作、插入操作的影响。
3. 讨论视图的数据更新情况，对于行列视图进行数据更新。
4. 使用 DROP 语句删除一个视图，由该视图导出的其他视图定义仍在数据字典中，但已不能使用，必须显式删除。同样的原因，删除基表时，由该基表导出的所有视图定义都必须显式删除。

课内实验

要求：

以 school 数据库为例 (与之前实验的数据同)，在该数据库中存在 4 张表格，分别为：

STUDENTS(sid,sname,email,grade)

TEACHERS(tid,tname,email,salary)

COURSES(cid,cname,hour)

CHOICES(no,sid,tid,cid,score)

CS 视图的创建

```
CREATE VIEW CS AS
  SELECT NO, SID, CID, SCORE
    FROM CHOICES
  WHERE SCORE >= 60;
```

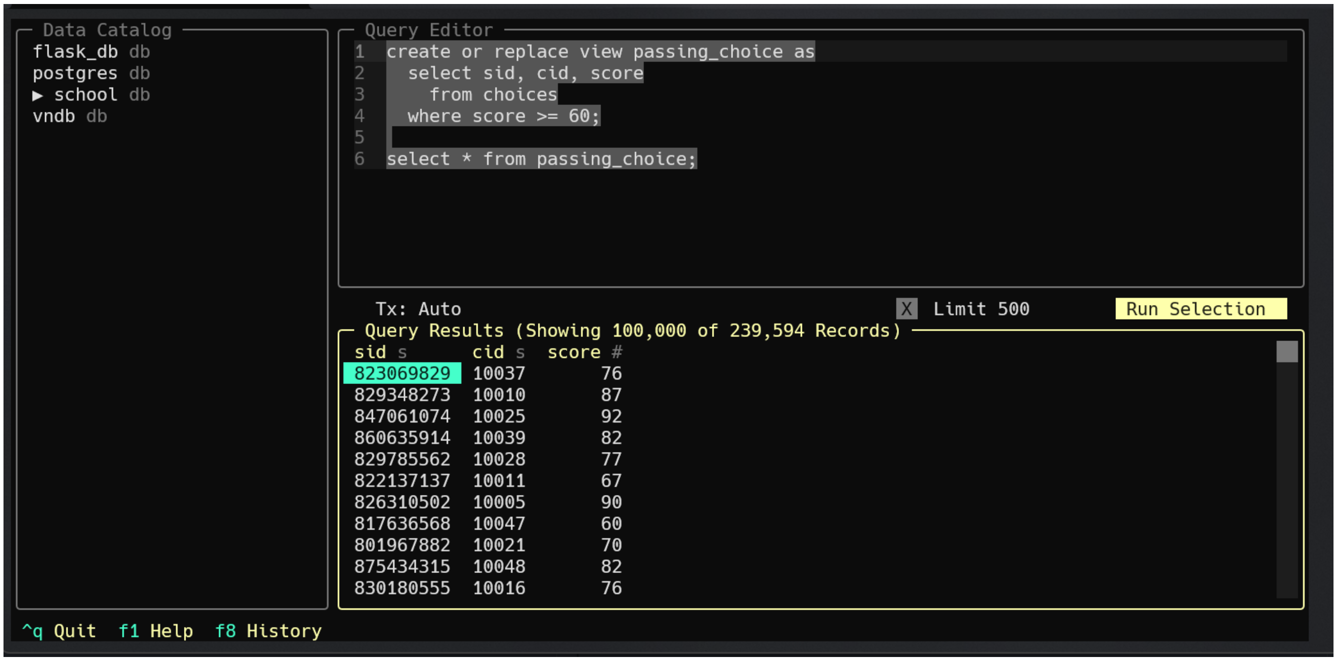
SCT 视图的创建

```
CREATE VIEW SCT (SNAME, CNAME, TNAME) AS
  SELECT STUDENTS.SNAME, COURSES.CNAME, TEACHERS.TNAME
```

```
    FROM CHOICES, STUDENTS, COURSES, TEACHERS
  WHERE CHOICES.TID = TEACHERS.TID
    AND CHOICES.CID = COURSES.CID
    AND CHOICES.SID = STUDENTS.SID;
```

1. 创建一个行列子集视图，给出选课成绩合格的学生的编号，所选课程号和该课程成绩

```
create or replace view passing_choice as
  select sid, cid, score
    from choices
  where score >= 60;

select * from passing_choice;
```

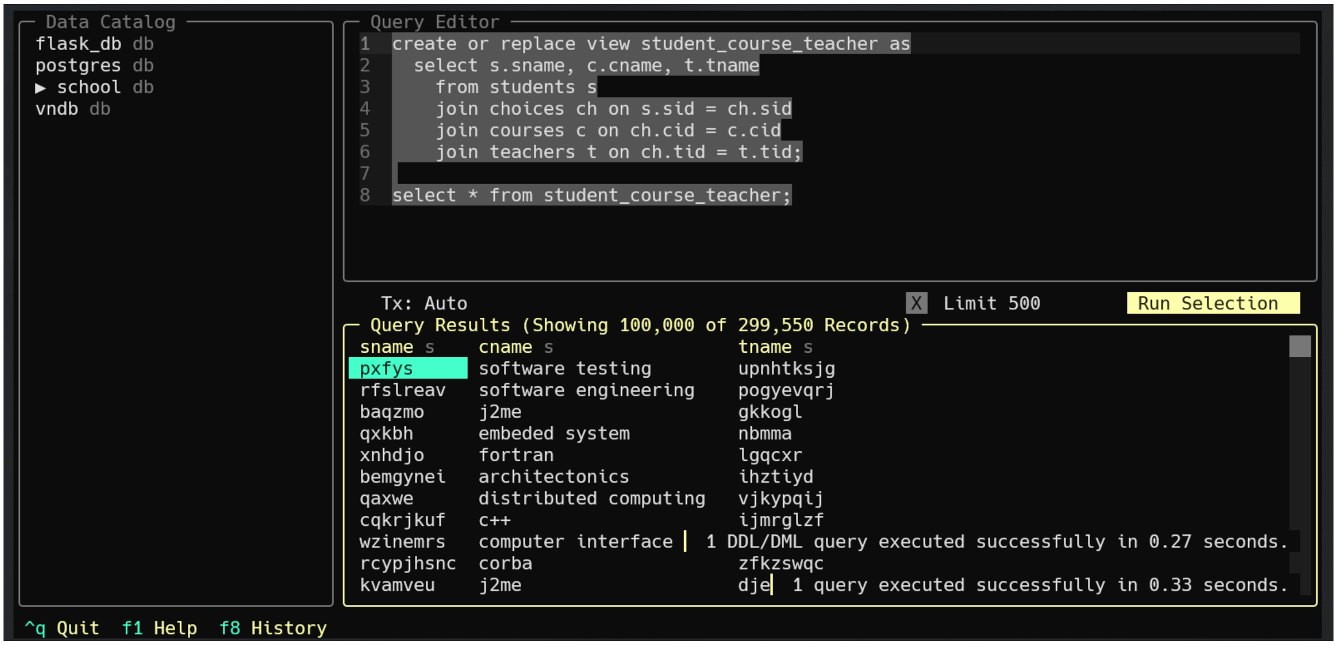


```
create or replace view passing_choice as
  select sid, cid, score
    from choices
  where score >= 60;

select * from passing_choice;
```

```
Query Results (Showing 100,000 of 239,594 Records)
sid s      cid s  score #
823069829  10037       76
829348273  10010       87
847061074  10025       92
860635914  10039       82
829785562  10028       77
822137137  10011       67
826310502  10005       90
817636568  10047       60
801967882  10021       70
875434315  10048       82
830180555  10016       76
```

2. 创建基于多个基表的视图，这个视图由学生姓名和其所选修的课程名及讲授该课程的教师姓名构成

```
create or replace view student_course_teacher as
  select s.sname, c.cname, t.tname
    from students s
    join choices ch on s.sid = ch.sid
    join courses c on ch.cid = c.cid
    join teachers t on ch.tid = t.tid;

select * from student_course_teacher;
```

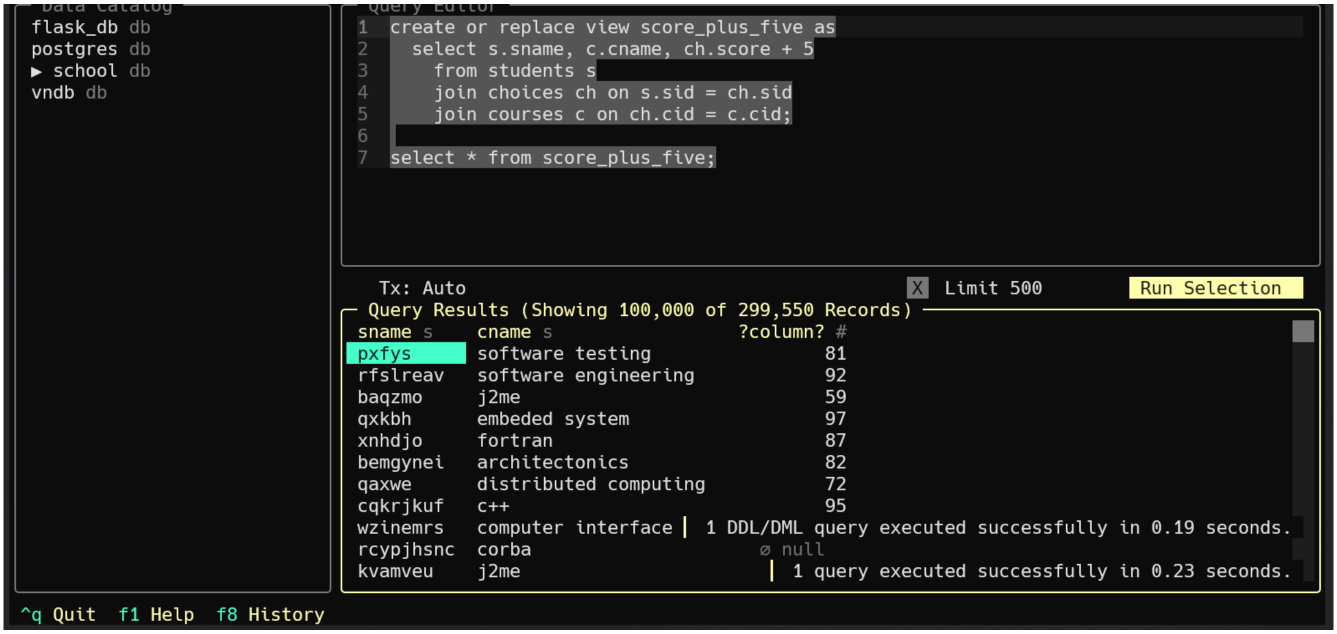


```
create or replace view student_course_teacher as
  select s.sname, c.cname, t.tname
    from students s
    join choices ch on s.sid = ch.sid
    join courses c on ch.cid = c.cid
    join teachers t on ch.tid = t.tid;

select * from student_course_teacher;
```

```
Query Results (Showing 100,000 of 299,550 Records)
sname s     cname s                 tname s
pxfys       software testing        upnhtksjg
rfslreav    software engineering    pogyevqrj
baqzmo      j2me                    gkkogl
qxkbh       embeded system          nbmma
xnhdjo      fortran                 lgqcxr
bemgynei    architectonics          ihztiyd
qaxwe       distributed computing   vjkypqij
cqkrjkuf    c++                     ijmrglzf
wzinemrs    computer interface | 1 DDL/DML query executed successfully in 0.27 seconds.
rcypjhsnc   corba                   zfkzswqc
kvamveu     j2me                    dje| 1 query executed successfully in 0.33 seconds.
```

3. 创建带表达式的视图，由学生姓名、所选课程名和所有课程成绩都比原来多 5 分这几个属性组成

```
create or replace view score_plus_five as
  select s.sname, c.cname, ch.score + 5
    from students s
    join choices ch on s.sid = ch.sid
    join courses c on ch.cid = c.cid;

select * from score_plus_five;
```



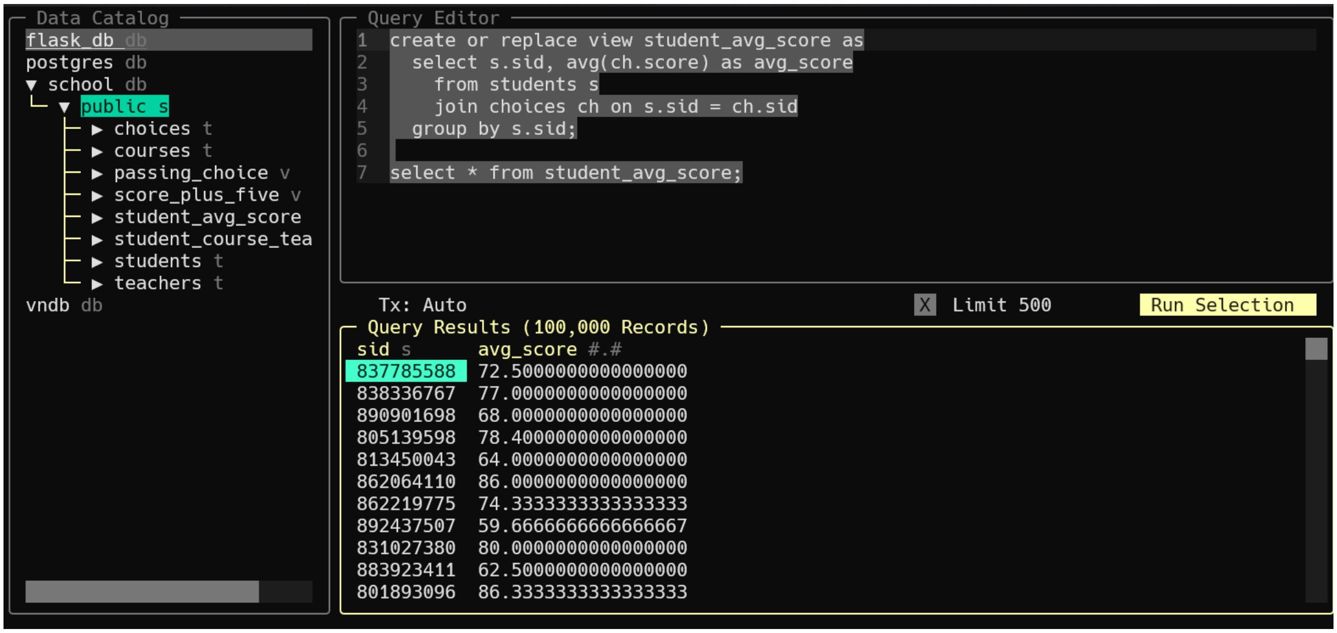
```
create or replace view score_plus_five as
  select s.sname, c.cname, ch.score + 5
    from students s
    join choices ch on s.sid = ch.sid
    join courses c on ch.cid = c.cid;

select * from score_plus_five;
```

```
Query Results (Showing 100,000 of 299,550 Records)
sname s     cname s                 ?column? #
pxfys       software testing              81
rfslreav    software engineering          92
baqzmo      j2me                          59
qxkbh       embeded system                97
xnhdjo      fortran                       87
bemgynei    architectonics                82
qaxwe       distributed computing         72
cqkrjkuf    c++                           95
wzinemrs    computer interface | 1 DDL/DML query executed successfully in 0.19 seconds.
rcypjhsnc   corba                     ∅ null
kvamveu     j2me                    | 1 query executed successfully in 0.23 seconds.
```

4. 创建分组视图，将学生的学号及其平均成绩定义为一个视图

```
create or replace view student_avg_score as
  select s.sid, avg(ch.score) as avg_score
    from students s
    join choices ch on s.sid = ch.sid
  group by s.sid;
```

```
select * from student_avg_score;
```



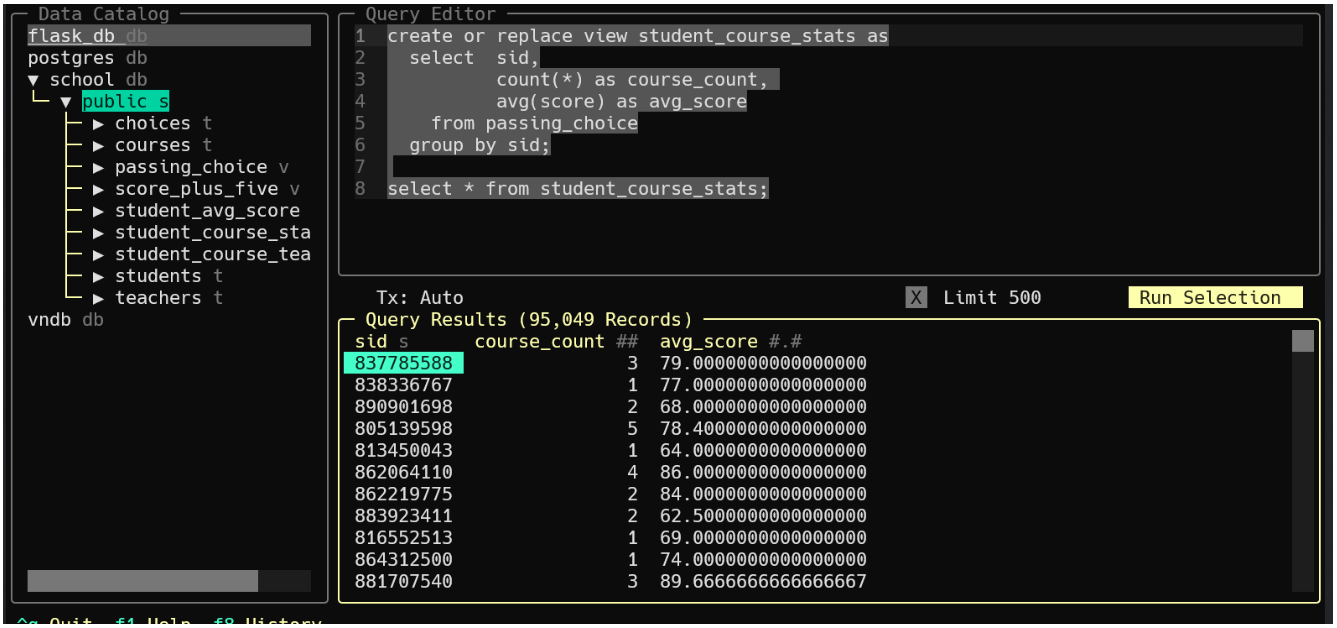
```
create or replace view student_avg_score as
  select s.sid, avg(ch.score) as avg_score
    from students s
    join choices ch on s.sid = ch.sid
  group by s.sid;

select * from student_avg_score;
```

Query Results (100,000 Records)

```
sid s      avg_score #.#
837785588  72.5000000000000000
838336767  77.0000000000000000
890901698  68.0000000000000000
805139598  78.4000000000000000
813450043  64.0000000000000000
862064110  86.0000000000000000
862219775  74.3333333333333333
892437507  59.6666666666666667
831027380  80.0000000000000000
883923411  62.5000000000000000
801893096  86.3333333333333333
```

5. 创建一个基于视图的视图，基于 (1) 中建立的视图，定义一个包括学生编号，学生所选课程数目和平均成绩的视图

```
create or replace view student_course_stats as
  select  sid,
          count(*) as course_count,
          avg(score) as avg_score
    from passing_choice
  group by sid;

select * from student_course_stats;
```



```
create or replace view student_course_stats as
  select  sid,
          count(*) as course_count,
          avg(score) as avg_score
    from passing_choice
  group by sid;

select * from student_course_stats;
```

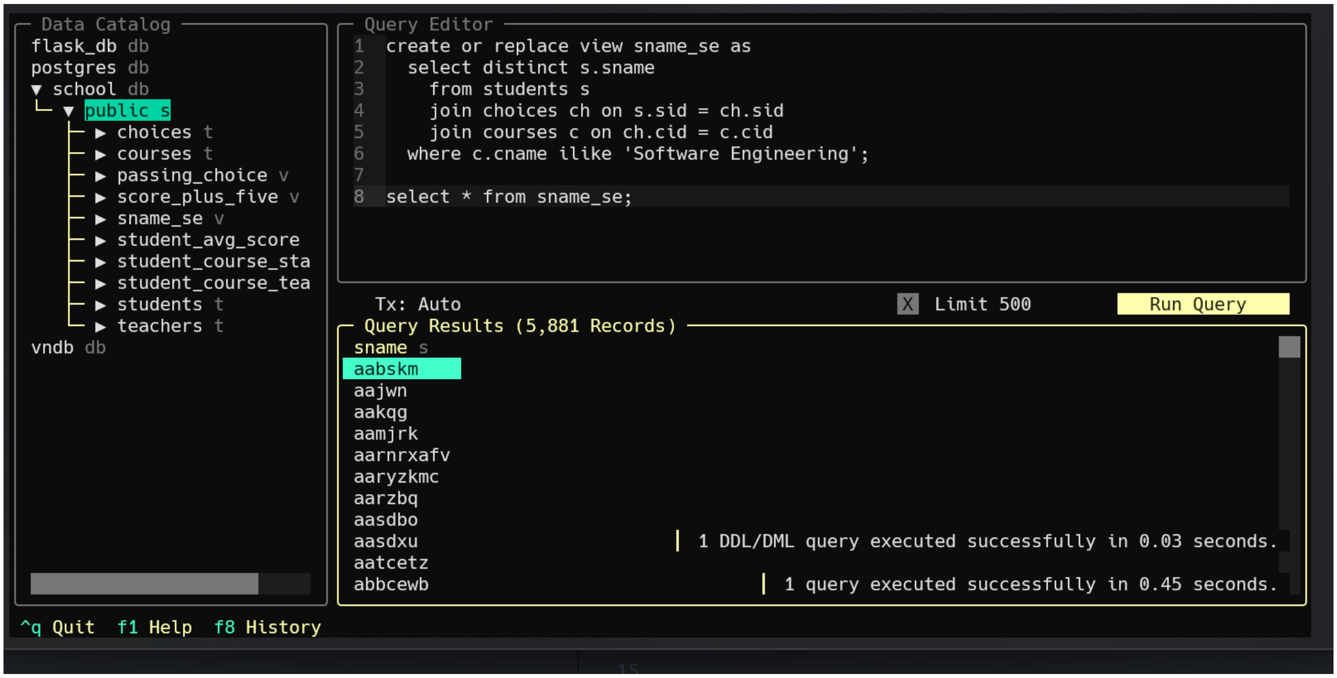
Query Results (95,049 Records)

```
sid s      course_count ##  avg_score #.#
837785588                3  79.0000000000000000
838336767                1  77.0000000000000000
890901698                2  68.0000000000000000
805139598                5  78.4000000000000000
813450043                1  64.0000000000000000
862064110                4  86.0000000000000000
862219775                2  84.0000000000000000
883923411                2  62.5000000000000000
816552513                1  69.0000000000000000
864312500                1  74.0000000000000000
881707540                3  89.6666666666666667
```

6. 查询所有选修课程 Software Engineering 的学生姓名

```
create or replace view sname_se as
  select distinct s.sname
    from students s
    join choices ch on s.sid = ch.sid
```

```sql
    join courses c on ch.cid = c.cid
  where c.cname ilike 'Software Engineering';

select * from sname_se;
```



```
create or replace view sname_se as
  select distinct s.sname
    from students s
    join choices ch on s.sid = ch.sid
    join courses c on ch.cid = c.cid
  where c.cname ilike 'Software Engineering';

select * from sname_se;
```

```
Query Results (5,881 Records)
sname
aabskm
aajwn
aakqg
aamjrk
aarnrxafv
aaryzkmc
aarzbq
aasdbo
aasdxu
aatcetz
abbcewb
```

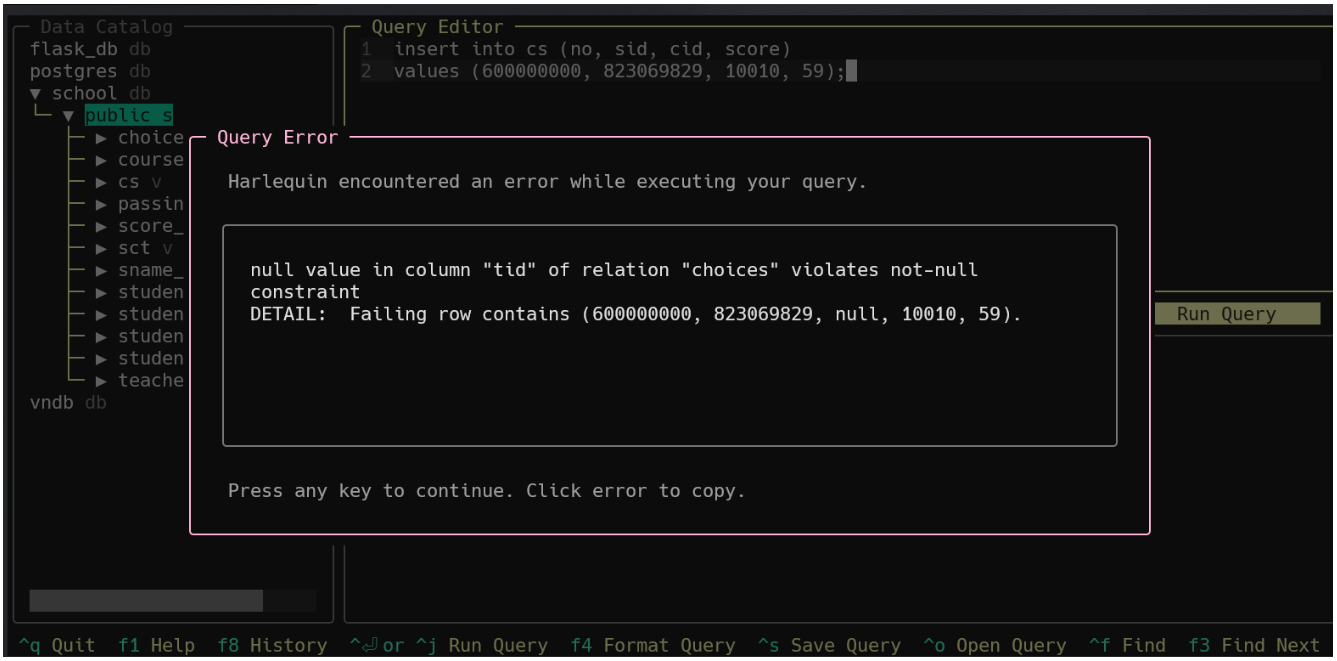
```
1 DDL/DML query executed successfully in 0.03 seconds.
1 query executed successfully in 0.45 seconds.
```

7. 插入元组 (600000000,823069829,10010,59) 到视图 CS 中。若是在视图的定义中存在 WITH CHECK OPTION 子句对插入操作有什么影响?

```sql
insert into cs (no, sid, cid, score)
values (600000000, 823069829, 10010, 59);
```

在讨论是否存在 WITH CHECK OPTION 子句之前，首先这个操作不会正确执行:

- 底层的 CHOICES 表 tid 列有 NOT NULL 约束与外键约束，但视图 CS 中并不存在 tid 列，因此无法插入。



```
insert into cs (no, sid, cid, score)
values (600000000, 823069829, 10010, 59);
```

```
Query Error

Harlequin encountered an error while executing your query.

null value in column "tid" of relation "choices" violates not-null
constraint
DETAIL:  Failing row contains (600000000, 823069829, null, 10010, 59).

Press any key to continue. Click error to copy.
```

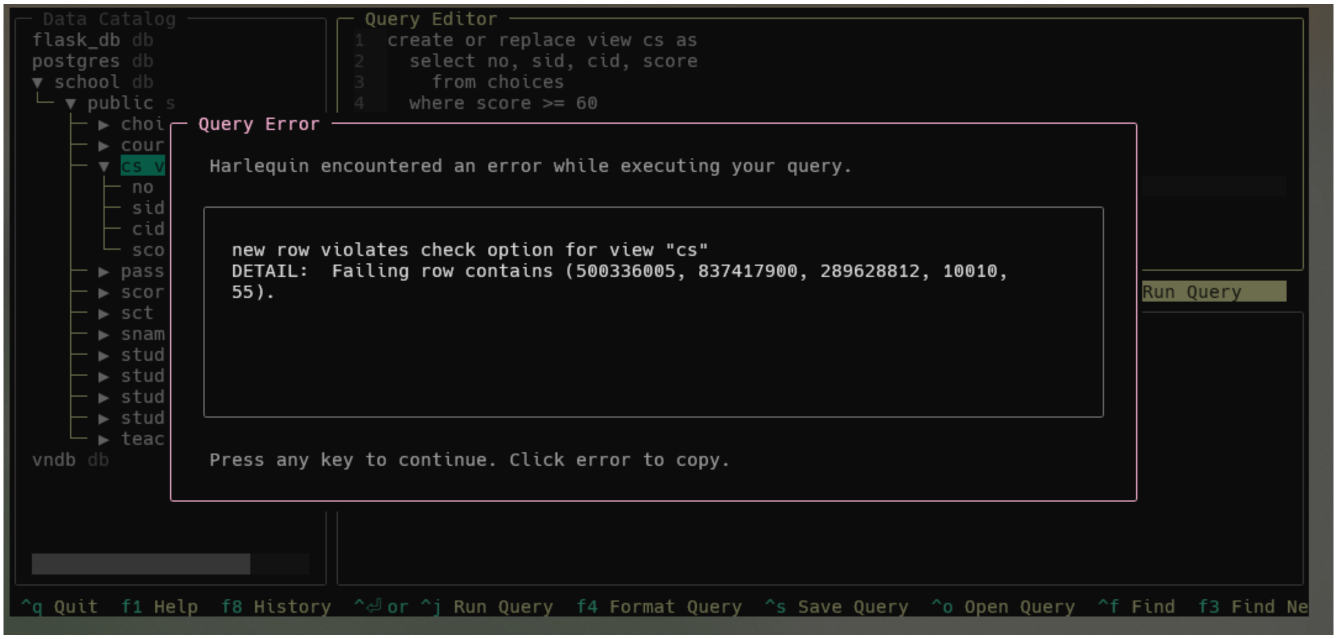
8. 将视图 CS (包含定义 WITH CHECK OPTION) 中，所有课程编号为 10010 的课程的成绩都减去 5 分。这个操作数据库是否会正确执行，为什么? 如果加上 5 分 (原来 95 分以上的不变) 呢?

- 减 5 分操作：

```
create or replace view cs as
  select no, sid, cid, score
    from choices
  where score >= 60
with check option;

update cs
set score = score - 5
where cid = '10010';
```

这个操作不会正确执行：

- WITH CHECK OPTION 确保通过视图进行的所有修改都符合视图的定义条件，也即是 score >= 60，但如果我们尝试将成绩减去 5 分，那么原本成绩为 60-64 分的记录将不再满足条件。此时，数据库会拒绝这个更新操作。



```
create or replace view cs as
  select no, sid, cid, score
    from choices
  where score >= 60
```

Query Error

Harlequin encountered an error while executing your query.

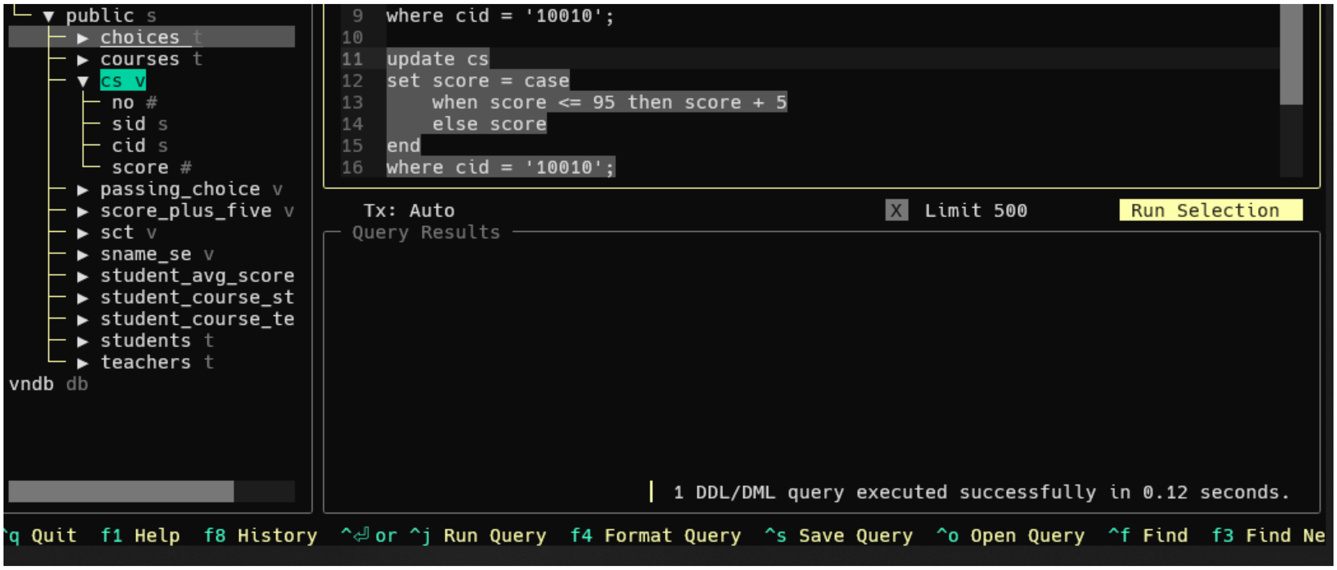
```
new row violates check option for view "cs"
DETAIL:  Failing row contains (500336005, 837417900, 289628812, 10010,
55).
```

Press any key to continue. Click error to copy.

- 加 5 分（原来 95 分以上的不变）操作：

```
update cs
set score = case
    when score <= 95 then score + 5
    else score
end
where cid = '10010';
```

这个操作将会正确执行：



```
where cid = '10010';

update cs
set score = case
    when score <= 95 then score + 5
    else score
end
where cid = '10010';
```

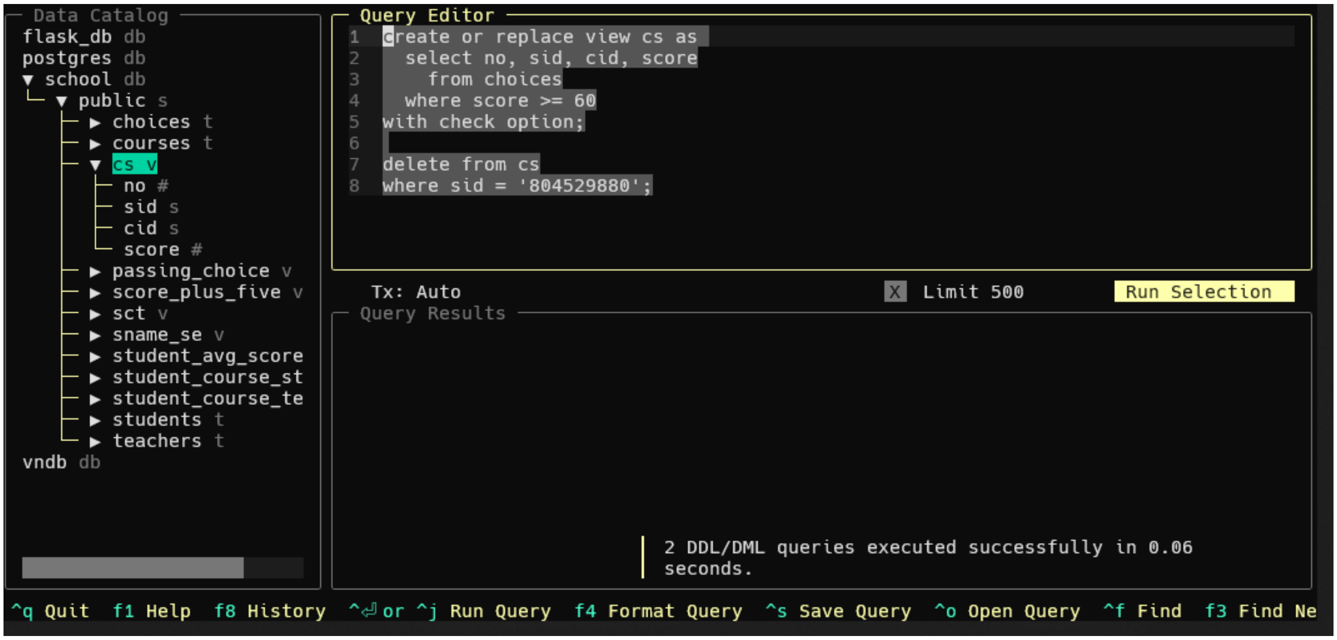
```
1 DDL/DML query executed successfully in 0.12 seconds.
```

9. 在视图 CS (包含定义 WITH CHECK OPTION) 删除编号为 804529880 学生的记录，会产生什么结果？

```
delete from cs
where sid = '804529880';
```

这个删除操作将会正常执行：

- WITH CHECK OPTION 主要用于限制 INSERT 和 UPDATE 操作，确保这些操作不会创建或修改不符合视图定义的行。
- DELETE 操作不会创建新的行或修改现有行的值，因此不会违反视图的定义条件。

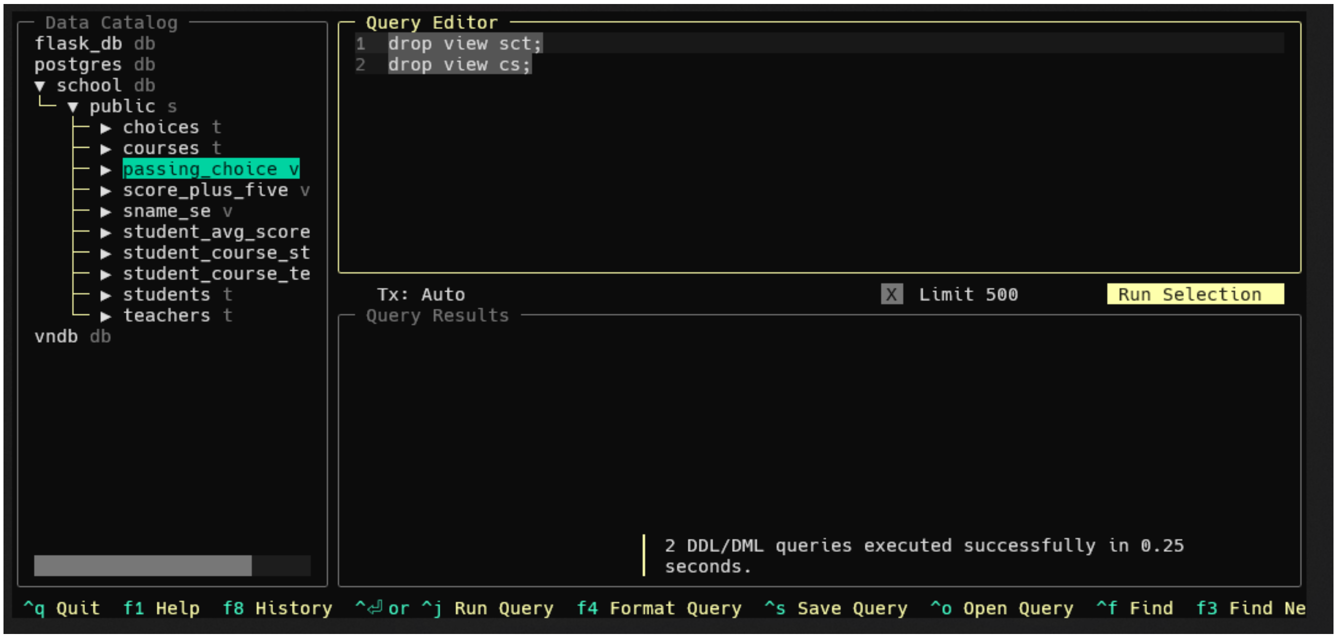


```
create or replace view cs as
  select no, sid, cid, score
    from choices
  where score >= 60
with check option;

delete from cs
where sid = '804529880';
```

```
2 DDL/DML queries executed successfully in 0.06
seconds.
```

10. 取消视图 SCT 和视图 CS

```
drop view sct;
drop view cs;
```



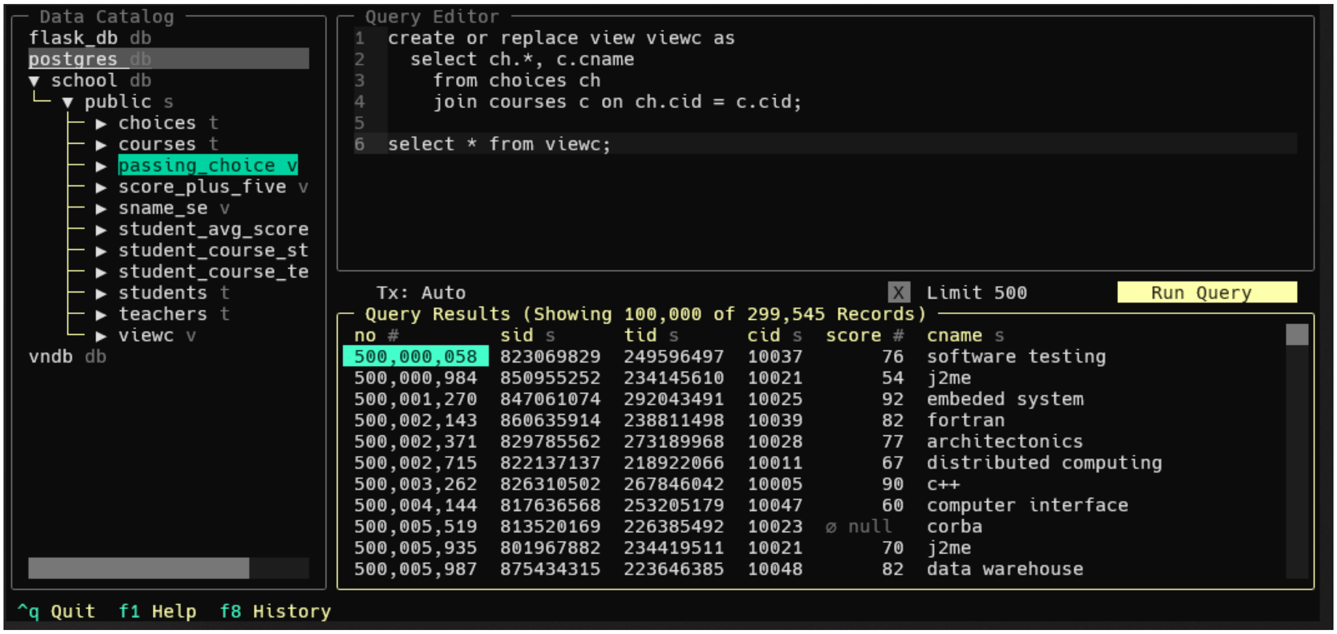
```
drop view sct;
drop view cs;
```

```
2 DDL/DML queries executed successfully in 0.25
seconds.
```

自我实践

1. 定义选课信息和课程名称的视图 VIEWC

```
create or replace view viewc as
  select ch.*, c.cname
    from choices ch
    join courses c on ch.cid = c.cid;

select * from viewc;
```



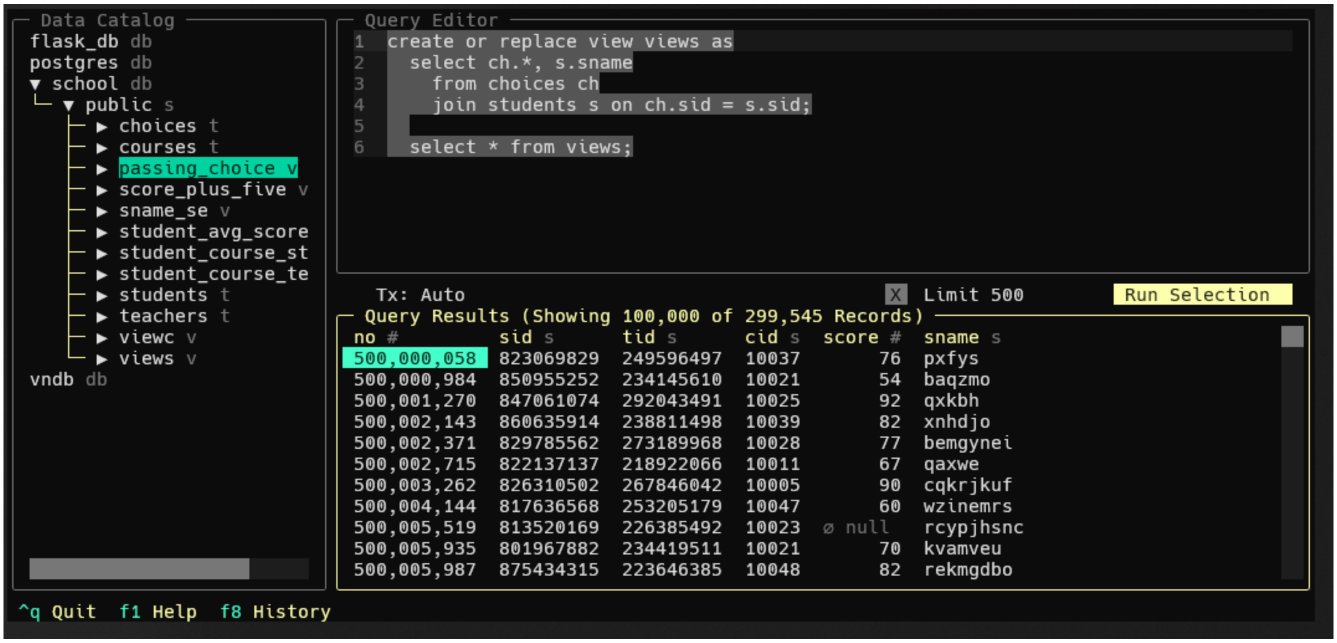
```
create or replace view viewc as
  select ch.*, c.cname
    from choices ch
    join courses c on ch.cid = c.cid;

select * from viewc;
```

```
Query Results (Showing 100,000 of 299,545 Records)
no #         sid s       tid s       cid s   score #   cname s
500,000,058  823069829   249596497   10037        76   software testing
500,000,984  850955252   234145610   10021        54   j2me
500,001,270  847061074   292043491   10025        92   embeded system
500,002,143  860635914   238811498   10039        82   fortran
500,002,371  829785562   273189968   10028        77   architectonics
500,002,715  822137137   218922066   10011        67   distributed computing
500,003,262  826310502   267846042   10005        90   c++
500,004,144  817636568   253205179   10047        60   computer interface
500,005,519  813520169   226385492   10023    ⌀ null   corba
500,005,935  801967882   234419511   10021        70   j2me
500,005,987  875434315   223646385   10048        82   data warehouse
```

2. 定义学生姓名与选课信息的视图 VIEWS

```
create or replace view views as
  select ch.*, s.sname
    from choices ch
    join students s on ch.sid = s.sid;
```

```
select * from views;
```

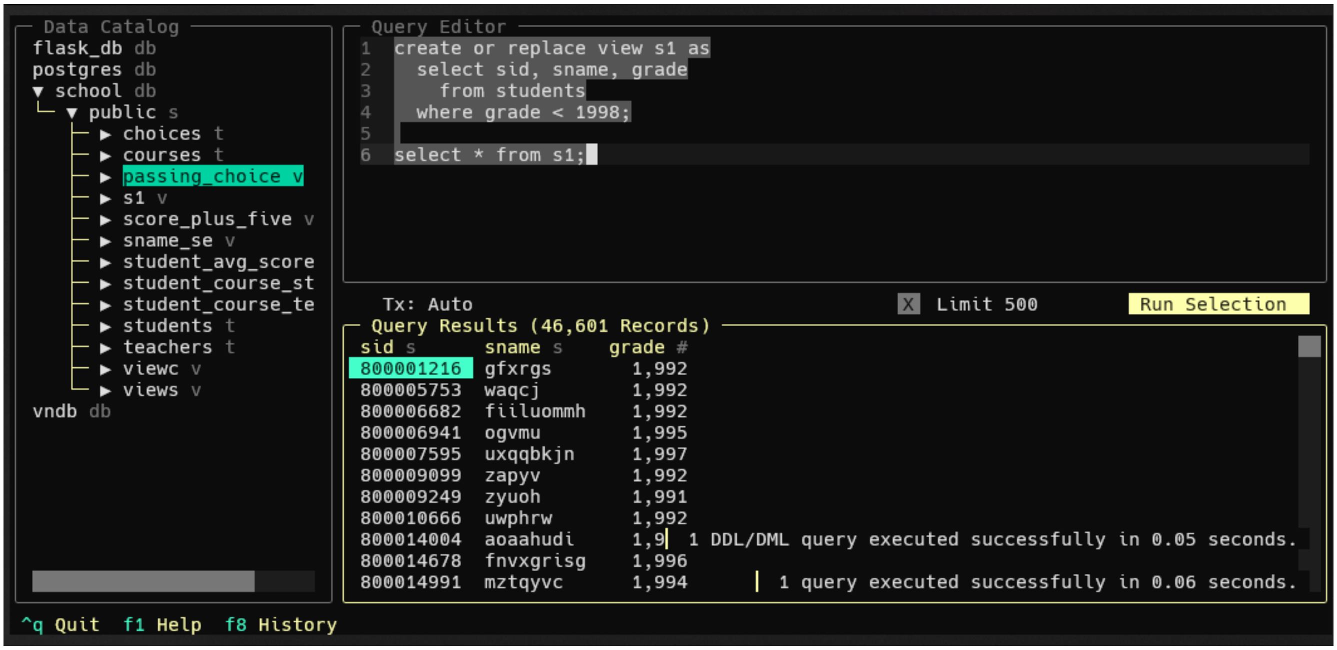


```
create or replace view views as
  select ch.*, s.sname
    from choices ch
    join students s on ch.sid = s.sid;

  select * from views;
```

```
Query Results (Showing 100,000 of 299,545 Records)
no #         sid s       tid s       cid s   score #  sname s
500,000,058  823069829   249596497   10037        76  pxfys
500,000,984  850955252   234145610   10021        54  baqzmo
500,001,270  847061074   292043491   10025        92  qxkbh
500,002,143  860635914   238811498   10039        82  xnhdjo
500,002,371  829785562   273189968   10028        77  bemgynei
500,002,715  822137137   218922066   10011        67  qaxwe
500,003,262  826310502   267846042   10005        90  cqkrjkuf
500,004,144  817636568   253205179   10047        60  wzinemrs
500,005,519  813520169   226385492   10023   ø null   rcypjhsnc
500,005,935  801967882   234419511   10021        70  kvamveu
500,005,987  875434315   223646385   10048        82  rekmgdbo
```

3. 定义年级低于 1998 的学生的视图 S1(SID,SNAME,GRADE)

```
create or replace view s1 as
  select sid, sname, grade
    from students
  where grade < 1998;

select * from s1;
```

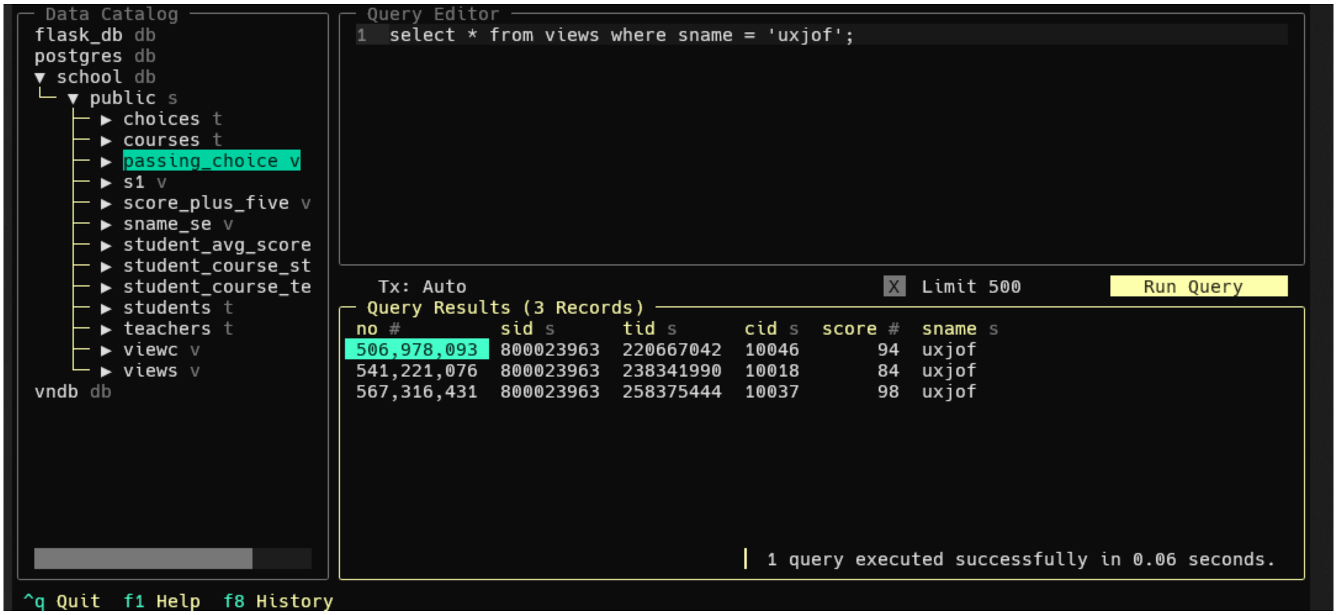


```
create or replace view s1 as
  select sid, sname, grade
    from students
  where grade < 1998;

select * from s1;
```

```
Query Results (46,601 Records)
sid s       sname s     grade #
800001216   gfxrgs        1,992
800005753   waqcj         1,992
800006682   fiiluommh     1,992
800006941   ogvmu         1,995
800007595   uxqqbkjn      1,997
800009099   zapyv         1,992
800009249   zyuoh         1,991
800010666   uwphrw        1,992
800014004   aoaahudi      1,9| 1 DDL/DML query executed successfully in 0.05 seconds.
800014678   fnvxgrisg     1,996
800014991   mztqyvc       1,994       | 1 query executed successfully in 0.06 seconds.
```

4. 查询学生为“uxjof”的学生的选课信息

```
select * from views where sname = 'uxjof';
```



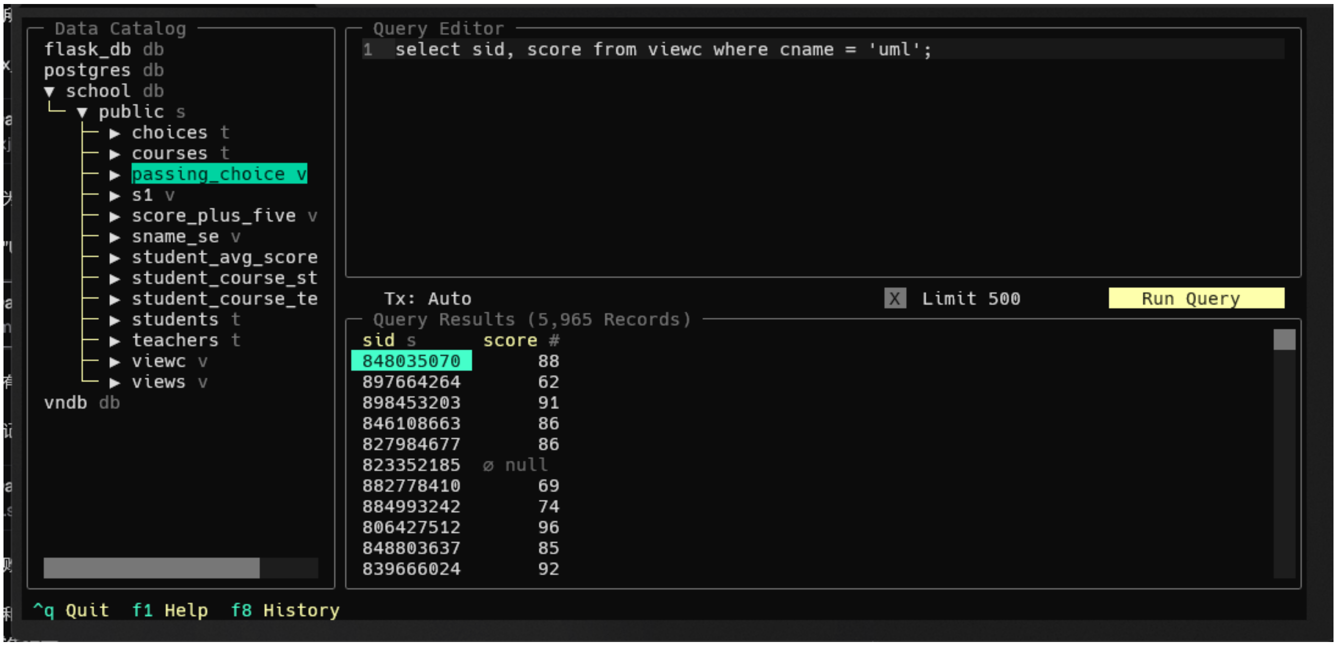
```
Data Catalog
flask_db db
postgres db
▼ school db
└ ▼ public s
    ├ ▶ choices t
    ├ ▶ courses t
    ├ ▶ passing_choice v
    ├ ▶ s1 v
    ├ ▶ score_plus_five v
    ├ ▶ sname_se v
    ├ ▶ student_avg_score
    ├ ▶ student_course_st
    ├ ▶ student_course_te
    ├ ▶ students t
    ├ ▶ teachers t
    ├ ▶ viewc v
    └ ▶ views v
vndb db
```

```
Query Editor
select * from views where sname = 'uxjof';
```

```
Query Results (3 Records)
no #         sid s       tid s       cid s   score #   sname s
506,978,093  800023963   220667042   10046        94   uxjof
541,221,076  800023963   238341990   10018        84   uxjof
567,316,431  800023963   258375444   10037        98   uxjof

1 query executed successfully in 0.06 seconds.
```

5. 查询选修课程“UML”的学生的编号和成绩

```
select sid, score from viewc where cname = 'uml';
```



```
Data Catalog
flask_db db
postgres db
▼ school db
└ ▼ public s
    ├ ▶ choices t
    ├ ▶ courses t
    ├ ▶ passing_choice v
    ├ ▶ s1 v
    ├ ▶ score_plus_five v
    ├ ▶ sname_se v
    ├ ▶ student_avg_score
    ├ ▶ student_course_st
    ├ ▶ student_course_te
    ├ ▶ students t
    ├ ▶ teachers t
    ├ ▶ viewc v
    └ ▶ views v
vndb db
```

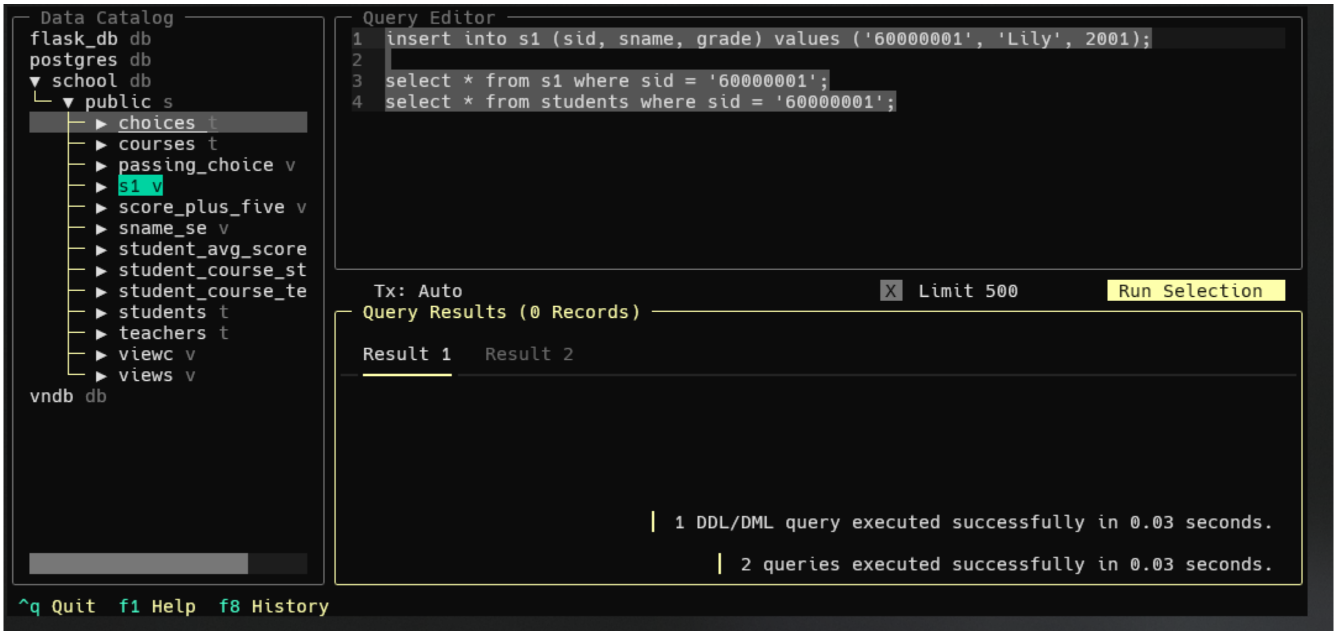
```
Query Editor
select sid, score from viewc where cname = 'uml';
```

```
Query Results (5,965 Records)
sid s       score #
848035070        88
897664264        62
898453203        91
846108663        86
827984677        86
823352185   ⌀ null
882778410        69
884993242        74
806427512        96
848803637        85
839666024        92
```

6. 向视图 S1 插入记录（“60000001,Lily,2001”）

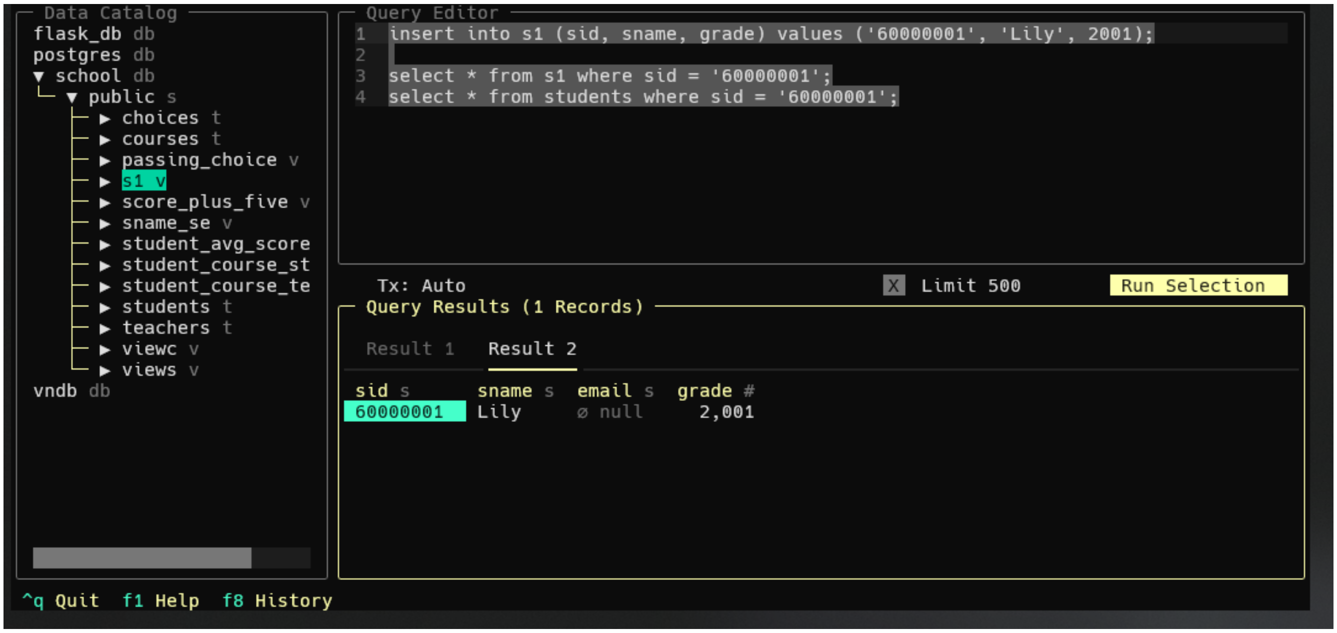
```
insert into s1 (sid, sname, grade) values ('60000001', 'Lily', 2001);

select * from s1 where sid = '60000001';
```

- 由于没有 WITH CHECK OPTION 子句，因此该插入语句能够正确执行。但是插入后的结果不会显示在视图中，因为它不满足视图的定义条件。



```
insert into s1 (sid, sname, grade) values ('60000001', 'Lily', 2001);

select * from s1 where sid = '60000001';
select * from students where sid = '60000001';
```

```
| 1 DDL/DML query executed successfully in 0.03 seconds.
| 2 queries executed successfully in 0.03 seconds.
```



```
insert into s1 (sid, sname, grade) values ('60000001', 'Lily', 2001);

select * from s1 where sid = '60000001';
select * from students where sid = '60000001';
```

```
sid s      sname s  email s  grade #
60000001   Lily     ∅ null     2,001
```

7. 定义包括更新和插入约束的视图 S1，尝试向视图插入记录（“60000001,Lily,1997”），删除所有年级为 1999 的学生记录，讨论更新和插入约束带来的影响

- 定义包括更新和插入约束的视图 S1：

```
create or replace view s1 as
  select sid, sname, grade
    from students
  where grade < 1998
with check option;
```

- 尝试向视图 S1 插入记录（“60000001,Lily,1997”）：

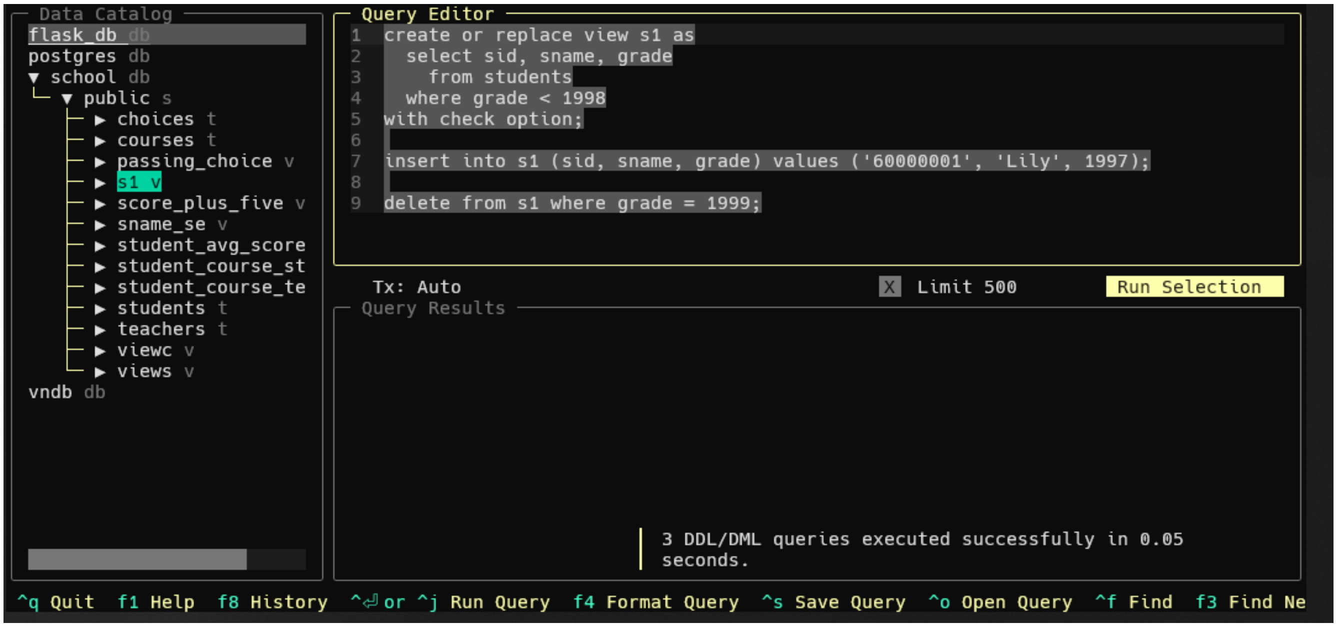
```
insert into s1 (sid, sname, grade) values ('60000001', 'Lily', 1997);
```

- 尝试删除所有年级为 1999 的学生记录：

```
delete from s1 where grede = 1999;
```

- 讨论更新和插入约束带来的影响：

  - 插入操作应该会成功，因为 1997 小于 1998，符合视图定义条件。
  - 删除操作不会有任何效果，因为视图 s1 中不包含任何年级为 1999 的学生记录。



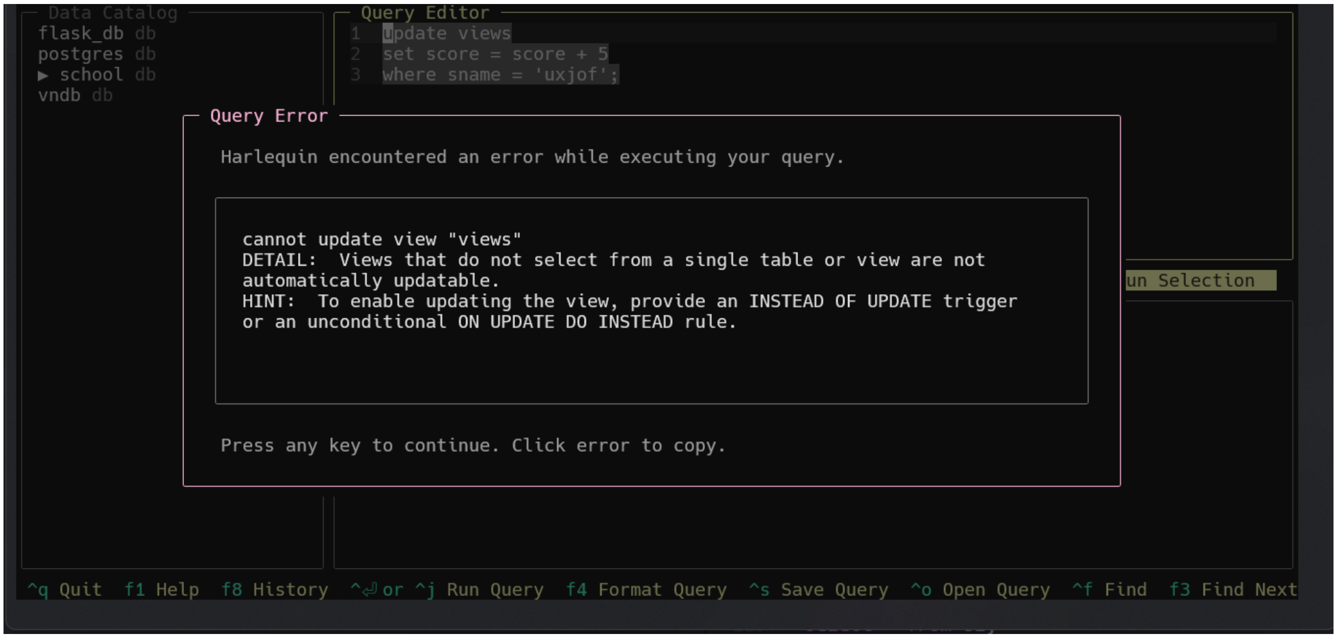
```
create or replace view s1 as
  select sid, sname, grade
    from students
  where grade < 1998
with check option;

insert into s1 (sid, sname, grade) values ('60000001', 'Lily', 1997);

delete from s1 where grade = 1999;
```

```
3 DDL/DML queries executed successfully in 0.05
seconds.
```

8. 在视图 VIEWS 中将姓名为“uxjof”的学生的选课成绩都加上 5 分

```
create or replace rule update_views_rule as
  on update to views do instead (
    update choices set score = new.score
    where choices.no = new.no
  );

update views
set score = score + 5
where sname = 'uxjof';

select * from views where sname = 'uxjof';
```

- PostgreSQL 中，对涉及多个表的视图进行 UPDATE 操作时不被允许的：


Data Catalog
flask_db db
postgres db
▶ school db
vndb db
Query Editor
Run Selection
^q Quit f1 Help f8 History ^⏎ or ^j Run Query f4 Format Query ^s Save Query ^o Open Query ^f Find f3 Find Next

```
update views
set score = score + 5
where sname = 'uxjof';
```

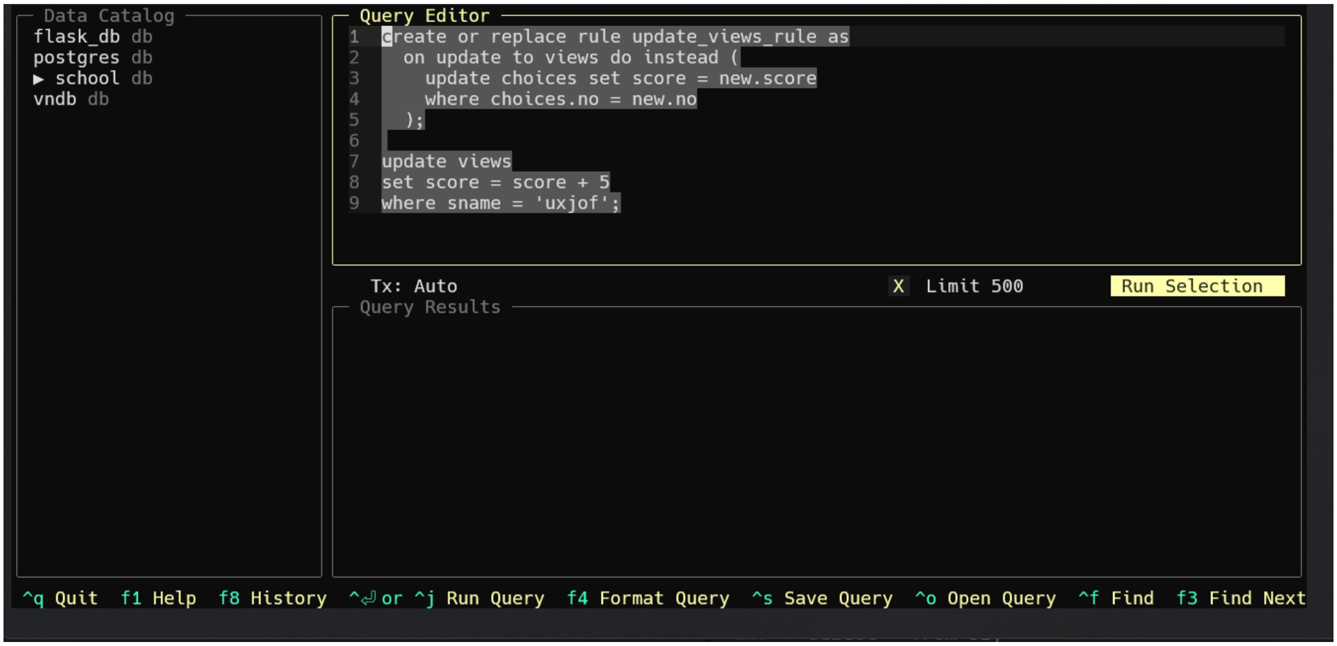
Query Error

Harlequin encountered an error while executing your query.

```
cannot update view "views"
DETAIL:  Views that do not select from a single table or view are not
automatically updatable.
HINT:  To enable updating the view, provide an INSTEAD OF UPDATE trigger
or an unconditional ON UPDATE DO INSTEAD rule.
```

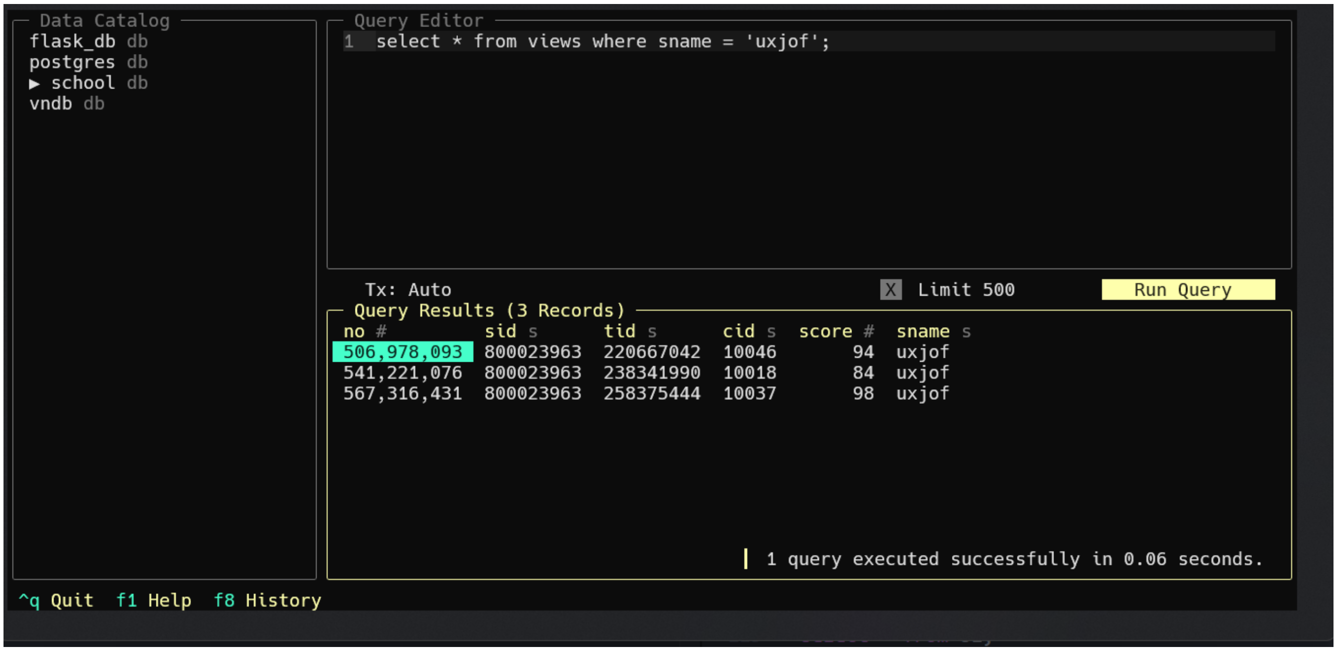
Press any key to continue. Click error to copy.

- 因此，需要主动定义一个更新操作的规则，再通过视图进行更新：


Data Catalog
flask_db db
postgres db
▶ school db
vndb db
Query Editor
Tx: Auto
X Limit 500
Run Selection
Query Results
^q Quit f1 Help f8 History ^⏎ or ^j Run Query f4 Format Query ^s Save Query ^o Open Query ^f Find f3 Find Next

```
create or replace rule update_views_rule as
  on update to views do instead (
    update choices set score = new.score
    where choices.no = new.no
  );

update views
set score = score + 5
where sname = 'uxjof';
```

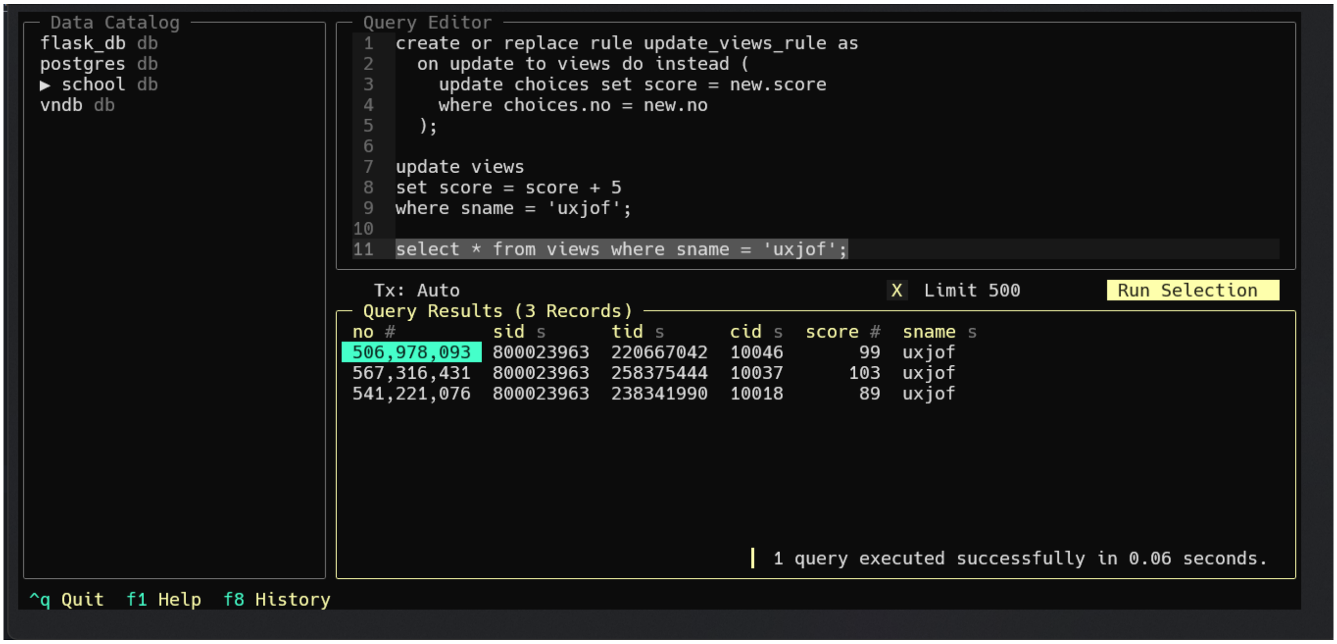
- 更新前：



```
select * from views where sname = 'uxjof';
```

```
Query Results (3 Records)
no #         sid s      tid s      cid s   score #  sname s
506,978,093  800023963  220667042  10046        94  uxjof
541,221,076  800023963  238341990  10018        84  uxjof
567,316,431  800023963  258375444  10037        98  uxjof

1 query executed successfully in 0.06 seconds.
```

- 更新后：



```
create or replace rule update_views_rule as
  on update to views do instead (
    update choices set score = new.score
    where choices.no = new.no
  );

update views
set score = score + 5
where sname = 'uxjof';

select * from views where sname = 'uxjof';
```

Query Results (3 Records)

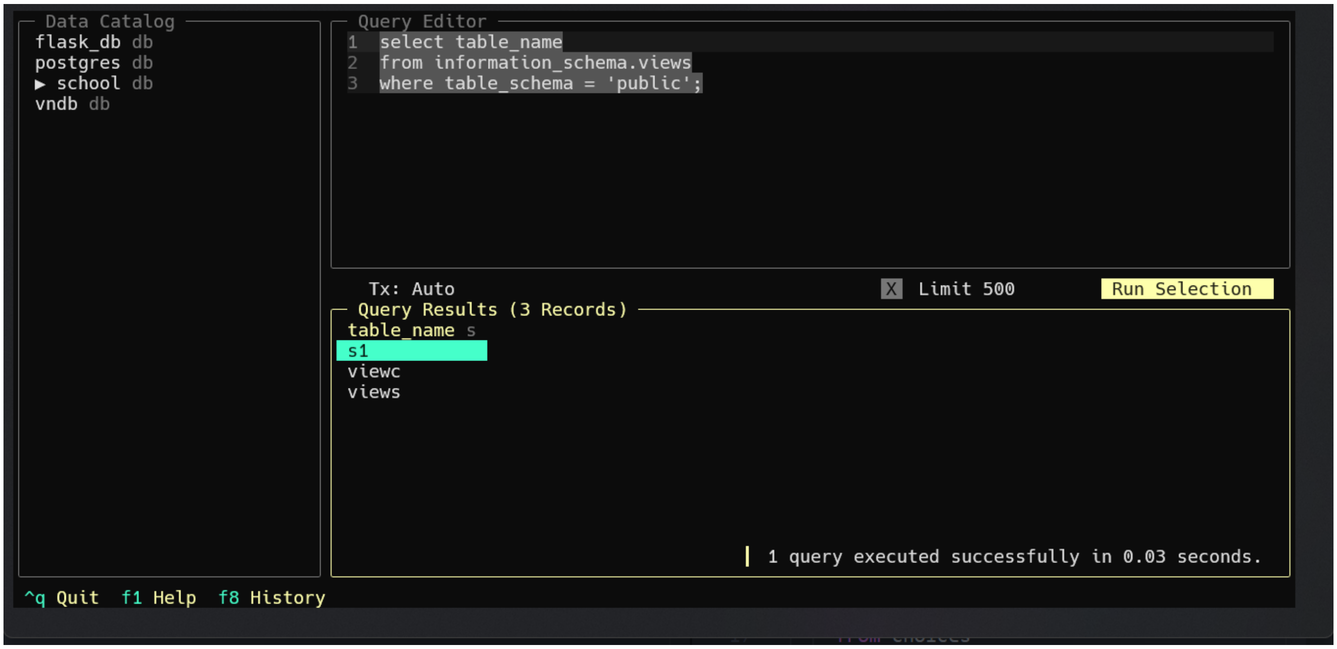
```
no #         sid s       tid s       cid s   score #  sname s
506,978,093  800023963   220667042   10046        99  uxjof
567,316,431  800023963   258375444   10037       103  uxjof
541,221,076  800023963   238341990   10018        89  uxjof
```

1 query executed successfully in 0.06 seconds.

9. 取消以上建立的所有视图

```
drop view if exists viewc;
drop view if exists views;
drop view if exists s1;

select table_name
from information_schema.views
where table_schema = 'public';
```

- 取消视图前：



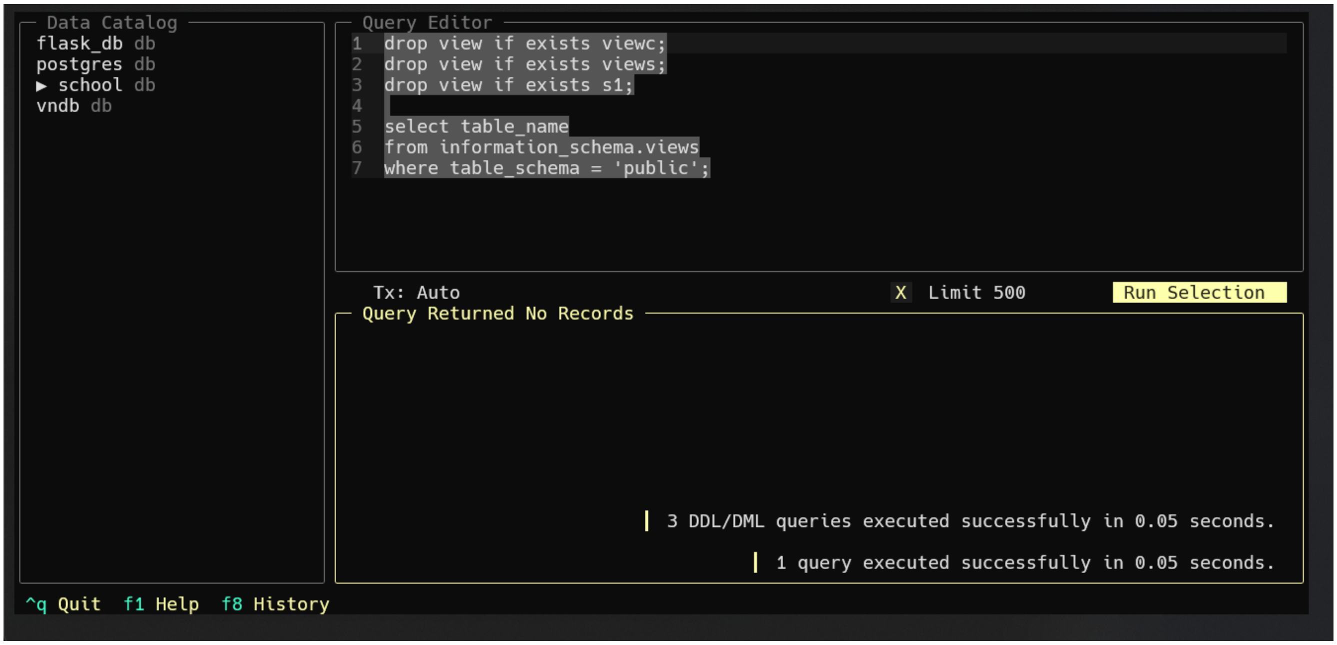
```
select table_name
from information_schema.views
where table_schema = 'public';
```

Query Results (3 Records)

```
table_name s
s1
viewc
views
```

1 query executed successfully in 0.03 seconds.

- 取消视图后：



```
drop view if exists viewc;
drop view if exists views;
drop view if exists s1;

select table_name
from information_schema.views
where table_schema = 'public';
```

Query Returned No Records

```
3 DDL/DML queries executed successfully in 0.05 seconds.

1 query executed successfully in 0.05 seconds.
```