DBT Assignment 1 : College Club Management

Name : Mohul Y P

SRN : PES1UG22CS360

a)Database preparation

Clubs Table: The central entity that stores information about different clubs

- **ClubID (primary key)**
- **ClubName (required)**
- **ClubType (categorizes clubs, e.g., "Sports")**
- **EstablishmentYear (when the club was founded)**

Members Table: Stores student/member information with a link to their club

- **MemberID (primary key)**
- **FirstName, LastName (required)**
- **Email (required, must be unique)**
- **PhoneNumber**
- **DOB (date of birth)**
- **ClubID (foreign key to Clubs table)**

Events Table: Tracks events organized by clubs

- **EventID (primary key)**
- **EventName (required)**
- **EventDate, EventLocation**
- **EventDescription (TEXT type for longer descriptions)**
- **ClubID (foreign key to Clubs table)**

Activities Table: Records specific activities conducted by clubs

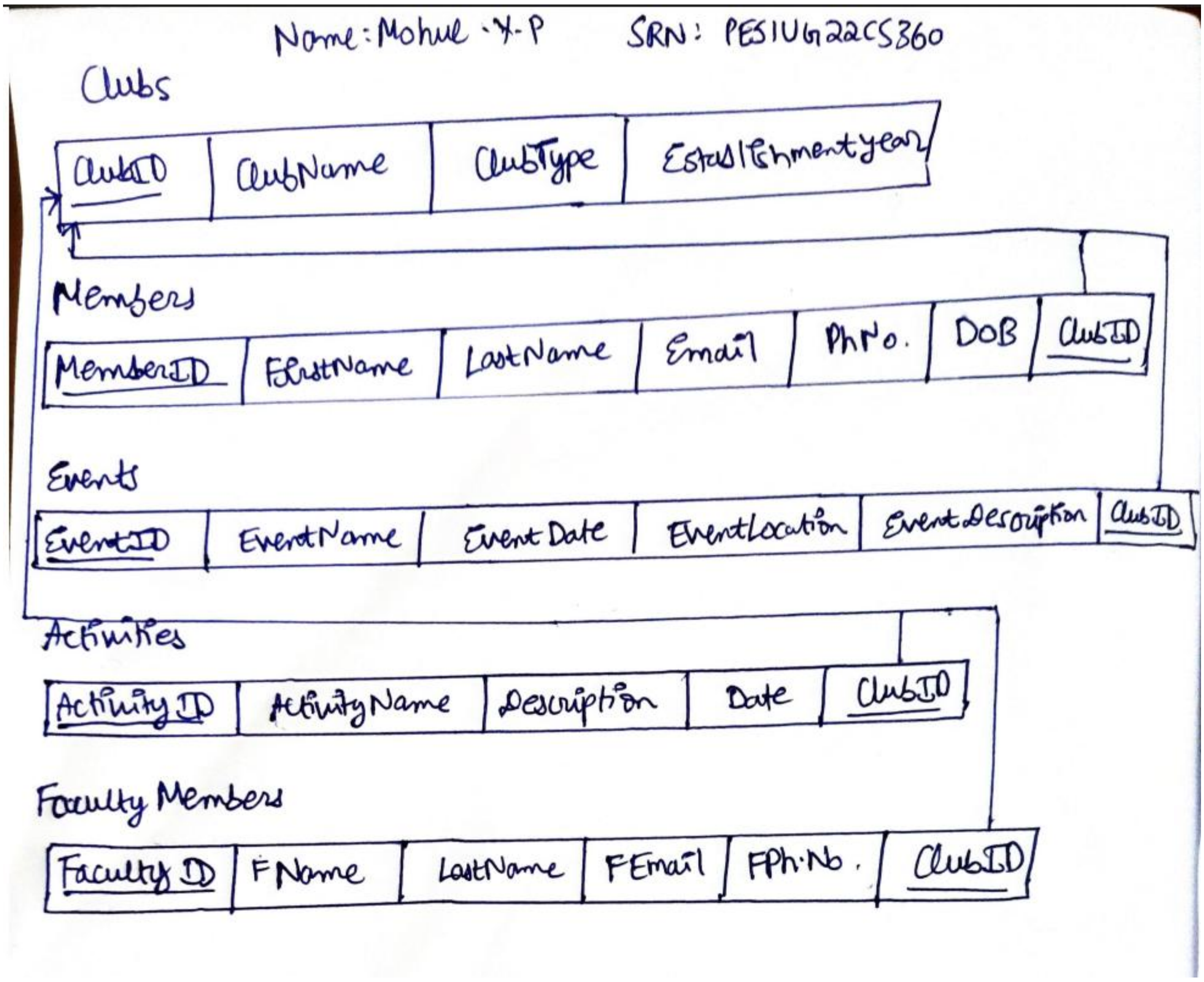
- **ActivityID (primary key)**
- **ActivityName (required)**
- **ActivityDescription**

- **ActivityDate**
- **ClubID (foreign key to Clubs table)**

FacultyMembers Table: Stores information about faculty members associated with clubs

- **FacultyID (primary key)**
- **FirstName, LastName (required)**
- **Email (required, must be unique)**
- **PhoneNumber**
- **ClubID (foreign key to Clubs table)**

Relational Schema:



Name: Mohul ·Y·P SRN: PES1UG22CS360

Clubs

ClubID	ClubName	ClubType	Establishmentyear

Members

MemberID	FirstName	LastName	Email	PhNo.	DOB	ClubID

Events

EventID	EventName	Event Date	EventLocation	EventDescription	ClubID

Activities

Activity ID	ActivityName	Description	Date	ClubID

Faculty Members

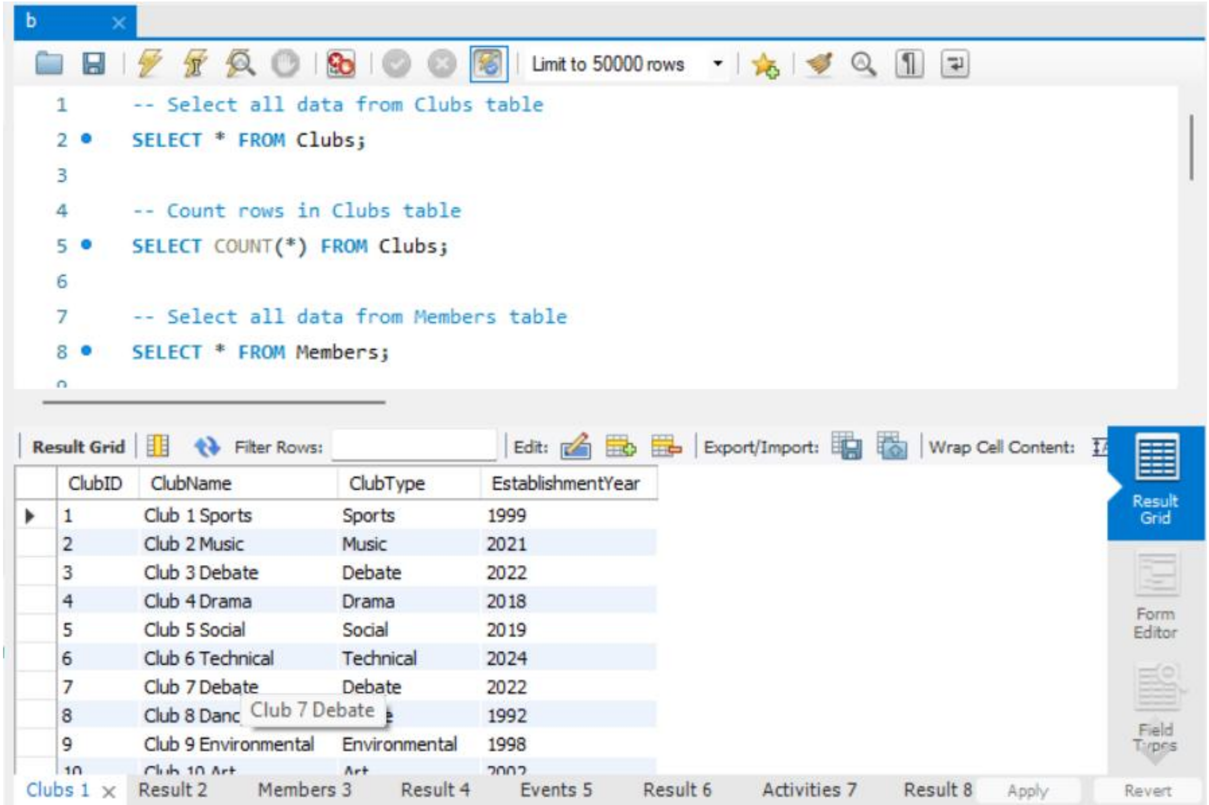
Faculty ID	FName	LastName	FEmail	FPh.No.	ClubID

To fill the tables with 10,000 rows, I used a python script which will be in the folder along with this submission.

b)**select and count queries on “clubs” table**

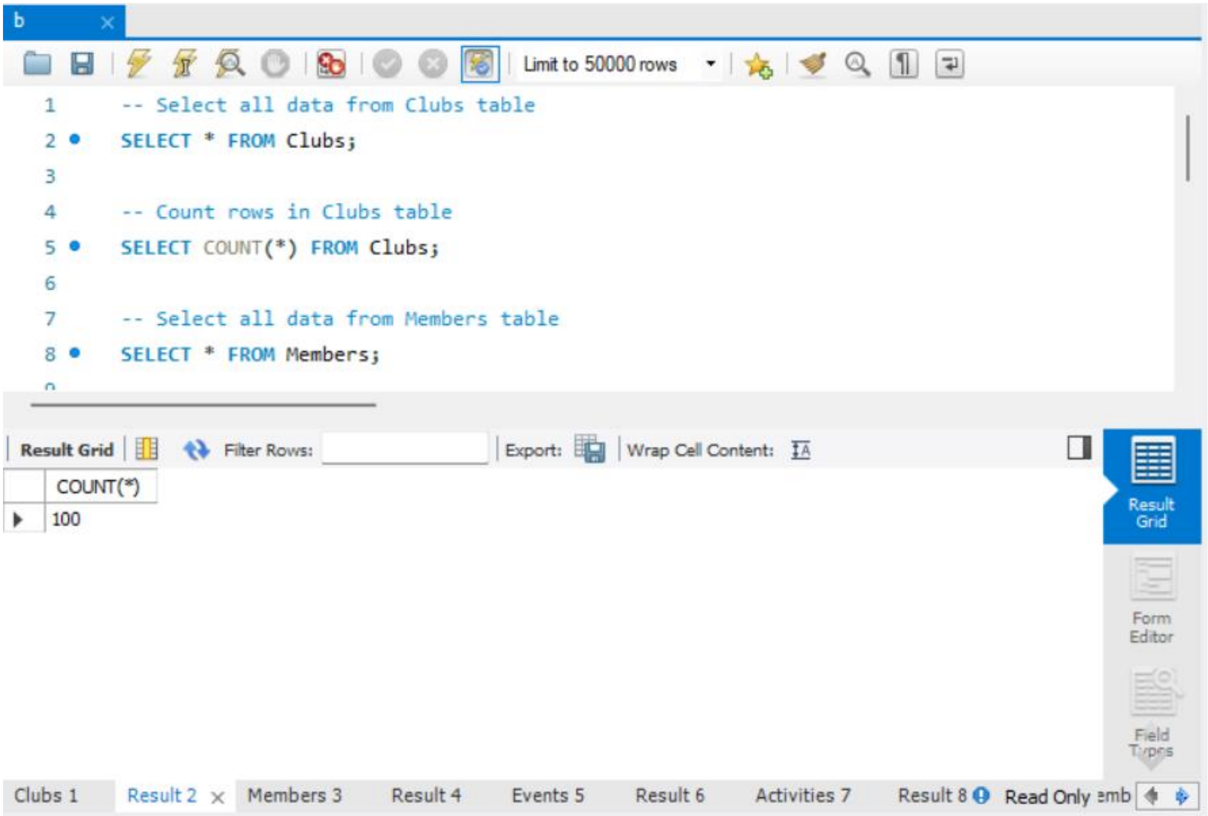
SELECT * FROM Clubs;

SELECT COUNT(*) FROM Clubs;



```
-- Select all data from Clubs table
SELECT * FROM Clubs;

-- Count rows in Clubs table
SELECT COUNT(*) FROM Clubs;

-- Select all data from Members table
SELECT * FROM Members;
```

ClubID	ClubName	ClubType	EstablishmentYear
1	Club 1 Sports	Sports	1999
2	Club 2 Music	Music	2021
3	Club 3 Debate	Debate	2022
4	Club 4 Drama	Drama	2018
5	Club 5 Social	Social	2019
6	Club 6 Technical	Technical	2024
7	Club 7 Debate	Debate	2022
8	Club 8 Danc	[illegible]	1992
9	Club 9 Environmental	Environmental	1998
10	Club 10 Art	Art	2002



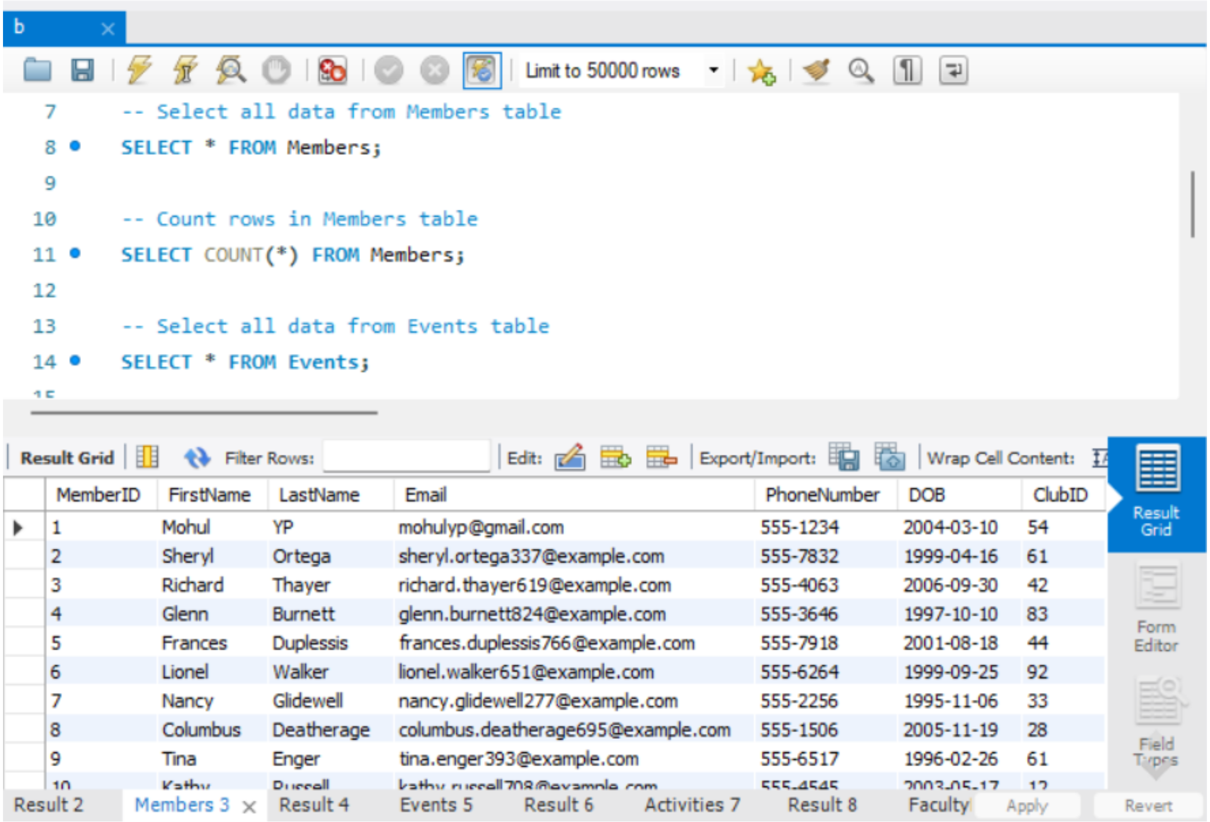
```
-- Select all data from Clubs table
SELECT * FROM Clubs;

-- Count rows in Clubs table
SELECT COUNT(*) FROM Clubs;

-- Select all data from Members table
SELECT * FROM Members;
```

COUNT(*)
100

select and count queries on “member” table

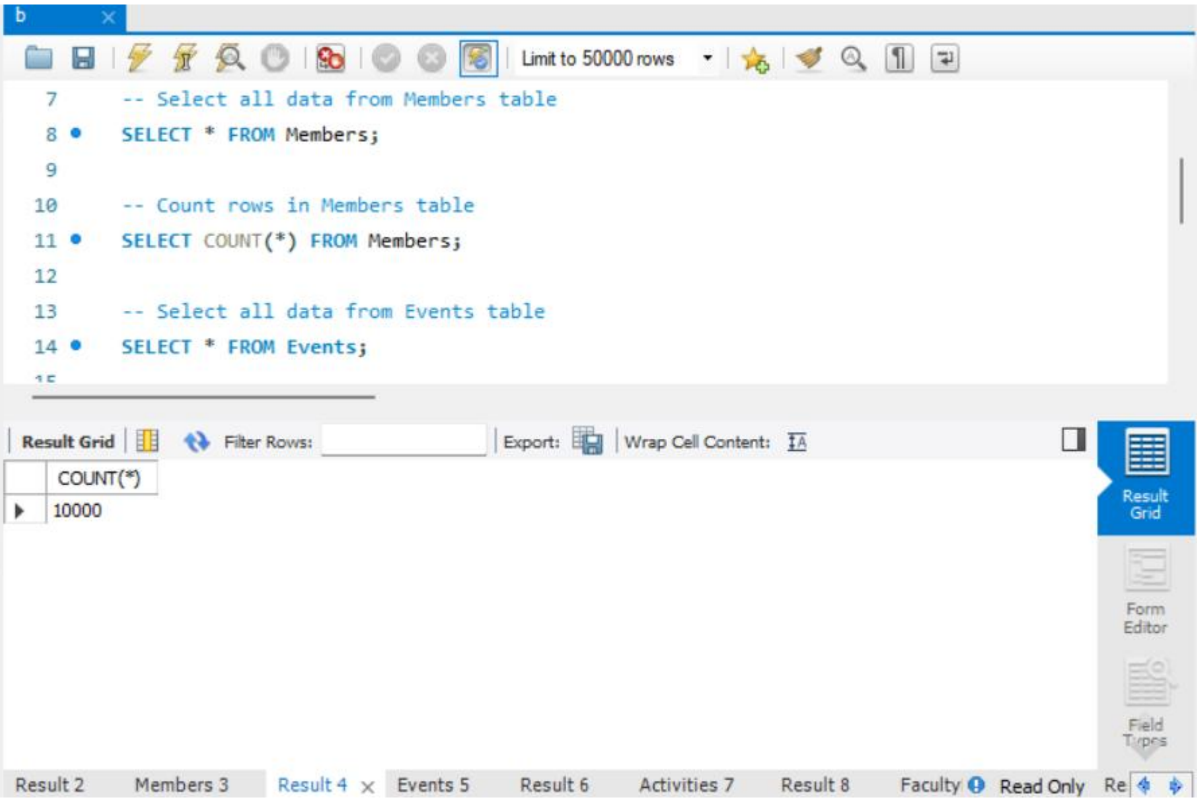
SELECT * FROM Members;

SELECT COUNT(*) FROM Members;



```sql
-- Select all data from Members table
SELECT * FROM Members;

-- Count rows in Members table
SELECT COUNT(*) FROM Members;

-- Select all data from Events table
SELECT * FROM Events;
```

MemberID	FirstName	LastName	Email	PhoneNumber	DOB	ClubID
1	Mohul	YP	mohulyp@gmail.com	555-1234	2004-03-10	54
2	Sheryl	Ortega	sheryl.ortega337@example.com	555-7832	1999-04-16	61
3	Richard	Thayer	richard.thayer619@example.com	555-4063	2006-09-30	42
4	Glenn	Burnett	glenn.burnett824@example.com	555-3646	1997-10-10	83
5	Frances	Duplessis	frances.duplessis766@example.com	555-7918	2001-08-18	44
6	Lionel	Walker	lionel.walker651@example.com	555-6264	1999-09-25	92
7	Nancy	Glidewell	nancy.glidewell277@example.com	555-2256	1995-11-06	33
8	Columbus	Deatherage	columbus.deatherage695@example.com	555-1506	2005-11-19	28
9	Tina	Enger	tina.enger393@example.com	555-6517	1996-02-26	61
10	Kathy	Russell	kathy.russell708@example.com	555-4545	2003-05-17	12



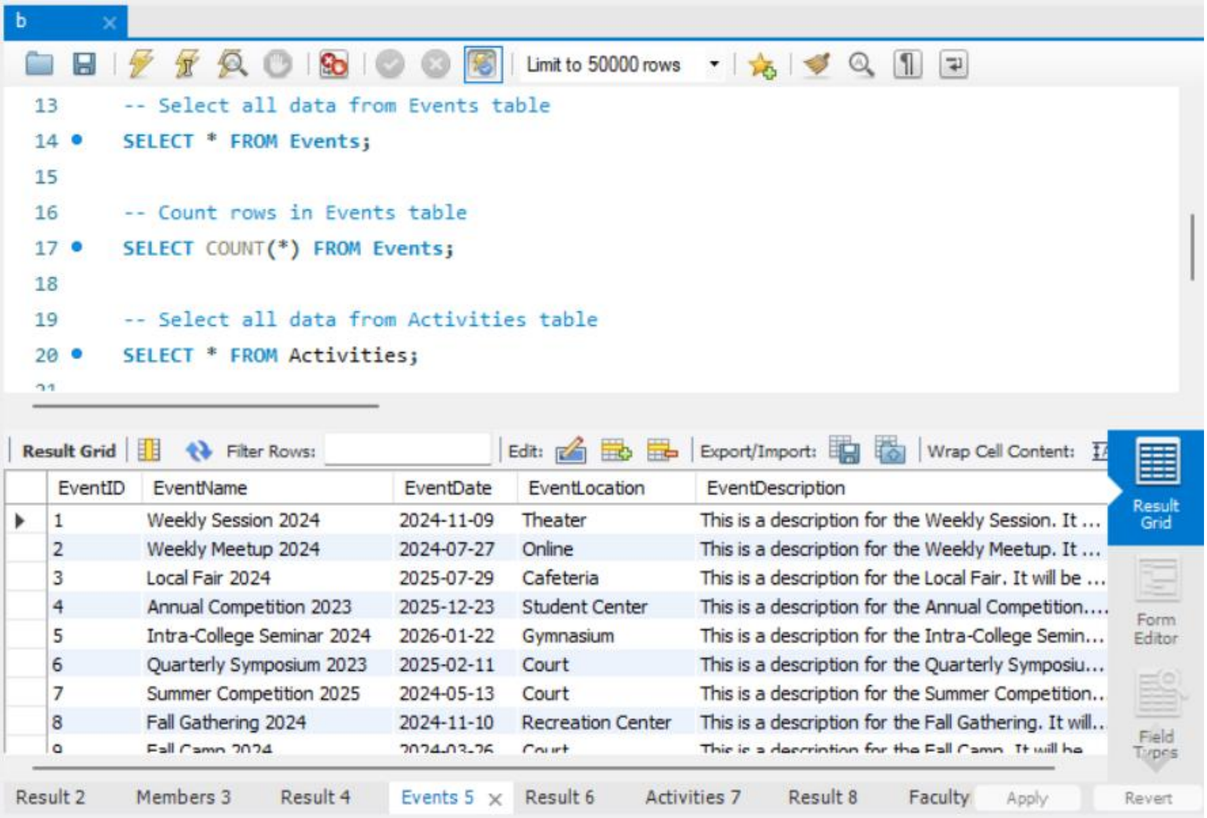
```sql
-- Select all data from Members table
SELECT * FROM Members;

-- Count rows in Members table
SELECT COUNT(*) FROM Members;

-- Select all data from Events table
SELECT * FROM Events;
```

COUNT(*)
10000

select and count queries on “events” table

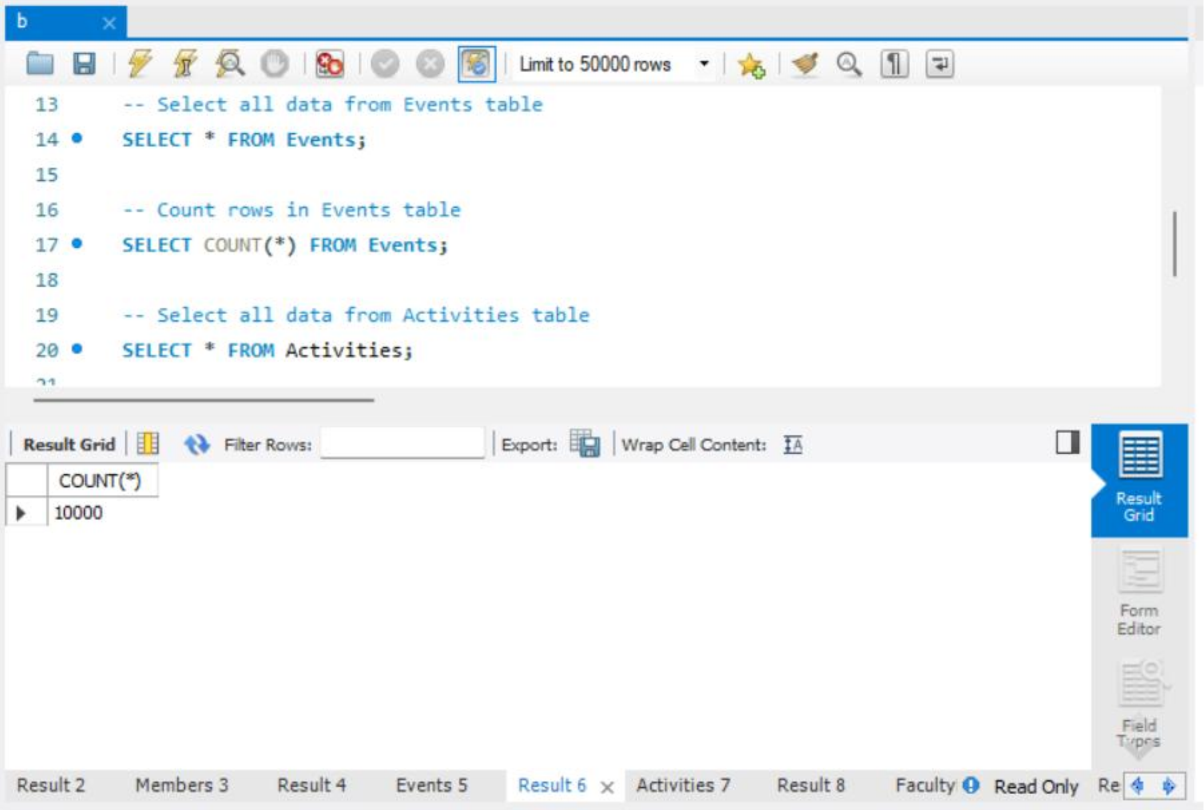
SELECT * FROM Events;

SELECT COUNT(*) FROM Events;



```sql
-- Select all data from Events table
SELECT * FROM Events;

-- Count rows in Events table
SELECT COUNT(*) FROM Events;

-- Select all data from Activities table
SELECT * FROM Activities;
```

EventID	EventName	EventDate	EventLocation	EventDescription
1	Weekly Session 2024	2024-11-09	Theater	This is a description for the Weekly Session. It ...
2	Weekly Meetup 2024	2024-07-27	Online	This is a description for the Weekly Meetup. It ...
3	Local Fair 2024	2025-07-29	Cafeteria	This is a description for the Local Fair. It will be ...
4	Annual Competition 2023	2025-12-23	Student Center	This is a description for the Annual Competition....
5	Intra-College Seminar 2024	2026-01-22	Gymnasium	This is a description for the Intra-College Semin...
6	Quarterly Symposium 2023	2025-02-11	Court	This is a description for the Quarterly Symposiu...
7	Summer Competition 2025	2024-05-13	Court	This is a description for the Summer Competition..
8	Fall Gathering 2024	2024-11-10	Recreation Center	This is a description for the Fall Gathering. It will..
9	Fall Camp 2024	2024-03-26	Court	This is a description for the Fall Camp. It will be



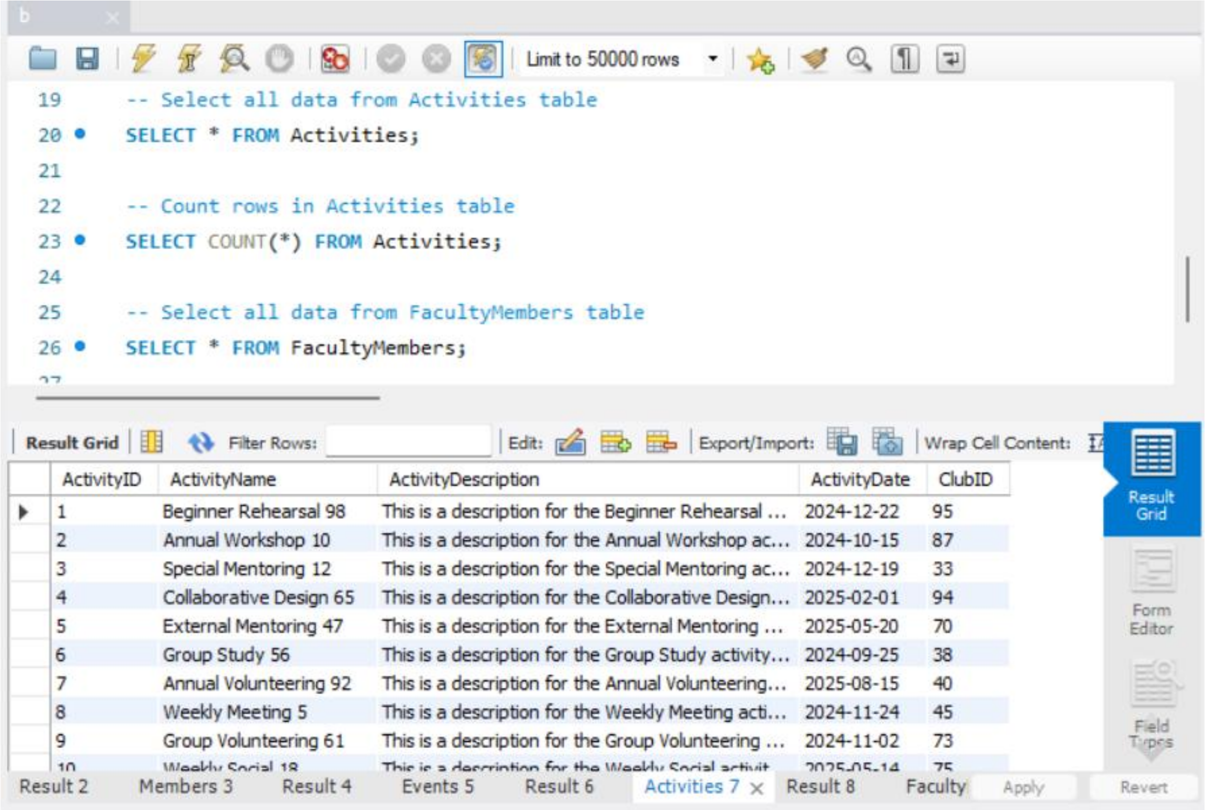
```sql
-- Select all data from Events table
SELECT * FROM Events;

-- Count rows in Events table
SELECT COUNT(*) FROM Events;

-- Select all data from Activities table
SELECT * FROM Activities;
```

COUNT(*)
10000

select and count queries on “activities” table

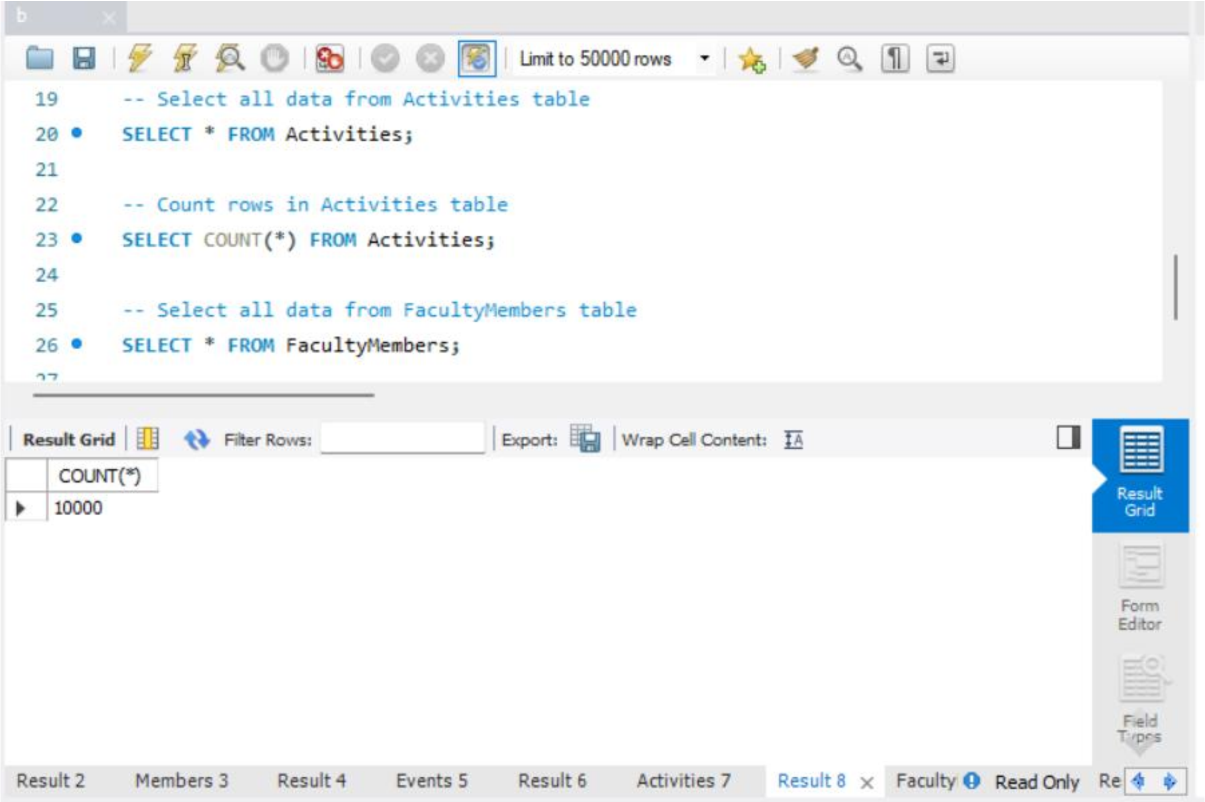
SELECT * FROM Activities;

SELECT COUNT(*) FROM Activities;



```
-- Select all data from Activities table
SELECT * FROM Activities;

-- Count rows in Activities table
SELECT COUNT(*) FROM Activities;

-- Select all data from FacultyMembers table
SELECT * FROM FacultyMembers;
```

ActivityID	ActivityName	ActivityDescription	ActivityDate	ClubID
1	Beginner Rehearsal 98	This is a description for the Beginner Rehearsal ...	2024-12-22	95
2	Annual Workshop 10	This is a description for the Annual Workshop ac...	2024-10-15	87
3	Special Mentoring 12	This is a description for the Special Mentoring ac...	2024-12-19	33
4	Collaborative Design 65	This is a description for the Collaborative Design...	2025-02-01	94
5	External Mentoring 47	This is a description for the External Mentoring ...	2025-05-20	70
6	Group Study 56	This is a description for the Group Study activity...	2024-09-25	38
7	Annual Volunteering 92	This is a description for the Annual Volunteering...	2025-08-15	40
8	Weekly Meeting 5	This is a description for the Weekly Meeting acti...	2024-11-24	45
9	Group Volunteering 61	This is a description for the Group Volunteering ...	2024-11-02	73
10	Weekly Social 18	This is a description for the Weekly Social activit	2025-05-14	75



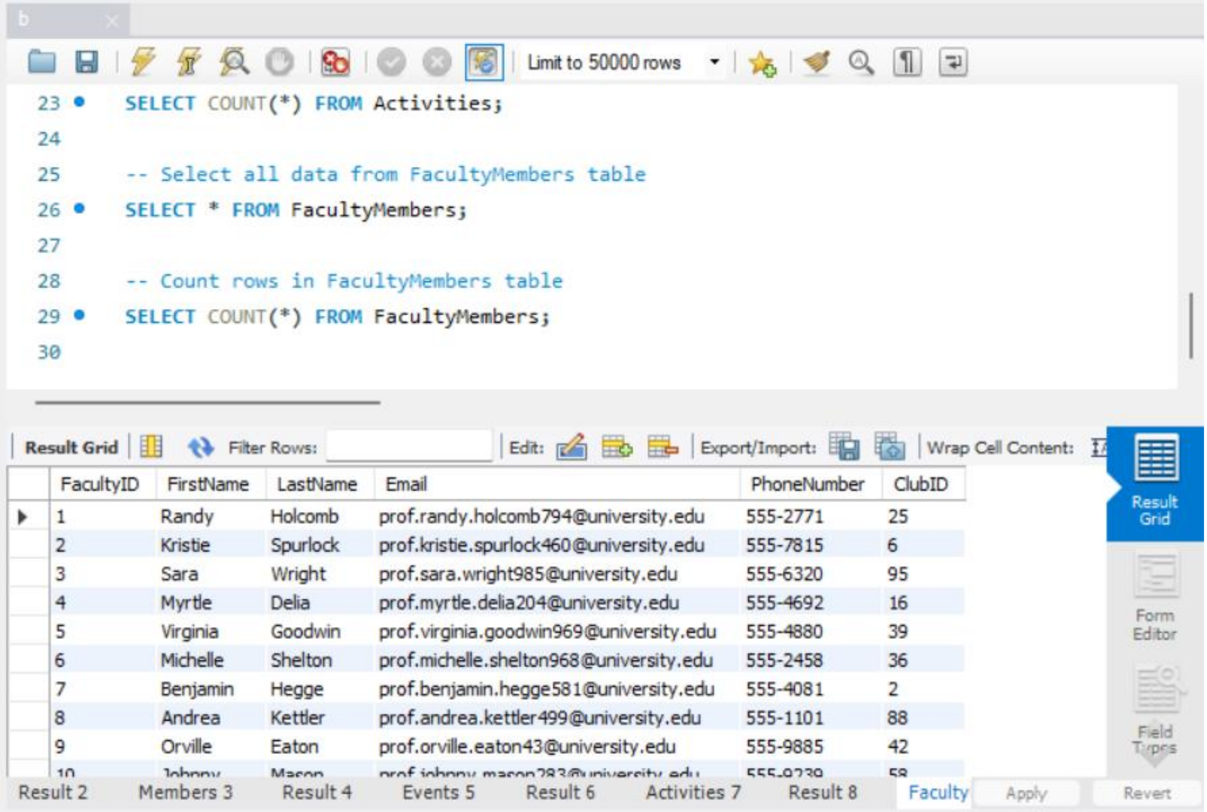
```
-- Select all data from Activities table
SELECT * FROM Activities;

-- Count rows in Activities table
SELECT COUNT(*) FROM Activities;

-- Select all data from FacultyMembers table
SELECT * FROM FacultyMembers;
```

COUNT(*)
10000

select and count queries on “faculty members” table

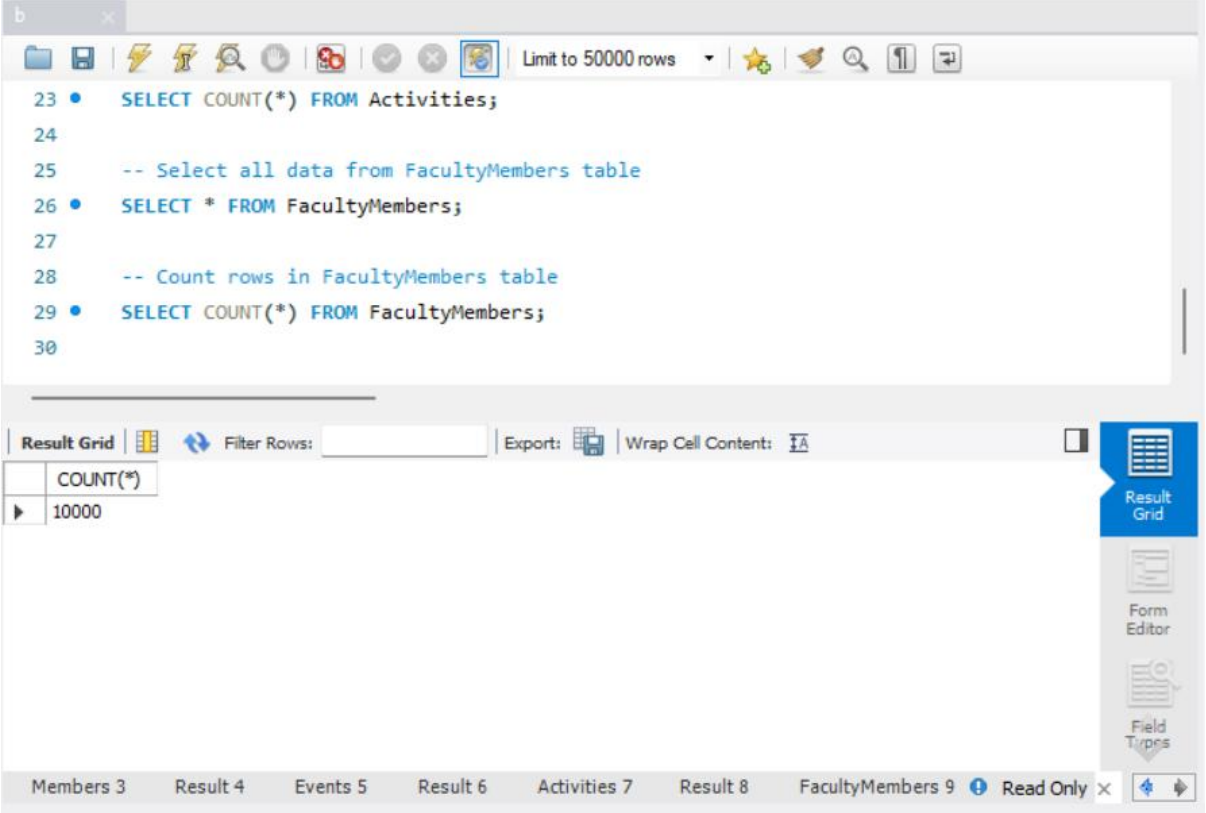
SELECT * FROM FacultyMembers;

SELECT COUNT(*) FROM FacultyMembers;



```
SELECT COUNT(*) FROM Activities;

-- Select all data from FacultyMembers table
SELECT * FROM FacultyMembers;

-- Count rows in FacultyMembers table
SELECT COUNT(*) FROM FacultyMembers;

```

FacultyID	FirstName	LastName	Email	PhoneNumber	ClubID
1	Randy	Holcomb	prof.randy.holcomb794@university.edu	555-2771	25
2	Kristie	Spurlock	prof.kristie.spurlock460@university.edu	555-7815	6
3	Sara	Wright	prof.sara.wright985@university.edu	555-6320	95
4	Myrtle	Delia	prof.myrtle.delia204@university.edu	555-4692	16
5	Virginia	Goodwin	prof.virginia.goodwin969@university.edu	555-4880	39
6	Michelle	Shelton	prof.michelle.shelton968@university.edu	555-2458	36
7	Benjamin	Hegge	prof.benjamin.hegge581@university.edu	555-4081	2
8	Andrea	Kettler	prof.andrea.kettler499@university.edu	555-1101	88
9	Orville	Eaton	prof.orville.eaton43@university.edu	555-9885	42
10	Johnny	Mason	prof.johnny.mason283@university.edu	555-9239	58



```
SELECT COUNT(*) FROM Activities;

-- Select all data from FacultyMembers table
SELECT * FROM FacultyMembers;

-- Count rows in FacultyMembers table
SELECT COUNT(*) FROM FacultyMembers;

```

COUNT(*)
10000

INDEX SCAN

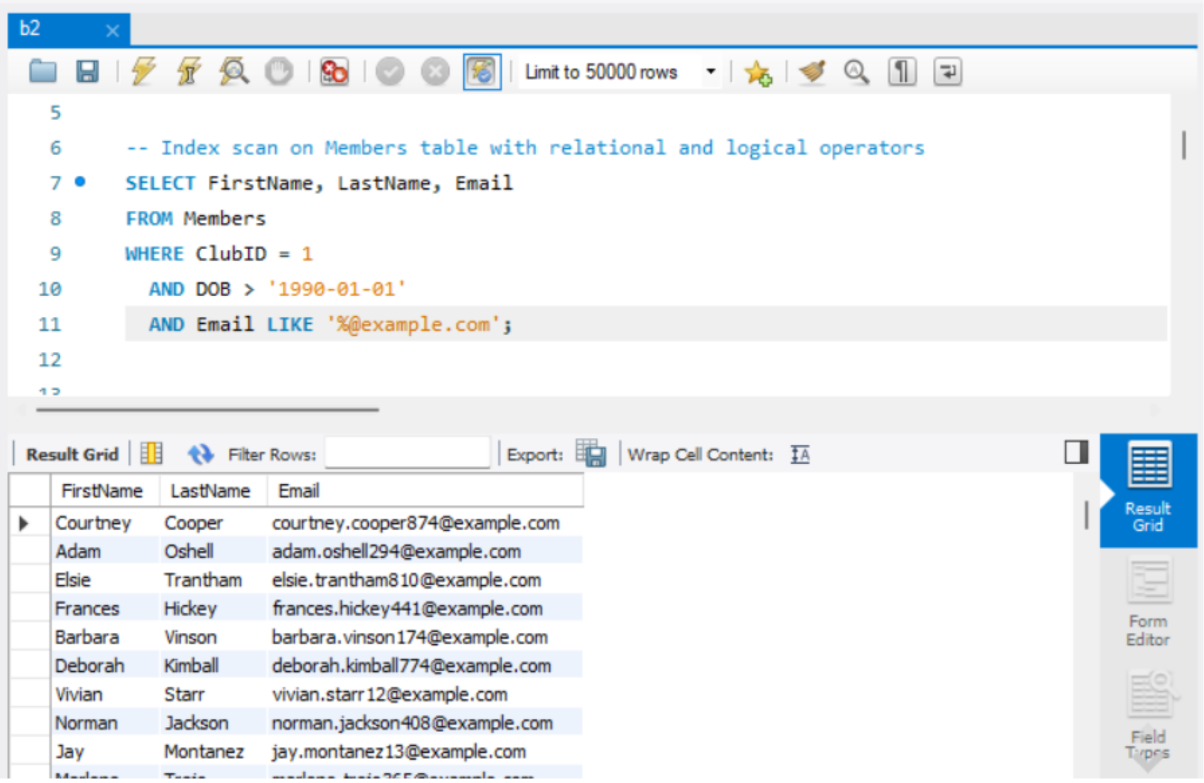
1) SELECT FirstName, LastName, Email

FROM Members

WHERE ClubID = 1

AND DOB > '1990-01-01'

AND Email LIKE '%@example.com';



```
-- Index scan on Members table with relational and logical operators
SELECT FirstName, LastName, Email
FROM Members
WHERE ClubID = 1
  AND DOB > '1990-01-01'
  AND Email LIKE '%@example.com';
```

FirstName	LastName	Email
Courtney	Cooper	courtney.cooper874@example.com
Adam	Oshell	adam.oshell294@example.com
Elsie	Trantham	elsie.trantham810@example.com
Frances	Hickey	frances.hickey441@example.com
Barbara	Vinson	barbara.vinson174@example.com
Deborah	Kimball	deborah.kimball774@example.com
Vivian	Starr	vivian.starr12@example.com
Norman	Jackson	norman.jackson408@example.com
Jay	Montanez	jay.montanez13@example.com
Marlene	Travis	marlene.travis365@example.com

TABLE SCAN

1) – table scan on members to find members born after 1990 ordered by first name who are not in sports clubs established after 2000

SELECT *

FROM Members m

WHERE m.ClubID NOT IN (

  SELECT c.ClubID

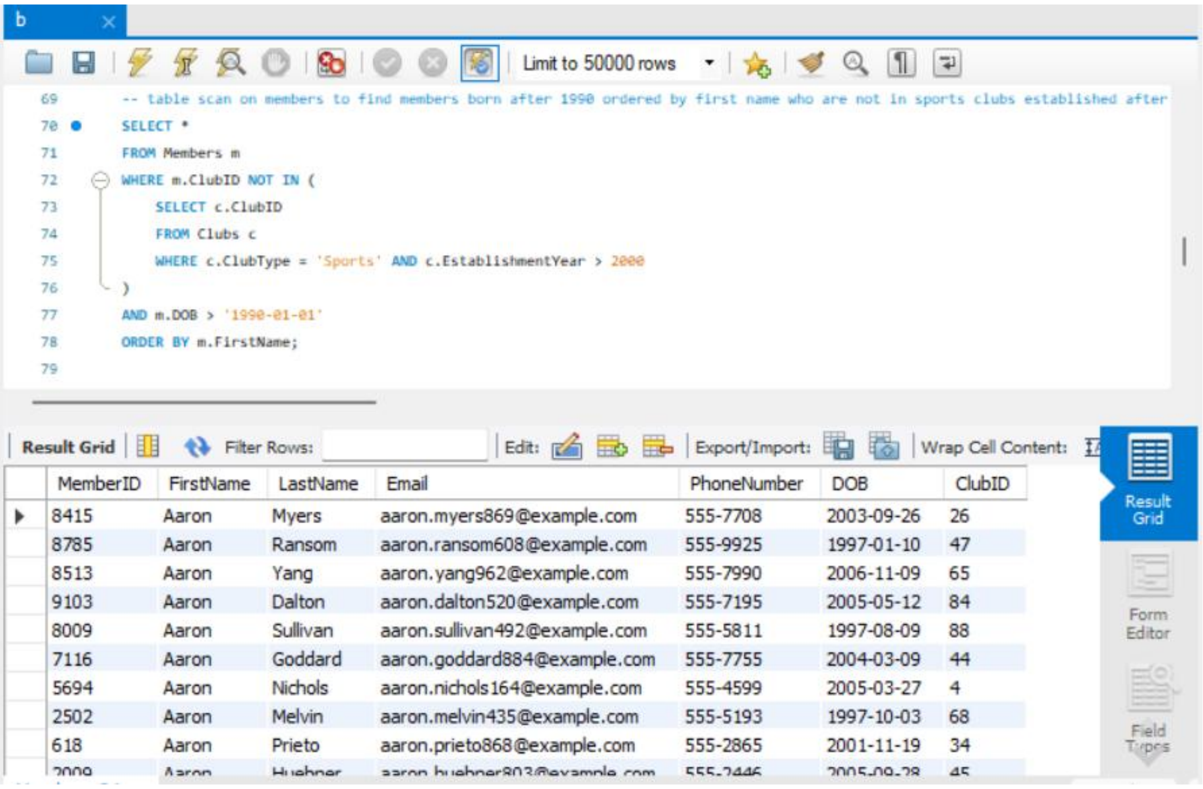
  FROM Clubs c

  WHERE c.ClubType = 'Sports' AND c.EstablishmentYear > 2000

)

AND m.DOB > '1990-01-01'

ORDER BY m.FirstName;

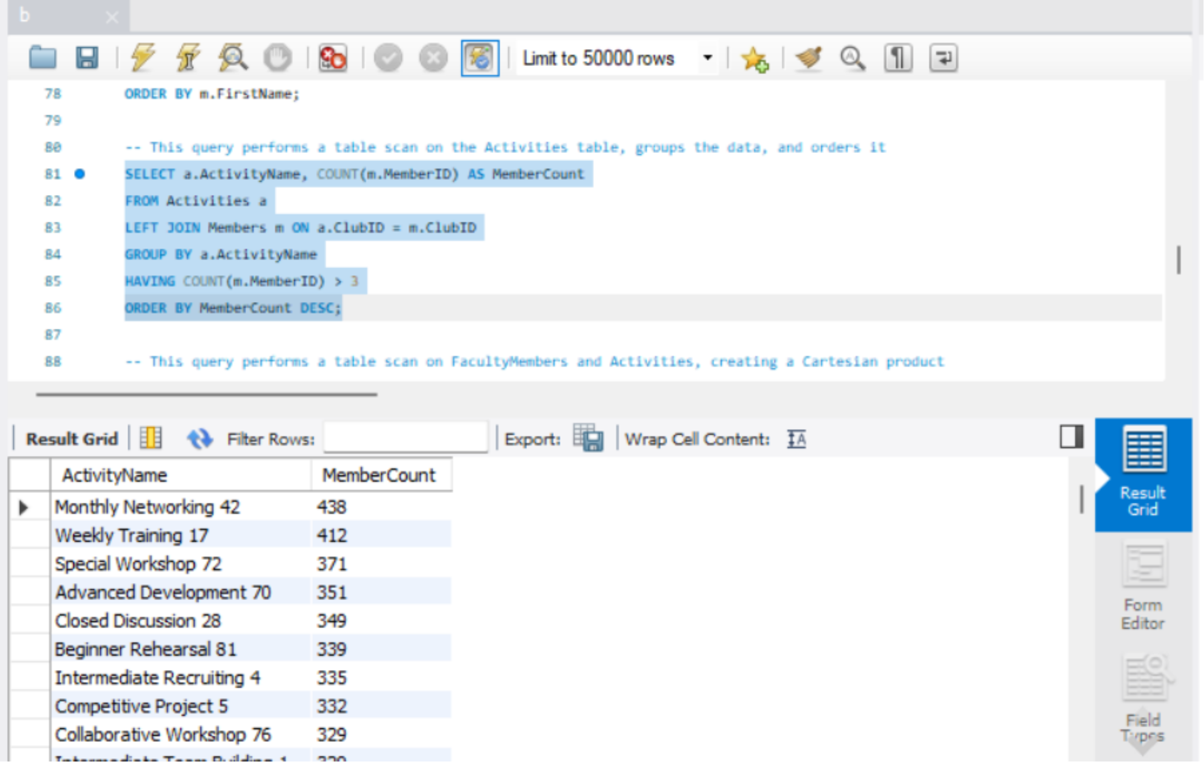


```
-- table scan on members to find members born after 1990 ordered by first name who are not in sports clubs established after
SELECT *
FROM Members m
WHERE m.ClubID NOT IN (
    SELECT c.ClubID
    FROM Clubs c
    WHERE c.ClubType = 'Sports' AND c.EstablishmentYear > 2000
)
AND m.DOB > '1990-01-01'
ORDER BY m.FirstName;
```

MemberID	FirstName	LastName	Email	PhoneNumber	DOB	ClubID
8415	Aaron	Myers	aaron.myers869@example.com	555-7708	2003-09-26	26
8785	Aaron	Ransom	aaron.ransom608@example.com	555-9925	1997-01-10	47
8513	Aaron	Yang	aaron.yang962@example.com	555-7990	2006-11-09	65
9103	Aaron	Dalton	aaron.dalton520@example.com	555-7195	2005-05-12	84
8009	Aaron	Sullivan	aaron.sullivan492@example.com	555-5811	1997-08-09	88
7116	Aaron	Goddard	aaron.goddard884@example.com	555-7755	2004-03-09	44
5694	Aaron	Nichols	aaron.nichols164@example.com	555-4599	2005-03-27	4
2502	Aaron	Melvin	aaron.melvin435@example.com	555-5193	1997-10-03	68
618	Aaron	Prieto	aaron.prieto868@example.com	555-2865	2001-11-19	34
2009	Aaron	Huebner	aaron.huebner803@example.com	555-2446	2005-09-28	45

2) --table scan on join of activities and members table.

```
SELECT a.ActivityName, COUNT(m.MemberID) AS MemberCount

FROM Activities a

LEFT JOIN Members m ON a.ClubID = m.ClubID

GROUP BY a.ActivityName

HAVING COUNT(m.MemberID) > 3

ORDER BY MemberCount DESC;
```



Limit to 50000 rows

```
ORDER BY m.FirstName;

-- This query performs a table scan on the Activities table, groups the data, and orders it
SELECT a.ActivityName, COUNT(m.MemberID) AS MemberCount
FROM Activities a
LEFT JOIN Members m ON a.ClubID = m.ClubID
GROUP BY a.ActivityName
HAVING COUNT(m.MemberID) > 3
ORDER BY MemberCount DESC;

-- This query performs a table scan on FacultyMembers and Activities, creating a Cartesian product
```

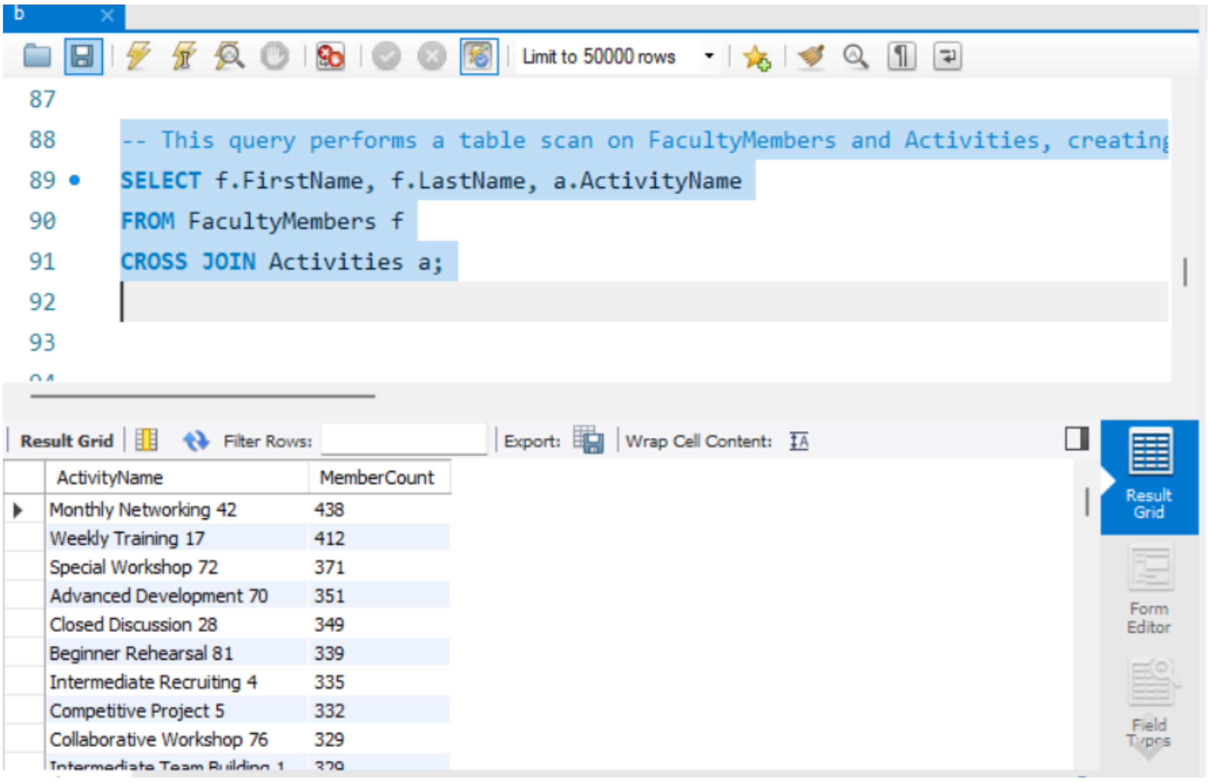
ActivityName	MemberCount
Monthly Networking 42	438
Weekly Training 17	412
Special Workshop 72	371
Advanced Development 70	351
Closed Discussion 28	349
Beginner Rehearsal 81	339
Intermediate Recruiting 4	335
Competitive Project 5	332
Collaborative Workshop 76	329
Intermediate Team Building 1	329

3) -- This query performs a table scan on FacultyMembers and Activities, creating a Cartesian product

SELECT f.FirstName, f.LastName, a.ActivityName

FROM FacultyMembers f

CROSS JOIN Activities a;



```
-- This query performs a table scan on FacultyMembers and Activities, creating
SELECT f.FirstName, f.LastName, a.ActivityName
FROM FacultyMembers f
CROSS JOIN Activities a;
```

ActivityName	MemberCount
Monthly Networking 42	438
Weekly Training 17	412
Special Workshop 72	371
Advanced Development 70	351
Closed Discussion 28	349
Beginner Rehearsal 81	339
Intermediate Recruiting 4	335
Competitive Project 5	332
Collaborative Workshop 76	329
Intermediate Team Building 1	329

queries with multi-table joins involving 3 tables; including both "SELECT *" and conditional "SELECT" queries with a subset of columns.

1) SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount

FROM Members m

INNER JOIN Clubs c ON m.ClubID = c.ClubID

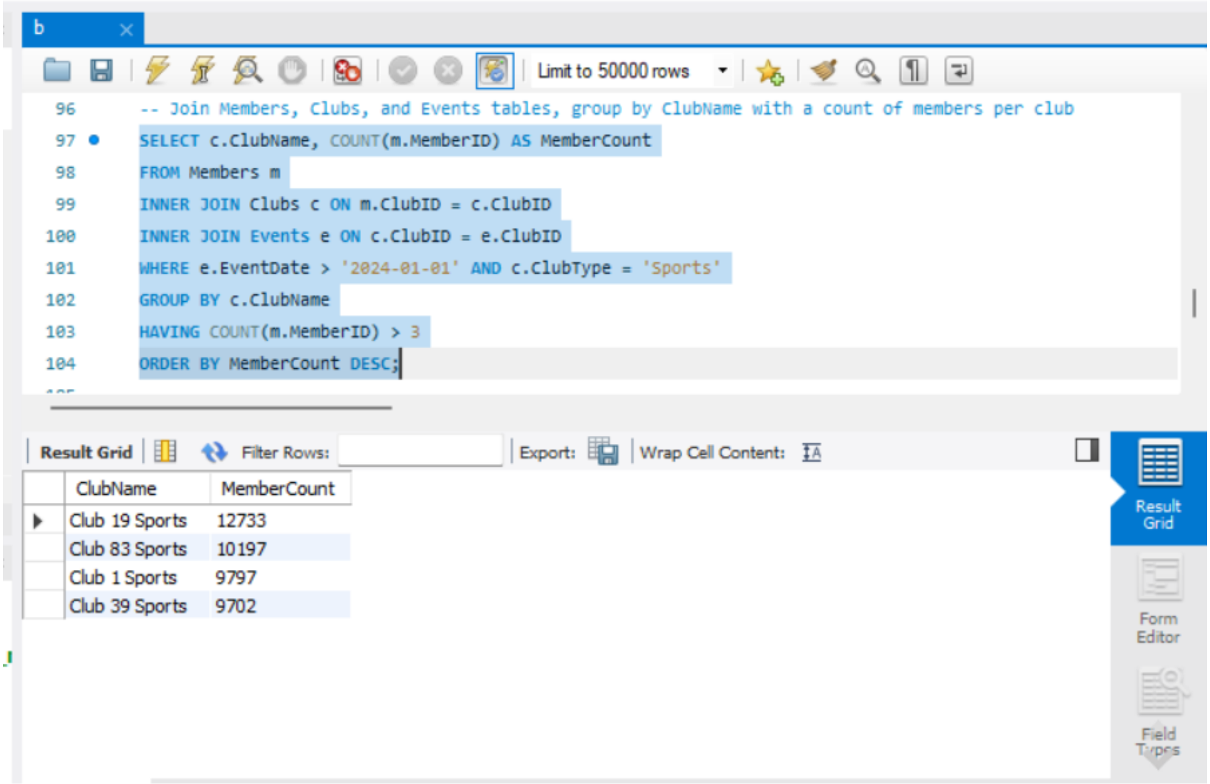
INNER JOIN Events e ON c.ClubID = e.ClubID

WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'

GROUP BY c.ClubName

HAVING COUNT(m.MemberID) > 3

ORDER BY MemberCount DESC;

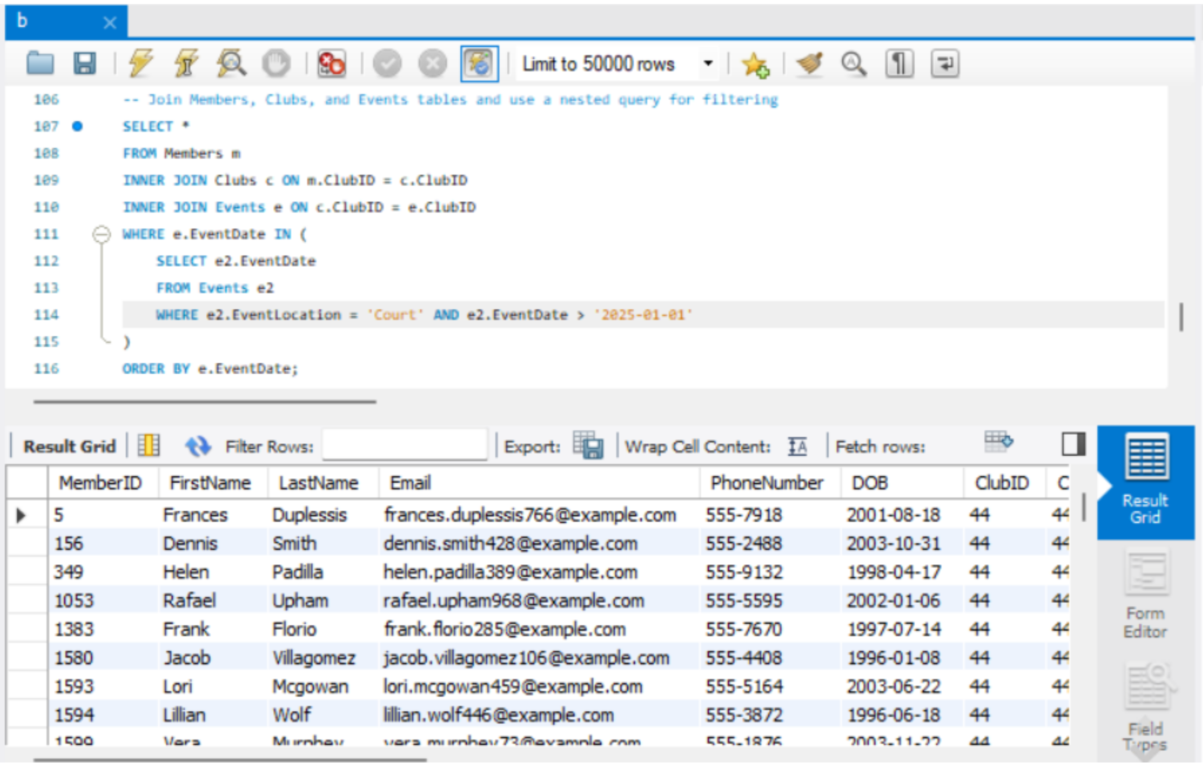


```
-- Join Members, Clubs, and Events tables, group by ClubName with a count of members per club
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount
FROM Members m
INNER JOIN Clubs c ON m.ClubID = c.ClubID
INNER JOIN Events e ON c.ClubID = e.ClubID
WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'
GROUP BY c.ClubName
HAVING COUNT(m.MemberID) > 3
ORDER BY MemberCount DESC;
```

ClubName	MemberCount
Club 19 Sports	12733
Club 83 Sports	10197
Club 1 Sports	9797
Club 39 Sports	9702

2)

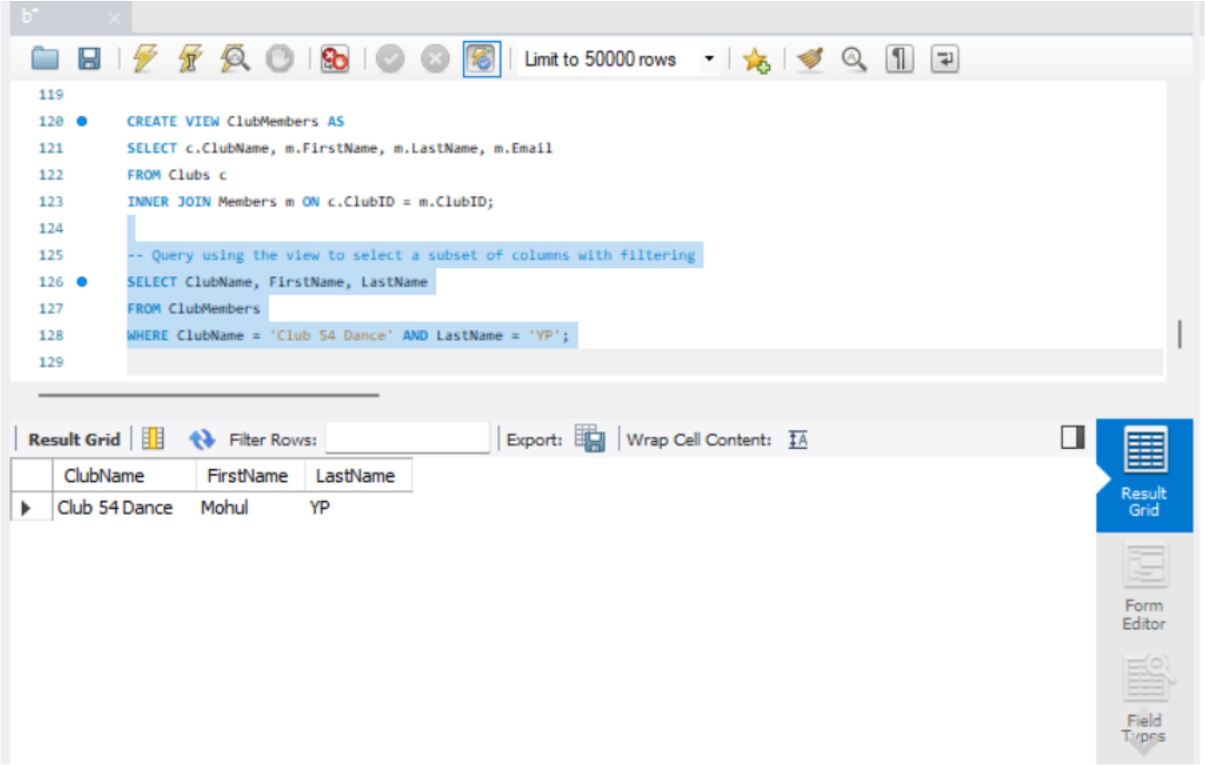
```
SELECT *

FROM Members m

INNER JOIN Clubs c ON m.ClubID = c.ClubID

INNER JOIN Events e ON c.ClubID = e.ClubID

WHERE e.EventDate IN (

  SELECT e2.EventDate

  FROM Events e2

  WHERE e2.EventLocation = 'Hall A' AND e2.EventDate > '2025-01-01'

)

ORDER BY e.EventDate;
```



```
-- Join Members, Clubs, and Events tables and use a nested query for filtering
SELECT *
FROM Members m
INNER JOIN Clubs c ON m.ClubID = c.ClubID
INNER JOIN Events e ON c.ClubID = e.ClubID
WHERE e.EventDate IN (
    SELECT e2.EventDate
    FROM Events e2
    WHERE e2.EventLocation = 'Court' AND e2.EventDate > '2025-01-01'
)
ORDER BY e.EventDate;
```

MemberID	FirstName	LastName	Email	PhoneNumber	DOB	ClubID	C
5	Frances	Duplessis	frances.duplessis766@example.com	555-7918	2001-08-18	44	44
156	Dennis	Smith	dennis.smith428@example.com	555-2488	2003-10-31	44	44
349	Helen	Padilla	helen.padilla389@example.com	555-9132	1998-04-17	44	44
1053	Rafael	Upham	rafael.upham968@example.com	555-5595	2002-01-06	44	44
1383	Frank	Florio	frank.florio285@example.com	555-7670	1997-07-14	44	44
1580	Jacob	Villagomez	jacob.villagomez106@example.com	555-4408	1996-01-08	44	44
1593	Lori	Mcgowan	lori.mcgowan459@example.com	555-5164	2003-06-22	44	44
1594	Lillian	Wolf	lillian.wolf446@example.com	555-3872	1996-06-18	44	44
1599	Vera	Murphey	vera.murphey73@example.com	555-1876	2003-11-22	44	44

```
3) CREATE VIEW ClubMembers AS

SELECT c.ClubName, m.FirstName, m.LastName, m.Email

FROM Clubs c

INNER JOIN Members m ON c.ClubID = m.ClubID;


-- Query using the view to select a subset of columns with filtering

SELECT ClubName, FirstName, LastName

FROM ClubMembers

WHERE ClubName = 'Club 54 Dance' AND LastName = 'YP';
```



```
CREATE VIEW ClubMembers AS
SELECT c.ClubName, m.FirstName, m.LastName, m.Email
FROM Clubs c
INNER JOIN Members m ON c.ClubID = m.ClubID;

-- Query using the view to select a subset of columns with filtering
SELECT ClubName, FirstName, LastName
FROM ClubMembers
WHERE ClubName = 'Club 54 Dance' AND LastName = 'YP';
```

ClubName	FirstName	LastName
Club 54 Dance	Mohul	YP

EXPLAIN ANALYZE on each of the queries mentioned above :

INDEX SCAN

1) EXPLAIN ANALYZE

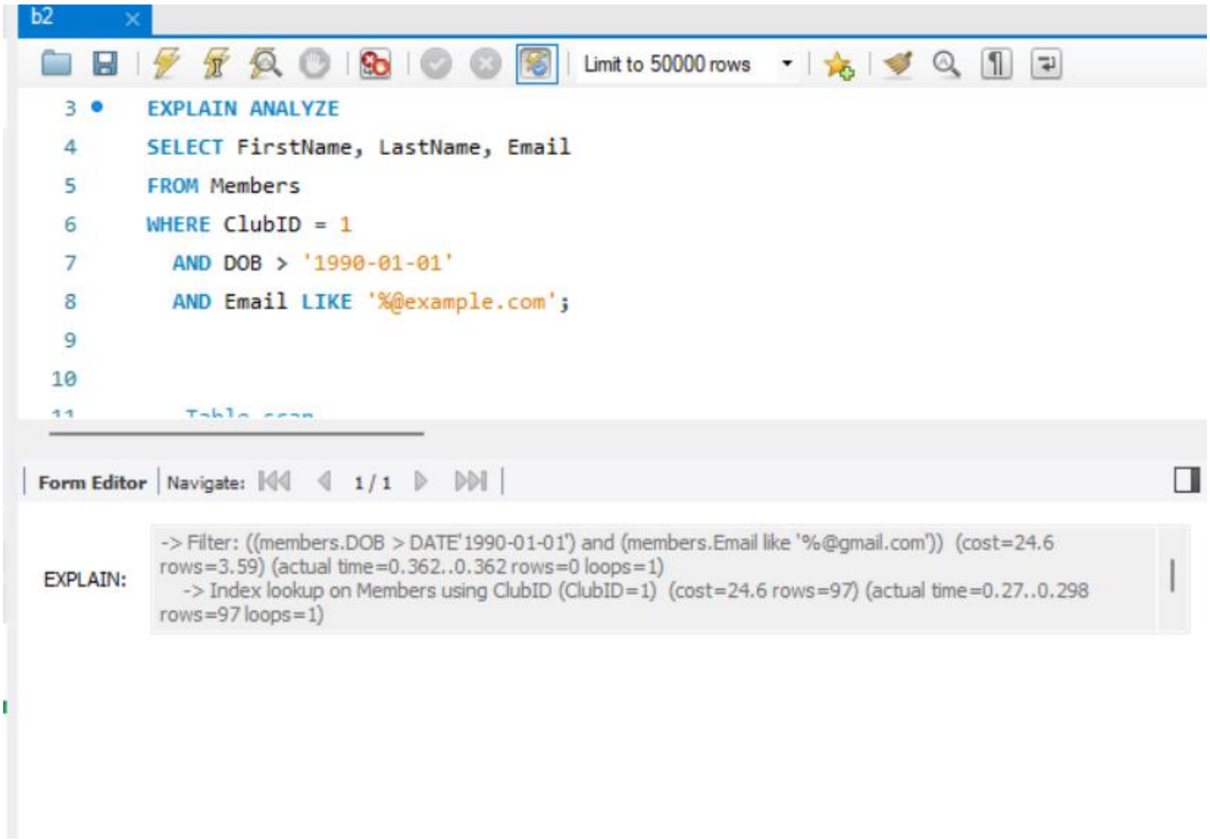
SELECT FirstName, LastName, Email

FROM Members

WHERE ClubID = 1

 AND DOB > '1990-01-01'

 AND Email LIKE '%@example.com';



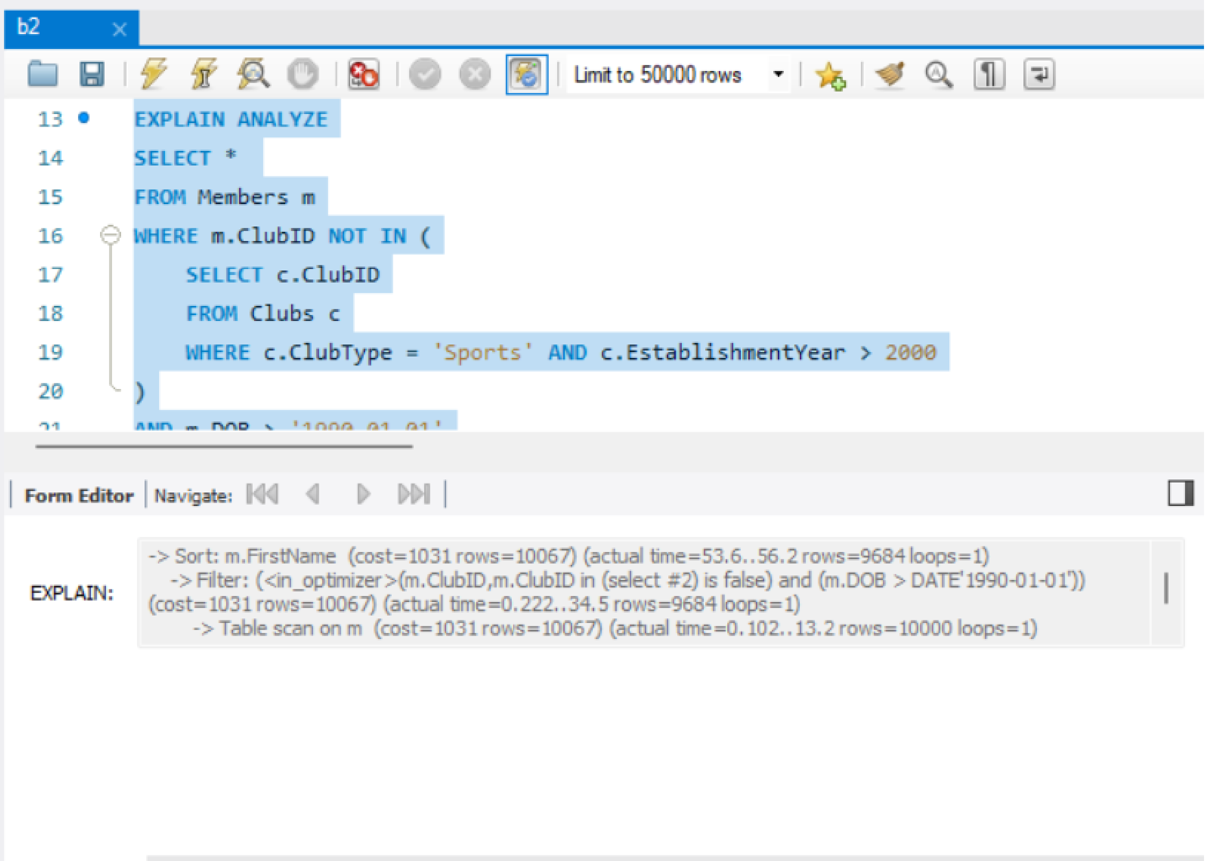
```
EXPLAIN ANALYZE
SELECT FirstName, LastName, Email
FROM Members
WHERE ClubID = 1
  AND DOB > '1990-01-01'
  AND Email LIKE '%@example.com';


   Table scan
```

```
-> Filter: ((members.DOB > DATE'1990-01-01') and (members.Email like '%@gmail.com'))  (cost=24.6
rows=3.59) (actual time=0.362..0.362 rows=0 loops=1)
   -> Index lookup on Members using ClubID (ClubID=1)  (cost=24.6 rows=97) (actual time=0.27..0.298
rows=97 loops=1)
```

TABLE SCAN

1)

```
EXPLAIN ANALYZE
SELECT *
FROM Members m
WHERE m.ClubID NOT IN (
   SELECT c.ClubID
   FROM Clubs c
   WHERE c.ClubType = 'Sports' AND c.EstablishmentYear > 2000
)
AND m.DOB > '1990-01-01'
ORDER BY m.FirstName;
```



```
EXPLAIN ANALYZE
SELECT *
FROM Members m
WHERE m.ClubID NOT IN (
    SELECT c.ClubID
    FROM Clubs c
    WHERE c.ClubType = 'Sports' AND c.EstablishmentYear > 2000
)
AND m.DOB > '1990-01-01'
```

```
-> Sort: m.FirstName  (cost=1031 rows=10067) (actual time=53.6..56.2 rows=9684 loops=1)
    -> Filter: (<in_optimizer>(m.ClubID,m.ClubID in (select #2) is false) and (m.DOB > DATE'1990-01-01'))
(cost=1031 rows=10067) (actual time=0.222..34.5 rows=9684 loops=1)
        -> Table scan on m  (cost=1031 rows=10067) (actual time=0.102..13.2 rows=10000 loops=1)
```

2)

EXPLAIN ANALYZE

SELECT a.ActivityName, COUNT(m.MemberID) AS MemberCount

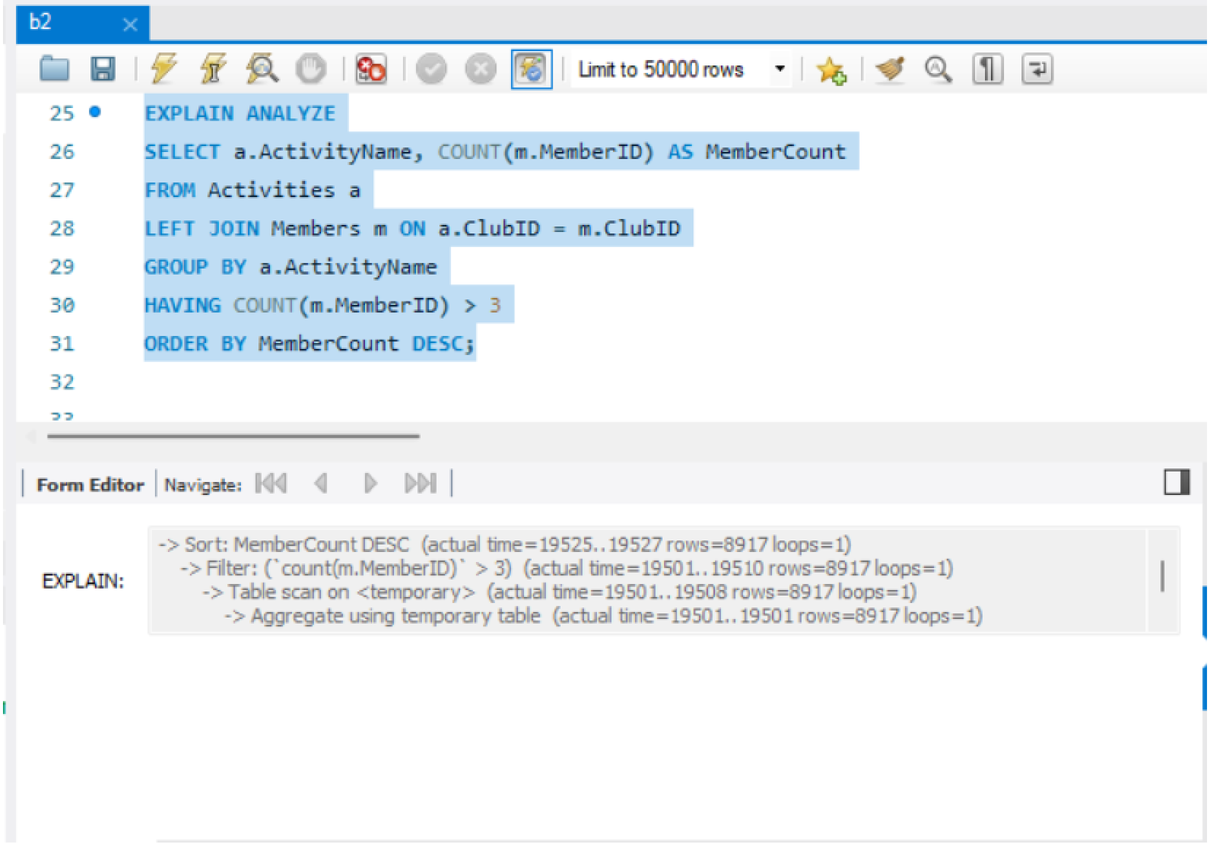
FROM Activities a

LEFT JOIN Members m ON a.ClubID = m.ClubID

GROUP BY a.ActivityName

HAVING COUNT(m.MemberID) > 3

ORDER BY MemberCount DESC;



```sql
EXPLAIN ANALYZE
SELECT a.ActivityName, COUNT(m.MemberID) AS MemberCount
FROM Activities a
LEFT JOIN Members m ON a.ClubID = m.ClubID
GROUP BY a.ActivityName
HAVING COUNT(m.MemberID) > 3
ORDER BY MemberCount DESC;
```

EXPLAIN:

```
-> Sort: MemberCount DESC  (actual time=19525..19527 rows=8917 loops=1)
    -> Filter: (`count(m.MemberID)` > 3)  (actual time=19501..19510 rows=8917 loops=1)
        -> Table scan on <temporary>  (actual time=19501..19508 rows=8917 loops=1)
            -> Aggregate using temporary table  (actual time=19501..19501 rows=8917 loops=1)
```

3)

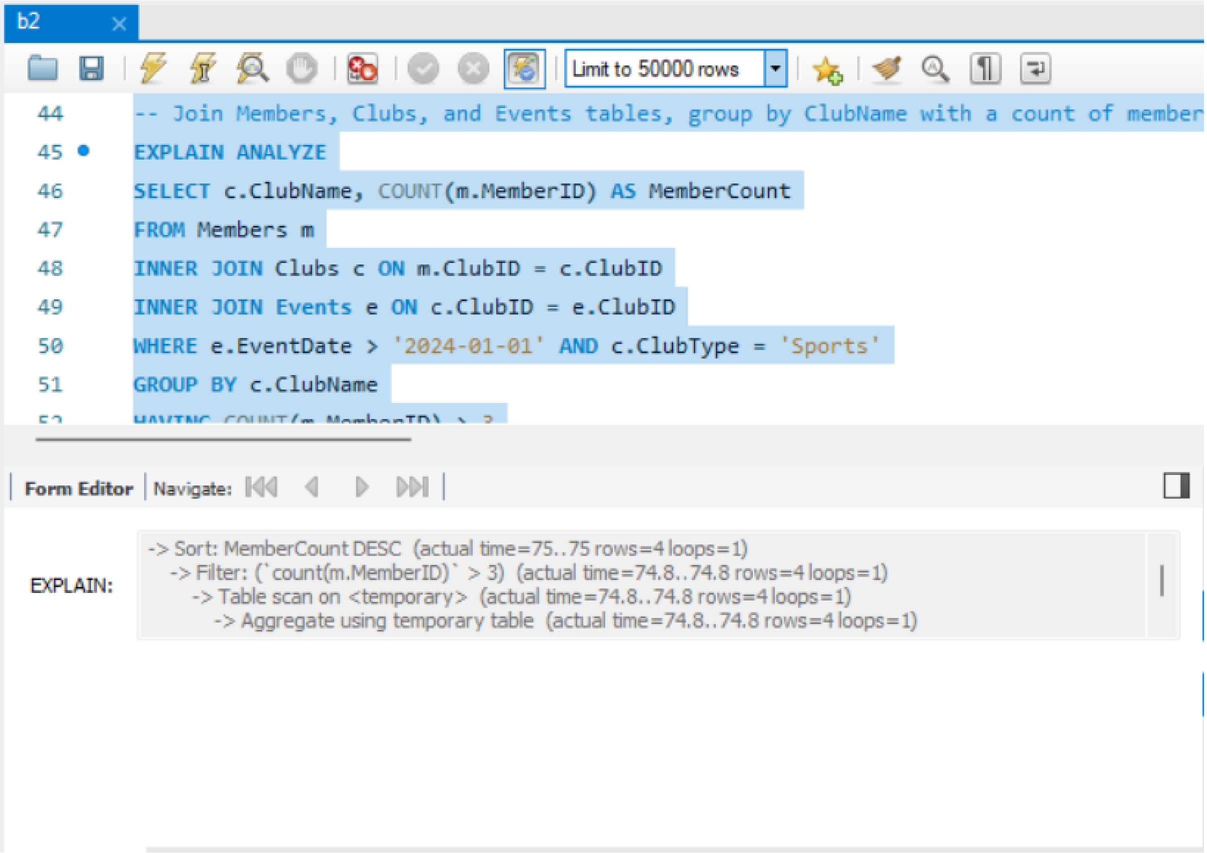
```
EXPLAIN ANALYZE

SELECT f.FirstName, f.LastName, a.ActivityName

FROM FacultyMembers f

CROSS JOIN Activities a;
```

Since we are doing a cross join(approximately 100000000 rows), the execution time is a lot and exceeds the limit set by the SQL server. Therefore, EXPLAIN ANALYZE could not be run

queries with multi-table joins involving 3 tables; including both "SELECT *" and conditional "SELECT" queries with a subset of columns.

1)

```
EXPLAIN ANALYZE

SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount

FROM Members m

INNER JOIN Clubs c ON m.ClubID = c.ClubID

INNER JOIN Events e ON c.ClubID = e.ClubID

WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'

GROUP BY c.ClubName

HAVING COUNT(m.MemberID) > 3

ORDER BY MemberCount DESC;
```

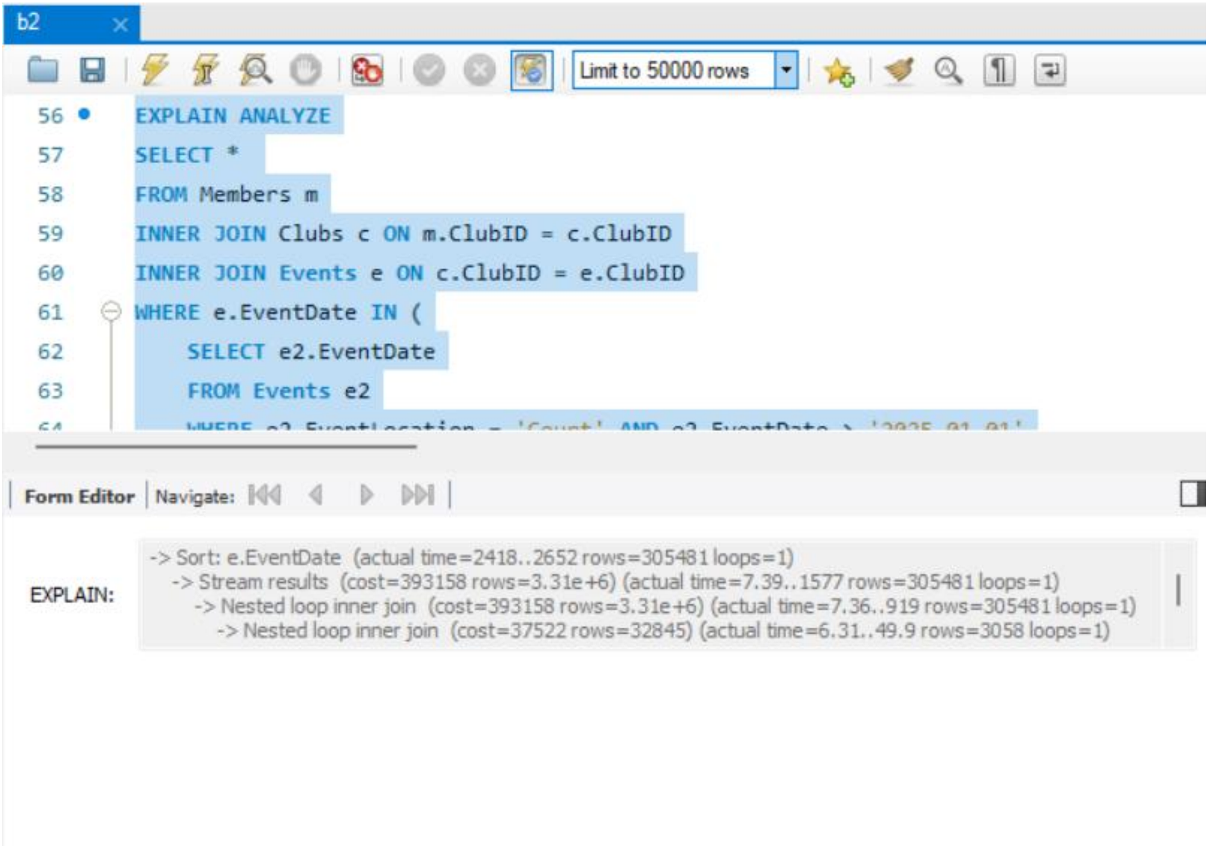


```
-- Join Members, Clubs, and Events tables, group by ClubName with a count of member
EXPLAIN ANALYZE
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount
FROM Members m
INNER JOIN Clubs c ON m.ClubID = c.ClubID
INNER JOIN Events e ON c.ClubID = e.ClubID
WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'
GROUP BY c.ClubName
HAVING COUNT(m.MemberID) > 3
```

```
-> Sort: MemberCount DESC  (actual time=75..75 rows=4 loops=1)
  -> Filter: (`count(m.MemberID)` > 3)  (actual time=74.8..74.8 rows=4 loops=1)
    -> Table scan on <temporary>  (actual time=74.8..74.8 rows=4 loops=1)
      -> Aggregate using temporary table  (actual time=74.8..74.8 rows=4 loops=1)
```

2)

```
EXPLAIN ANALYZE

SELECT *

FROM Members m

INNER JOIN Clubs c ON m.ClubID = c.ClubID

INNER JOIN Events e ON c.ClubID = e.ClubID

WHERE e.EventDate IN (

  SELECT e2.EventDate

  FROM Events e2

  WHERE e2.EventLocation = 'Court' AND e2.EventDate > '2025-01-01'

)

ORDER BY e.EventDate;
```

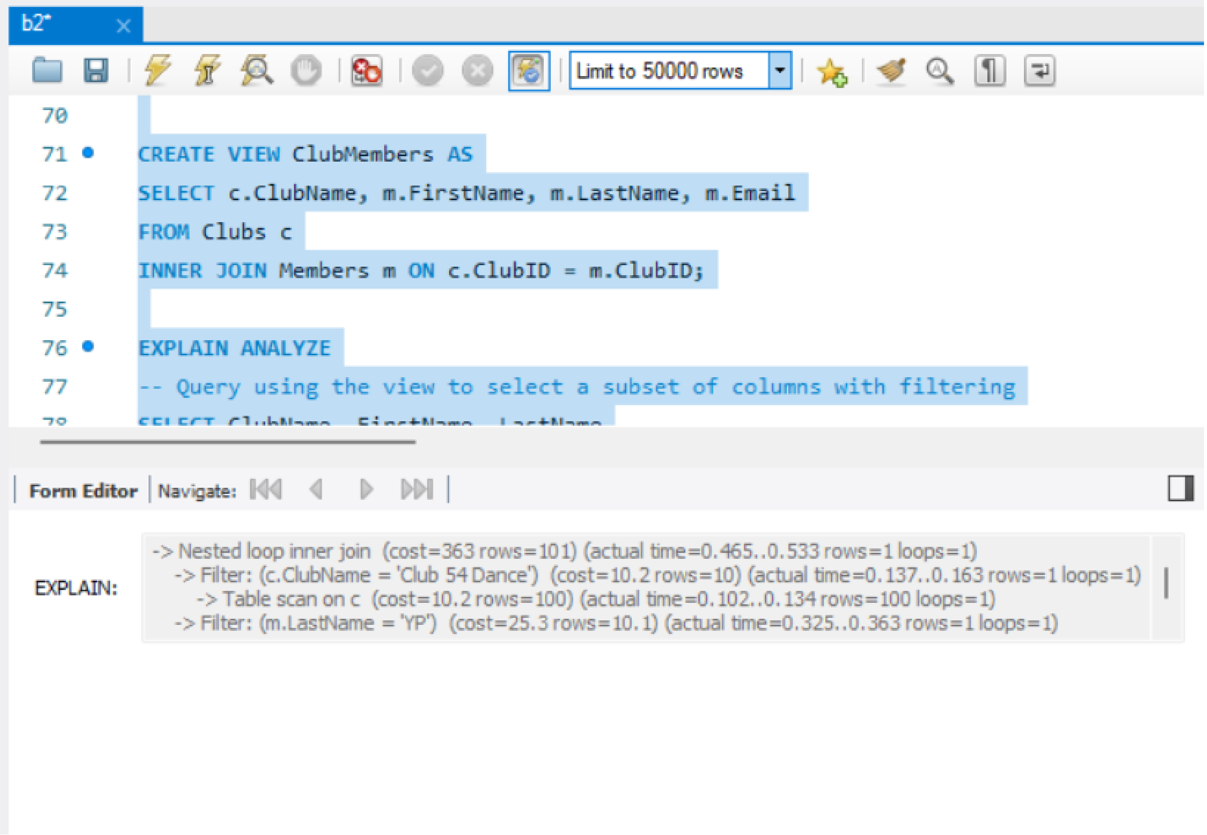


```
EXPLAIN ANALYZE
SELECT *
FROM Members m
INNER JOIN Clubs c ON m.ClubID = c.ClubID
INNER JOIN Events e ON c.ClubID = e.ClubID
WHERE e.EventDate IN (
    SELECT e2.EventDate
    FROM Events e2
    WHERE e2.EventLocation = 'Court' AND e2.EventDate > '2025-01-01'
```

```
-> Sort: e.EventDate  (actual time=2418..2652 rows=305481 loops=1)
    -> Stream results  (cost=393158 rows=3.31e+6) (actual time=7.39..1577 rows=305481 loops=1)
        -> Nested loop inner join  (cost=393158 rows=3.31e+6) (actual time=7.36..919 rows=305481 loops=1)
            -> Nested loop inner join  (cost=37522 rows=32845) (actual time=6.31..49.9 rows=3058 loops=1)
```

3)

```
CREATE VIEW ClubMembers AS

SELECT c.ClubName, m.FirstName, m.LastName, m.Email

FROM Clubs c

INNER JOIN Members m ON c.ClubID = m.ClubID;


EXPLAIN ANALYZE

-- Query using the view to select a subset of columns with filtering

SELECT ClubName, FirstName, LastName

FROM ClubMembers

WHERE ClubName = 'Club 54 Dance' AND LastName = 'YP';
```



```

CREATE VIEW ClubMembers AS
SELECT c.ClubName, m.FirstName, m.LastName, m.Email
FROM Clubs c
INNER JOIN Members m ON c.ClubID = m.ClubID;

EXPLAIN ANALYZE
-- Query using the view to select a subset of columns with filtering
SELECT ClubName, FirstName, LastName
```

```
-> Nested loop inner join  (cost=363 rows=101) (actual time=0.465..0.533 rows=1 loops=1)
    -> Filter: (c.ClubName = 'Club 54 Dance')  (cost=10.2 rows=10) (actual time=0.137..0.163 rows=1 loops=1)
        -> Table scan on c  (cost=10.2 rows=100) (actual time=0.102..0.134 rows=100 loops=1)
    -> Filter: (m.LastName = 'YP')  (cost=25.3 rows=10.1) (actual time=0.325..0.363 rows=1 loops=1)
```

c)

Indexes made to improve performance :

CREATE INDEX idx_members_dob_firstname ON Members(DOB, FirstName);

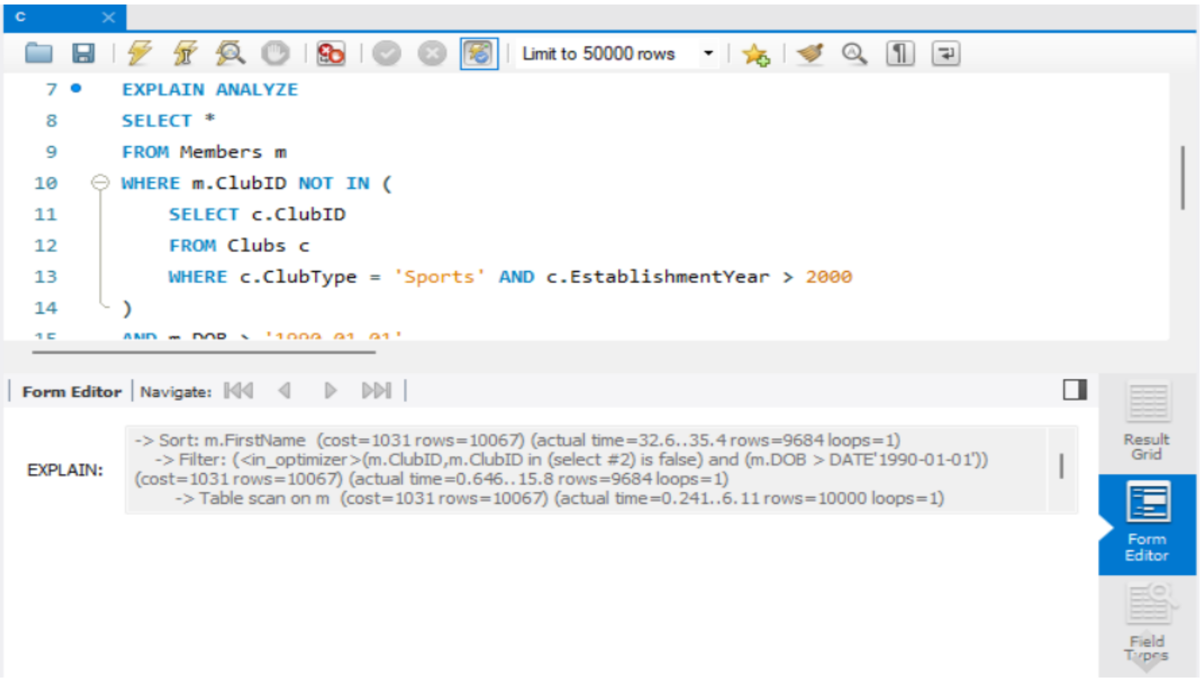
CREATE INDEX idx_clubs_clubtype_establishmentyear ON Clubs(ClubType, EstablishmentYear);

CREATE INDEX idx_clubs_clubname ON Clubs(ClubName);

CREATE INDEX idx_events_eventdate ON Events(EventDate);

1)analyzing below query :

```
SELECT *

FROM Members m

WHERE m.ClubID NOT IN (

   SELECT c.ClubID

   FROM Clubs c

   WHERE c.ClubType = 'Sports' AND c.EstablishmentYear > 2000

)

AND m.DOB > '1990-01-01'

ORDER BY m.FirstName;
```

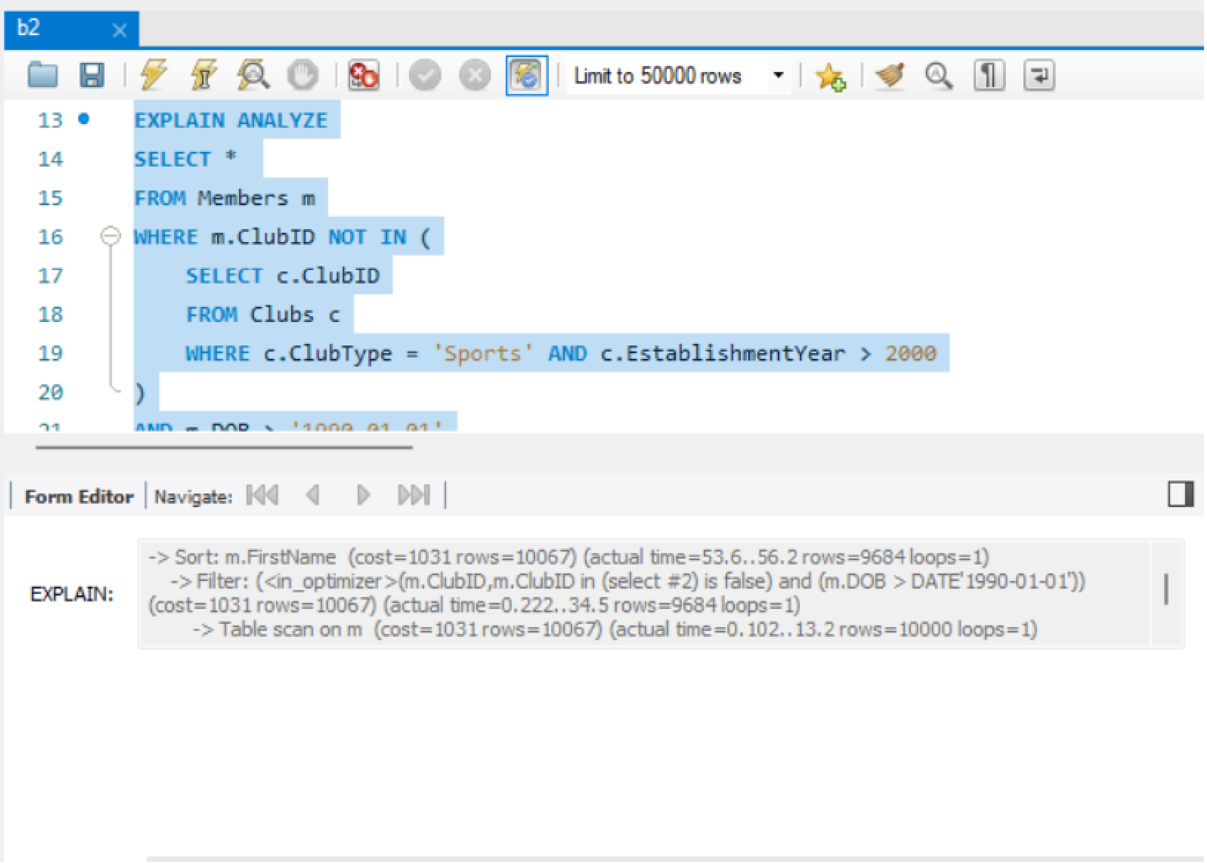


```
EXPLAIN ANALYZE
SELECT *
FROM Members m
WHERE m.ClubID NOT IN (
    SELECT c.ClubID
    FROM Clubs c
    WHERE c.ClubType = 'Sports' AND c.EstablishmentYear > 2000
)
AND m.DOB > '1990-01-01'
```

EXPLAIN:

```
-> Sort: m.FirstName  (cost=1031 rows=10067) (actual time=32.6..35.4 rows=9684 loops=1)
    -> Filter: (<in_optimizer>(m.ClubID,m.ClubID in (select #2) is false) and (m.DOB > DATE'1990-01-01'))
(cost=1031 rows=10067) (actual time=0.646..15.8 rows=9684 loops=1)
        -> Table scan on m  (cost=1031 rows=10067) (actual time=0.241..6.11 rows=10000 loops=1)
```

Old query with indexes :



```
EXPLAIN ANALYZE
SELECT *
FROM Members m
WHERE m.ClubID NOT IN (
    SELECT c.ClubID
    FROM Clubs c
    WHERE c.ClubType = 'Sports' AND c.EstablishmentYear > 2000
)
AND m.DOB > '1990-01-01'
```

EXPLAIN:

```
-> Sort: m.FirstName  (cost=1031 rows=10067) (actual time=53.6..56.2 rows=9684 loops=1)
    -> Filter: (<in_optimizer>(m.ClubID,m.ClubID in (select #2) is false) and (m.DOB > DATE'1990-01-01'))
(cost=1031 rows=10067) (actual time=0.222..34.5 rows=9684 loops=1)
        -> Table scan on m  (cost=1031 rows=10067) (actual time=0.102..13.2 rows=10000 loops=1)
```

As we can see the execution time has reduced from 53.6 sec to 32.6 sec

2)analyzing below query :

SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount

FROM Members m

INNER JOIN Clubs c ON m.ClubID = c.ClubID

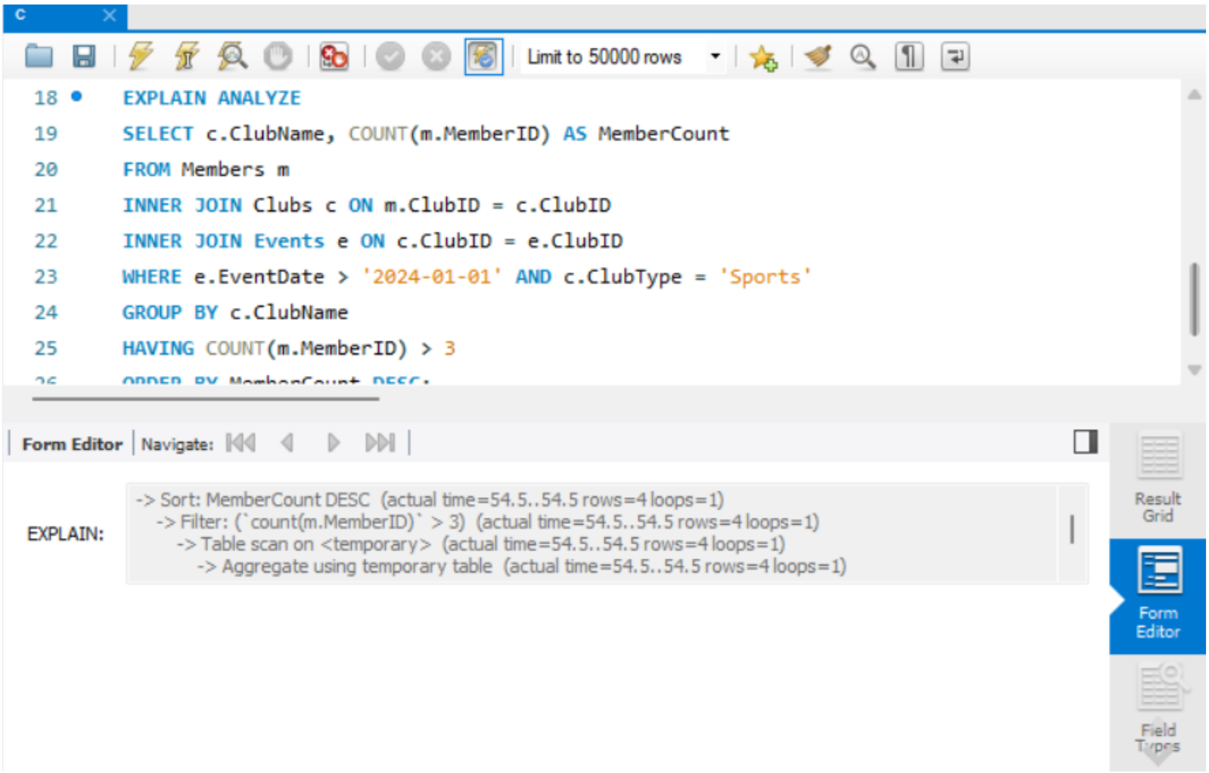
INNER JOIN Events e ON c.ClubID = e.ClubID

WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'

GROUP BY c.ClubName

HAVING COUNT(m.MemberID) > 3

ORDER BY MemberCount DESC;

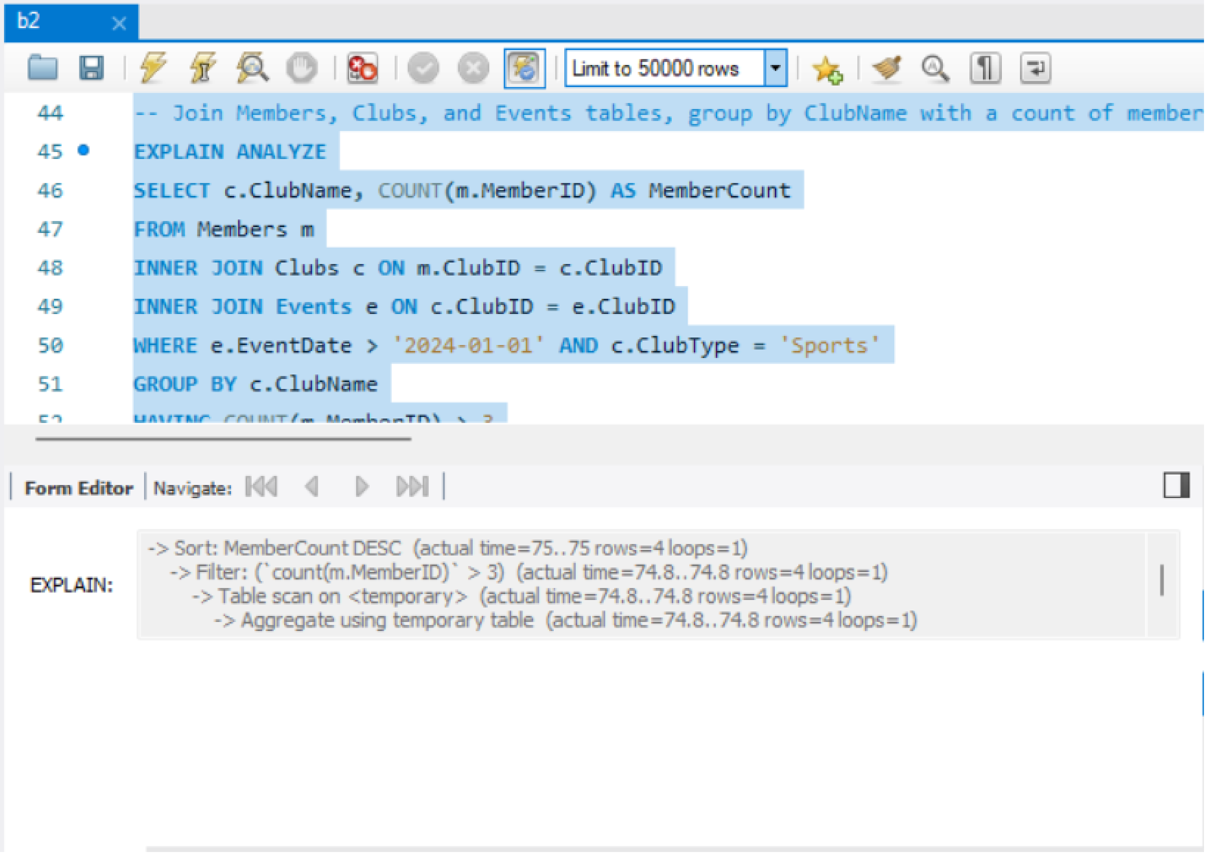


```
EXPLAIN ANALYZE
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount
FROM Members m
INNER JOIN Clubs c ON m.ClubID = c.ClubID
INNER JOIN Events e ON c.ClubID = e.ClubID
WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'
GROUP BY c.ClubName
HAVING COUNT(m.MemberID) > 3
ORDER BY MemberCount DESC;
```

EXPLAIN:

```
-> Sort: MemberCount DESC  (actual time=54.5..54.5 rows=4 loops=1)
    -> Filter: (`count(m.MemberID)` > 3)  (actual time=54.5..54.5 rows=4 loops=1)
        -> Table scan on <temporary>  (actual time=54.5..54.5 rows=4 loops=1)
            -> Aggregate using temporary table  (actual time=54.5..54.5 rows=4 loops=1)
```

Old query without indexes:



```
-- Join Members, Clubs, and Events tables, group by ClubName with a count of member
EXPLAIN ANALYZE
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount
FROM Members m
INNER JOIN Clubs c ON m.ClubID = c.ClubID
INNER JOIN Events e ON c.ClubID = e.ClubID
WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'
GROUP BY c.ClubName
HAVING COUNT(m.MemberID) > 3
```

EXPLAIN:

```
-> Sort: MemberCount DESC  (actual time=75..75 rows=4 loops=1)
    -> Filter: (`count(m.MemberID)` > 3)  (actual time=74.8..74.8 rows=4 loops=1)
        -> Table scan on <temporary>  (actual time=74.8..74.8 rows=4 loops=1)
            -> Aggregate using temporary table  (actual time=74.8..74.8 rows=4 loops=1)
```

As we can see, execution time has reduced from 75 sec to 54.5 sec

d) The multi join query to optimize :

1)

SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount

FROM Members m

INNER JOIN Clubs c ON m.ClubID = c.ClubID

INNER JOIN Events e ON c.ClubID = e.ClubID

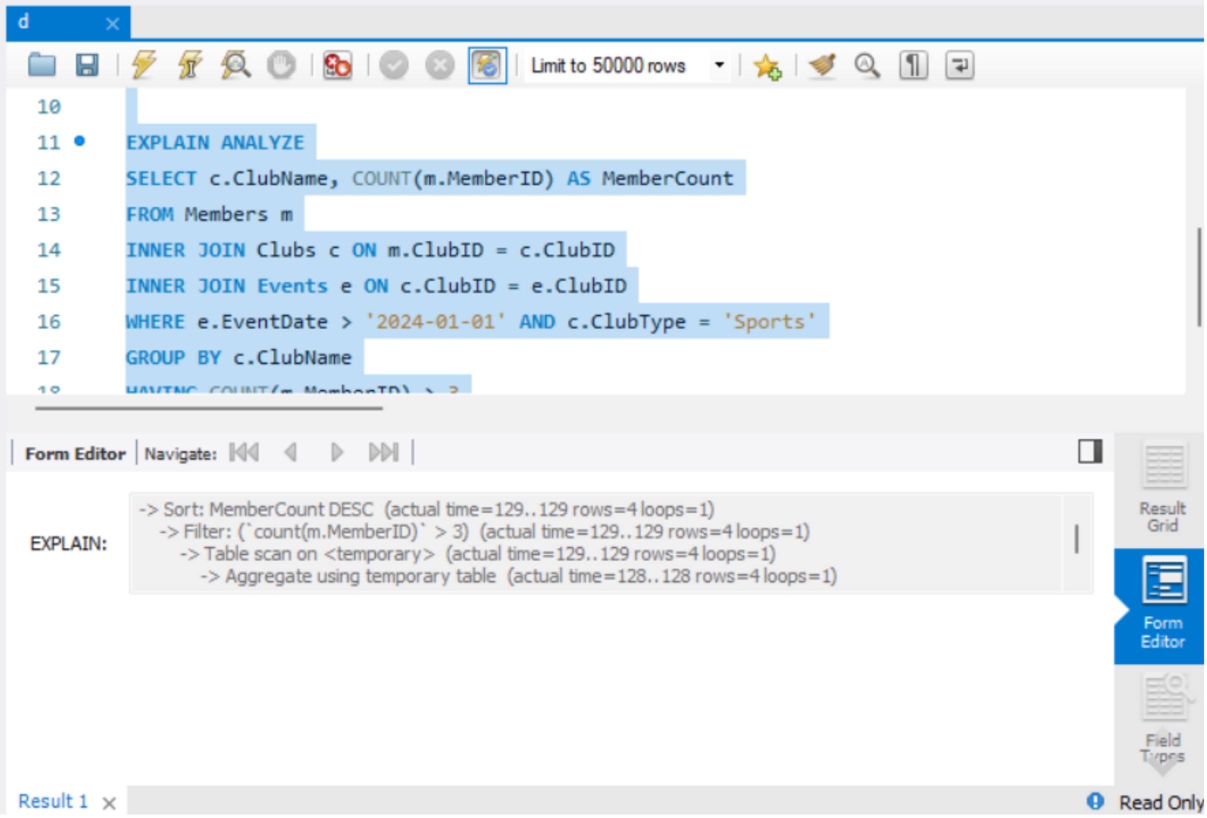
WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'

GROUP BY c.ClubName

HAVING COUNT(m.MemberID) > 3

ORDER BY MemberCount DESC;

Running EXPLAIN ANALYZE on the above query :



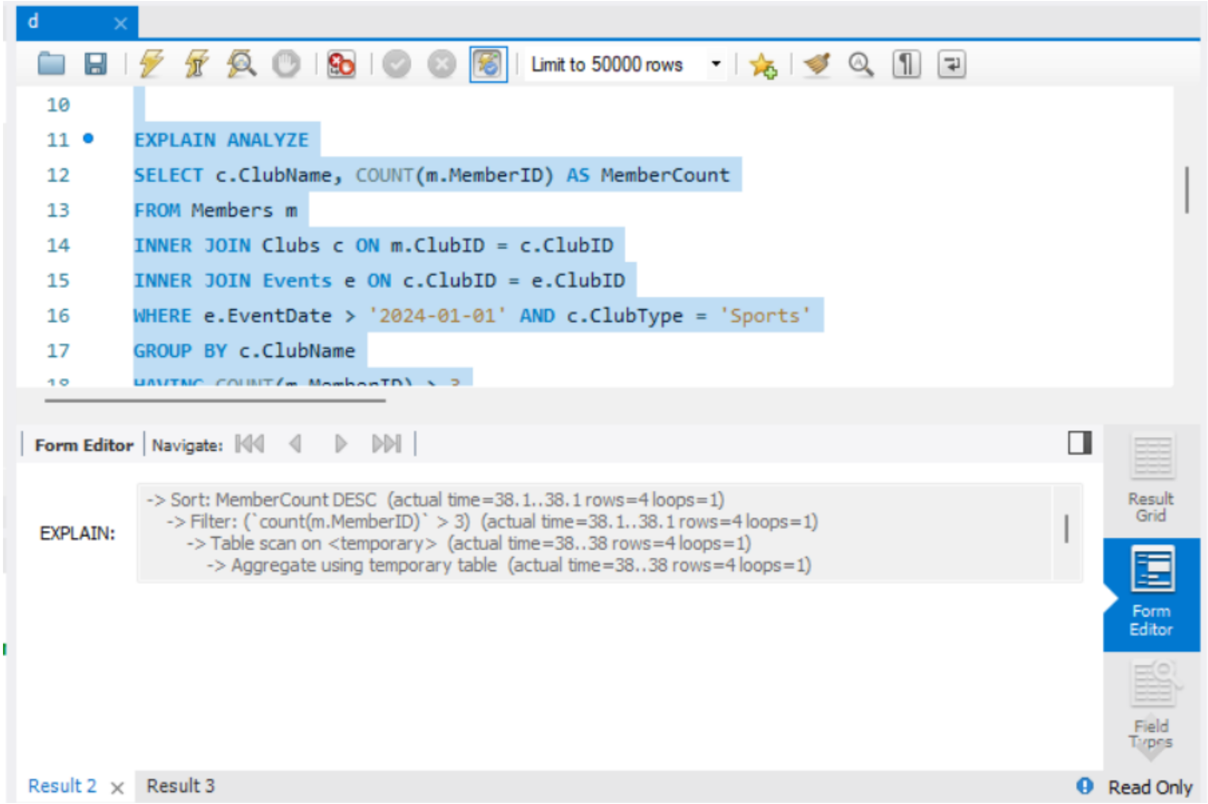
```
EXPLAIN ANALYZE
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount
FROM Members m
INNER JOIN Clubs c ON m.ClubID = c.ClubID
INNER JOIN Events e ON c.ClubID = e.ClubID
WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'
GROUP BY c.ClubName
HAVING COUNT(m.MemberID) > 3
```

EXPLAIN:

```
-> Sort: MemberCount DESC  (actual time=129..129 rows=4 loops=1)
    -> Filter: (`count(m.MemberID)` > 3)  (actual time=129..129 rows=4 loops=1)
        -> Table scan on <temporary>  (actual time=129..129 rows=4 loops=1)
            -> Aggregate using temporary table  (actual time=128..128 rows=4 loops=1)
```

Join order variation 1 : Start with clubs

```sql
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount

FROM Clubs c

INNER JOIN Events e ON c.ClubID = e.ClubID

INNER JOIN Members m ON c.ClubID = m.ClubID

WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'

GROUP BY c.ClubName

HAVING COUNT(m.MemberID) > 3

ORDER BY MemberCount DESC;
```



```sql
EXPLAIN ANALYZE
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount
FROM Members m
INNER JOIN Clubs c ON m.ClubID = c.ClubID
INNER JOIN Events e ON c.ClubID = e.ClubID
WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'
GROUP BY c.ClubName
HAVING COUNT(m.MemberID) > 3
```

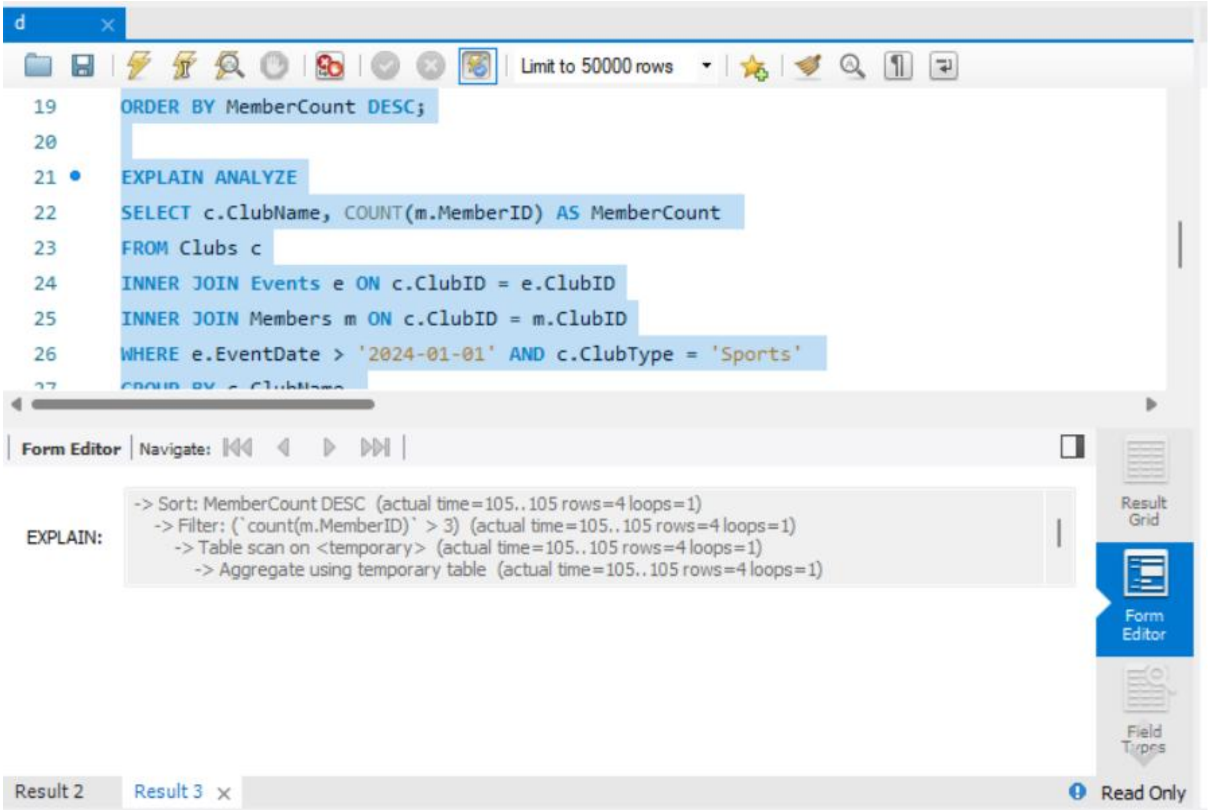
EXPLAIN:

```
-> Sort: MemberCount DESC  (actual time=38.1..38.1 rows=4 loops=1)
    -> Filter: (`count(m.MemberID)` > 3)  (actual time=38.1..38.1 rows=4 loops=1)
        -> Table scan on <temporary>  (actual time=38..38 rows=4 loops=1)
            -> Aggregate using temporary table  (actual time=38..38 rows=4 loops=1)
```

As we can compare, the execution time after optimization has reduced from 129 sec to 38 sec

Join order variation 2 : Start with events

```
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount

FROM Events e

INNER JOIN Clubs c ON e.ClubID = c.ClubID

INNER JOIN Members m ON c.ClubID = m.ClubID

WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'

GROUP BY c.ClubName

HAVING COUNT(m.MemberID) > 3

ORDER BY MemberCount DESC;
```



```
ORDER BY MemberCount DESC;

EXPLAIN ANALYZE
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount
FROM Clubs c
INNER JOIN Events e ON c.ClubID = e.ClubID
INNER JOIN Members m ON c.ClubID = m.ClubID
WHERE e.EventDate > '2024-01-01' AND c.ClubType = 'Sports'
GROUP BY c.ClubName
```

EXPLAIN:

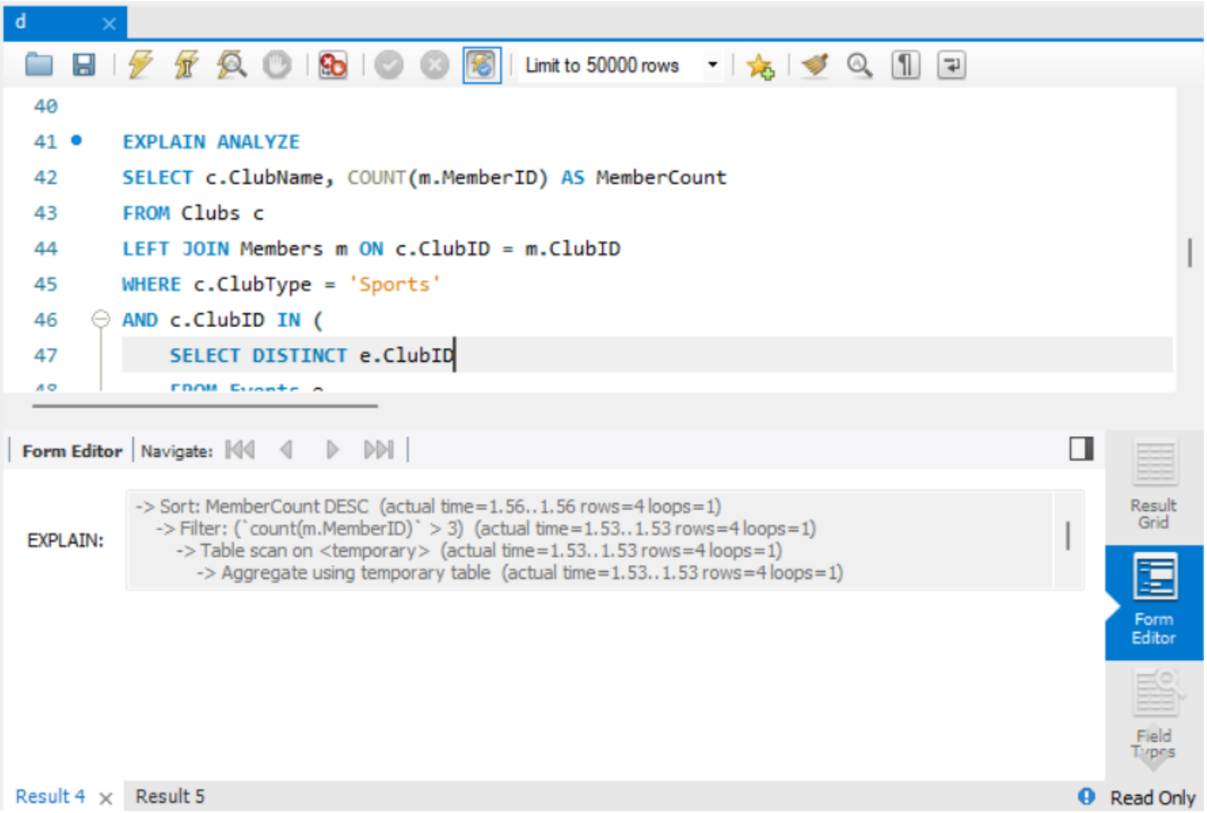
```
-> Sort: MemberCount DESC  (actual time=105..105 rows=4 loops=1)
    -> Filter: (`count(m.MemberID)` > 3)  (actual time=105..105 rows=4 loops=1)
        -> Table scan on <temporary>  (actual time=105..105 rows=4 loops=1)
            -> Aggregate using temporary table  (actual time=105..105 rows=4 loops=1)
```

As we can see the execution time has reduced from 129 sec to 105 sec

Incorporating a variety of join types such as outer joins, subqueries, etc., to diversify optimization approaches.

1) Using LEFT JOIN with Subquery Filtering

```
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount

FROM Clubs c

LEFT JOIN Members m ON c.ClubID = m.ClubID

WHERE c.ClubType = 'Sports'

AND c.ClubID IN (

  SELECT DISTINCT e.ClubID

  FROM Events e

  WHERE e.EventDate > '2024-01-01'

)

GROUP BY c.ClubName

HAVING COUNT(m.MemberID) > 3

ORDER BY MemberCount DESC;
```



```

EXPLAIN ANALYZE
SELECT c.ClubName, COUNT(m.MemberID) AS MemberCount
FROM Clubs c
LEFT JOIN Members m ON c.ClubID = m.ClubID
WHERE c.ClubType = 'Sports'
AND c.ClubID IN (
    SELECT DISTINCT e.ClubID
    FROM Events e
```

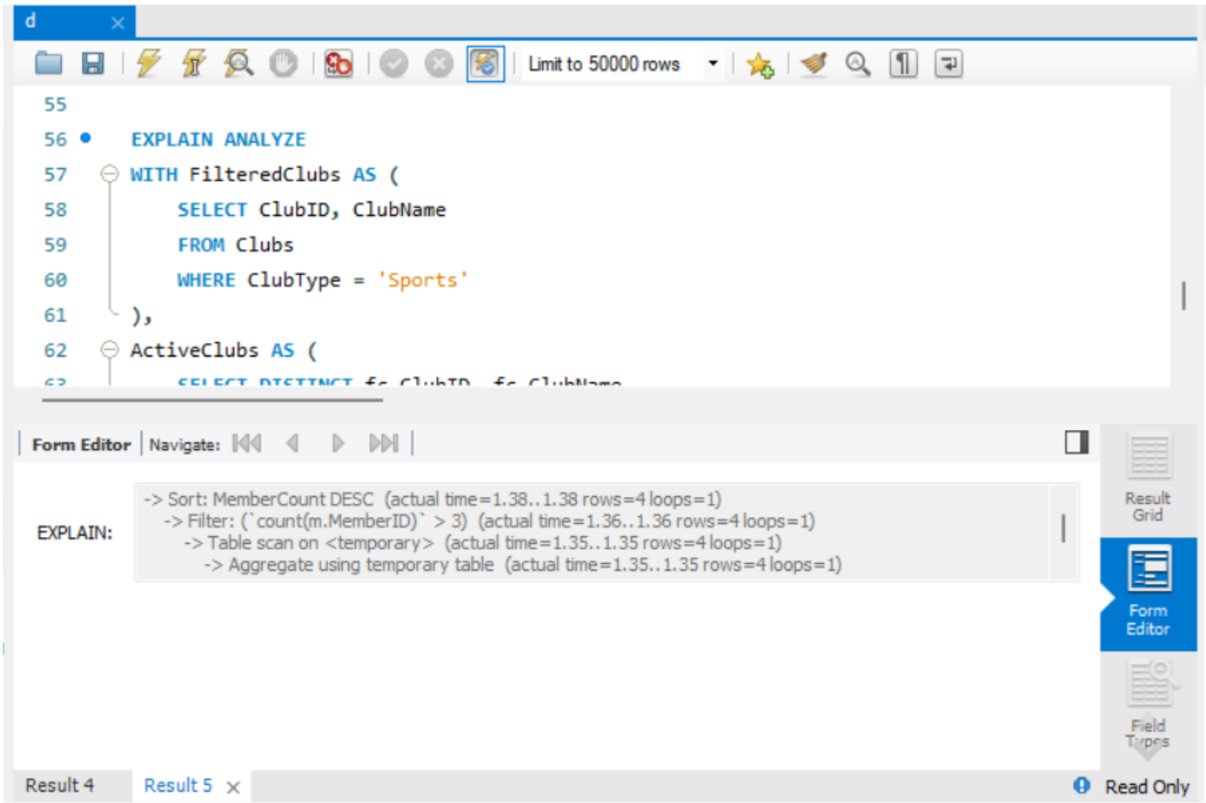
EXPLAIN:

```
-> Sort: MemberCount DESC  (actual time=1.56..1.56 rows=4 loops=1)
  -> Filter: (`count(m.MemberID)` > 3)  (actual time=1.53..1.53 rows=4 loops=1)
    -> Table scan on <temporary>  (actual time=1.53..1.53 rows=4 loops=1)
      -> Aggregate using temporary table  (actual time=1.53..1.53 rows=4 loops=1)
```

As we can see the execution time has reduced from 129 sec to 1.56 sec

2) Using Common Table Expressions with INNER JOIN

```
WITH FilteredClubs AS (
   SELECT ClubID, ClubName
   FROM Clubs
   WHERE ClubType = 'Sports'
),
ActiveClubs AS (
   SELECT DISTINCT fc.ClubID, fc.ClubName
   FROM FilteredClubs fc
   INNER JOIN Events e ON fc.ClubID = e.ClubID
   WHERE e.EventDate > '2024-01-01'
)
SELECT ac.ClubName, COUNT(m.MemberID) AS MemberCount
FROM ActiveClubs ac
INNER JOIN Members m ON ac.ClubID = m.ClubID
GROUP BY ac.ClubName
HAVING COUNT(m.MemberID) > 3
ORDER BY MemberCount DESC;
```



```

EXPLAIN ANALYZE
WITH FilteredClubs AS (
    SELECT ClubID, ClubName
    FROM Clubs
    WHERE ClubType = 'Sports'
),
ActiveClubs AS (
    SELECT DISTINCT fc.ClubID, fc.ClubName
```

EXPLAIN:

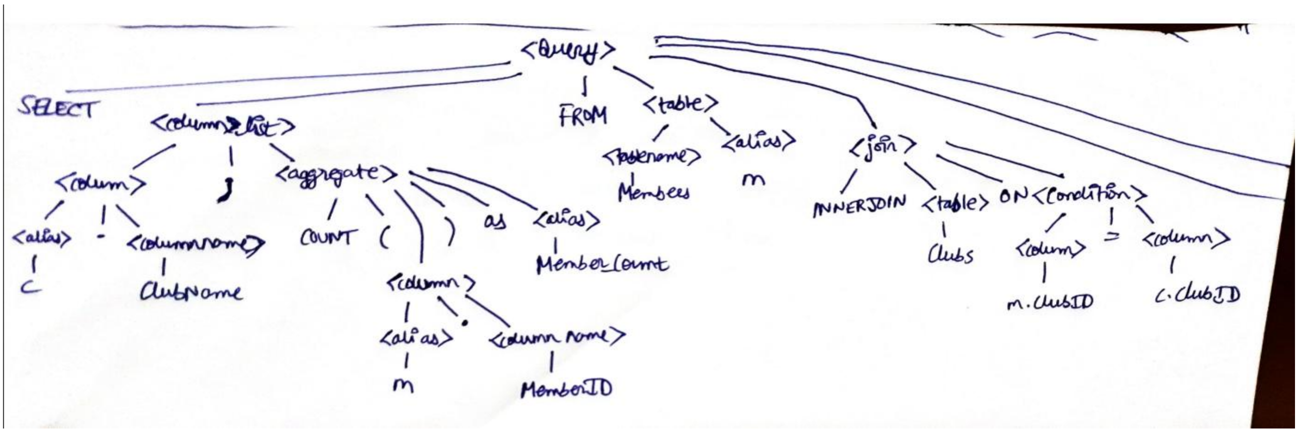
```
-> Sort: MemberCount DESC  (actual time=1.38..1.38 rows=4 loops=1)
   -> Filter: (`count(m.MemberID)` > 3)  (actual time=1.36..1.36 rows=4 loops=1)
      -> Table scan on <temporary>  (actual time=1.35..1.35 rows=4 loops=1)
         -> Aggregate using temporary table  (actual time=1.35..1.35 rows=4 loops=1)
```

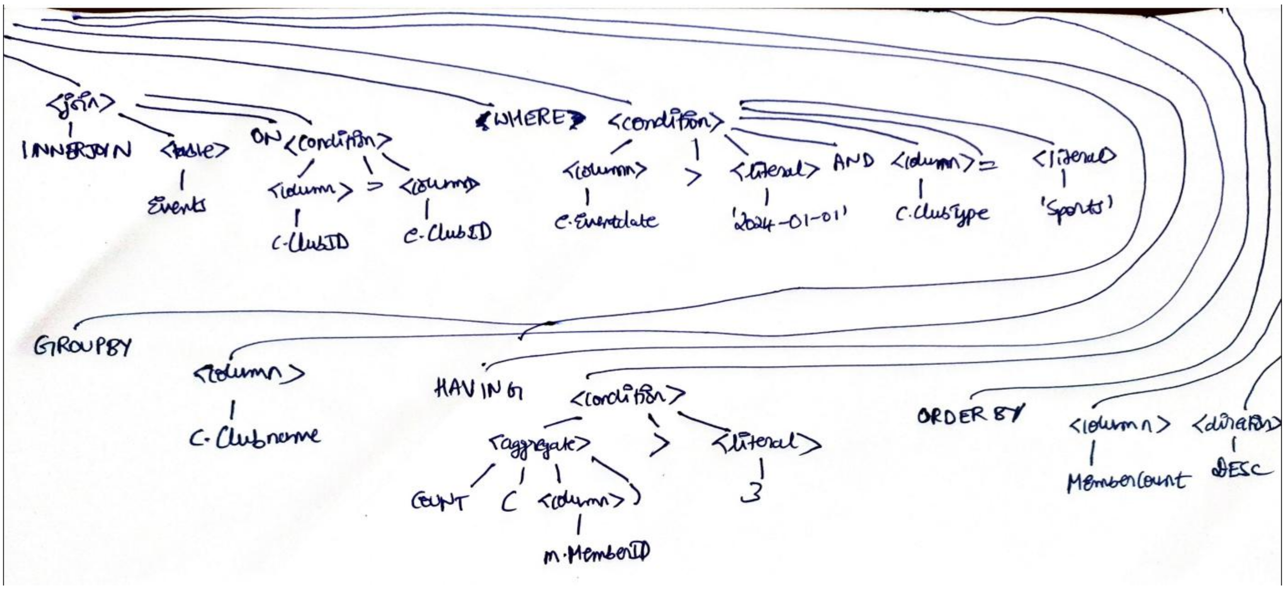
As we can see the execution time has reduced from 129 to 1.38

e)

Part 1:

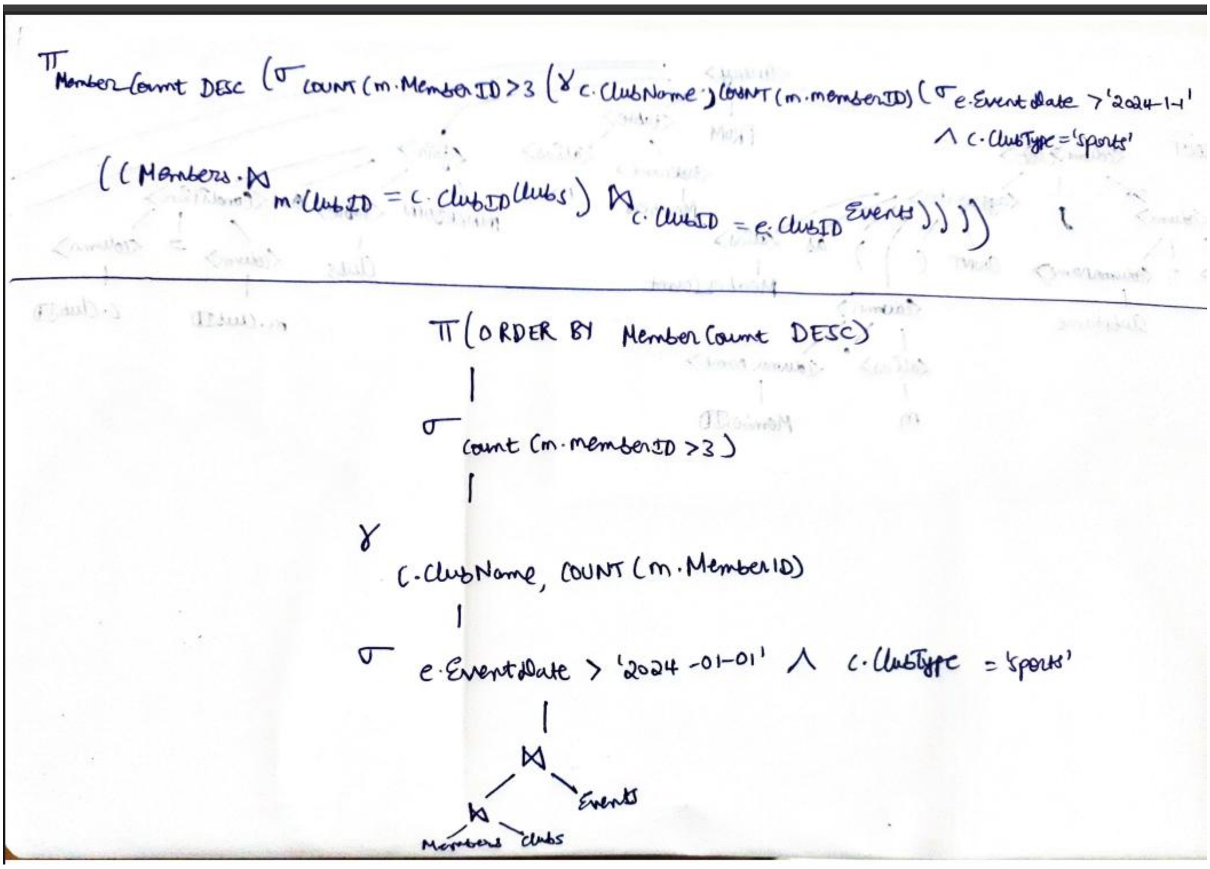
Parse tree:





The long lines drawn on the 2nd screenshot are all coming from <Query>. I didn't have space to draw it on 1 single sheet which is why I combined 2 screenshots in this manner.

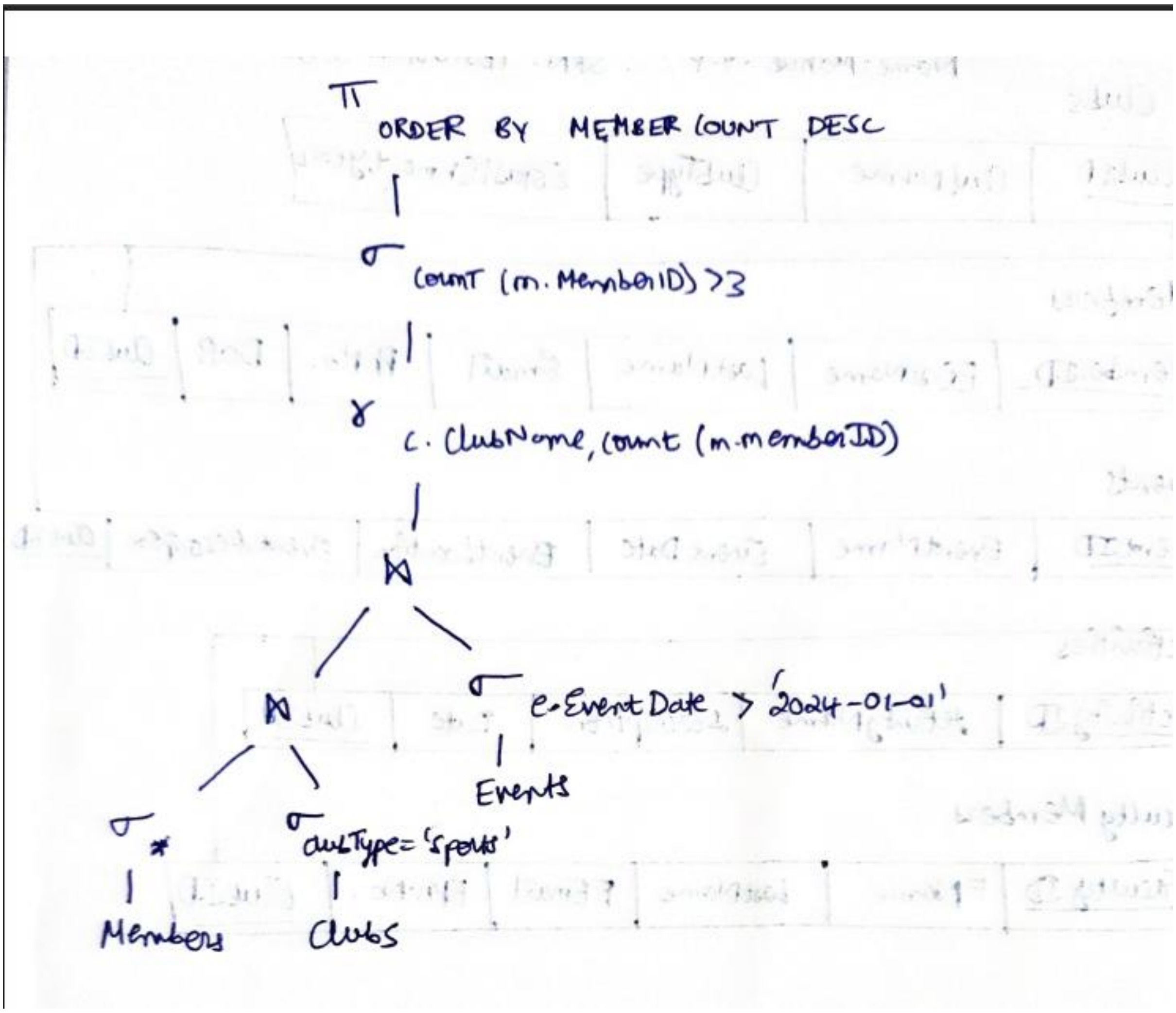
Relational Algebric Expression and Initial query tree



$$\pi_{\text{MemberCount DESC}} \left(\sigma_{\text{COUNT(m.MemberID}>3} \left(\gamma_{\text{c.ClubName};\ \text{COUNT(m.memberID)}} \left(\sigma_{\text{e.EventDate} > \text{'2024-1-1'} \wedge \text{c.ClubType}=\text{'sports'}} \left(\left(\text{Members} \bowtie_{\text{m.ClubID}=\text{c.ClubID}} \text{Clubs} \right) \bowtie_{\text{c.ClubID}=\text{e.ClubID}} \text{Events} \right) \right) \right) \right)$$

π (ORDER BY MemberCount DESC)
σ count (m.memberID >3)
γ c.ClubName, COUNT (m.MemberID)
σ e.EventDate > '2024-01-01' ∧ c.ClubType = 'sports'
⋈
⋈
Events
Members
Clubs

Part 2:


π ORDER BY MEMBER COUNT DESC
σ COUNT (m.MemberID) >3
γ c.ClubName, count (m.memberID)
⋈
⋈
σ e.EventDate > '2024-01-01'
Events
σ *
σ clubType='sports'
Members
Clubs

Optimization : Pushing Selections Down

- **In the initial query tree, the selection σ (e.EventDate > '2024-01-01' ∧ c.ClubType = 'sports') is applied after the joins.**
- **In the optimized query tree, these selection operations are pushed down and applied earlier on Events and Clubs before the joins.**
- **This reduces the number of tuples participating in the joins, making the query more efficient.**