

LAB 4: DQL (DATA QUERY LANGUAGE) WITH COMPLEX QUERIES

Objective:

To understand and implement advanced Data Query Language (DQL) concepts in SQL, with a focus on handling complex queries involving conditional logic, aggregate functions, and group operations.

Theory:

Data Query Language (DQL) is a subset of SQL primarily used for retrieving and analyzing data from relational databases. Advanced DQL techniques enhance its utility by enabling users to:

- **Handle multiple conditions:** Utilize `CASE`, `WHERE`, and `HAVING` clauses to implement conditional logic in queries.
- **Perform aggregate analysis:** Leverage functions such as `SUM`, `COUNT`, `AVG`, `MIN`, and `MAX` for in-depth data analysis.
- **Group and filter data:** Use `GROUP BY` to organize data based on shared attributes and the `HAVING` clause to apply conditions to grouped data.
- **Integrate subqueries:** Employ nested queries to address hierarchical or dependent data retrieval scenarios.

Key Features of Complex Queries:

- **Conditional Logic:** Dynamically modify or analyze data using `CASE` statements and conditional clauses.
- **Aggregate Analysis:** Perform statistical operations, such as calculating totals, averages, or extreme values, to derive meaningful insights from datasets.
- **Grouping and Filtering:** Organize data into logical groups using `GROUP BY` and refine results by applying conditions on aggregated data through the `HAVING` clause.
- **Subqueries:** Use queries within queries to handle multi-layered or dependent data operations efficiently.

SQL QUERY:

```
--CREATE DATABASE LAB4;
USE LAB4;
--DQL With complex queries
DROP TABLE issue;
DROP TABLE book;
DROP TABLE student;
DROP TABLE teacher;
CREATE TABLE book(
bid INT PRIMARY KEY,
bname VARCHAR(50),
publication VARCHAR(50),
author VARCHAR(50),
price DECIMAL(8,2)
);
SELECT *FROM book;
```

bid	bname	publication	author	price
-----	-------	-------------	--------	-------

-Created table book along with its various attributes.

```
CREATE TABLE student(
sid INT PRIMARY KEY,
sfname VARCHAR(50),
slname VARCHAR(50),
sbranch VARCHAR(50),
address VARCHAR(50)
);
```

sid	sfname	slname	sbranch	address
-----	--------	--------	---------	---------

-Created table student along with its various attributes.

```
CREATE TABLE teacher(
tid INT PRIMARY KEY,
tfname VARCHAR(50),
tlname VARCHAR(50),
tbranch VARCHAR(50),
tsalary BIGINT,
hid INT
);
```

tid	tfname	tlname	tbranch	tsalary	hid
-----	--------	--------	---------	---------	-----

-Created table teacher along with its various attributes.

```
CREATE TABLE issue(
iid INT PRIMARY KEY,
bid INT FOREIGN KEY REFERENCES book(bid),
sid INT FOREIGN KEY REFERENCES student(sid) ON DELETE CASCADE ON UPDATE SET
NULL,
tid INT FOREIGN KEY REFERENCES teacher(tid) ON DELETE CASCADE ON UPDATE SET
NULL,
dateOfIssue DATE,
);
```

iid	bid	sid	tid	dateOfIssue
-----	-----	-----	-----	-------------

-Created table issue along with its various attributes.

```
INSERT INTO book VALUES (101, 'Atomic Habits', 'Hamro Publication', 'Navathe',
500.00);
```

```
INSERT INTO book VALUES (102, 'The power of your subconscious mind', 'Modern
Pub', 'Galvin', 600.00);
```

```
INSERT INTO book VALUES (103, 'Deep work', 'AdvancePub', 'Weiss', 450.00);
```

```

INSERT INTO book VALUES (104, 'The Let Them Theory', 'Apub', 'Tanenbaum',
                          700.00);
INSERT INTO book VALUES (105, 'The Anxious Generation', 'Bpub', 'Anthony',
                          800.00);
INSERT INTO book VALUES (106, 'The Daily Stoic ', 'Cpub', 'Bob', 900.00);
INSERT INTO book VALUES (107, 'Nexus ', 'Dpub', 'Casey', 200.00);
INSERT INTO book VALUES (108, 'Elon Musk', 'Epub', 'Donald', 300.00);
INSERT INTO book VALUES (109, 'The psychology of Money', 'Fpub', 'Emerald',
                          400.00);
INSERT INTO book VALUES (110, 'Revenge of the Tipping Point ', 'Gpub',
                          'Franklin', 500.00);
INSERT INTO book VALUES (111, 'Outlive', 'Gpub', 'Franklin', 500.00);
INSERT INTO book VALUES (112, 'Sapiens', 'Gpub', 'Franklin', 500.00);
INSERT INTO book VALUES (113, 'Good Energy', 'Epub', 'Franklin', 500.00);
INSERT INTO book VALUES (114, 'We who wrestle with god', 'Epub', 'Franklin',
                          500.00);

```

Output:

-inserted various data into the table book.

	bid	bname	publication	author	price
1	101	Atomic Habits	Hamro Publication	Navathe	500.00
2	102	The power of your subconscious mind	Modern Pub	Galvin	600.00
3	103	Deep work	AdvancePub	Weiss	450.00
4	104	The Let Them Theory	Apub	Tanenbaum	700.00
5	105	The Anxious Generation	Bpub	Anthony	800.00
6	106	The Daily Stoic	Cpub	Bob	900.00
7	107	Nexus	Dpub	Casey	200.00
8	108	Elon Musk	Epub	Donald	300.00
9	109	The psychology of Money	Fpub	Emerald	400.00
10	110	Revenge of the Tipping Point	Gpub	Franklin	500.00
11	111	Outlive	Gpub	Franklin	500.00
12	112	Sapiens	Gpub	Franklin	500.00
13	113	Good Energy	Epub	Franklin	500.00
14	114	We who wrestle with god	Epub	Franklin	500.00

```

INSERT INTO student VALUES (1, 'Deepak', 'Thapa', 'BCT', 'Kageshowri Manohara'),
                             (2, 'Bipana', 'Ranabhat', 'BCE', 'Kathmandu'),
                             (3, 'Dikshya', 'Shrestha', 'BCT', 'Kathmandu'),
                             (4, 'Abhiyan', 'Paudel', 'BEX', 'Swayambhu'),
                             (5, 'Aashutosh', 'Jha', 'BEI', 'Kritipur'),
                             (6, 'Abhinav', 'Sharma', 'BCT', 'Tokha'),
                             (7, 'Adrin', 'Pradhan', 'BEI', 'Pokhara'),
                             (8, 'Bishranta', 'Paudel', 'BEX', 'Chitwan'),
                             (9, 'Aashutosh', 'Paudel', 'BCT', 'Jamal'),
                             (10, 'Isha', 'Karki', 'BAG', 'Tokha');

```

	sid	sfname	sname	sbranch	address
1	1	Deepak	Thapa	BCT	Kageshowri Manohara
2	2	Bipana	Ranabhat	BCE	Kathmandu
3	3	Dikshya	Shrestha	BCT	Kathmandu
4	4	Abhiyan	Paudel	BEX	Swayambhu
5	5	Aashutosh	Jha	BEI	Kritipur
6	6	Abhinav	Sharma	BCT	Tokha
7	7	Adrin	Pradhan	BEI	Pokhara
8	8	Bishranta	Paudel	BEX	Chitwan
9	9	Aashutosh	Paudel	BCT	Jamal
10	10	Isha	Karki	BAG	Tokha

INSERT

INTO teacher VALUES (1, 'Dhawa', 'Adhikari', 'BCT', 100000,1),
 (2, 'Sujan', 'Ranabhat', 'BCE', 200000,1),
 (3, 'Ritu', 'Shrestha', 'BCT', 300000, 2),
 (4, 'Sharad', 'Paudel', 'BEX', 400000,4),
 (5, 'Nabin', 'Jha', 'BEI', 500000,4),
 (6, 'Anju', 'Sharma', 'BCT', 600000,4),
 (7, 'Aman', 'Pradhan', 'BEI', 700000,4),
 (8, 'Rubi', 'Paudel', 'BEX', 800000,4),
 (9, 'Nikesh', 'Paudel', 'BCT', 900000,10),
 (10, 'Ravi', 'Karki', 'BAG', 950000,10);

	tid	tfname	tname	tbranch	tsalary	hid
1	1	Dhawa	Adhikari	BCT	100000	1
2	2	Sujan	Ranabhat	BCE	200000	1
3	3	Ritu	Shrestha	BCT	300000	2
4	4	Sharad	Paudel	BEX	400000	4
5	5	Nabin	Jha	BEI	500000	4
6	6	Anju	Sharma	BCT	600000	4
7	7	Aman	Pradhan	BEI	700000	4
8	8	Rubi	Paudel	BEX	800000	4
9	9	Nikesh	Paudel	BCT	900000	10
10	10	Ravi	Karki	BAG	950000	10

INSERT INTO issue VALUES (1001,101,NULL,2,'2024-06-01'),
 (1002,102,1,NULL,'2024-06-02'),
 (1003,103,7,NULL,'2024-06-03'),
 (1004,104,NULL,9,'2024-06-04'),
 (1005,105,5,NULL,'2024-06-05'),
 (1006,106,NULL,8,'2024-06-06'),
 (1007,107,8,NULL,'2024-06-07'),
 (1008,108,NULL,6,'2024-06-08'),
 (1009,109,3,NULL,'2024-06-09'),
 (1010,110,NULL,5,'2024-06-10');

	iid	bid	sid	tid	dateOfIssue
1	1001	101	NULL	2	2024-06-01
2	1002	102	1	NULL	2024-06-02
3	1003	103	7	NULL	2024-06-03
4	1004	104	NULL	9	2024-06-04
5	1005	105	5	NULL	2024-06-05
6	1006	106	NULL	8	2024-06-06
7	1007	107	8	NULL	2024-06-07
8	1008	108	NULL	6	2024-06-08
9	1009	109	3	NULL	2024-06-09
10	1010	110	NULL	5	2024-06-10

QUESTIONS:

- Update the salary of teacher by 10% if teacher earns in between 110000 to 140000, by 5% if teacher earns more than 140000 else by 20%.

Ans: UPDATE teacher SET tsalary = CASE WHEN tsalary>110000 AND tsalary<140000
 THEN 1.1*tsalary
 WHEN tsalary>140000 THEN 1.05*tsalary
 ELSE 1.2*tsalary
 END
 SELECT *FROM teacher;

$(\pi_{tid, tsalary \times 1.1}(\sigma_{tsalary > 110000 \wedge tsalary < 140000}(teacher))) \cup (\pi_{tid, tsalary \times 1.05}(\sigma_{tsalary > 140000}(teacher))) \cup$
 $(\pi_{tid, tsalary \times 1.2}(\sigma_{tsalary \leq 110000 \vee tsalary \geq 140000}(teacher)))$

Output: Updated teachers table (tsalary) after above query implementation.

	tid	tfname	tname	tbranch	tsalary	hid
1	1	Dhawa	Adhikari	BCT	120000	1
2	2	Sujan	Ranabhat	BCE	210000	1
3	3	Ritu	Shrestha	BCT	315000	2
4	4	Sharad	Paudel	BEX	420000	4
5	5	Nabin	Jha	BEI	525000	4
6	6	Anju	Sharma	BCT	630000	4
7	7	Aman	Pradhan	BEI	735000	4
8	8	Rubi	Paudel	BEX	840000	4
9	9	Nikesh	Paudel	BCT	945000	10
10	10	Ravi	Karki	BAG	997500	10

- Here, the salary of Dhawa is updated by 20% since his salary was less than 110000 whereas all others salary was updated by 5% since everyone's salary was more than 140000.
- What is the maximum salary of teacher, total salary of all teachers, no of teachers getting salary, minimum salary of teacher and average salary of teachers? Display them as their respective names.

Ans: SELECT MAX(tsalary) AS maximun_salary FROM teacher;
 SELECT SUM(tsalary) AS TOTAL_SALARY FROM teacher;
 SELECT COUNT(tsalary) AS noOfPeopleGettingSalary FROM teacher;

```
SELECT MIN(tsalary) AS minimumSalary FROM teacher;
SELECT AVG(tsalary) AS averageSalary FROM teacher;
```

Output:

	maximun_salary
1	997500

	TOTAL_SALARY
1	5737500

	noOfPeopleGettingSalary
1	10

	minimumSalary
1	120000

	averageSalary
1	573750

G_{MAX(tsalary)} (teacher)

G_{MIN(tsalary)} (teacher)

G_{AVG(tsalary)} (teacher)

G_{SUM(tsalary)} (teacher)

G_{COUNT(tsalary)} (teacher)

-here, we have displayed total, max, count, min and average salary of teachers from the teachers table and to display it properly we have used: AS columnName to display the result along with its column name if we don't use it then, we get output like this:

```
SELECT MAX(tsalary) FROM teacher;
```

	(No column name)
1	997500

3. Display the details of all the teachers with maximum salary.

Ans:

```
SELECT *FROM teacher WHERE tsalary=(SELECT MAX(tsalary) FROM teacher);
```

Output:

	tid	tfname	tlname	tbranch	tsalary	hid
1	10	Ravi	Karki	BAG	997500	10

$\sigma_{\text{salary} = G(\text{MAX}(\text{tsalary}))(\text{teacher})}(\text{teacher})$

4. Display the details of teacher with 2nd maximum salary.

Ans: `SELECT MAX (tsalary) AS SecondMaxSalary FROM teacher WHERE tsalary<(SELECT MAX(tsalary) FROM teacher);`

Output:

	SecondMaxSalary
1	945000

All details:

`SELECT * FROM teacher WHERE tsalary=(SELECT MAX(tsalary) FROM teacher WHERE tsalary<(SELECT MAX(tsalary) FROM teacher));`

	tid	tfname	tname	tbranch	tsalary	hid
1	9	Nikesh	Paudel	BCT	945000	10

$c1 = G_{MAX(tsalary)}(teacher)$

$e1 = \sigma_{(tsalary < c1)}(teacher)$

$c2 = G_{MAX(tsalary)}(e1)$

$\pi_{e1.tfname}(\sigma_{(tsalary = c2)}(e1))$

5. Display the count of the book according to the book publisher/ publication.

Ans: `SELECT publication,COUNT(bid) AS BOOKCOUNT FROM book GROUP BY publication;`

$\gamma_{publication,COUNT(bid) \rightarrow BOOKCOUNT}(book)$

Output:

	publication	BOOKCOUNT
1	AdvancePub	1
2	Apub	1
3	Bpub	1
4	Cpub	1
5	Dpub	1
6	Epub	3
7	Fpub	1
8	Gpub	3
9	Hamro Publication	1
10	Modern Pub	1

6. Display the count of the book according to the book publisher/publication having count greater than 2.

Ans: `SELECT publication,COUNT(bid) AS BOOKCOUNT FROM book GROUP BY publication HAVING COUNT(bid)>2;`

$\gamma_{publication,count(bid)>2 \rightarrow BOOKCOUNT}(book)$

	publication	BOOKCOUNT
1	Epub	3
2	Gpub	3

7. Display the count of the book according to the book publisher/publication and author.

Ans: `SELECT publication,author,COUNT(bid) AS BOOKCOUNT FROM book GROUP BY publication,author ;`

Y_{publication,author,count(bid)→BOOKCOUNT}(book)

	publication	author	BOOKCOUNT
1	Bpub	Anthony	1
2	Cpub	Bob	1
3	Dpub	Casey	1
4	Epub	Donald	1
5	Fpub	Emerald	1
6	Epub	Franklin	2
7	Gpub	Franklin	3
8	Modern Pub	Galvin	1
9	Hamro Publication	Navathe	1
10	Apub	Tanenbaum	1
11	AdvancePub	Weiss	1

8. Display the count of the book according to the book author and publisher/publication(reverse).

Ans: `SELECT author,publication,COUNT(bid) AS BOOKCOUNT FROM book GROUP BY author,publication ;`

Y_{author,publication,count(bid)→BOOKCOUNT}(book)

	author	publication	BOOKCOUNT
1	Weiss	AdvancePub	1
2	Tanenbaum	Apub	1
3	Anthony	Bpub	1
4	Bob	Cpub	1
5	Casey	Dpub	1
6	Donald	Epub	1
7	Franklin	Epub	2
8	Emerald	Fpub	1
9	Franklin	Gpub	3
10	Navathe	Hamro Publication	1
11	Galvin	Modern Pub	1

Assignment Questions:

9. Update the price of book by 10% if the price of the book is in between 300 to 600, by 5% if the price of the book is more than 600 else increase the price of the book by 20%.

Ans: `UPDATE book SET price= CASE WHEN price>300 AND price<600`


```

THEN 1.1*price
WHEN price>600
THEN 1.05*price
ELSE 1.2*price
END
SELECT *FROM book;

```

$(\pi_{bid, price \times 1.1}(\sigma_{price > 300 \wedge price < 600}(book))) \cup (\pi_{bid, price \times 1.05}(\sigma_{price > 600}(book))) \cup$
 $(\pi_{bid, price \times 1.2}(\sigma_{price \leq 300 \vee price \geq 600}(book)))$

	bid	bname	publication	author	price
1	101	Atomic Habits	Hamro Publication	Navathe	550.00
2	102	The power of your subconscious mind	Modern Pub	Galvin	720.00
3	103	Deep work	AdvancePub	Weiss	495.00
4	104	The Let Them Theory	Apub	Tanenbaum	735.00
5	105	The Anxious Generation	Bpub	Anthony	840.00
6	106	The Daily Stoic	Cpub	Bob	945.00
7	107	Nexus	Dpub	Casey	240.00
8	108	Elon Musk	Epub	Donald	360.00
9	109	The psychology of Money	Fpub	Emerald	440.00
10	110	Revenge of the Tipping Point	Gpub	Franklin	550.00
11	111	Outlive	Gpub	Franklin	550.00
12	112	Sapiens	Gpub	Franklin	550.00
13	113	Good Energy	Epub	Franklin	550.00
14	114	We who wrestle with god	Epub	Franklin	550.00

10. What is the maximum price of the book, total price of all books, no of books, minimum price of the book and average price of books.

Ans: `SELECT MAX(price) AS maximumPriceOfBook FROM book;`
`SELECT SUM(price) AS totalPriceOfAllBooks FROM book;`
`SELECT COUNT(price) AS noOfBooks FROM book;`
`SELECT MIN(price) AS minimumPriceOfBook FROM book;`
`SELECT AVG(price) AS averagePriceOfBooks FROM book;`

G MAX(price) → maximumPriceOfBook (book)

G SUM(price) → totalPriceOfBooks (book)

G COUNT(price) → noOfBooks (book)

G MIN(price) → minimumPriceOfBook (book)

G AVG(price) → averagePriceOfBooks (book)

	maximumPriceOfBook
1	945.00

	totalPriceOfAllBooks
1	8075.00

	noOfBooks
1	14

	minimumPriceOfBook
1	240.00

	averagePriceOfBooks
1	576.785714

11. Display the details of books with maximum price.

Ans: `SELECT * FROM book WHERE price=(SELECT MAX(price) FROM book);`

$\sigma_{(price = G(MAX(price))(book))}(book)$

	bid	bname	publication	author	price
1	106	The Daily Stoic	Cpub	Bob	945.00

12. Display the details of book with 2nd maximum price.

Ans: `SELECT * FROM book WHERE price=(SELECT MAX(price) FROM book WHERE price<(SELECT MAX(price) FROM book));`

$c1 = G_{MAX(price)}(book)$

$e1 = \sigma_{(price < c1)}(book)$

$c2 = G_{MAX(price)}(e1)$

$\pi_{e1.price}(\sigma_{(price = c2)}(e1))$

	bid	bname	publication	author	price
1	105	The Anxious Generation	Bpub	Anthony	840.00

13. Di

splay the count of teacher according to the teachers last name.

Ans: `SELECT tlname, COUNT(tid) AS CountteachersLastName FROM teacher GROUP BY tlname;`

$\gamma_{tlname, COUNT(tid) \rightarrow CountteachersLastName}(teacher)$

	tname	CountteachersLastName
1	Adhikari	1
2	Jha	1
3	Karki	1
4	Paudel	3
5	Pradhan	1
6	Ranabhat	1
7	Sharma	1
8	Shrestha	1

14. Display the count of teacher according to the teachers branch if count is greater than 3.

Ans: `SELECT tbranch, COUNT(tid) AS teachersBranch FROM teacher GROUP BY tbranch HAVING COUNT(tid)>3;`

$\sigma_{\text{teachersBranch}>3}(\gamma_{\text{tbranch, count(tid)} \rightarrow \text{teachersBranch}}(\text{teacher}))$

	tbranch	teachersBranch
1	BCT	4

15. Display the count of teacher according to the teachers last name if the count is greater than 2.

Ans: `SELECT tlname, COUNT(tid) AS teachersLastName FROM teacher GROUP BY tlname HAVING COUNT(tid)>2;`

$\gamma_{\text{tlname, COUNT(tid)} \rightarrow \text{CountteachersLastName}>2}(\text{teacher})$

	tlname	teachersLastName
1	Paudel	3

16. Display the count of the teacher according to the branch and head id.

Ans: `SELECT tbranch, hid, COUNT(tid) AS teacherCount FROM teacher GROUP BY tbranch, hid;`

$\gamma_{\text{tbranch, hid, count(tid)} \rightarrow \text{teacherCount}}(\text{teacher})$

	tbranch	hid	teacherCount
1	BCE	1	1
2	BCT	1	1
3	BCT	2	1
4	BCT	4	1
5	BEI	4	2
6	BEX	4	2
7	BAG	10	1
8	BCT	10	1

17. Display the count of the teacher according to the head id and branch.

Ans: `SELECT hid,tbranch,COUNT(tid) AS teacherCount FROM teacher GROUP BY tbranch,hid;`

Y_{hid,tbranch,count(tid)→teacherCount} (teacher)

	hid	tbranch	teacherCount
1	1	BCE	1
2	1	BCT	1
3	2	BCT	1
4	4	BCT	1
5	4	BEI	2
6	4	BEX	2
7	10	BAG	1
8	10	BCT	1

Discussion:

This lab focused on advanced SQL operations, exploring complex queries with conditional logic and data aggregation. Key tasks included dynamically adjusting teacher salaries based on specific conditions, calculating statistical measures such as maximum, minimum, and average salaries, and using subqueries to identify details like the second-highest salary. We also applied aggregate functions with GROUP BY and used the HAVING clause to filter grouped data, analyzing information about books categorized by publishers and authors.

Through these practical exercises, we developed the ability to write intricate SQL queries tailored to address real-world database scenarios. The lab highlighted the importance of integrating various SQL features to manage and analyze data accurately and efficiently.

Conclusion:

This lab enhanced our understanding of advanced SQL techniques through hands-on tasks. By working on conditional updates, statistical analysis, and group-based data exploration, we gained valuable experience in creating efficient and practical SQL queries for real-world applications.