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DETAILED LECTURE NOTES

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Unit-2

* Relationship algebra and calculus:

Relation algebra is a widely used procedural query language. It collects instances of relation as input and gives occurrences of relation as output. It uses various operation to perform this action. SQL Relation algebra query operations are performed recursively on a relation.

Relation algebra divided in various groups.

① Unary relation operation

SELECT (Symbol: σ)

PROJECT (π)

RENAME (ρ)

Relation algebra operation from set theory

UNION (U)

INTER SECTION (∩)

DIFFERENCE (-)

CARTESIAN PRODUCT (X)

Binary Relation operations

JOIN

DIVISION

1 SELECT operations:

The Select operation selects tuples that satisfy a given predicate it is denoted by sigma (σ).



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NOTATION : $\sigma P(\delta)$

Where:

σ is used for Selection Prediction

δ is used for selection

P is used as a propositional logic formula which may use connectives like: AND OR and NOT.

These relational can use as relational operator like $=, \neq, \geq, \leq$

Project operation:

This operation show the list of those attributes that we wish it appears in the result. Rest of the attributes are eliminated from the table.

It is denoted by π .

Notation : $\pi A_1, A_2, A_3 \dots (r)$

Where A_1, A_2, A_3 is used as an attribute name of selection or.

Example Customer Relation

Name	Street	city
Jones	main	Harrison
Smith	North	Rye
Hoys	main	Harrison
Carry	North	Rye

Output

Name	city
Jones	Harrison
Smith	Rye
Hoys	Harrison
Carry	Rye

Input

$\pi \text{name, city (Customer)}$

Input

$\pi \text{name, city (Customer)}$



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(Set operation, Renaming and Joins, Division)

① Set operation in SQL

SQL supports few set operations which can be performed on the table data. These are used to get meaningful result from data stored in the table.

Different type of Set operation..

① UNION.

② UNION ALL.

③ INTERSECT.

④ MINUS

① UNION

UNION combines two different result obtained by a query into a single result in the form of a table. However the result should be similar in union lists to be applied on them, union removes all duplicate.

ID	Name
1	abhi
2	adam

ID	Name
2	adam
3	chester

UNION SQL query will be

SELECT * FROM first UNION SELECT * FROM second;



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The result

ID	Name
1	abhi
2	adam
3	chester

② INTER SECTION

The intersection Operator gives the common data values b/w the Two sets that are intersected, the two sets that are intersected should be similar for the intersection operator to work.

Query: `SELECT * FROM first INTERSECT SELECT * FROM second;`

Result

ID	Name
2	Adam

③ UNION ALL

This operation is similar to the union, but it also shows the duplicate rows.

`SELECT * FROM first UNION ALL SELECT * FROM second;`

Result table

ID	NAME
1	abhi
2	adam
2	adam
3	chester

④ MINUS

The minus operation combine result of two SELECT Statement and returns only those in the final result, which belong to the first set of the result.

`SELECT * FROM first MINUS SELECT * FROM second;`

The result:



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ID	Name
1	abhi

Rename operation

The rename operation is used to rename the output relation. It is denoted by rho (ρ)

Student

Stud-Id	Stud-name
12	Shyam
11	Ram

Division operator Division operator will have attributes
= (All attribute of A - All attribute of B)

The relation returned by division operator will return
these tuples from relation A which are associated with
every B's tuple.

Consider the relation Student -> Sports and all sports

Student -> Sports

Rollno	SPORTS
1	Badminton
2	Cricket
2	Badminton
4	Badminton

Division

All Sports

SPORTS
Badminton
Cricket



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Join Join in DBMS is a Binary operation which allows you to combine Join product and Selection in one statement. The goal of creating a Join condition is that help you to combine the data from two or more DBMS tables.

Types of Join

- ① Inner Join • Theta, Natural
- ② Outer Join • Left, Right, full.

① Inner Joins Inner Joins is used to Join certain row from both tables which satisfy the given condition, it is the most widely used Join operation and can be considered.

Theta Joins

Natural Joins

② Outer Joins Theta join, and Natural Join are called Joins, An inner Join includes only those tuples with matching attributes and the rest are discarded in the resulting relation.

- ① Left Outer Join.
- ② Right Outer Join.
- ③ full Outer Join.

(Relation calculus, Expressive Power of algebra and calculus)

Relation calculus it is a non-procedural query language and instead of algebra, it uses mathematical predicate calculus. The relation calculus is not the same as that of different and integral calculus in mathematics but takes its name from a branch of symbolic logic termed as predicate calculus. Relation calculus is a non-procedural query language.



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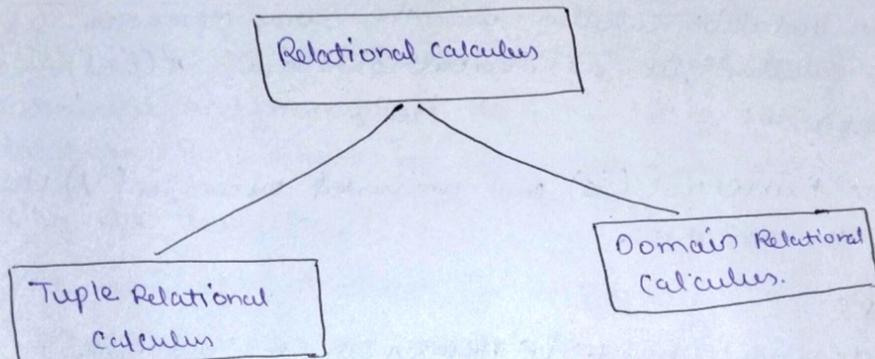
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Types of Relational calculus:



① Tuple relational calculus (TRC)

The Tuple relational calculus is specified to select the tuples in a relation. In TRC filtering variable uses the tuples of a relation.

The result of the relation can have one or more tuples.

Notation:

$\{T | P(T)\}$ or $\{T | \text{condition}(T)\}$

where

T is the condition used to fetch T .

$P(T)$ is the condition used to fetch T .

Example $\{T \cdot \text{name} | \text{Author}(T) \text{ AND } T \cdot \text{article} = \text{'database'}\}$

Output → This query selects the tuple from the author relation it returns a tuple with 'name' from author who has



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written an Article on 'database'.

Algebra and Calculus

② Domain Relation calculus (DRC)

The Second form of relation is known as Domain relation calculus. In domain relational calculus, filtering variable uses the domains of attributes.

Domain relation calculus uses the same operator as Tuple calculus, it uses logical connectives \wedge (and), \vee (or), \neg (not).

It uses Existential (\exists) and universal quantifiers (\forall) to bind the variable.

Example

{<Article, Page, Subject> | \in DBMS \wedge Subject = 'database'}

Output → This query will yield Article, Page, and Subject from the relational DBMS, where the Subject is Database.

Difference b/w Relational algebra and Relational calculus:

Relational algebra	Relational calculus
① it is a procedural language	while Relation calculus is Deductive language
② R.A means how to obtain the result	while R.C means what result we have to obtain
③ R.A is independent of the domain	while R.C can be domain dependent
④ R.A is never the a programming language	while R.C is not never the programming language;





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Domain selection
variable



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(SQL various Programming and triggers)

SQL SQL is computer language designed for the retrieval and management of data in relational database. SQL stand for Structured query language.

Why we learn SQL?

SQL is Structured query language which is a computer language for storing, manipulating and retrieving data stored in a relational database.

Application of SQL

- Allow user to access data in the relational database management system.
- Allow user to describe the data
- allows user to define the data and database and manipulate that data.
- allows to embed within other language using SQL modules, libraries & Pre-compilers.
- Allow user to create and drop database and tables.

Union union combines two different result sets into a single result set in the time. The result should be similar if union removes all duplicate, if any from the data and only display distinct values.

First table

ID	NAME
1	ashi
2	adam

Second table

ID	NAME
2	adam
3	chester

Union SQL query will be
`SELECT * FROM first UNION SELECT * FROM second.`

The result set table

ID	NAME
1	ashi
2	adam
3	chester

Intersection

The intersection operator gives the common data values b/w the two data sets that are intersected. The two data sets that are intersected should be similar for the intersection operator to work. intersection will also removes all the duplicate before displaying the result.

Triggers

Triggers are the SQL Statement that are automatically executed when there is any change in the database. The triggers are executed in response to certain events. (Insert, Update

at result 5
time. the
data and only displays
removed all



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Update or Delete) in Particular table. These Triggers help in maintaining the integrity of the data by changing the data of the database in a systematic fashion.

Advantage of triggers

- Triggers provide a way to check the integrity of the data when there is a change in the database. the triggers can adjust the entire database.
- Triggers help in checking user - Interface straightforward. Instead of putting the same function call all over the application you can put a trigger because executed.

Disadvantage of triggers

- Triggers may be difficult to troubleshoot as they execute automatically in the database if there is some error then it is hard to find the logic of triggers because they are fired before or after update / insert update.
- The triggers may increase the overhead of the database as they are executed every time any field is updated.



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Nested queries

In nested query, Inner query runs first and only one is executed with result from inner query. Hence, Inner query is used execution of outer query. We will use STUDENTS, COURSE, STUDENT-COURSE tables for understanding nested queries.

Students

S_ID	S_NAME	S_ADDRESS	S_PHONE	S_AGE
S1	RAM	DELHI	9455123451	18
S2	RAMESH	GURGAON	9622754321	18
S3	SUJIT	ROHTAK	9156253131	20
S4	SURESH	DELHI	9156768971	18

Course

C_ID	C_NAME
C1	DSA
C2	Programming
C3	DBMS

Student Course

S_ID	C_ID
S1	C1
S1	C3
S2	C1
S3	C1
S4	C2
S4	C3



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There are mainly two type of nested queries

① Independent Nested Queries

In independent nested queries, query execution starts from innermost query to outermost queries. The execution of inner query is independent of outer queries.

Queries But the result of inner query is used in execution of outer query, various operator like IN, NOT IN, ANY, ALL etc.

Orders (Order ID, Customer ID, Order Date);
Customers (Customer ID, Customer Name, Contact Name, Country);
find detail of customers who have ordered.

SELECT * FROM Customer WHERE

Customer ID (SELECT Customer ID FROM Orders);

Correlated query

In correlated query, Outer query executes first and for every Outer query row inner query is executed. Hence, inner query uses values from Outer query.



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Example

orders (order ID, customer ID, Order Date);
customers (customer ID, customer name, contact name, country)

find details of customers where

SELECT * from customers where

EXISTS (SELECT customer ID from orders

where orders. customer ID = customers.ID = customer).

(Set Com parision operation and Aggregate Operator)

SQL supports few set operation which can be performed on table data

① Union

② UNION ALL

③ INTERSECT.

Union operation

Union is used to combine the result of two or more select statement it will eliminate the duplicate row from its result set

Ex ->

ID	Name
1	abhi
2	adam

SELECT * from UNION SELECT *
FROM Second;

ID	Name
2	adam
3	ashu



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The result

ID	NAME
----	------

Aggregate Operator

1	abhi
2	adam
3	chester

② union all

This is similar to union.

ID	name
1	abhi
2	adam

ID	name
2	adam
3	chester

Result

SELECT * FROM first UNION ALL SELECT * FROM second

ID	NAME
1	abhi
2	adam
2	adam
3	chester



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③ INTERSECT

It is used the combined two Select Statement.
But, it only retrieves the records which are common from the Both Select.

Note → MySQL does not support INTERSECT Operator.

ID	name
1	abhi
2	Adam

ID	name
2	Adam
3	chester

SELECT * FROM first INTERSECT SELECT * FROM Second

Result

ID	Name
2	Adam

④ MINUS

It combines the two Select Statement.
minus operator is used to display the rows which are present in the first query but absent in the second query.

SELECT column_name from table 1

minus

SELECT column_name from table 2



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SQL Aggregate functions

It is used to perform the calculation on multiple rows of a single column of a table. It returns a single value.

① Count function

Count function is used to count the number of the rows of database table.

Count function use COUNT(*) that returns the count all the rows in specified table.

COUNT(*) considers duplicate and null.

② Sum function Suppose we want a report that gives total amount made so far we can use SQL SUM function which returns the sum of all the values in the specified column.

SELECT SUM(COST) from Product - MAST;

③ Avg. function SQL AVG function returns the average of the value in a specified column, just like sum function.

SELECT AVG(COST) from Product - MAST.



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④ MAX function max function is the opposite of the MIN function, It return the largest value from the specified table.

SELECT max(RATE) from PRODUCT-MAST;

⑤ MIN function The min function return the smallest value of Table ., as example:
let suppose we want to know the year movie oldest movie in library was released

SELECT min(YEAR) from PRODUCT-MAST;