

Unit 4: Database Design and Development

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Lecture 05 (2 hrs)

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Structured Query Language (SQL)

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Lecture content

- ☐ Introduction to SQL
- ☐ Data definition language
- ☐ Data manipulation language

Lecture content

At the end of this lecture students should be able to

- ☐ Write syntactically correct SQL statements to create and modify relations in a RDBMS
- ☐ Write syntactically correct SQL statements to answer user defined queries in a RDBMS

- ❑ SQL Initially called SEQUEL (for Structured English QUery Language)
- ❑ It was developed for an experimental relational database system called System R
- ❑ A joint effort between ANSI (American National Standard Institute) and ISO (International Standards Organization) led to a standard version of SQL in 1986 (SQL1, SQL-86, etc.)
- ❑ Major revisions have been proposed and SQL2 (also called SQL-92) has subsequently been developed

Relational Model Vs. SQL

Terminology

Relational Model	SQL
Relation	Table
Attribute	Column
Tuple	Row

SQL: Review (contd.)

SQL is a comprehensive database language:

- ☐ Data Definition Language (DDL)
- ☐ Data Manipulation Language (DML)
- ☐ Facilities for security & authorization
- ☐ Facilities for transaction processing
- ☐ Facilities for embedding SQL in general purpose languages (Embedded SQL).....

Data Definition Language (DDL)

- ❑ DDL is the subset of SQL that supports the creation, deletion and modifications for tables and views.
- ❑ Constraints can be defined on the tables

Constraint	Purpose
Not Null	Ensure that column doesn't have null values
Unique	Ensure that column doesn't have duplicate values
Primary key	Defines the primary key
Foreign key	Defines a foreign key
Default	Defines a default value for a column (When no values are given)
Check	Validates data in a column

Creating a Table - Example

CREATE TABLE STUDENT

```
(  
    studentId INTEGER PRIMARY KEY,  
    sName VARCHAR (30) NOT NULL,  
    nic CHAR(10) UNIQUE,  
    gpa FLOAT,  
    progId VARCHAR(10) DEFAULT 'IT',  
    CONSTRAINT student_prog_fk FOREIGN KEY (progId) REFERENCES programs(id)  
        ON DELETE SET DEFAULT ON UPDATE CASCADE,  
    CONSTRAINT gpa_ck CHECK (gpa<= 4.0 )  
)
```

Modifications to Tables

ALTER commands – to alter the definition of the object

- Ex : Adding a new column to a table
 - **ALTER TABLE** student **ADD** age **INT**
- Ex : Adding a new constraint to a column
 - **ALTER TABLE** student **ADD CONSTRAINT** chk_age **CHECK** (age > 18)
- Ex : removing a column from a table
 - **ALTER TABLE** student **DROP COLUMN** age

DROP commands – for dropping objects

- Ex: Deleting a table
 - **DROP TABLE** Employee

Data Manipulation Language (DML)

DML is the subset of SQL that allows users to write statements to insert, delete, modify and display rows.

❑ **INSERT INTO** student **VALUES** (1000, 'Amal', '123456789V', 3.2, 'BM')

❑ **INSERT INTO** student(studentId, sName, nic) **VALUES** (1001, 'Nimali', '234567890V')

StudentID	SName	nic	gpa	progId
1000	Amal	123456789V	3.2	BM
1001	Nimali	234567890V	Null	IT

Data Manipulation Language (DML)(Contd.)

☐ Deleting a row

- **DELETE** student **WHERE** studentId=1000

☐ Updating a row

- **UPDATE** student
 - ✓ **SET** gpa=2.8
 - ✓ **WHERE** studentId=1001

Select clause

Select clause in SQL is the basic statement for retrieving information from a database

Basic form

SELECT <attributes>

FROM <one or more relations>

WHERE <conditions>

Ex : display ids of all students whose gpa is above 3.0

❑ Select StudentId from student where gpa > 3.0

Clauses and operators used with SELECT

- IS [NOT] NULL operator
- LIKE operator
- DISTINCT operators
- BETWEEN operator
- ORDER BY clause
- Joins (inner & outer)
- Nested query (IN/SOME/ANY, ALL), [NOT] EXISTS
- Aggregate functions
- GROUP BY – HAVING clauses

LIKE operator

- Used for matching patterns
- Syntax : <string> LIKE <pattern>
 - <pattern> may contain two special symbols:
 - % = any sequence of characters
 - _ = any single character

Student

StudentID	Name	gpa	progId
1000	Amal	3.2	BM
1001	Nimali	Null	IT
1002	Aruni	3.0	SE
1003	Surani	2.5	IT

- Ex : Find students whose name starts with a 'A'
 - Select Name From student where Name Like 'A%'

Name
Amal
Aruni

IS [NOT] NULL operator

- IS NULL :Used to check whether attribute value is null
- Ex : Find studentIDs of the students who have not completed a semester yet.
 - Select studentId
 - From student
 - Where gpa IS NULL



StudentID
1001
1004

Student

StudentID	Name	gpa	progId
1000	Amal	3.2	BM
1001	Nimali	Null	IT
1002	Aruni	3.0	SE
1003	Surani	2.5	IT
1004	Imali	Null	BM

DISTINCT operator

- In a table, a column may contain many duplicate values.
- Duplicates in results can be eliminated using DISTINCT operator

Ex :

Select proglid
From student

Proglid
BM
IT
SE
IT
BM

Student

StudentID	Name	gpa	proglid
1000	Amal	3.2	BM
1001	Nimali	Null	IT
1002	Aruni	3.0	SE
1003	Surani	2.5	IT
1004	Imali	Null	BM

Select DISTINCT proglid
From student

Proglid
BM
IT
SE

BETWEEN operator

- Used to check whether attribute value is within a range
- Ex :Find the students who will be obtaining a first class ($3.7 \leq \text{gpa} \leq 4.0$)

Select studentID

From student

Where gpa between 3.7 and 4.00

Student

StudentID	Name	gpa	progId
1000	Amal	3.2	BM
1001	Nimali	Null	IT
1002	Aruni	3.8	SE
1003	Surani	2.5	IT
1004	Imali	4.0	BM



StudentID
1002
1004

ORDER BY Clause

- Used to order results based on a given field
- Ordering is ascending (ASC), unless you specify the DESC keyword
- Ex : display the student names and gpa's in the ascending order of gpa's.

Select Name, gpa
From student
Order by gpa



Name	gpa
Surani	2.5
Nimali	2.8
Amal	3.2
Aruni	3.8
Imali	4.0

Student

StudentID	Name	gpa	progld
1000	Amal	3.2	BM
1001	Nimali	2.8	IT
1002	Aruni	3.8	SE
1003	Surani	2.5	IT
1004	Imali	4.0	BM



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[INNER] Join



- Joins two tables based on a certain condition
- Ex : Find the names of students who follow programs offered by Saegis

Select s.Name

From student s, program p

where s.pid=p.ProgId and offerBy='Saegis'

Or

Select s.Name

From student s INNER JOIN program p on

s.pid=p.progId

Where offerBy='Saegis'

Student

SID	Name	gpa	pid
1000	Amal	3.2	BM
1001	Nimali	2.8	IT
1002	Aruni	3.8	SE
1003	Surani	2.5	IT

Program

progId	years	Offer By
BM	3	CCCU
IT	4	Saegis
SE	3	Pearson

Name

Nimali

Surani



Approved Centre from Pearson



Pearson



LEFT OUTER JOIN

- Returns all rows from the table on the left hand side of join, with the matching rows in the table on the right hand side of the join.
- The result is NULL in the right side when there is no match.

- Ex : For all the students display the name and the offering institute

Select s.Name, p.offerBy

From student s LEFT OUTER JOIN program p

on s.pid=p.progId

Student

SID	Name	gpa	pid
1000	Amal	3.2	BM
1001	Nimali	2.8	IT
1002	Aruni	3.8	SE
1003	Surani	2.5	IT

Program

progId	years	Offer By
BM	3	CCCU
IT	4	Saegis



Name	offerBy
Amal	CCCU
Nimali	Saegis
Aruni	NULL
Surani	Saegis



RIGHT OUTER JOIN

- Returns all rows from the table on the right hand side of join, with the matching rows in the table on the left hand side of the join.
- The result is NULL in the left side when there is no match.
 - Ex : For all the programs display the offering institute and names of the students following

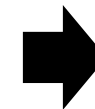
Select s.Name, p.offerBy
 From student s RIGHT OUTER JOIN program p
 on s.pid=p.progId

Student

SID	Name	gpa	pid
1000	Amal	3.2	BM
1001	Nimali	2.8	IT
1002	Aruni	3.8	SE
1003	Surani	2.5	IT

Program

progId	years	Offer By
BM	3	CCCU
IT	4	Saegis
SE	3	Pearson



Name	offerBy
Amal	CCCU
Nimali	Saegis
Surani	Saegis
NULL	Pearson

IN operator

Used to check whether attribute value matches any value within a value list

Ex : Find the students who has obtained a 'A'.

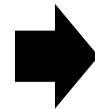
Select s.Name

From Student s

Where s.SID IN (Select SID

from Grades

Where Grade='A')



Student

SID	Name	gpa
1000	Amal	3.2
1001	Nimali	2.8
1002	Aruni	3.8

Grades

SID	cid	Grade
1000	IT102	A
1000	IT100	B
1001	IT102	A
1002	IT102	C
1002	IT200	C

Name
Amal
Nimali



Pearson



EXISTS operator

- Used to check if subquery returns any rows
- Ex : Find the students who has obtained a 'A'.

Select s.Name

From Student s

Where EXISTS (Select *

from grades g

Where g.SID=s.SID and g.Grade='A'

Student

SID	Name	gpa
1000	Amal	3.2
1001	Nimali	2.8
1002	Aruni	3.8

Grades

SID	cid	Grade
1000	IT102	A
1000	IT100	B
1001	IT102	A
1002	IT102	C
1002	IT200	C



Name
Amal
Nimali

Comparison operators with SOME, ANY & ALL

- Comparison operators such as =, <>, >, >=, < and <= could be modified using operators SOME, ANY and ALL.
 - SOME and ANY : used to compare a value to a list or subquery. Return true if at least one of the comparison evaluates as true.
 - ALL : used to compare a value to a list or subquery. If all of the comparisons evaluate to true then the result of the ALL expression will be true. Otherwise the result will be false

ANY and SOME operators

Ex : Find BM students who has gpa greater than any of the IT students.

```
Select s.Name  
From student s  
Where s.progID='BM' and  
      s.gpa > ANY (  
          select s1.gpa  
          from student s1 where  
          s1.progId='IT')
```



Student

StudentID	Name	Gpa	progId
1000	Amal	3.2	BM
1001	Nimali	2.8	IT
1002	Aruni	3.8	SE
1003	Surani	2.5	BM
1004	Imali	4.0	IT

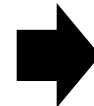
Name
Amal

ALL operator

Ex : Find IT students who has gpa greater than all the BM students.

```

Select s.Name
From student s
Where s.progID='IT' and
      s.gpa > ALL (
        select s1.gpa
        from student s1 where
        s1.progId='BM')
    
```



Student

StudentID	Name	gpa	progId
1000	Amal	3.2	BM
1001	Nimali	2.8	IT
1002	Aruni	3.8	SE
1003	Surani	2.5	BM
1004	Imali	4.0	IT

Name
Imali

Aggregation

- ❑ An aggregate function summarizes the results of an expression over a number of rows, returning a single value.
- ❑ Some of the commonly used aggregate functions are **SUM, COUNT, AVG, MIN and MAX**

Aggregation (Contd.)

Ex : Find the average, minimum, maximum gpa of students

Student

StudentID	Name	gpa	progId
1000	Amal	3.2	BM
1001	Nimali	2.8	IT
1002	Aruni	3.8	SE
1003	Surani	2.5	BM
1004	Imali	4.0	IT

Select AVG(gpa), MIN(gpa), MAX(gpa)

From student



AVG(gpa)	MIN(gpa)	MAX(gpa)
3.26	2.5	4.0



Grouping (GROUP BY Clause)

- Groups the data in tables and produces a single summary row for each group.
- Grouping is done based on a values in a given field
- When using group by
 - Each item in the SELECT list must be single valued per group.
 - SELECT clause may only contain Columns names, aggregate function, constants or an expression involving combinations of the above.
 - All column names in SELECT list must appear in the GROUP BY clause unless the name is used only in the aggregate function.

Grouping (Contd.)

Ex: Count the number of students who has followed each module.

Student

SID	CID	Grade
1000	DBII	A
1000	SEI	B
1001	DBII	A
1002	DBII	C
1002	SPD	C

SID	CID	Grade
1000	DBII	A
1001	DBII	A
1002	DBII	C
1000	SEI	B
1002	SPD	C

Select CID, Count(SID)
From Student
Group by CID



CID	Count (SID)
DBII	3
SEI	1
SPD	1

HAVING Clause

Used to apply conditions on the groupings

Ex: Find courses which is followed by more than two students

Select CID, Count(SID)
From course
Group by CID
Having count(SID)>2



CID	Count (SID)
DBII	3

Student

SID	CID	Grade
1000	DBII	A
1000	SEI	B
1001	DBII	A
1002	DBII	C
1002	SPD	C

SID	CID	Grade
1000	DBII	A
1001	DBII	A
1002	DBII	C
1000	SEI	B
1002	SPD	C

SQL: Review (contd.)

Summary of SQL Queries...

- ☐ SELECT <attribute-list>
- ☐ FROM <table-list>
- ☐ [WHERE <condition>]
- ☐ [GROUP BY <group attribute(s)>]
- ☐ [HAVING <group condition>]
- ☐ [ORDER BY <attribute list>];



Thank you!