

Relational Database Management System

Relational Database: It is a collection of logically related tables.

Table: Employee

Eno	Name	Desig
34	Ankur Singh	Mgr
45	Jatin Dua	Dir
32	Ravina	Mgr
12	Harshit	Acc
01	Raj	Recp
09	Kirti	Mgr

Table: Pay

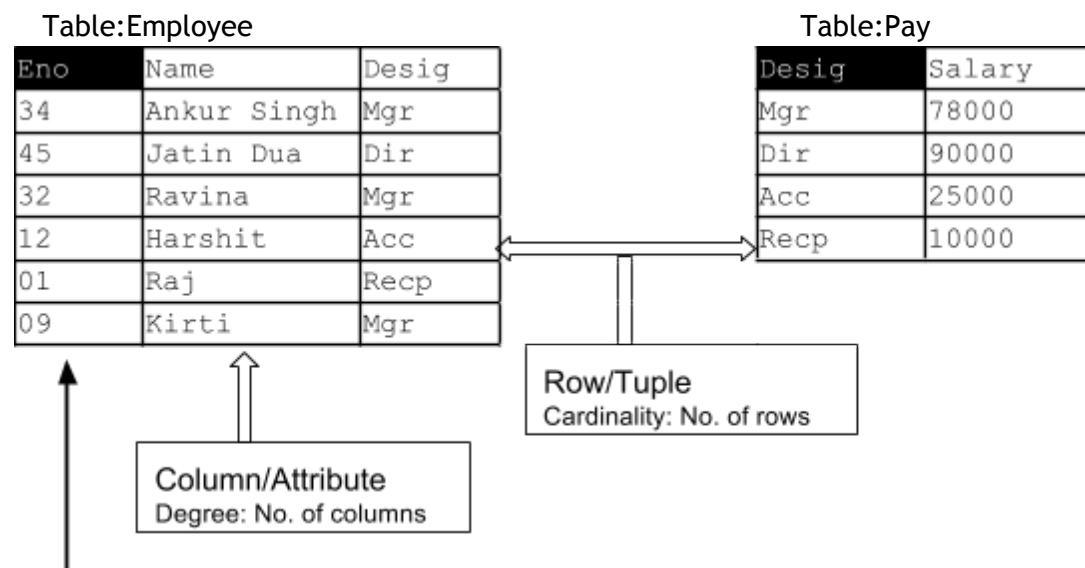
Desig	Designation	Salary
Mgr	Manager	78000
Dir	Director	90000
Acc	Accountant	25000
Recp	Receptionist	10000

Relational Database Management System: The software required to handle/manipulate these tables/relations is known as Relational Database Management System (RDBMS) - Oracle, Sybase, DB2, MS SQL Server, MYSQL, etc.

Table/Relation: Table is the collection of related data entries which means that the table should consists of columns and rows. The horizontal subset of the Table is known as a Row/Tuple. The vertical subset of the Table is known as a Column/an Attribute. A relation in a database has the following characteristics:

1. Every value in a relation is atomic - i.e. it cannot be further divided
2. Names of columns are distinct and order of columns is immaterial
3. The rows in the relation are not ordered

“Since relation is a set, and sets are not ordered hence no ordering defined on tuples of relation”



Key: An attribute/group of attributes in a table that identifies a tuple uniquely is known as a Key. A table may have more than one such attribute/group of attribute that identifies a tuple uniquely, all such attribute(s) are known as **Candidate Keys**. Out of the Candidate keys, one is selected as **Primary Key**, and others become **Alternate Keys**.

Table:Stock

Ino	Item	Qty
I01	Pen	560
I02	Pencil	780
I04	CD	450
I09	Floppy	700
I05	Eraser	300
I03	Duster	200

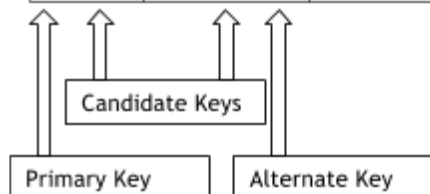
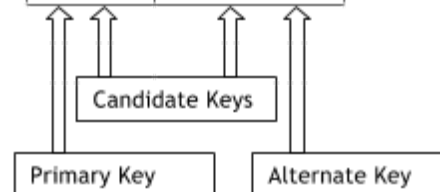


Table:Department

DCode	Dname
D01	Acc
D05	Recp
D02	HR
D03	Admin



Relational algebra: Following set of operations can be carried out on a relation:

1. **Selection (unary operator):** To select a horizontal subset of a relation.
2. **Projection (unary operator):** To select vertical subset of a relation
3. **Cartesian Product (binary operator):** It operates on two relations and is denoted by X. For example Cartesian product of two relations R1 and R2 is represented by $R = R1 \times R2$. The degree of R is equal to sum of degrees of R1 and R2. The cardinality of R is product of cardinality of R1 and cardinality of R2.

Example:

Relation: R1

RollNo	Name	Class
1	Akash	XII
4	Debakar	X
10	Rishi	XI

Relation: R2

Code	TeacherName
102	Ms. Rinee
309	Mr. Tanmoy

Resultant : $R = R1 \times R2$

RollNo	Name	Class	Code	TeacherName
1	Akash	XII	102	Ms Rinee.
1	Akash	XII	309	Mr. Tanmoy
4	Debakar	X	102	Ms. Rinee
4	Debakar	X	309	Mr. Tanmoy
10	Rishi	XI	102	Ms. Rinee
10	Rishi	XI	309	Mr. Tanmoy

4. **Union (binary operator):** It operates on two relations and is indicated by U. For example, $R=R1 \cup R2$ represents union operation between two relations R1 and R2. The degree of R is equal to degree of R1. The cardinality of R is sum of cardinality of R1 and cardinality of R2. Following have to be considered for the operation $R1 \cup R2$.

- Degree of R1 = Degree of R2
- jth attribute of R1 and jth attribute of R2 must have a common domain.

Example:

Relation: R1

Student_ID	Name
R490	Fatima
R876	Faraz
R342	Gauri

Relation: R2

Student_Code	Student_Name
S123	Rekha
S456	Tushi

Resultant Relation : $R = R1 \cup R2$

Column1	Column2
R490	Fatima
R876	Faraz
R342	Gauri
S123	Rekha
S456	Tushi

SQL - Structured Query Language

DDL-Data Definition Language

The SQL-DDL contains set of commands, which sets up, changes or removes data structures from the database. These data structures can be tables or other database objects.

DML - Data Manipulation Language

The SQL-DML includes those commands, which are based on both the relational algebra and the tuple relational calculus. DML is a language that enables users to access or manipulate data. By data manipulation, we mean:

- The retrieval of information stored in the table
- The insertion of new row with information into the table
- The deletion of information from the table (not deleting the column)
- The modification of information stored in the table (not modifying the data type of column)

DCL - Data Control Language

TCL - Transaction Control Language

Data Types (as supported by SQL in MySQL & Oracle)

CHAR, VARCHAR/VARCHAR2	To store textual data
DECIMAL/NUMERIC/ NUMBER	To store numeric data
DATE	To store date
	(Default format in MySQL is ' yyyy-mm-dd')
	(Default format in ORACLE is ' dd-mon-yy')

To create a new table in the database (DDL)

Syntax:

```
CREATE TABLE <Table Name>
    (<Column Name1> <Data Type>,<Column Name2> <Data Type> ,
    ... <Column Name n> <Data Type>);
```

Example:

```
CREATE TABLE student
    (Rno DECIMAL(5),Name VARCHAR(25),Fees DECIMAL(8,2), DOB Date);
```

To insert a new row at the bottom of the table (DML)

Syntax:

```
INSERT INTO <Table Name> [(<Col1>,<Col2>,... <Col N>)]
    VALUES ((<Col1 Value>,<Col2 Value>,... <Col N Value>);
```

Examples:

```
INSERT INTO student (Name, Rno, DOB, Fees) VALUES
('Manish',34,'2003-09-07',7000);
INSERT INTO student VALUES (34,'Manish',7800,'2003-09-07');

INSERT INTO student VALUES (35,'Dhruv',8800,'2000-02-29');

INSERT INTO student VALUES (38,'Gagan',9800,'2001-09-10');
```

To add/modify structure of new/existing column(s) in the table (DDL)

Syntax:

```
ALTER TABLE <Table Name>
    ADD (<Column Name1> <Data Type>,<Column Name2> <Data Type>,
    ... <Column Name n> <Data Type>);
```

Examples:

```
ALTER TABLE student ADD (ClassSec VARCHAR(3));
```

```
INSERT INTO student (Rno,Name,Fees,ClassSec)
VALUES (23,'Rimal',6700,'12C');
```

To display the content from a table - SELECT

Syntax:

```
SELECT */<Col1>,<Col2>, ... <Col N>
FROM <Table Name>
WHERE <Condition>;
```

Example:

```
SELECT * FROM student;
```

RNO	NAME	FEES	DOB	CLASSEC
34	Manish	7800	2007-09-03	
35	Dhruv	8800	2000-02-29	
38	Gagan	9800	2010-09-01	
23	Rimal	6700		12C

```
SELECT name FROM student;
```

NAME
Manish
Dhruv
Gagan
Rimal

Relational Operators =, <, >, <=, >=, <>

Logical Operators AND, OR, NOT

```
SELECT * FROM student WHERE Rno>35;
```

RNO	NAME	FEES	DOB	CLASSEC
38	Gagan	9800	2010-09-01	

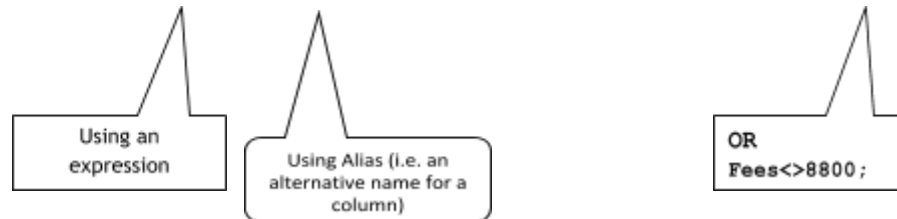
```
SELECT * FROM student WHERE Rno>23 AND Rno<38;
```

RNO	NAME	FEES	DOB	CLASSEC
34	Manish	7800	2007-09-03	
35	Dhruv	8800	2000-02-29	

```
SELECT * FROM student WHERE Rno>35 OR ClassSec='12C';
```

RNO	NAME	FEES	DOB	CLASSEC
38	Gagan	9800	2010-09-01	
23	Rimal	6700		12C

```
SELECT Name, Fees, 12*Fees AFEES FROM student WHERE NOT Fees=8800;
```



NAME	FEES	AFEES
Manish	7800	93600
Gagan	9800	117600
Rimal	6700	80400

Use of IN (used for distinct set) and BETWEEN (used for a range) with all data types

```
SELECT * FROM student WHERE Rno IN (23,34,38);
```

RNO	NAME	FEES	DOB	CLASSEC
34	Manish	7800	2007-09-03	
38	Gagan	9800	2010-09-01	
23	Rimal	6700		12C

```
SELECT * FROM student WHERE Rno BETWEEN 34 AND 38;
```

RNO	NAME	FEES	DOB	CLASSEC
34	Manish	7800	2007-09-03	
35	Dhruv	8800	2000-02-29	
38	Gagan	9800	2010-09-01	

```
SELECT * FROM student WHERE Name BETWEEN 'Dhruv' AND 'Gagan';
```

RNO	NAME	FEES	DOB	CLASSEC
35	Dhruv	8800	2000-02-29	
38	Gagan	9800	2010-09-01	

To modify the existing content of the table (DML)

Syntax:

```
UPDATE <Table Name>
```

```
SET <Col1>=<Value1> [,<Col2>=<Value2>,... <Col N>=<Value N>]
```

```
[WHERE <Condition>];
```

Example:

```
UPDATE student SET ClassSec='12A' WHERE Rno<36 AND Name<>'Rimal';
```

```
SELECT Rno, Name, ClassSec FROM student;
```

RNO	NAME	CLASSEC
34	Manish	12A
35	Dhruv	12A
38	Gagan	
23	Rimal	12C

```
UPDATE student SET Name='Suryansh' WHERE Rno=38;
```

```
SELECT * FROM student;
```

RNO	NAME	FEES	DOB	CLASSEC
34	Manish	7800	2007-09-03	12A
35	Dhruv	8800	2000-02-29	12A
38	Suryansh	9800	2010-09-01	
23	Rimal	6700		12C

```
UPDATE student SET ClassSec='12B' WHERE Rno=38;
```

```
SELECT * FROM student;
```

RNO	NAME	FEES	DOB	CLASSEC
34	Manish	7800	2007-09-03	12A
35	Dhruv	8800	2000-02-29	12A
38	Suryansh	9800	2010-09-01	12B
23	Rimal	6700		12C

```
UPDATE student SET DOB='2001-07-01' WHERE Rno=23;
```

```
SELECT * FROM student;
```

RNO	NAME	FEES	DOB	CLASSEC
34	Manish	7800	2007-09-03	12A
35	Dhruv	8800	2000-02-29	12A
38	Suryansh	9800	2010-09-01	12B
23	Rimal	6700	2001-07-01	12C

```
SELECT Name,DOB FROM student;
```

NAME	DOB
Manish	2007-09-03
Dhruv	2000-02-29
Suryansh	2010-09-01
Rimal	2001-07-01

To arrange the data in ascending or descending order of one/multiple columns

(use of ORDER BY clause with SELECT)

Syntax:

```
SELECT */<Col1>,<Col2>, ... <Col N>
```

```
FROM <Table Name> ORDER BY <Col1> [ASC/DESC],<Col2> [ASC/DESC],... ;
```

Example:

SELECT * FROM student ORDER BY Rno;

RNO	NAME	FEES	DOB	CLASSEC
23	Rimal	6700	2001-07-01	12C
34	Manish	7800	2007-09-03	12A
35	Dhruv	8800	2000-02-29	12A
38	Suryansh	9800	2010-09-01	12B

SELECT * FROM student ORDER BY Name;

RNO	NAME	FEES	DOB	CLASSEC
35	Dhruv	8800	2000-02-29	12A
34	Manish	7800	2007-09-03	12A
23	Rimal	6700	2001-07-01	12C
38	Suryansh	9800	2010-09-01	12B

SELECT * FROM student ORDER BY Fees DESC;

RNO	NAME	FEES	DOB	CLASSEC
38	Suryansh	9800	2010-09-01	12B
35	Dhruv	8800	2000-02-29	12A
34	Manish	7800	2007-09-03	12A
23	Rimal	6700	2001-07-01	12C

SELECT * FROM student where Fees>7000 ORDER BY Name;

RNO	NAME	FEES	DOB	CLASSEC
35	Dhruv	8800	2000-02-29	12A
34	Manish	7800	2007-09-03	12A
38	Suryansh	9800	2010-09-01	12B

SELECT ClassSec, Name, DOB, Fees

FROM student ORDER BY ClassSec, Name;

CLASSEC	NAME	DOB	FEES
12A	Dhruv	2000-02-29	8800
12A	Manish	2007-09-03	7800
12B	Suryansh	2010-09-01	9800
12C	Rimal	2001-07-01	6700

SELECT ClassSec, Name, DOB, Fees

FROM student ORDER BY ClassSec, Name DESC;

CLASSEC	NAME	DOB	FEES
12A	Manish	2007-09-03	7800
12A	Dhruv	2000-02-29	8800
12B	Suryansh	2010-09-01	9800
12C	Rimal	2001-07-01	6700

**SELECT ClassSec, Name, DOB, Fees FROM student ORDER BY ClassSec
DESC, Name;**

CLASSEC	NAME	DOB	FEEES
12C	Rimal	2001-07-01	6700
12B	Suryansh	2010-09-01	9800
12A	Dhruv	2000-02-29	8800
12A	Manish	2007-09-03	7800

To use Aggregate Functions with SELECT

COUNT() To count the number of rows/values (non-null)
SUM() To find the sum of values in the column (Numeric Data)
AVG() To find the average of values in the column (Numeric Data)
MAX() To find the maximum value in the column
MIN() To find the minimum value in the column

SELECT COUNT(*) FROM student;

COUNT (*)
4

SELECT COUNT(Rno) FROM student;

COUNT (RNO)
4

SELECT SUM(Fees) FROM student;

SUM (FEES)
33100

SELECT AVG(Fees) FROM student;

AVG (FEES)
8275

SELECT MAX(Fees) ,MIN(Fees) FROM student;

MAX (FEES)	MIN (FEES)
9800	6700

SELECT DISTINCT ClassSec FROM Student;

CLASSEC
12A
12B
12C

SELECT COUNT(DISTINCT ClassSec) FROM Student;

COUNT (DISTINCT CLASSEC)
3

```
SELECT COUNT(ClassSec) FROM Student;
```

COUNT (CLASSEC)
4

```
INSERT INTO Student VALUES (12, 'Jatin',6600, '2009-01-31', '12B');
```

```
SELECT * FROM Student;
```

RNO	NAME	FEES	DOB	CLASSEC
34	Manish	7800	2007-09-03	12A
35	Dhruv	8800	2000-02-29	12A
38	Suryansh	9800	2010-09-01	12B
23	Rimal	6700	2001-07-01	12C
12	Jatin	6600	2009-01-31	12B

```
SELECT SUM(Fees) FROM Student WHERE ClassSec='12A';
```

SUM(FEES)
16600

```
SELECT SUM(Fees) FROM Student WHERE ClassSec='12B';
```

SUM(FEES)
16400

```
SELECT SUM(Fees) FROM Student WHERE ClassSec='12C';
```

SUM(FEES)
6700

To group data under given Column(s) - GROUP BY

```
SELECT ClassSec,SUM(Fees) FROM Student
```

```
GROUP BY ClassSec;
```

CLASSEC	SUM(FEES)
12A	16600
12B	16400
12C	6700

```
SELECT ClassSec, COUNT(*) FROM Student
```

```
GROUP BY ClassSec;
```

CLASSEC	COUNT (*)
12A	2
12B	2
12C	1

```
SELECT ClassSec,MAX(Fees) ,MIN(Fees)FROM Student
```

```
GROUP BY ClassSec;
```

CLASSEC	MAX (FEES)	MIN (FEES)
12A	8800	7800
12B	9800	6600
12C	6700	6700

```
SELECT ClassSec,MAX(DOB)FROM Student
GROUP BY ClassSec HAVING COUNT(*)>1;
```

CLASSEC	MAX (DOB)
12A	2007-09-03
12B	2010-09-01

Precedence of Clauses

```
SELECT      */<Col1>,<Col2>,..., <Col.N>/<Expression>/<Agg.Func.>
FROM        <Table Name>
[WHERE      <Condition>]
[GROUP BY <Grouping Col.>]
[HAVING     <Aggregate Condition>]
[ORDER BY <OrderingCol1>[ASC/DESC],<OrderingCol2> [ASC/DESC]...];
```

To delete a row/rows from a table - (DML)

Syntax:

```
DELETE FROM <Table Name> [WHERE <Condition> ];
```

Example:

```
DELETE FROM Student WHERE Rno=13;
```

To delete all rows of a table (Does not delete the structure of the table)

```
DELETE FROM Student;
```

To delete structure of a table - (DDL) To delete the data as well as the structure

Syntax:

```
DROP TABLE <Table Name>;
```

Example:

```
DROP TABLE Student;
```

To modify the data type of a column - (DDL)

Syntax:

```
ALTER TABLE <Table Name> MODIFY <Col1> <Data Type>;
```

Example:

```
ALTER TABLE Student MODIFY Name CHAR(30);
```

To delete a column from a table - (DDL)

Syntax:

```
ALTER TABLE <Table Name> DROP COLUMN <Column Name>;
```

Example:

```
ALTER TABLE Student DROP COLUMN Rno;
```

To work with more than one table

Cartesian product (CROSS Product)

Table: Student

Rno	Name
1	Rahat
2	Jaya
3	Tarun

Table: Games

Gcode	Gname
101	Football
102	Table Tennis

```
SELECT Name,Gname FROM Student,Games;
```

Name	Gname
Rahat	Football
Rahat	Table Tennis
Jaya	Football
Jaya	Table Tennis
Tarun	Football
Tarun	Table Tennis

Join

Table:ADMISSION

RNO	NAME
2	Fardeen
3	Harish
1	ANIK
4	PRIYA

Table: FEE

RNO	FEES
3	3500
1	2500
4	3000

```
SELECT A.Rno,Name, Fees
FROM Admission A,Fee B WHERE A.Rno=B.Rno;
```

RNO	NAME	FEES
3	Harish	3500
1	ANIK	2500
4	PRIYA	3000

```
SELECT A.Rno,Name,Fees
```

```
FROM Admission A,Fee B WHERE A.Rno=B.Rno ORDER BY 1;
```

RNO	NAME	FEES
1	ANIK	2500
3	Harish	3500
4	PRIYA	3000

```
SELECT A.Rno,Name,Fees
```

```
FROM Admission A,Fees B WHERE A.Rno=B.Rno ORDER BY 3 DESC;
```

RNO	NAME	FEES
3	Harish	3500
4	PRIYA	3000
1	ANIK	2500

Union

- The number of columns selected from each table should be same
- The data types of corresponding columns selected from each table should be same

Table: Boys

Rno	Name
1	Rahat
2	Harish
13	Tarun

Table: Girls

Rno	Name
7	Tara
12	Jaya

```
SELECT Rno,Name FROM Boys
```

```
UNION
```

```
SELECT Rno,Name FROM Girls;
```

Rno	Name
1	Rahat
2	Harish
13	Tarun
7	Tara
12	Jaya

```
SELECT Rno,Name FROM Boys
```

```
UNION
```

```
SELECT Rno,Name FROM Girls ORDER BY 2;
```

Rno	Name
2	Harish
12	Jaya
1	Rahat
7	Tara
13	Tarun

```
SELECT Name FROM Boys WHERE Rno<13  
UNION  
SELECT Name FROM Girls WHERE Rno>7;
```

Name
Rahat
Harish
Jaya

```
SELECT Rno,Name FROM Boys WHERE Rno<>1  
UNION  
SELECT Rno,Name FROM Girls ORDER BY 1 DESC;
```

Rno	Name
13	Tarun
12	Jaya
7	Tara
2	Harish