# SQL -Basics

Database System Concepts

Abraham Silberschatz,Henry F. Korth, S. Sudarshan

&

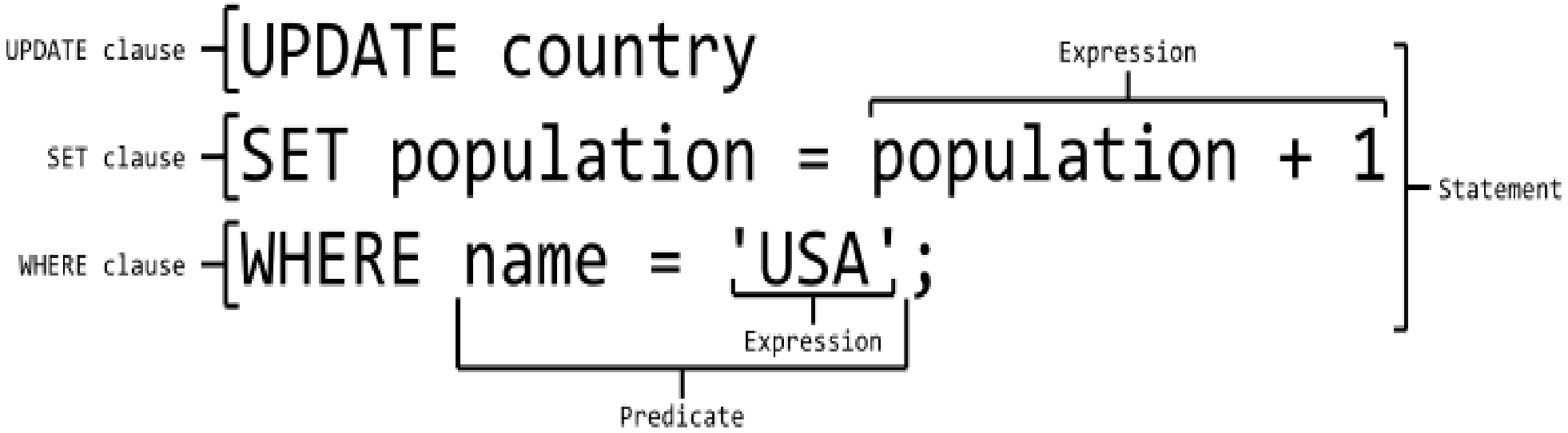
Oracle database The Complete Reference

Oracle Press

# SQL(Structured Query Language)

- SQL-(SEQUEL) was developed by IBM Corporation, Inc., based on E. F. Codd's model
- Proposed 12 Rules such as-
  - Information rule, Guaranteed Access Rule, Systematic Treatment of NULL Values, Dynamic Online Catalog Based on the Relational Model, Comprehensive Data Sublanguage (see notes section for details),… Non-Subversion Rule.
- 1st Commercial SQL- Relational Software, Inc. –Now Oracle
- MS SQL Server, IBM DB2, Oracle, MySQL, and Microsoft Access

# SQL Language Elements




•SQL statements also include the semicolon (";") statement terminator.

# Data Definition Language

The SQL **data-definition language (DDL)** allows the specification of information about relations, including:

- The **schema** for each relation/table.
- The **domain of values** associated with each attribute.
- **Integrity constraints**
- And as we will see later, also other information such as
  - The set of **indices** to be maintained for each relations.
  - Security and **authorization information** for each relation.
  - The **physical storage structure** of each relation on disk.

# Domain Types in SQL

- **char(n).** Fixed length character string, with user-specified length *n.*
- **varchar(n)/varchar2(n).** Variable length character strings, with user-specified maximum length *n.*
- **int.** Integer (a finite subset of the integers that is machine-dependent).
- **smallint.** Small integer (a machine-dependent subset of the integer domain type).
- **numeric(p,d)/number(p,d).** Fixed point number, with user-specified precision of ***p*** digits, with ***d*** digits to the right of decimal point.
- **real, double precision.** Floating point and double-precision floating point numbers, with machine-dependent precision.
- **float(n).** Floating point number, with user-specified precision of at least *n* digits.

# Built-in Data Types in SQL

- **date:** Dates, containing a (4 digit) year, month and date
  - Example: **date** '2005-7-27'
- **time:** Time of day, in hours, minutes and seconds.
  - Example: **time** '09:00:30' **time** '09:00:30.75'
- **timestamp**: date plus time of day
  - Example: **timestamp** '2005-7-27 09:00:30.75'
- **interval:** period of time.

In Oracle this data type is used as below-

**Example:** CREATE TABLE Emp ( empno NUMBER, ename VARCHAR2(50),
job VARCHAR2(255) , **year_of_experience INTERVAL YEAR TO MONTH** );

INSERT INTO EMP VALUES (1,'Rajesh','S.Manager', **INTERVAL '10-5' YEAR TO MONTH);**

SELECT * FROM Emp;

# Oracle- SQL Data Types…

1. Character
    - **Char** – fixed length character string that can varies between 1-2000 bytes
    - **Varchar / Varchar2** – variable length character string, size ranges from 1-4000 bytes.
    - **Long** - variable length character string, maximum size is 2 GB

2. Number : Can store +ve,-ve,zero,fixed point, floating point with 38 precision.
    - Number – {p=38,s=0}
    - Number(p) - fixed point
    - Number(p,s) –floating point

# SQL Data Types

3. Date : used to store date and time in the table. DB uses its own format of storing in fixed length of **7** bytes for century, date, month, year, hour, minutes, seconds. The default data type is "**dd-mon-yy**"

4. Interval Year To Month : Stores a period of time using the YEAR and MONTH date time fields

5. Raw Datatype: used to store byte oriented data like binary data and byte string. Mainly used when moving data between different systems. Oracle Recommends to store as **BLOB**

6. Other :

- CLOB – A character large object containing single-byte or multi byte characters.
- BLOB – stores large binary objects such as graphics, video, sounds..
- BFILE – Contains a locator to a large binary file stored outside the database.

# Different Types of Commands

- ✓**DDL commands: -**

  To create and modify database objects - CREATE, ALTER, DROP

- ✓**DML commands: -**

  To manipulate data of a database objects- INSERT, DELETE, UPDATE

- ✓**DQL command: -**

  To retrieve the data from a database - SELECT

- ✓**DCL commands: -**

  To control the data of a database – GRANT, REVOKE

- ✓**TCL commands:-**

  To control and manage transactions – COMMIT, SAVEPOINT,

# Create Table Construct

- An SQL relation is defined using the **create table** command:

  **create table** ***r*** ($A_1$ $D_1$, $A_2$ $D_2$, ..., $A_n$ $D_n$); both are equivalent syntax

  **CREATE TABLE** table-name ( *column_name* Datatype(size),

  *column_name* Datatype (size), . . . );

  - ***r*** is the name of the relation/table
  - each $A_i$ is an attribute (column) name in the schema of relation *r*
  - $D_i$ is the data type of values in the domain of attribute $A_i$
- **Example:**

```
create table instructor (
        ID          char(5),
        name        varchar(20),
        dept_name   varchar(20),
        salary      numeric(8,2));
```

- **insert into** *instructor* **values** ('10211', 'Smith', 'Biology', 66000);
- **insert into** *instructor* **values** ('10211', **null**, 'Biology', 66000);

# INTEGRITY CONSTSRAINTS

- Valid data means –the data which follows certain rules/ regulations of real world system.
- Therefore designer has to ensure that data entered by user has to be checked against these rules and allowed to store if valid **otherwise** need to be rejected**.**
- **Integrity constraints guard against accidental damage** to the database, by ensuring that authorized changes to the database do not result in a loss of data consistency.
- **Example:**
  - Data in some Column such as *Phone_Number* is **mandatory** for user to enter.
  - Data in some Column such as *Registration_Number* has to be **Unique** ( No duplicated allowed).
  - Data in some Column such as *Registration_Number* is used **to identify every student** distinctly.
  - **Valid range of Data** for some Column such as *Under_Gradate* is BSc, B.Tech. BE.
  - A SB account must have a balance **greater than 1000/-**

# TYPE of CONSTSRINTS

- **Rule/Constraints** can be imposed on **single column** or **combination of columns**.
  - Column-level Constraints- Imposed on **Single Column. Defined along with Column**
  - Table Level Constraint.- Defined at the end after defining all the columns.
    - **Multi-level Column**.
      - **Primary key** imposed on combination of columns- (Name,F.name,Surname)
    - **Constraint imposed on a column that reference another column** in the constraint.
      - Assume that are two columns in the table say- Date_of_Birth and Date_of_Join.
      - We want to impose condition(constraint) on Date_of_Join that

        Date_of_Join > Date_of_Birth.

# Integrity Constraints in Create Table

SQL supports a number of different integrity constraints.

- **not null -**
- **primary key** ($A_1$, ..., $A_n$ )
- **foreign key** ($A_m$, ..., $A_n$ ) **references** *r*
- **Unique**
- **Check**
- **Default**

# NOT NULL

- NULL is special kind of value applicable to any domain(datatype).
  - **Note**: NULL is **not equivalent** to '' or ' '
- In some cases, value to some column is mandatory to enter.
- In other words we want to force the user to enter some value to the column.

**Example:** Assume that the table Instructor considered in previous slide, we want make user to enter some values, can't be left null vales.

**create table** *instructor* (

*ID* **char**(5),

*name* **varchar**(20) NOT NULL , *dept_name* **varchar**(20),

*salary* **numeric**(8,2) );

- **insert into** *instructor* **values** ('10211', 'Smith', 'Biology', 66000);
- **insert into** *instructor* **values** ('10211', **null**, 'Biology', 66000); **GIVES ERROR**

* Insert commands are discussed in detail later.

# PRIMARY KEY

- Identifies every tuple(record/row) in the table uniquely.
- **primary key ($A_{j1}$, $A_{j2}$, . . . , $A_{jm}$ )**
  - Where $A_{j1}$, $A_{j2}$, . . . , $A_{jm}$ are the set of attributes in the table used to form a primary key.
  - $A_{j1}$, $A_{j2}$, . . . , $A_{jm}$ are said to be components of primary key.
  - Primary key may be imposed on a single attribute **or** multiple attributes of the table.
- There can be **ONLY ONE PRIMARY** key for a table.
- **Properties**:
  - NO component of primary key can be NULL.
  - Values to the columns must be Unique( Duplicate values can't be entered to a column)

**Example:** Declare *ID* as the primary key for *instructor*

```
create table instructor (
        ID          char(5) PRIMARY KEY
        name        varchar(20) not null,
        dept_name   varchar(20),
        salary      numeric(8,2));
```

# PRIMARY KEY-Table Level

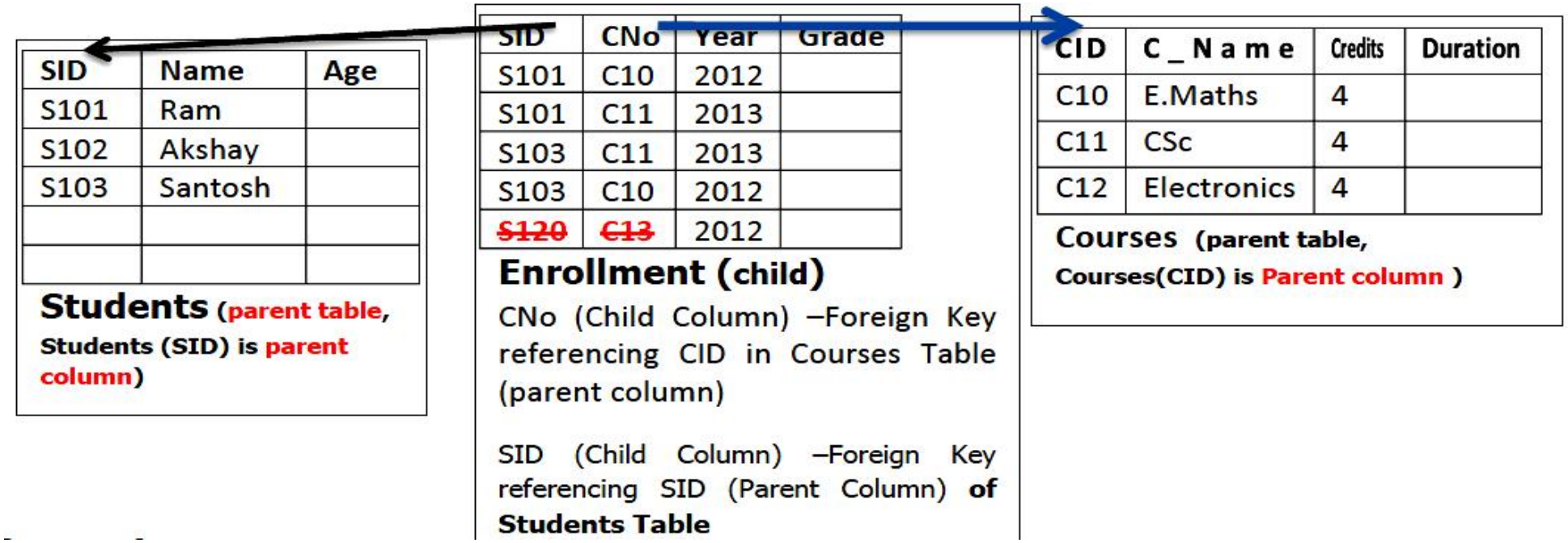
- **Example**: Create a table Enrollment containing fields –**SID –**student ID **, CNo-**Course Number **and Year –** Joining Year to the Course.
- Condition to be imposed that – We want to identify a student Uniquely who enrolled to a Course on a Particular year. Therefore combination of SID,CNO and YEAR has to be Unique and can't be Null.
- Therefore we need to impose Primary Key on SID,CNO and YEAR .
- Since Constraint is on multiple column, it has to be defined as Table level Constraints.

```
CREATE TABLE Enrollment
(SID char(9) NOT NULL,
CNO varchar2(7) NOT NULL,
Year number(2) NOT NULL,
Grade char(2),
PRIMARY KEY (SID, CNO, Year));
```

**Note:** primary key defined after defining all the columns

# FOREIGN KEY

- **foreign key ($A_{k1}$ , $A_{k2}$, . . . , $A_{kn}$ ) references s**: The foreign key in a relation **r** specification says that the values of attributes **($A_{k1}$ , $A_{k2}$, . . . , $A_{kn}$ )** for any tuple in the relation **r** must correspond to values of the primary key attributes of some tuple in relation **s**.



| SID | Name | Age |
|---|---|---|
| S101 | Ram | |
| S102 | Akshay | |
| S103 | Santosh | |
| | | |
| | | |

**Students** (parent table, Students (SID) is parent column)

| SID | CNo | Year | Grade |
|---|---|---|---|
| S101 | C10 | 2012 | |
| S101 | C11 | 2013 | |
| S103 | C11 | 2013 | |
| S103 | C10 | 2012 | |
| ~~S120~~ | ~~C13~~ | 2012 | |

**Enrollment (child)**

CNo (Child Column) –Foreign Key referencing CID in Courses Table (parent column)

SID (Child Column) –Foreign Key referencing SID (Parent Column) **of Students Table**

| CID | C_Name | Credits | Duration |
|---|---|---|---|
| C10 | E.Maths | 4 | |
| C11 | CSc | 4 | |
| C12 | Electronics | 4 | |

**Courses** (parent table, Courses(CID) is Parent column )

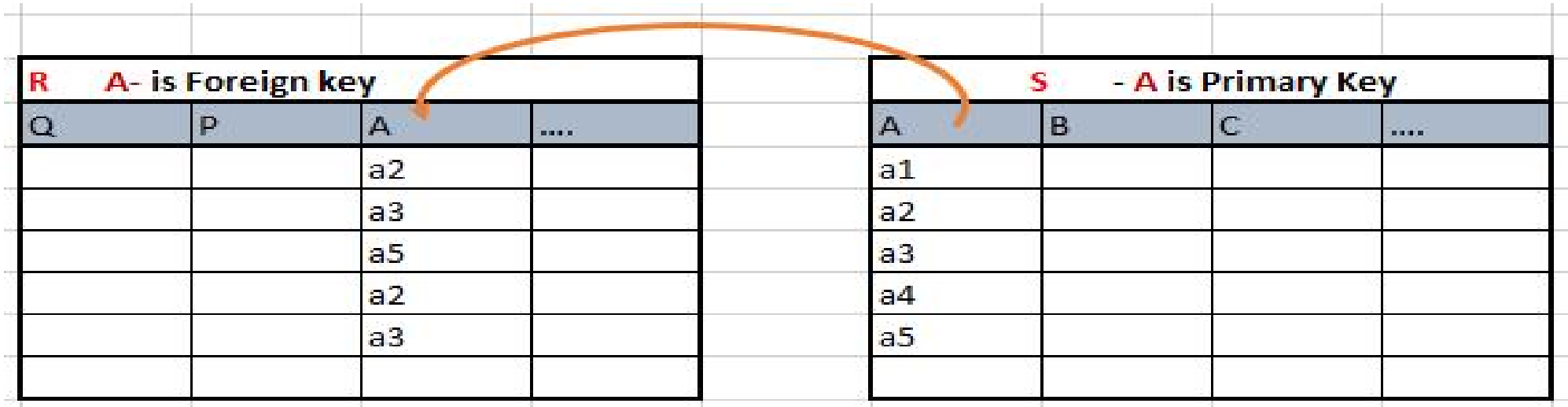
Enrollment can be done to only to those who are student, therefore SID column in Enrollment can have only values which are present in SID in Student table.

This condition is imposed by defining **SID in Enrollment as Foreign key referencing Students**

**This is known as Referential Integrity Constraint**

# Referential Integrity Constraint

- Ensures that a value that appears in one relation for a given set of attributes also appears for a certain set of attributes in another relation.
  - **Example:** If "S101" is a Student Id appearing in one of the tuples in the *Enrollment* relation, then there exists a tuple in the *Students* relation for "S101".
- Let **A** be a **set of attributes**. Let **R** and **S** be two relations that contain attributes A and where **A** is the **primary key of S**. **A** is said to be a **foreign key of R** if for any **values of A appearing in R** these values **also appear in S**.



**R** A- is Foreign key

| Q | P | A | .... |
|---|---|---|---|
| | | a2 | |
| | | a3 | |
| | | a5 | |
| | | a2 | |
| | | a3 | |
| | | | |

**S** - A is Primary Key

| A | B | C | .... |
|---|---|---|---|
| a1 | | | |
| a2 | | | |
| a3 | | | |
| a4 | | | |
| a5 | | | |
| | | | |

**Note:** In relation **R**, attribute **A** can't contain a value which is not existing in attribute **A** of relation **S**.
In the example above , at this instance **A** in **R** can't have a value **a6** or **a7** etc.

# ..FOREIGN KEY column-level

- **Example:**
- We have to create **Parent Tables** First.
  - CREATE TABLE **Students** (SID char (9) PRIMARY KEY , Name varchar2(25) not null, Age integer);
  - CREATE TABLE **Courses** (CID varchar2 (9) UNIQUE , C_Name varchar2(25) not null, Credits number(2), Duration Number(2));
- **After Creating Parent Table/s, create Child tables**
  - **CREATE TABLE** Enrollment

    ( SID char (9) **NOT NULL References Students,**

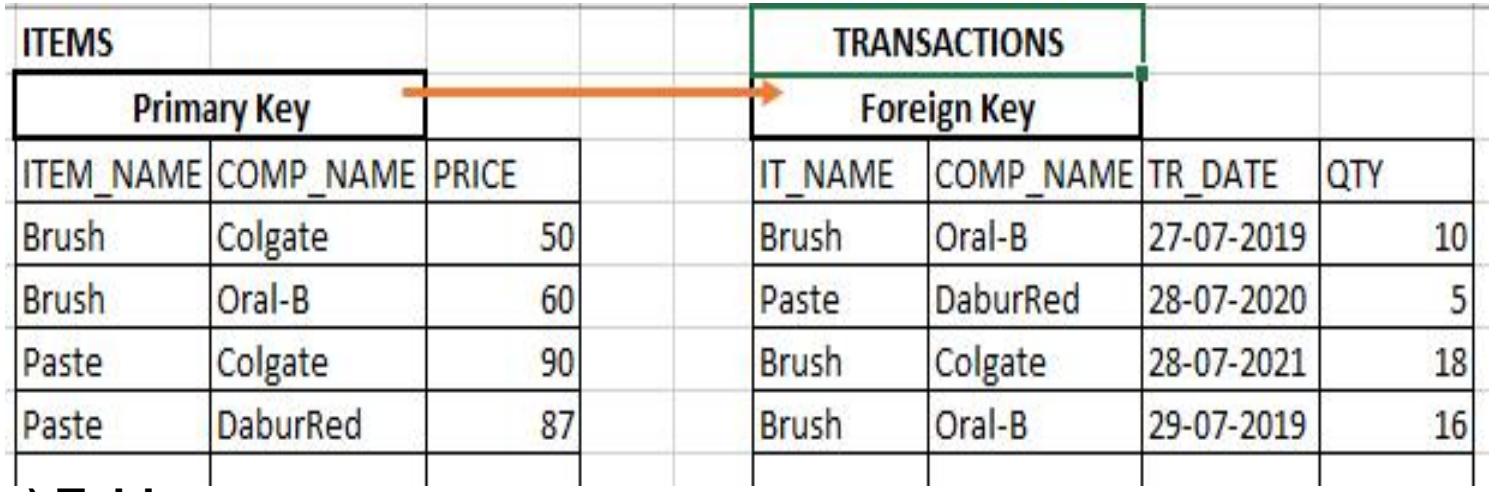
    CNo varchar2 **(9) References Courses(CID),**

    Year number (2) **not null,**

    **Grade char (2), Primary key** (SID, CNO, Year) );

# ..FOREIGN KEY table-level

- **Example:**



| ITEMS | | | TRANSACTIONS | | | |
|---|---|---|---|---|---|---|
| Primary Key | | | Foreign Key | | | |
| ITEM_NAME | COMP_NAME | PRICE | IT_NAME | COMP_NAME | TR_DATE | QTY |
| Brush | Colgate | 50 | Brush | Oral-B | 27-07-2019 | 10 |
| Brush | Oral-B | 60 | Paste | DaburRed | 28-07-2020 | 5 |
| Paste | Colgate | 90 | Brush | Colgate | 28-07-2021 | 18 |
| Paste | DaburRed | 87 | Brush | Oral-B | 29-07-2019 | 16 |

- **Parent(Master) Table**:

  **CREATE TABLE Items(** Item_name varchar2(10), Comp_name varchar2(10),

  Price Number(3),

  **PRIMARY KEY** (Item_name,Comp_name) **);**

- **Child(Detail) Table**

  **CREATE TABLE Transactions(** It_name varchar2(10), Comp_name varchar2(10),

  Tr_Date date, Qty Number(3),

  **FOREIGN KEY**(It_name,Comp_name) **REFERENCES** Items**)**;

# ..FOREIGN KEY

- **Properties:**
  - A Foreign key can contain-
    - Only values present in the corresponding Parent Column.
    - NULL values, provided Foreign key is not defined with additional NOT NULL constraints.
  - Foreign key column can reference to any column (parent column) **whose data type, width is same** and **Parent column** has to be defined **with Primary key or Unique constraint**.
  - A **Parent Column has to exist before creation of Child Column** with Foreign key Constraint.

***Restrictions:*** ***Any UPDATE/INSERT/DELETE of Records , ALTER or DROP Operation that Violates any of the above properties is restricted and hence Rejected by the Database System.***

# Sample Tables

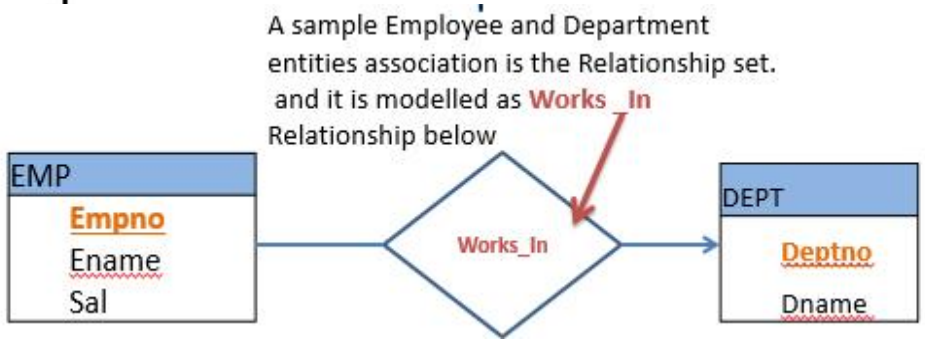
| EMP- DEPTNO Foreign Key | | |
|---|---|---|
| EMPNO | NAME | DEPTNO |
| 100 | Raj | D1 |
| 101 | Krishna | D2 |
| 102 | Manoj | D1 |
| 103 | Ravi | D3 |
| 104 | Shriivas | |

| DEPARTMENT - DNO Primary Key | | |
|---|---|---|
| DNO | NAME | BUDGET |
| D1 | MCA | 128999 |
| D2 | CompSc | 124456 |
| D3 | Mech | 123562 |
| | | |
| | | |

# ..FOREIGN KEY – INSERT Restrictions

| EMP- DEPTNO Foreign Key | | |
|---|---|---|
| EMPNO | NAME | DEPTNO |
| 100 | Raj | D1 |
| 101 | Krishna | D2 |
| 102 | Manoj | D1 |
| 103 | Ravi | D3 |
| 104 | Shriivas | |

| DEPARTMENT - DNO Primary Key | | |
|---|---|---|
| DNO | NAME | BUDGET |
| D1 | MCA | 128999 |
| D2 | CompSc | 124456 |
| D3 | Mech | 123562 |
| | | |
| | | |




- INSERT INTO EMP VALUES(105,'Rajesh','**D4'**); is Rejected
- **To execute above INSERT command, execute in following Order**
- INSERT INTO DEPT VALUES('D4','Physics',125678);
- **Note**-Parent record with parent column value D4 is added to DEPARTMENT and now we can add child Employee record with D4(child column value) department
- INSERT INTO EMP VALUES(105,'Rajesh','**D4'**); Now it is Accepted.

# ..FOREIGN KEY- UPDATE/DELETE Restrictions

| EMP- DEPTNO Foreign Key | | |
|---|---|---|
| EMPNO | NAME | DEPTNO |
| 100 | Raj | D1 |
| 101 | Krishna | D2 |
| 102 | Manoj | D1 |
| 103 | Ravi | D3 |
| 104 | Shriivas | |

| DEPARTMENT - DNO Primary Key | | |
|---|---|---|
| DNO | NAME | BUDGET |
| D1 | MCA | 128999 |
| D2 | CompSc | 124456 |
| D3 | Mech | 123562 |
| | | |
| | | |

- **Similarly,**
- UPDATE EMP SET DEPTNO='D5' WHERE EMPNO=100; is Rejected.
- UPDATE EMP SET DEPTNO='D3' WHERE EMPNO=100; is Accepted.
- DELETE FROM DEPARTMENT WHERE DNO='D1' is Rejected
- **To execute above DELETE command, execute in following Order**
- 1st Delete from Child Table(EMP) and then 2nd Delete from Parent(DEPARTMENT)
  - This Deletion process **can be automated** by using Clause **ON DELETE CASCADE / ON DELETE SET NULL** while creating Child Table
- Similarly **Altering Structure** of DNO or **Dropping** DNO is Rejected.

# ..FOREIGN KEY- ON DELETE CASCADE/ON DELETE SET NULL

- A foreign key with cascade delete means that if a record in the parent table is deleted, then the corresponding records in the child table will automatically be deleted. This is called a cascade delete in Oracle.
  - **Example:** Create tables give in slide 18 with **ON DELETE CASCADE** clause along with FOREIGN KEY.

- **Parent(Master) Table**:
  - **CREATE TABLE Department** ( Dno varchar(2) PRIMARY KEY, Name varchar(10),Budget Number(9) );
- **Child(Detail) Table**
  - **CREATE TABLE Emp**(Empno number(3) PRIMARY KEY, Name varchar(10), Deptno varchar(2) **REFERENCES Department ON DELETE CASCADE**);

**Any Delete operation on the table Department(Parent) first deletes dependent records in the EMP(child) table automatically. Thus Delete operation restriction on Foreign key constraint is get resolved automatically.**

# ..FOREIGN KEY- ON DELETE CASCADE/ON DELETE SET NULL

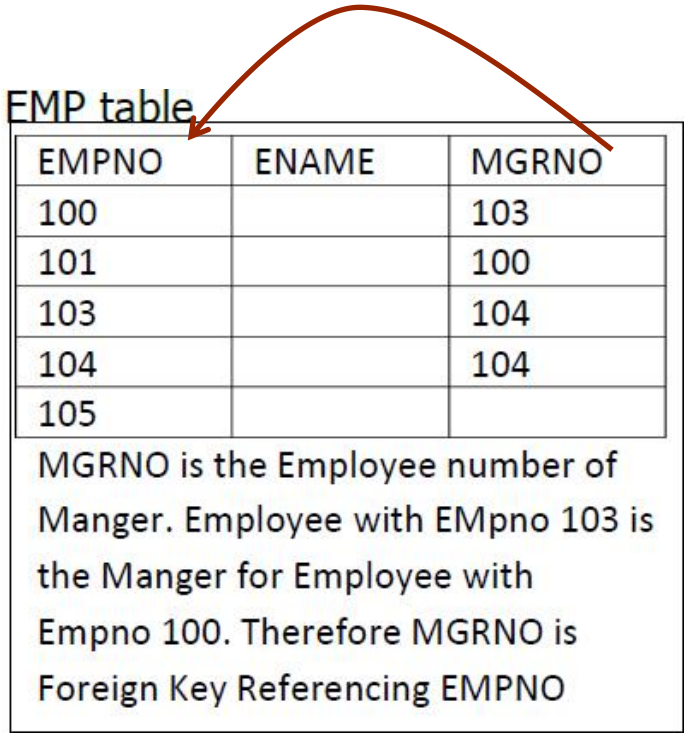
- A foreign key with "**ON DELETE SET NULL** " means that if a record in the parent table is deleted, then the corresponding records in the child table will have the **foreign key fields set to null**. The records in the child table will **not** be deleted.
- **Example:** Create tables give in slide 18 with **ON DELETE SET NULL** clause along with FOREIGN KEY.
- **Parent(Master) Table**:
  - **CREATE TABLE Department(**Dno varchar(2) PRIMARY KEY, Name varchar(10),Budget Number(9)**);**
- **Child(Detail) Table**
  - **CREATE TABLE Emp(** Empno number(3) PRIMARY KEY, Name varchar(10), Deptno varchar(2) **REFERENCES Department ON DELETE SET NULL );**

# ..FOREIGN KEY- ON DELETE CASCADE/ON DELETE SET NULL

**When a record is deleted from Department(Parent) table it will not delete dependent records in the EMP(child) table instead puts NULL values to corresponding foreign key column/s. Thus removes dependency of corresponding records in the child table on table records being deleted in the Parent table.**

**Thus Delete operation restriction on Foreign key is get resolved automatically.**

# ..FOREIGN KEY - Recursive Relationship




**Example:**

CREATE TABLE EMP(Empno number(3) PRIMARY KEY, Ename Varchar2(10), MGRNO number(3))**;**

Note: Referential Integrity constraint on MGR_NO can be defined using **Alter Table** command **after creating EMP table**

**OR**

CREATE TABLE EMP(Empno number(3) PRIMARY KEY, Ename Varchar2(10), MGRNO number(3) REFERENCES EMP);

# UNIQUE

- **unique** ( $A_1$, $A_2$, …, $A_m$)
  - The unique specification states that the attributes ***A*1, *A*2, … *A*m** form a candidate key.
  - Candidate keys are **permitted to be null** (in contrast to primary keys).
- **Example:**

```
CREATE TABLE Student(
    ID  varchar(5)  PRIMARY KEY,
    Name Varchar(10),
   Phone  number(10)  UNIQUE,
   tot_credit  Number(2) );
```

**Phone is implemented with Column level UNIQUE Constraints.**

# ..UNIQUE

- In the following table combination of **Area_code & Phone_Num** is **Unique** for a landline phone.
- **Area_code & Phone_Num** is to be implemented as **Table-level Constraint**,
- **Example:**

```
CREATE TABLE BsnL_Customer (
Customer_ID number(7)  PRIMARY KEY,
Name  varchar(10)  NOT NULL,
Address  varchar(20),
Area_Code  Number(4),
Phone_Num   Number(6),
UNIQUE(Area_Code , Phone_Num ) );
```

# Some Exercises

- Create the following tables with constraints.

**EMP**

| Attribute | Datatype | size | Constraint |
|---|---|---|---|
| RegNo | Number | 3 | Primary key |
| Name | Varchar | 10 | |
| Faculty_Advisor | | | F.key referring Faculty |

**FACULTY**

| Attribute | Datatype | size | Constraint |
|---|---|---|---|
| Faculty_ID | Number | 3 | Primary Key |
| Name | Varchar | 10 | |
| Dno | | | References with set null constraint |

**DEPT**

| Attribute | Datatype | size | Constraint |
|---|---|---|---|
| DeptID | Char | 3 | Unique |
| Dname | Varchar | 10 | Unique |
| HOD | Varchar | 10 | |

# The CHECK clause – Using IN

- **check (P)** where **P** is a predicate(condition)

Ensures the data entering into the column must satisfy **P** otherwise rejected

**Example:** ensure that Type of Courses offered by a Department is any one of MCA, MTech, BTec,MS.

```
CREATE TABLE Department (
    Department_name varchar (8) PRIMARY KEY,
    Course_Type varchar (8) CHECK( Course_Type IN( 'MCA ',' MTech ',' BTech', 'MS')),
    Numb_of_Semester  Number(1),
    In_take_stud_num    Number(2),
    Department_Phone   Number(10) NOT NULL UNIQUE );
```

**Note: IN works like a Belongs to a SET Operator**

**User_enetred_value ϵ { 'MCA ',' MTech ',' BTech', 'MS' }**

# ..The CHECK clause –Using BETWEEN

- Create table *Instructor* and ensure that **Salary** column accepts only values in the **range 50000 to 200000** ( both upper and lower bound values are valid).

- **CREATE TABLE** *instructor* **(**

  *ID* **char**(5),

  *name* **varchar**(20)**,**

  *dept_name* **varchar**(20),

  *salary* **numeric**(8,2) **CHECK( Salary>=50000 AND Salary<=200000)**

  **);**

- **CREATE TABLE** *instructor* **(**

  *ID* **char**(5),

  *name* **varchar**(20)**,**

  *dept_name* **varchar**(20),

  *salary* **numeric**(8,2) **CHECK( Salary BETWEEN 50000 AND 200000)**

  **);**

# ..The check clause - using LIKE %

**LIKE** is used for pattern matching.

**%** symbol is a wildcard character which ignores **zero** or **any number of** characters.

**Example:**

- Create a table CANDIDATES(CandtID, Name, Branch) appearing for entrance exam at MIT. Candidate numbers must be Unique & every **candidate number must start with MIT**.
- CREATE TABLE CANDIDATE( CandtId varchar2(7) PRIMARY KEY **CHECK (CandtId LIKE 'MIT%')**, Name varchar(10),Branch varchar(10));
- INSERT INTO CANDIDATE VALUES**('MIT1020'**, **'**Raghu**'**, **'**CompSc**');** accepted
- INSERT INTO CANDIDATE VALUES**('MIT'**, **'**Raghu**'**, **'**CompSc**');** accepted - ignoring ZERO char
- INSERT INTO CANDIDATE VALUES**(‘ABC1021'**, **‘**Raj**'**, **'**CompSc**');** rejected

# ..The check clause - using LIKE _

_ is a wildcard character which ignores **1** character(accepts exactly one any character).

**Example:**

- Create a table PRODUCT(ProdID, Name, Price) to store products of **JOI** company. Product numbers must be of the form **JOI-** followed by any 5 characters(use 5 under score character).
- CREATE TABLE PRODUCT(ProdID varchar2(9) PRIMARY KEY **CHECK** (ProdID **LIKE 'JOI-_____')**, Name varchar(10),Price Number(5)); Note: 5 underscore characters
  - INSERT INTO PRODUCT VALUES('JOI-22232', 'Mobile',3344);; accepted.
  - INSERT INTO PRODUCT VALUES('JOI-','S.WATCH',2344); rejected
  - INSERT INTO PRODUCT VALUES('JOI-222','Tab',7344); rejected
  - INSERT INTO PRODUCT VALUES('JOI-222456','ROUTER',9344); rejected

# ..The check clause - using function UPPER()

**Example:**

- Create a table CANDIDATES(CandtID, Name, Branch) appearing for entrance exam at MIT.
  Candidate numbers must be Unique & every candidate number must start with MIT.
  User must enter **Branch in Capital letters only**.
- CREATE TABLE CANDIDATE**(** CandtId varchar2(7) PRIMARY KEY **CHECK**
  **(CandtId LIKE 'MIT%')**, Name varchar(10),Branch varchar(10)
  CHECK(Branch=**UPPER**(Branch))**)**;

- INSERT INTO CANDIDATE VALUES(**'MIT1021'**, 'Raghu', 'COMP.SC'); accepted
- If user enters Branch as –'Comp.Sc' , it is rejected with constraint error message.
- INSERT INTO CANDIDATE VALUES**('MIT1021'**, 'Raj', 'Comp Sc'**);** rejected

# DEFAULT

The DEFAULT constraint is used to provide a default value for a column.

**Example:**

```
CREATE TABLE Persons (
ID Number(3) NOT NULL,
LastName varchar(10) NOT NULL,
FirstName varchar(10),
Age Number(2),
City varchar(15) DEFAULT 'Manipal' );
```

**INSERT INTO Persons(ID, Lastname) values(100,'AAA');**

Inserts value to ID=100 , Lastname=AAA , FirstName= NULL , Age=NULL & City takes value **Manipal** automatically even though City value is not specified in the INSERT command.

# Example

Create following tables with constraint names.

**CUSTOMER**

| Attribute | Datatype | size | Constraint | Constraint Name |
|---|---|---|---|---|
| CustNo | Number | 3 | Primary key | Pkey_Cust_Number |
| Phone | number | 10 | Unique , Can't be Null | UNQ_Phone; Ph_NoNULL |
| email | varchar | 20 | Unique | |
| City | varchar | 20 | BNG/MUB/CHN | Valid_City |

**ACCOUNT**

| Attribute | Datatype | size | Constraint | Constraint Name |
|---|---|---|---|---|
| Accno | Number | 3 | Priamry key | Pkey_AccNo |
| CustNo | | | Primary key; Foreign Key | |
| Balance | Number | 7 | >1000 | Min_Balance |

# Example

Tables created without constraint Name:

CREATE TABLE Organization(Dept_name varchar (8) **PRIMARY KEY**, Head varchar(10));

CREATE TABLE Department (Dname varchar (8) **PRIMARY KEY REFERENCES** Organization, Course_Type varchar (8) **CHECK**( Course_Type IN( 'MCA','MTech' ,'BTech','MS')), Numb_of_Sem Number(1) **CHECK** (Numb_of_Sem BETWEEN 1 AND 8), In_take_stud Number(2), Dep_Phone Number(10) **NOT NULL UNIQUE** );

# ..Example

**Note the constraint name and error numbers displayed when data being inserted violates constraint**

INSERT INTO organization VALUES('DCSA',’KAK');

INSERT INTO Department VALUES(‘DCSA','mca',4,66,78899);

ORA-02290: check constraint (DSE123.SYS_C0010498) violated

INSERT INTO Department VALUES(‘DCSA','MCA',9,66,78899);

ORA-02290: check constraint (DSE123.SYS_C0010499) violated

# Naming the Constraints

- If user do not specifies Constraint Name while defining Constraints, System itself gives a name. System uses auto generate method to give unique constraints names such as – SYS_C0003461 etc. As constraint names have to be unique. In case of constraint violation, it is easy to user to track the constraint if user defined constraint name is given.

- Use **CONSTRAINT *name_of_constraint*** along with constraint definition in CRETAE or ALTER table.

**Example**:

```
CREATE TABLE  table_name(
 column_name1 datatype(size) CONSTRAINT name_of_constraint  constraint definition ,
 column_name2 datatype(size) …., …..);
```

***constraint definition – maybe Primary key, Foreign key, Check, Unique, Not Null etc.**

# Example

- CREATE TABLE Organization(Dept_name varchar (8) CONSTRAINT Dept_PK **PRIMARY KEY**, Head varchar(10));

- CREATE TABLE Department (Dname varchar (8) CONSTRAINT Dname_PK **PRIMARY KEY** CONSTRAINT fk_Orga **REFERENCES Organization**, Course_Type varchar (8) CONSTRAINT Course_Chk_Type **CHECK( Course_Type IN( 'MCA','MTech ', 'BTech', 'MS'))**, Numb_of_Sem Number(1) CONSTRAINT Sem_Num **CHECK(**Numb_of_Sem BETWEEN 1 AND 8), In_take_stud Number(2), Dep_Phone Number(10) CONSTRAINT NoNul **NOT NULL** CONSTRAINT Unq_Ph **UNIQUE**);

# ..Example

**Note the constraint name displayed when data being inserted violates constraint**

**INSERT INTO organization VALUES(‘DCSA’,’KAK');**

**INSERT INTO Department VALUES(‘DCSA','mca',4,66,78899);**

ORA-02290: check constraint (MCA2020.COURSE_CHK_TYPE) violated

**INSERT INTO Department VALUES(‘DCSA','MCA',9,66,78899);**

ORA-02290: check constraint (MCA2020.SEM_NUM) violated

# Drop Table Constructs

The **DROP TABLE** statement allows you to remove or delete a table from the database.

**Syntax:**

```
DROP TABLE tablename;
```

**Example:** DROP TABLE Emp;

# Alter Table Constructs

The **ALTER TABLE** statement is used to add, modify, or drop/delete columns/constraints in a table.

The SQL ALTER TABLE statement is also used to rename a table.

## Adding Column

**Syntax:**

ALTER TABLE table_name **ADD** (column_name1 column-definition, column_name1 column-definition,…..) ;

**Example:** Add column Salary and Phone to Emp table.

ALTER TABLE Emp **ADD** (Salary Number(7), Phone Number(10));

# ..Alter Table Constructs

## Modifying Column

**Syntax:**

```
ALTER TABLE table_name
MODIFY (column_1 column_type, column_2 column_type, ... column_n
column_type);
```

**Example:** Modify column Name to size 25 and Salary to 9,2 in the Emp table.

```
ALTER TABLE Emp MODIFY ( Name VARCHAR(25) NOT NULL, Salary
Number(9,2));
```

# ..Alter Table Constructs

## DROP a Column

**Syntax:**

ALTER TABLE table_name

DROP column_name;

**Example:** Add column Name to Emp table.

**ALTER TABLE Emp DROP COLUMN Name;**

# ..Alter Table Constructs

## RENAME a Table

**Syntax:**

```
ALTER TABLE table_name RENAME TO  New_table_name;
```

**Example:** Add column Salary to Emp table.

```
ALTER TABLE Emp  RENAME TO  Employee;
```

# ..Alter Table Constructs

## Adding CHECK Constraint to a column

**Syntax:**

```
ALTER TABLE table_name
    ADD CONSTRAINT constraint_name  CHECK( p ) );
```

Where **p** - predicate

**Example:** Add constraint to **Students** table to check **Mark2** column takes values only in the **range 0 to 100.**

```
ALTER TABLE Student
ADD CONSTRAINT check_mark_range
CHECK (mark2>=0 AND mark2<=100);
```

# ..Alter Table Constructs

## Adding UNIQUE Constraint to a column

**Syntax:**

ALTER TABLE table_name

ADD CONSTRAINT constraint_name UNIQUE**( column*1*,column*2*,..column*n* ) );**

**Example:** Add constraint to **Students** table make **Phone** column as Unique**.**

ALTER TABLE Student

ADD **CONSTRAINT uniq_phone**

**UNIQUE**(Phone);

# ..Alter Table Constructs

## Adding PRIMARY KEY Constraint to a column

**Syntax:**

```
ALTER TABLE table_name
ADD CONSTRAINT constraint_name
PRIMARY  KEY (column1, column2, ... column_n) ;
```

**Example:** Assume that Person(Fname, Lname, Address) table is already created. Add constraint to **Person** table to make (**FName,LName)** column as Primary Key**.**

```
ALTER TABLE Person ADD CONSTRAINT F_L_Name_FK
PRIMARY KEY (FName,LName);
```

# ..Alter Table Constructs

## Adding FOREIGN KEY Constraint to a column

**Syntax:**

ALTER TABLE table_name

ADD CONSTRAINT constraint_name

**FOREIGN KEY** (column1, column2, ... column_n)

**REFERENCES parent_table** (column1, column2, ... column_n);

**Example:** Assume that **Person(Fname, Lname, Address)** table is already created with **(Fname, LName)** as **Primary Key.** Also a table **Customer(**Cust_Id, Cust_FName,Cust_Lname,Credits**)** is also created already.

Now we want to **make (Cust_FName,Cust_Lname) as foreign key referencing Person**

ALTER TABLE Customer ADD CONSTRAINT **Cust_FLName_FK**

**FOREIGN KEY(Cust_FName, Cust_Lname) REFERENCES Person;**

# ..Alter Table Constructs

## Removing Constraints

**Syntax:**

ALTER TABLE table_name

**DROP CONSTRAINT** constraint_name ;

**Example:** Assume that **Person(Fname, Lname, Address)** table is already created with **(Fname,LName)** as **Primary Key.** Also a table **Customer(Cust_Id, Cust_FName,Cust_Lname,Credits)** is also created already.

- Now we want to **remove foreign key constraint** from **(Cust_FName,Cust_Lname).**

ALTER TABLE Customer **DROP CONSTRAINT Cust_FLName_FK;**

# ..Alter Table Constructs

## Renaming Constraints

The ALTER TABLE...RENAME CONSTRAINT statement enables you to rename any currently existing constraint for a table. The new constraint name must not conflict with any existing constraint names for a user.

**Syntax:**

ALTER TABLE table_name **RENAME CONSTRAINT old_constraint_name TO new_constraint_name;**

**Example:** Assume that **Person(Fname, Lname, Address,Phone)** table is already created with **(Fname,LName)** as Primary Key **and** Unique constraint on Phone with constraint name – **'PHONE_UNQ'. Rename the PHONE_UNQ to UNIQUE_PHONE.**

ALTER TABLE **Person RENAME CONSTRAINT** PHONE_UNQ **TO** UNIQUE_PHONE;

# ..Alter Table Constructs

## Disabling Constraints

The ALTER TABLE...DISABLE CONSTRAINT statement disables constraint defined.

**Syntax:**

ALTER TABLE table_name **DISABLE CONSTRAINT constraint_name;**

ALTER TABLE table_name DISABLE PRIMARY KEY;

ALTER TABLE table_name DISABLE UNIQUE(column1,column2,..);

**Example:** Assume that **Person(Fname, Lname, Address,Phone)** table is already created with **(Fname,LName)** as Primary Key with constraint name FLName_PKey **and** Unique constraint on Phone with constraint name – **'PHONE_UNQ'.**

**Disable the PHONE_UNQ Constraint.**

ALTER TABLE **Person DISABLE CONSTRAINT** PHONE_UNQ; **or**

ALTER TABLE **Person DISABLE UNIQUE(Phone);**

**Disable Primary key**

ALTER TABLE **Person DISABLE** PRIMARY KEY;

# ..Alter Table Constructs

## Enabling disabled Constraints

The ALTER TABLE...ENABLE CONSTRAINT statement enables the constraint defined which is presently disable state..

**Syntax:**

ALTER TABLE table_name **ENABLE CONSTRAINT constraint_name;**

ALTER TABLE table_name ENABLE PRIMARY KEY;

ALTER TABLE table_name ENABLE UNIQUE(column1,column2,..);

**Example:** Assume that **Person(Fname, Lname, Address,Phone)** table is already created with **(Fname,LName)** as Primary Key with constraint name FLName_PKey **and** Unique constraint on Phone with constraint name – **'PHONE_UNQ'.**

**Enable the PHONE_UNQ Constraint.**

ALTER TABLE **Person CONSTRAINT ENABLE** PHONE_UNQ; **or**

ALTER TABLE **Person ENABLE UNIQUE(Phone);**

**Enable Primary key**

ALTER TABLE **Person ENABLE** PRIMARY KEY;

# INSERT

**Inserts a new record at the end of given table.**

**Syntax**-

INSERT INTO table_name VALUES (value1,value2,….)

**Example:** Insert a record to a table **Course(Course_id,title,Dept_Name,Credits)**

**insert into** *course*

**values** (’CS-437’, ’Database Systems’, ’Comp. Sci.’, 4);

There will be **1 to 1 mapping** between values given and order in which columns are created in relation Course.

1st value ‘CS-437’ is mapped to column Course_id,

2nd value ‘Database Systems’ is mapped to column title and so on.

# ..INSERT

## Inserting values to fewer columns

**Syntax**-

INSERT INTO table_name(column1,column2,..) VALUES (value1,value2,….)

**Example:** Insert a record into Course table having values to Course_id, Dept_Name columns only. **Course(Course_id,title,Dept_Name,Credits)**

**insert into** *course* (*course_id,dept_name*) **values** (’CS-438’, ’Comp. Sci.’);

It is **equivalent** to –

**insert into** *course* **values** (’CS-438’, NULL, ’Comp. Sci.’, NULL);

**Note: NULL is not same as ‘NULL’**

# ..INSERT (date value)

**Example:** Assume we have a table **STUD** (Rno, Name, Birth_Date)

**Insert a record into STUD table.**

INSERT INTO Stud VALUES(19011102, 'Ajay', **TO_DATE('21-09-2001','DD-MM-YYYY')**);

**TO_DATE ()** is a oracle inbuilt function, which converts given date value (in the form character value) into date type.
More details about formats we will discuss latter.

Date has a default format set.
**Default format** is : **DD-MON-YY** , then you can enter data as below without TO_DATE()
**Example:**

INSERT INTO Stud VALUES(19011103, 'Aman', '21-OCT-2001');

# Insert into… Select .. From…

- Some time instead of giving data for every tuple in the INSERT INTO command, we can insert tuples on the basis of the result of a query.
- Using **SELECT statement as sub query** in the INSERT INTO, we can select (copy) some set of records from a relation(source) and insert into another relation(Destination).
- Note that we **need to take care of datatype** and **size compatibility**.

**STUD**

| Rollno | Name | Course | Dept |
|---|---|---|---|
| 101 | Ajit | Algorithms | CS |
| 102 | Ravi | IoT | IT |
| 103 | Anish | Algorithms | MCA |
| 101 | Ram | ML | MCA |

**MARKS**

| Rno | Course | Marks | Attendance |
|---|---|---|---|
| | | | |
| | | | |

**Example:** Insert Rollno and course information of students enrolled to MCA department into MARKS relation.

INSERT INTO MARKS(RNo, Course) **SELECT Rollno, Course FROM STUD WHERE Dept='MCA';**

# ..INSERT

## Inserting multiple records

**Syntax-**

**INSERT INTO** table1(column1,column2,..) **SELECT** column1,column2,.. **FROM** table2;

- **Example:** Consider the tables **Student(Id, Name, D_name, tot_cred)** and Instructor(Id, Name, Dept_name, Salary). Add all instructors to the *student* relation with tot_creds set to 0

```
insert into student
    select ID, name, dept_name, 0
      from   instructor;
```

***OR***

```
insert into student(ID,name,D_name)
        select ID, name, dept_name
          from   instructor;
```

The **select from where** statement is evaluated fully before any of its results are inserted into the relation

# UPDATE

To modify any column/s value in a already existing record.

Syntax:

**UPDATE** table_name **SET** column1=value1,column2=value2,…

**WHERE** *condition involving any of column/s in the table* ;

**Example:** Consider the table Instructor(Id, Name, Dept_name, Salary). Increase the salary of instructor with ID I201 by 10%.

**UPDATE** Instructor **SET** Salary=Salary+Salary*0.1 **WHERE** Id='I201';

# ..UPDATE

- **Example:** Consider the table **Instructor(**Id, Name, Dept_name, Salary**).** Increase salaries of instructors whose salary is over **$**100,000 by 3%, and all others receive a 5% raise
  - Write two update statements:

```
UPDATE instructor
   SET salary = salary * 1.03
   WHERE salary > 100000;

UPDATE instructor
    SET salary = salary * 1.05
    WHERE salary <= 100000;
```

  - The **order is important**

# ..UPDATE –using CASE

- Same query(previous slide) as before but with case statement

```
UPDATE instructor
    SET salary = CASE
                    WHEN salary <= 100000 THEN salary * 1.05
                    ELSE salary * 1.03
                 END;
```

**Assume the table Emp(Empno, ename, deptnosal)**

```
UPDATE emp SET sal=CASE
        WHEN sal<=3000 THEN sal*1.1
        WHEN sal<=5000 THEN sal*1.05
        ELSE sal*1
        END;
```

# DELETE

**Syntax:**

DELETE FROM table_name WHERE condition;

Example:

- Delete all instructors

  **delete from** *instructor*

- Delete all instructors from the Finance department

  **delete from** *instructor*
  **where** *dept_name*= ’Finance’;

# ..DELETE

**Syntax:**

DELETE FROM table_name WHERE condition;

**Note-** Condition is involving some sub-query

Example:

- Delete all tuples in the *instructor* relation for those instructors associated with a department located in the '**Watson**' building.

```
Delete from instructor
 where dept_name in (select dept_name
                     from department
                     where building = 'Watson');
```

# END

```
SQL> select * from emp;

EMPNO DEP ENAME          SAL DOB       JOB
----- --- --------- ------- --------- ----------
  100 D1  RAJ         75000 10-FEB-19
  101 D2  MAHESH      80000 15-FEB-20
  102 D3  RAVI        89000 12-DEC-19
  103 D1  TOM         78000 12-JAN-19
  104 D2  JAMES      100000
```

```
SQL> select * from dept;

DNO DNAME      LOCATION
--- ---------- ---------
D1  RESEARCH   MNG
D2  SALES      BNG
D3  ACCOUNTS   HYD
```

**CREATE VIEW emp_view(ENO,NAME,DATE_OF_BIRTH) AS SELECT empno, ename, dob FROM emp;**

```
SQL> create view emp_view(ENO,NAME,DATE_OF_BIRTH) as select empno,enam

View created.

SQL> select * from emp_view;

       ENO NAME       DATE_OF_B
---------- ---------- ---------
       100 RAJ        10-FEB-19
       101 MAHESH     15-FEB-20
       102 RAVI       12-DEC-19
       103 TOM        12-JAN-19
       104 JAMES
```

```
SQL> select * from emp;

EMPNO DEP ENAME          SAL DOB       JOB
----- --- --------- ------- --------- ----
  100 D1  RAJ         75000 10-FEB-19
  101 D2  MAHESH      80000 15-FEB-20
  102 D3  RAVI        89000 12-DEC-19
  103 D1  TOM         78000 12-JAN-19
  104 D2  JAMES      100000
  105     VIJAY             01-OCT-21

6 rows selected.
```

```
SQL> INSERT INTO emp_view VALUES(105,'VIJAY','01-OCT-2021');

1 row created.
```

# Sample Tables

| EMP- DEPTNO Foreign Key | | |
|---|---|---|
| EMPNO | NAME | DEPTNO |
| 100 | Raj | D1 |
| 101 | Krishna | D2 |
| 102 | Manoj | D1 |
| 103 | Ravi | D3 |
| 104 | Shriivas | |

| DEPARTMENT - DNO Primary Key | | |
|---|---|---|
| DNO | NAME | BUDGET |
| D1 | MCA | 128999 |
| D2 | CompSc | 124456 |
| D3 | Mech | 123562 |
| | | |
| | | |