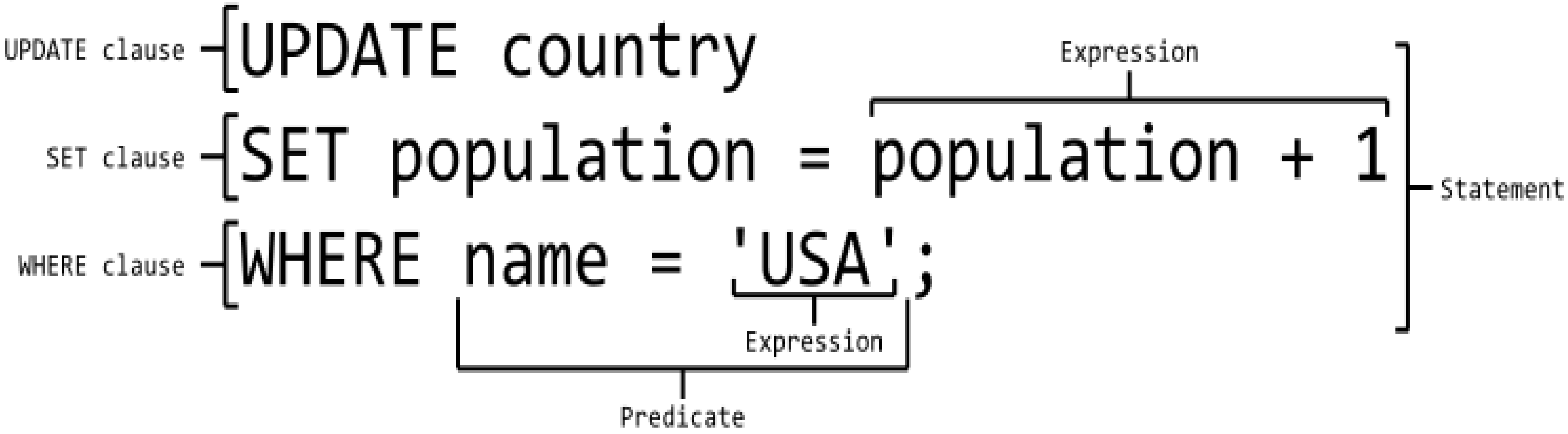
Unit 3

Structured Query Language

Overview of SQL Query Language

- IBM developed the original version of SQL, originally SEQUEL in 1970s
- The sequel language has evolved since then and the name changed as SQL and has established itself as the standard relational database language
- In 1986, the ANSI and ISO published an SQL standard called SQL-86
- Recently SQL:2008
- **SQL** (**Structured Query Language**) is a special – purpose programming language designed for managing data held in a relational database management system(RDBMS), or for stream processing in a relational data stream management system(RDSMS).

SQL Language Elements



```
UPDATE country
SET population = population + 1
WHERE name = 'USA';
```

- 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).** 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).** 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);**

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

Example: **Name** Char(10)

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 (p=1 to 38,s= 84 to 127)

Example:	**Marks** Number(3)	**fixed point**
	Salary Number(9,2)	**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” **Example:** Birth_date Date

4. Interval Year To Month : Stores a period of time using the YEAR and MONTH date time fields **Example:** year_of_experience INTERVAL YEAR TO MONTH

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 **Example:** blob_data 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 CONSTRAINTS

- 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 CONSTRAINTS

- **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 for the table Instructor we want to make user to enter some values for name

```
create table instructor (
                ID          char(5),
                name        varchar(20) NOT NULL ,  dept_name  varchar(20),
                salary      numeric(8,2) );
```

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.

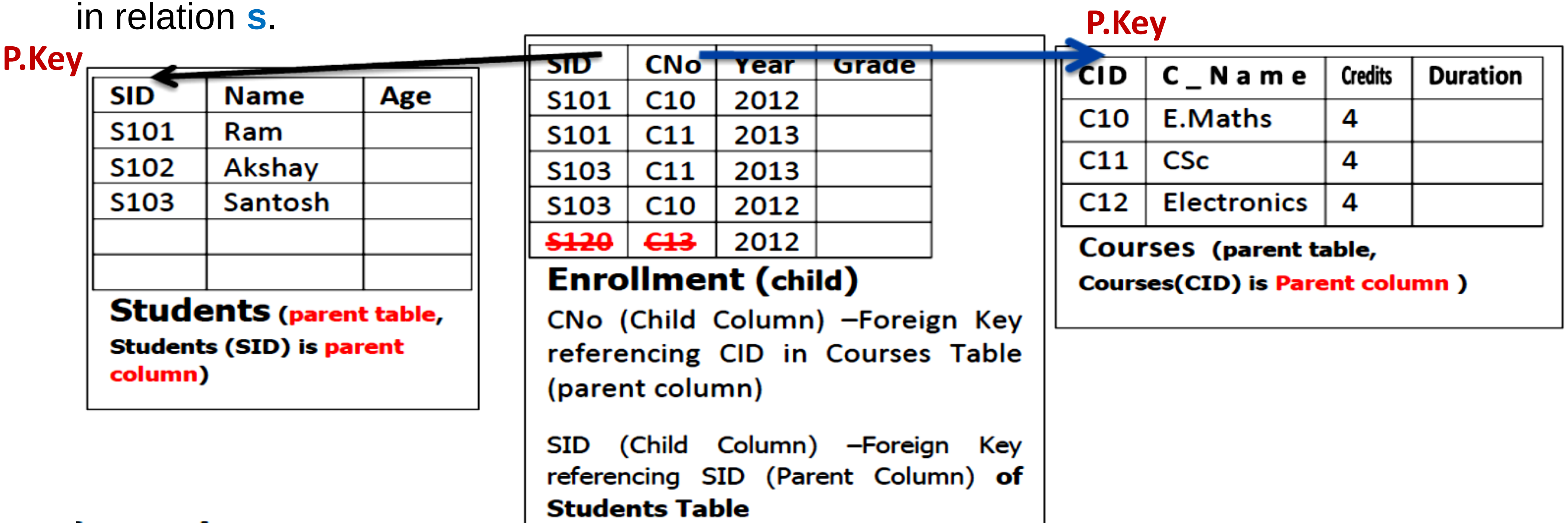
```
CREATE TABLE Enrollment
(SID char(9) NOT NULL,
CNO varchar2(7) NOT NULL,
Year number(2) NOT NULL,
Grade char(2),
PRIMARY KEY (SID, CNO, Year));
```

Note: primary key defined after defining all the columns

Note: **NO component** of primary key can be **NULL**

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**.



P.Key

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**

P.Key

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

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

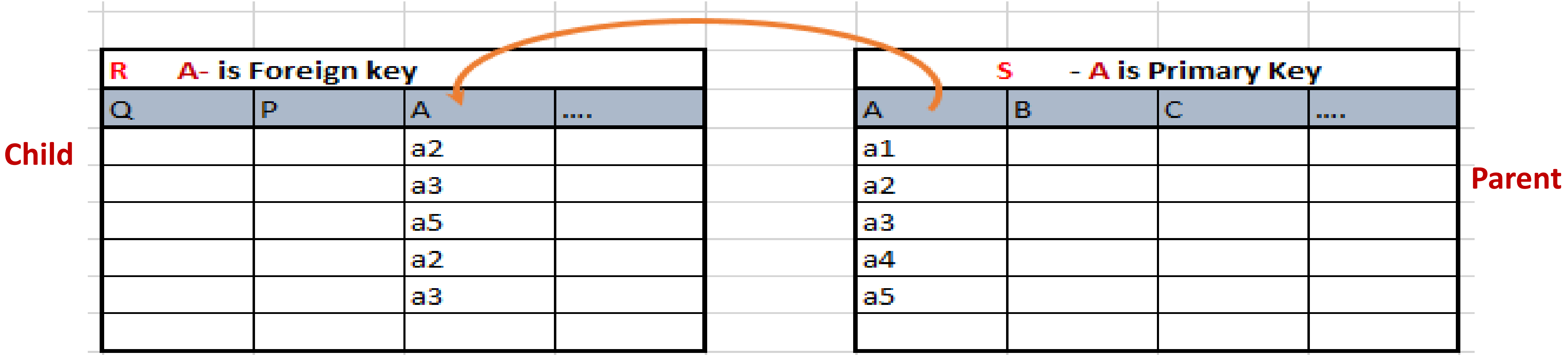
Enrollment can be done to only to those who are student, therefore **SID** column in **Enrollment** can have only values which are present in **SID** in **Student** table.

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**.



Child

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			

Parent

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

- **Properties:**
  - A **Foreign key** can contain-
    - Only values present in the corresponding Parent Column/s.
    - **NULL** values accepted, if 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.

..FOREIGN KEY column-level

- **Example:**
- We have to create both **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),**

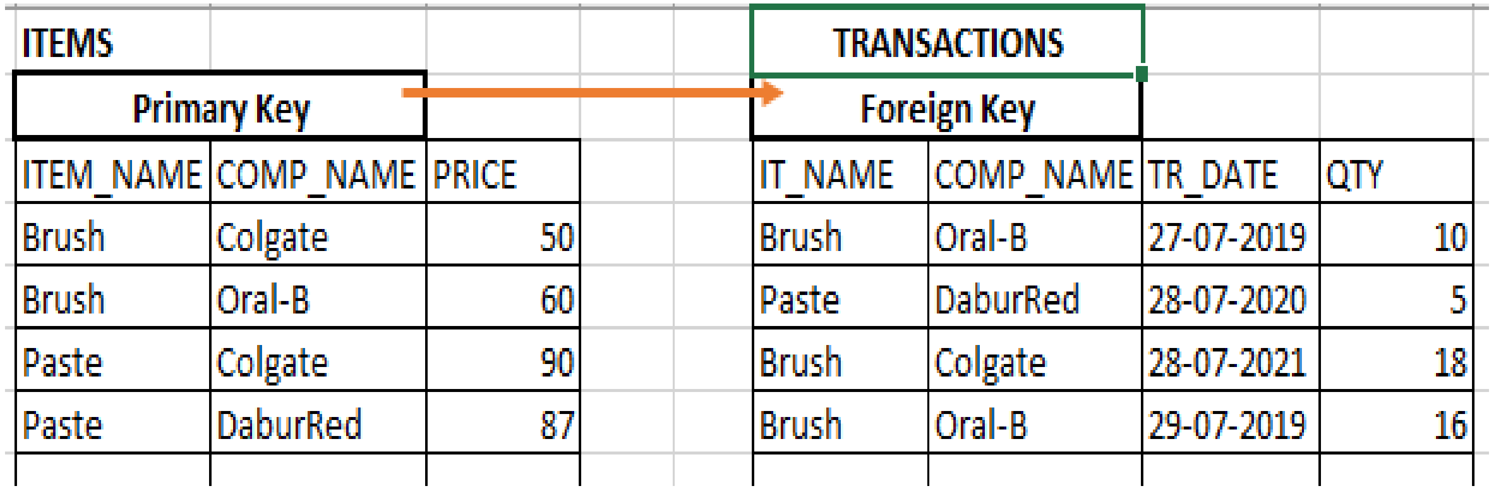
    Year number (2) **not null,**

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

Why- Courses(CID)?

..FOREIGN KEY table-level

- **Example:**



ITEMS

Primary Key		
ITEM_NAME	COMP_NAME	PRICE
Brush	Colgate	50
Brush	Oral-B	60
Paste	Colgate	90
Paste	DaburRed	87

TRANSACTIONS

Foreign Key			
IT_NAME	COMP_NAME	TR_DATE	QTY
Brush	Oral-B	27-07-2019	10
Paste	DaburRed	28-07-2020	5
Brush	Colgate	28-07-2021	18
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**)**;

Does the following table get created with Foreign key constraint?

- Create table DEPT (Dno Varchar2(3) ,Dname varchar2(10));

- Create table EMP(Empno Number(3) Primary key, Name varchar2(10), Deptno varchar2(3) References Dept);

ERROR: referenced table does not have a primary key

Does the following table get created with Foreign key constraint?

- Create table DEPT (Dno Varchar2(3) UNIQUE ,Dname varchar2(10));

- Create table EMP(Empno Number(3) Primary key, Name varchar2(10), Deptno varchar2(3) References Dept);

No: referenced table has a unique key so it has to be refered during foreign key definition

Write the SQL commands to create following tables with mentioned constraints

*Assume that one student stays in one particular room of one particular Hostel only.

Student

Column	DataType	Constraint
RegNo	Number	Primary key
Name	Varchar	
Phone	Number	Unique

Hostel

Column	DataType	Constraint
Hostel_No	Varchar	Primary Key
Room_No	Number	Primary Key
RegNum		Foreign Key

```
Create table Student( RegNo Number(3) PRIMARY KEY, Name  Varchar2(10),Phone Number(10) UNIQUE);

Create table Hostel (Hostel_no Varchar2(5), Room_no Number(3), Reg_no Number(3) REFERENCES Student, PRIMARY KEY( Hostel_no, Room_no));
```

Restrictions on INSERT / UPDATE / DELETE Operations Over Foreign Key

Any INSERT / UPDATE / DELETE of Records , ALTER or DROP Operation that Violates any of the Foreign key properties is restricted and hence the operation is Rejected by the Database System.

..INSERT

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

Note: NULL is not same as ‘NULL’

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’;
```

DELETE

Syntax:

DELETE FROM table_name WHERE condition;

Example:

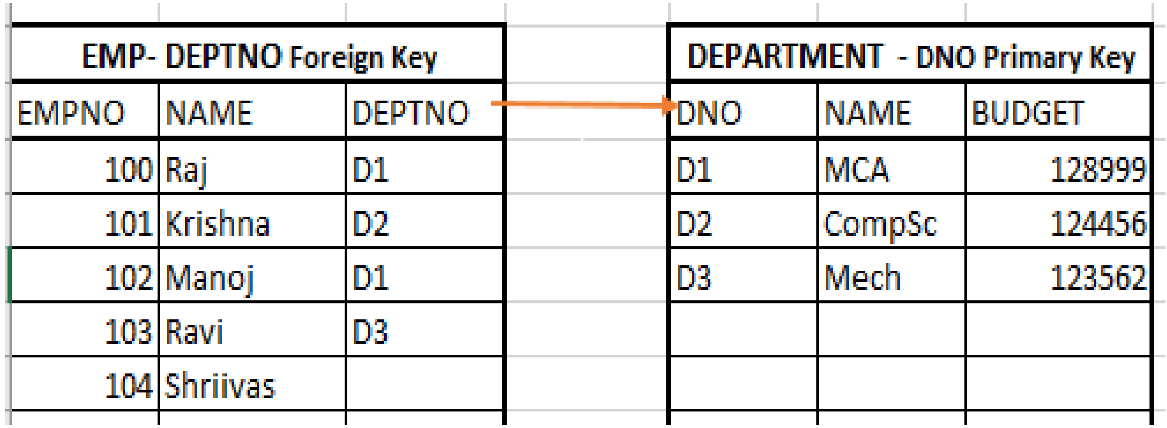
- Delete all instructors

  delete from *instructor*

- Delete all instructors from the Finance department

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

..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’**);

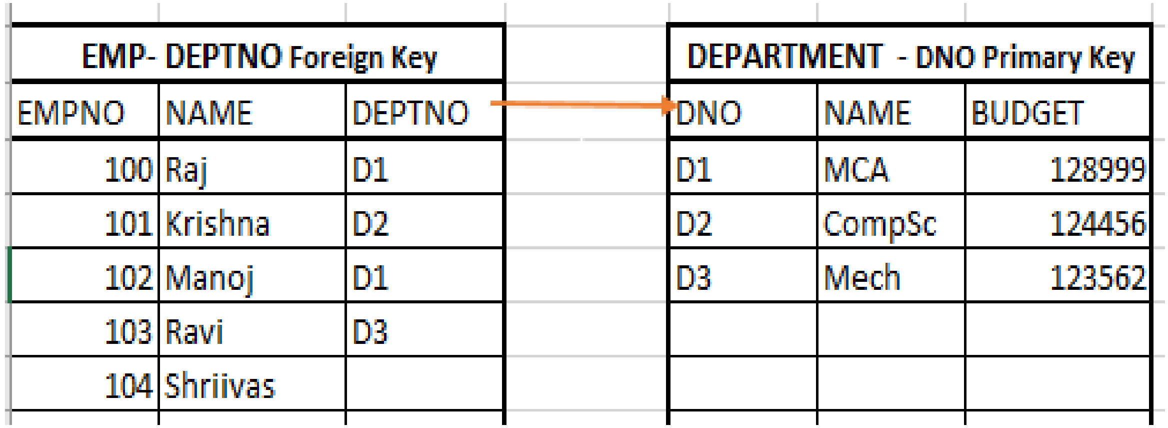
  Is rejected, to execute above INSERT command, execute in following Order

- INSERT INTO DEPT VALUES(‘D4’,’Physics’,125678);

  Note-Parent record is added to DEPARTMENT and now we can add Employee with D4 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 29 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

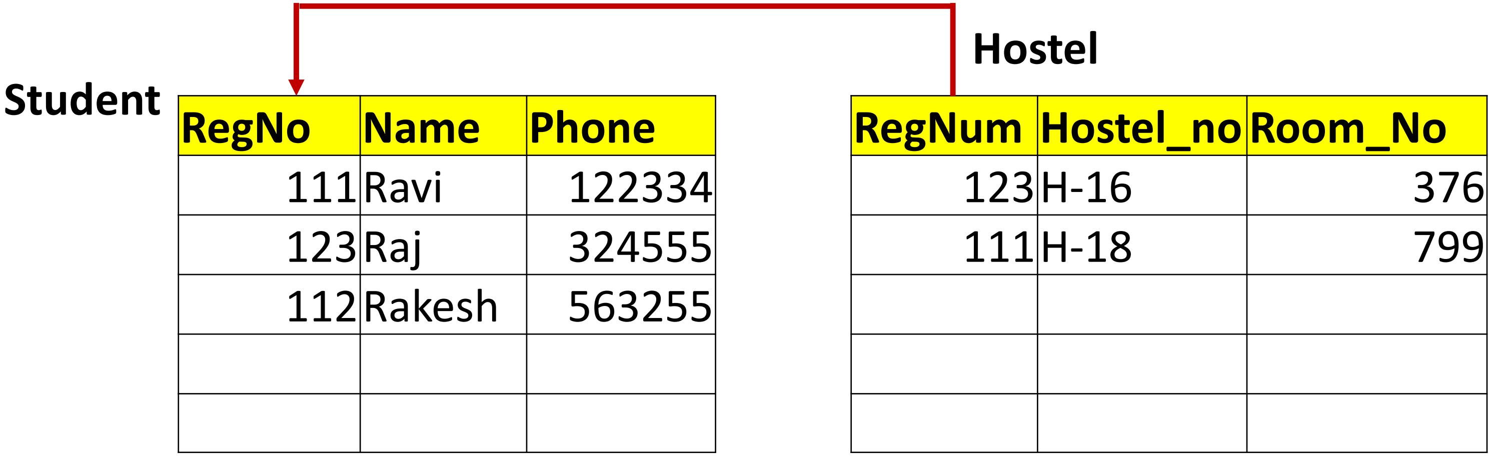
- A foreign key with "**ON DELETE SET NULL** " means that if a record in the parent table is deleted, then the corresponding records in the child table will have the **foreign key fields set to null**. The records in the child table will **not** be deleted.
- **Example:** Create tables give in slide 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.

Exercise

Note: RegNo-P.key ;
(Hostel_No,Room_No)- P.Key
RegNum- F.Key



Student

RegNo	Name	Phone
111	Ravi	122334
123	Raj	324555
112	Rakesh	563255

Hostel

RegNum	Hostel_no	Room_No
123	H-16	376
111	H-18	799

What is the result of execution of following SQL statements?

INSERT INTO Student VALUES(115,’Ajay’,567899);	INSERTED
INSERT INTO Student VALUES(112,’Sridhar’,89979);	NOT-INSERTED
INSERT INTO Hostel VALUES(112,’H-16’,376);	NOT INSERTED
INSERT INTO Hostel VALUES(113,’H-17’,234);	NOT-INSERTED
INSERT INTO Hostel VALUES(115,’H-18’,376);	INSERTED

Exercise

Note: RegNo-P.key ;
(Hostel_No,Room_No)- P.Key
RegNum- F.Key

Student

RegNo	Name	Phone
111	Ravi	122334
123	Raj	324555
112	Rakesh	563255
115	Ajay	567899

Hostel

RegNum	Hostel_no	Room_No
123	H-16	376
111	H-18	799
115	H-18	376

What is the result of execution of following SQL statements?

UPDATE Student SET Regno=113 WHERE Regno=112; UPDATED

UPDATE Student SET Regno=222 WHERE Regno=123; NOT-UPDATED

UPDATE Hostel SET RegNum=113 WHERE RegNum=123; UPDATED

UPDATE Hostel SET RegNum=null WHERE RegNum=111; UPDATED

UPDATE Hostel SET RegNum=118 WHERE RegNum=111; NOT-UPDATED

Exercise

Note: RegNo-P.key ;
(Hostel_No,Room_No)- P.Key
RegNum- F.Key

Student

RegNo	Name	Phone
111	Ravi	122334
123	Raj	324555
112	Rakesh	563255
115	Ajay	567899

Hostel

RegNum	Hostel_no	Room_No
123	H-16	376
111	H-18	799
115	H-18	376

What is the result of execution of following SQL statements?

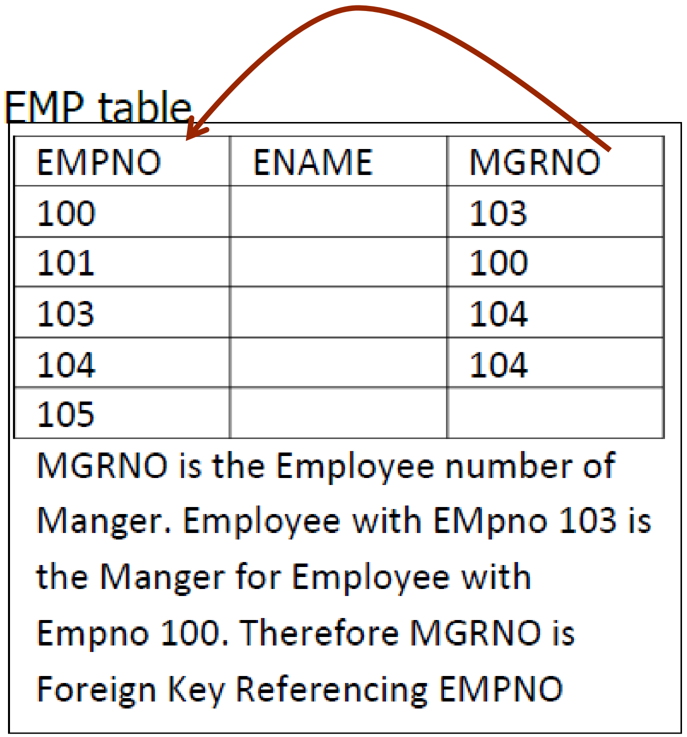
DELETE FROM Student WHERE Regno=112; DELETED

DELETE FROM Student WHERE Regno=123; NOT-DELETED

DELETE FROM Hostel WHERE Regnum=123; DELETED

DELETE FROM Student WHERE Regno=123; DELETED

..FOREIGN KEY - Recursive Relationship



EMP table

EMPNO	ENAME	MGRNO
100		103
101		100
103		104
104		104
105		

MGRNO is the Employee number of Manger. Employee with EMpno 103 is the Manger for Employee with Empno 100. Therefore MGRNO is Foreign Key Referencing EMPNO

Example:

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

Note: Referential Integrity constraint on MGRNO 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);

Exercise

Create a table **Student** (Regno, Name, Class_Representative)

Where RegNo is Primary key and Class_Representative is RegNo of students who are Class Representatives. Assume proper data type and size.

```
CREATE TABLE Student(Regno Number(3) PRIMARY KEY, Name Varchar2(10),
Class_Representative Number(3) References Student);
```

Inserting Data into Student table having Recursive relationship

CREATE TABLE Student(Regno Number(3) PRIMARY KEY, Name Varchar2(10), Class_Representative Number(3) References Student);

- INSERT INTO Student VALUES(123,'AAAA’,122);

Error

ORA-02291: integrity constraint (MCA2020.SYS_C007551) violated - parent key not

- INSERT INTO Student VALUES (123,'AAAA',NULL);
- INSERT INTO Student VALUES(122,'AAAA',NULL);
- UPDATE Student SET Class_Representative=122 WHERE Regno= 123;

OR

INSERT INTO Student VALUES(122,'AAAA',NULL); followed by INSERT INTO Student VALUES (123,'AAAA’,122);

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.

Exercise UNIQUE…

Answer the validity of following statements with respect UNIQUE constraint on ID column-

INSERT INTO Student VALUES(123,’Vinay’,7799889788,54) ; YES/~~NO~~

INSERT INTO Student VALUES(123,’Vinay’,7799889788,54); ~~YES~~/NO

INSERT INTO Student VALUES (NULL,’Vinay’,7799999788,54); ~~YE~~S/NO

INSERT INTO Student VALUES (124,’Raj’,NULL,54); YES/~~NO~~

..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 ) );
```

Exercise

Create a table **Customer**(Cust_id, Name, Phone, Email, Policy_No) Cust_id, Phone, Email & Policy_No contains unique values and assume Cust_id as Primary key. Also make Phone number mandatory.

Assume proper data type and size

```
CREATE TABLE Customer(Cust_id Varchar2(5) PRIMARY KEY ,
Name Varchar2(10), Phone  Varchar2(10) UNIQUE  NOT NULL,
Email Varchar2(20) UNIQUE , Policy_No Varchar2(10) UNIQUE );
```

The CHECK clause – Using IN

- **check (P)**

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

Example: Ensure that Type of Courses offered by a department is any one of MCA, MTech, BTech, MS.

```
CREATE TABLE Department (
    Department_name varchar2 (8) PRIMARY KEY,
    Course_Type varchar2 (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' } , evaluates to TRUE or FALSE

..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        varchar2(20),
                    dept_name   varchar2(20),
                    salary      number(8,2) CHECK( Salary>=50000 AND Salary<=200000)
                );
```

-
```
CREATE TABLE instructor (
                    ID          char(5),
                    name        varchar2(20),
                    dept_name   varchar2(20),
                    salary      number(8,2) CHECK( Salary BETWEEN 50000 AND 200000) );
```

..The check clause - using LIKE (Pattern Matching)

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 CANDIDATES(CandtId varchar2(7) PRIMARY KEY **CHECK (CandtId LIKE 'MIT%')**, Name varchar2(10),Branch varchar2(10));

- INSERT INTO CANDIDATES VALUES('**MIT1020**', 'Raghu', 'CompSc’); Accepted
- INSERT INTO CANDIDATES VALUES('**MIIT1021**', 'Ram', 'CompSc’); Rejected

Wild characters-

% any number of characters

_ (underscore) Single character

..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 CANDIDATES**(** CandtId varchar2(7) PRIMARY KEY CHECK (CandtId LIKE 'MIT%'), Name varchar(10),Branch varchar(10) **CHECK(Branch=UPPER(Branch)))**;
- **Is this Insert command executed successful?**
- INSERT INTO CANDIDATES VALUES('**MIT1021**', 'Raghu', 'COMP.SC');
- If user enters Branch as –'Comp.Sc' , it is **rejected** with constraint error message.

* We will see other inbuilt functions later

Exercise

Create a table **Student**(Regno,Name,Mark1,Mark2), Regno is primary key and Mark1 must accept values in the range 0 to 100 , Mark2 must accept values in the range 0 to 150.

```
CREATE  TABLE Student(Regno Number(9) PRIMARY KEY , Name Varchar2(10), Mark1
Number(3) CHECK (Mark1>=0 AND Mark1<=100),Mark2 Number(3) CHECK( Mark2
BETWEEN 0 AND 150 ));
```

What is the result of following insert command ?

```
INSERT INTO Student VALUES (100, ‘Raghu’,99, 159)
```

Error - ORA-02290: check constraint (SYSTEM.SYS_C007566) violated

Exercise

Create a table **Student**(Regno, Name, Grade), Regno is primary key and Grade must accept only values- A+,A,B,C,D,E,F

```
CREATE  TABLE Student(Regno Number(9) PRIMARY KEY , Name
Varchar2(10), Grade Char(2) CHECK ( Grade IN ('A+','A','B','C','D','E','F'))) ;
```

What is the result of following insert command ?

```
INSERT INTO Student VALUES(100, 'Raghu', 'B+')
```

Error - ORA-02290: check constraint (SYSTEM.SYS_C007563) violated

Exercise

Create a table **Course_Structure**(Subject_id, Sub_Name, Credits, Sem), Subject_id is primary key and Subject Id must start with MCA. Credit values must be 1 ,2,3,4. E.g. MCA4151, MCA5151 etc.

```
CREATE  TABLE Course_Structure (Subject_id Varchar2(10) PRIMARY KEY
CHECK(Subject_id LIKE 'MCA%'), Sub_name Varchar2(20), Credits Number(1)
CHECK ( Credits IN (1,2,3,4))) ;
```

What is the result of following insert command ?

```
        INSERT INTO Course_structure VALUES('MCa100', 'DBMS', 4)
```

Error - ORA-02290: check constraint (SYSTEM.SYS_C007557) violated

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' );
```

Example:

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

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

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 CREATE or ALTER table.
- Create following tables with constraint names.

Department

Attribute	**Constraint**	**Constr_Name**
Dname	PRIMARY KEY	Dname_PK
	Refers Organization	fk_Orga
Course_Type	Check	Chk_Type
Numb_of_Sem		
In_take_stud		
Dep_Phone	Not Null	NoNul
	Unique	Unq_Ph

Organization

Attribute	**Constraint**	**Constr_Name**
Dept_name	Primary Key	dp_PK
Head		

Example

- CREATE TABLE Organization(Dept_name varchar2(8) CONSTRAINT dp_PK **PRIMARY KEY**, Head varchar2(10));

- CREATE TABLE Department (Dname varchar2(8) CONSTRAINT Dname_PK **PRIMARY KEY** CONSTRAINT fk_Orga **REFERENCES Organization**, Course_Type varchar2(8) CONSTRAINT Chk_Type **CHECK(Course_Type IN('MCA','MTech ', 'BTech', 'MS'))**, Numb_of_Sem Number(1), In_take_stud Number(2), Dep_Phone Number(10) CONSTRAINT noNul **NOT NULL** CONSTRAINT Unq_Ph **UNIQUE**);

Exercise

Create a table **Course_Structure**(Subject_id, Sub_Name, Credits, Sem), Subject_id is primary key and Subject Id must start with MCA. Credit values must be 1 ,2,3,4. E.g. MCA4151, MCA5151 etc. **Assign proper constraint names**.

```
CREATE  TABLE Course_Structure (Subject_id Varchar2(10) CONSTRAINT SubID_PK PRIMARY
KEY CONSTRAINT Starts_MCA CHECK(Subject_id LIKE 'MCA%’), Sub_name Varchar2(20),
Credits Number(1) CONSTRAINT Credt_Range CHECK ( Credits IN (1,2,3,4))) ;
```

What is the result of following insert command ?

```
INSERT INTO Course_structure VALUES('MCa100', 'DBMS', 4);
```

Error - ORA-02290: check constraint (SYSTEM.STARTS_MCA) violated

Exercise

Create following tables(DEPT & EMP) with given constraint names.

DEPT

Attribute	Data Type	Size	Constraints	Constraint Name
DNO	VARCHAR2	2	PRIMARY KEY	
DNAME	VARCHAR2	10		
HEAD_OFFC_CITY	VARCHAR2	10	UDP,BNG,HYD,MUB,LA	Valid_offc_city

EMP

Attribute	Data Type	Size	Constraints	Constraint Name
EMPNO	NUMBER	3	PRIMARY KEY	PK_Empno
ENAME	VARCHAR2	10		
MGRNO	NUMBER	3	References EMP(EMPNO)	FK_MgrNo_EMP
DEPTNO	VARCHAR2	2	References DEPT(DNO)	FK_Deptno_DEPT
DOB	DATE			
DOJ	DATE		DOJ>DOB	DOJ_Grtr_DOB
SAL	NUMBER	7,2	SAL>30000	SAL_Grtr_30K

CREATE TABLE … AS SELECT…

The **CREATE TABLE** … **AS SELECT…** statement is used to create a new table having same/partial structure of an existing table given with SELECT statement.

EMP_SPOUSE

Attribute	DataType	Size
EMPNO	NUMBER	3
ENAME	VARCHAR2	10
SPOUSE_NAME	VARCHAR2	10

We can create EMP_SPOUSE table by copying structure for EMPNO and ENAME from EMP table.

EMP

Attribute	Data Type	Size	Constraints	Constraint Name
EMPNO	NUMBER	3	PRIMARY KEY	PK_Empno
ENAME	VARCHAR2	10		
MGRNO	NUMBER	3	References EMP(EMPNO)	FK_MgrNo_EMP
DEPTNO	VARCHAR2	2	References DEPT(DNO)	FK_Deptno_DEPT
DOB	DATE			
DOJ	DATE		DOJ>DOB	DOJ_Grtr_DOB
SAL	NUMBER	7,2	SAL>30000	SAL_Grtr_30K

CREATE TABLE … AS SELECT…

CREATE TABLE EMP_SPOUSE(ENO,NAME) **AS SELECT** EMPNO,ENAME FROM EMP;

ALTER TABLE EMP_SPOUSE **ADD**(Spouse_name Varchar2(10));

EMP_SPOUSE

Attribute	DataType	Size
ENO	NUMBER	3
NAME	VARCHAR2	10
SPOUSE_NAME	VARCHAR2	10

EXAMPLE: Create a table EMP_SPOUSE using already existing EMP table

***More about ALTER TABLE we will see in coming slides**

EMP

Attribute	Data Type	Size	Constraints	Constraint Name
EMPNO	NUMBER	3	PRIMARY KEY	PK_Empno
ENAME	VARCHAR2	10		
MGRNO	NUMBER	3	References EMP(EMPNO)	FK_MgrNo_EMP
DEPTNO	VARCHAR2	2	References DEPT(DNO)	FK_Deptno_DEPT
DOB	DATE			
DOJ	DATE		DOJ>DOB	DOJ_Grtr_DOB
SAL	NUMBER	7,2	SAL>30000	SAL_Grtr_30K

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(already existing).

```
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: Increase the size of Salary column & modify Name column definition by adding NOT NULL rule

```
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 column_name;
```

Example: Drop a column EName from Emp table.

```
ALTER TABLE Emp  DROP  COLUMN EName;
```

..Alter Table Constructs

RENAME a Table

Syntax:

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

Example: Rename the table Emp as Employee

```
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 Students
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( column1,column2,..columnn ) );
```

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;
```

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

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 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

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

..INSERT (date value)

Example: Assume 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.

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

```
INSERT INTO Stud VALUES(19011103, ‘Aman’, ‘21-OCT-2001’);
```

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<=30000 then sal*1.1
        when sal<=50000 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’);
```

..DELETE

Example:

Delete all instructors whose salary is less than the average salary of instructors

```
delete from instructor
       where salary< (select avg (salary) from instructor);
```

- Problem: as we delete tuples from deposit, the average salary changes
- Solution used in SQL:
  1. First, compute **avg** salary and find all tuples to delete
  2. Next, delete all tuples found above (without recomputing **avg** or retesting the tuples)

END