LAB # 7: DDL AND DML

Objective:

In this lesson, you learn how to use the data manipulation language (DML) statements to insert rows into a table, update existing rows in a table, and delete existing rows from a table. You also learn how to control transactions with the COMMIT, SAVEPOINT, and ROLLBACK statements.

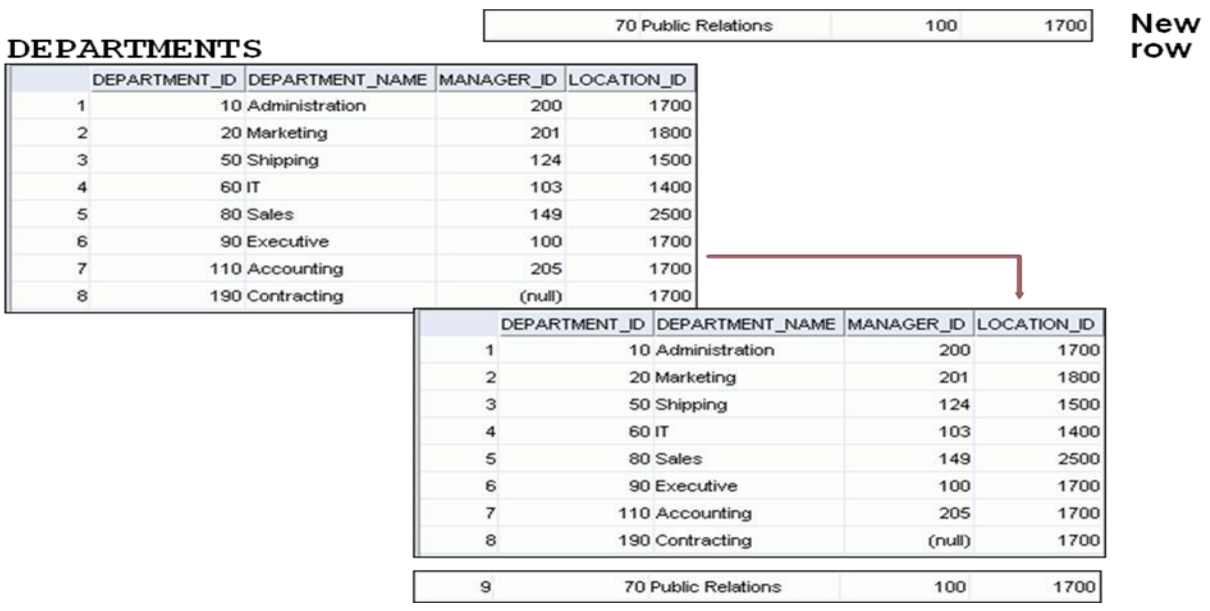
Data Manipulation Language

Data manipulation language (DML) is a core part of SQL. When you want to add, update, or delete data in the database, you execute a DML statement. A collection of DML statements that form a logical unit of work is called a *transaction*.

Consider a banking database. When a bank customer transfers money from a savings account to a checking account, the transaction might consist of three separate operations: decreasing the savings account, increasing the checking account, and recording the transaction in the transaction journal. The database server must guarantee that all the three SQL statements are performed to maintain the accounts in proper balance. When something prevents one of the statements in the transaction from executing, the other statements of the transaction must be undone.

Adding a New Row to a Table

The graphic in the following example illustrates the addition of a new department to the DEPARTMENTS table


New row
DEPARTMENTS

70	Public Relations	100	1700

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700
9	70	Public Relations	100	1700

INSERT Statement Syntax

You can add new rows to a table by issuing the INSERT statement.

Syntax:

```
INSERT INTO   table [(column [, column...])]
VALUES        (value [, value...]);
```

In the syntax:

table	is the name of the table
column	is the name of the column in the table to populate
value	is the corresponding value for the column

Because you can insert a new row that contains values for each column, the column list is not required in the INSERT clause. However, if you do not use the column list, the values must be listed according to the default order of the columns in the table, and a value must be provided for each column.

Example 1:

INSERT INTO departments

VALUES (70, 'Public Relations', 100, 1700);

Output:

```
1 rows inserted
```

For clarity, use the column list in the INSERT clause. Enclose character and date values within single quotation marks; however, it is not recommended that you enclose numeric values within single quotation marks.

Inserting Rows with Null Values

Be sure that you can use null values in the targeted column by verifying the Null status with the DESCRIBE command.

The Oracle server automatically enforces all data types, data ranges, and data integrity constraints. Any column that is not listed explicitly obtains a null value in the new row.

Common errors that can occur during user input are checked in the following order:

- Mandatory value missing for a NOT NULL column
- Duplicate value violating any unique or primary key constraint
- Any value violating a CHECK constraint
- Referential integrity maintained for foreign key constraint
- Data type mismatches or values too wide to fit in column

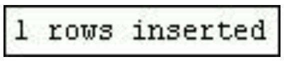
Implicit method:

Omit the column from the column list.

Example:

```
INSERT INTO   departments (department_id,  department_name)
VALUES         (30, 'Purchasing');
```

Output:



```
1 rows inserted
```

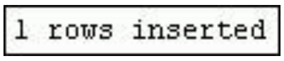
Explicit method:

Specify the NULL keyword in the VALUES clause.

Example:

```
INSERT INTO   departments
VALUES (100, 'Finance', NULL, NULL);
```

Output:



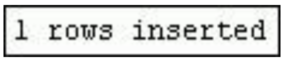
```
1 rows inserted
```

Inserting Special Values

You can use functions to enter special values in your table.

```
INSERT INTO employees (employee_id,
            first_name, last_name,
            email, phone_number,
            hire_date, job_id, salary,
            commission_pct, manager_id,
            department_id)
VALUES                  (113,
            'Louis', 'Popp',
            'LPOPP', '515.124.4567',
            SYSDATE, 'AC_ACCOUNT', 6900,
            NULL, 205, 110);
```

Output:



```
1 rows inserted
```

The above example records information for employee Popp in the EMPLOYEES table. It supplies the current date and time in the HIRE_DATE column. It uses the SYSDATE function that returns the current date and time of the database server. You may also use the CURRENT_DATE function to get the current date in the session time zone. You can also use the USER function when inserting rows in a table. The USER function records the current username.

Inserting Specific Date and Time Values

The DD-MON-RR format is generally used to insert a date value. With the RR format, the system provides the correct century automatically.

You may also supply the date value in the DD-MON-YYYY format. This is recommended because it clearly specifies the century and does not depend on the internal RR format logic of specifying the correct century.

If a date must be entered in a format other than the default format (for example, with another century or a specific time), you must use the TO_DATE function.

Example:

```
INSERT INTO employees
```

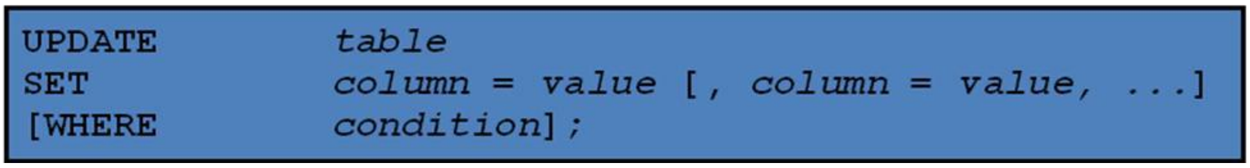
```
VALUES     (114,   'Den', 'Raphealy',  'DRAPHEAL', '515.127.4561',
           TO_DATE('FEB 3, 1999', 'MON DD, YYYY'),
           'SA_REP', 11000, 0.2, 100, 60);
```

The above example records information for employee Raphealy in the EMPLOYEES table. It sets the HIRE_DATE column to be February 3, 1999.

Changing Data in a Table

You can modify the existing values in a table by using the UPDATE statement.

Syntax:



```
UPDATE         table
SET            column = value [, column = value, ...]
[WHERE         condition];
```

In the syntax:

table	is the name of the table
column	is the name of the column in the table to populate
value	is the corresponding value or subquery for the column
condition	identifies the rows to be updated and is composed of column names, expressions, constants, subqueries, and comparison operators

Confirm the update operation by querying the table to display the updated rows.

Updating Rows in a Table

The UPDATE statement modifies the values of a specific row or rows if the WHERE clause is specified. The following example shows the transfer of employee 113 (Popp) to department 50.

Example:

```
UPDATE employees
SET    department_id = 50
WHERE  employee_id = 113;
```

Output:

```
1 rows updated
```

Values for all the rows in the table are modified if you omit the WHERE clause:

Example:

```
UPDATE         copy_emp
SET      department_id = 110;
```

Output:

```
22 rows updated
```

Specify SET *column_name*= NULL to update a column value to NULL.

Updating Two Columns with a Subquery

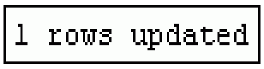
You can update multiple columns in the SET clause of an UPDATE statement by writing multiple subqueries. The syntax is as follows:

```
 UPDATE table
SET     column  = (SELECT  column
                           FROM table
                           WHERE condition)
     [ ,column  = (SELECT    column
                           FROM table
                           WHERE condition)]
[WHERE  condition ];
```

Example:

```
UPDATE   employees
SET     job_id  = (SELECT  job_id
             FROM    employees
             WHERE   employee_id = 205),
      salary  = (SELECT  salary
             FROM    employees
             WHERE   employee_id = 205)
WHERE    employee_id    =  113;
```

Output:



```
1 rows updated
```

Updating Rows Based on Another Table

You can use the subqueries in the UPDATE statements to update values in a table.

Example:

```
UPDATE  copy_emp
SET     department_id  =  (SELECT department_id
                  FROM employees
                  WHERE employee_id = 100)
WHERE   job_id        =  (SELECT job_id
                  FROM employees
                  WHERE employee_id = 200);
```

Output:

```
1 rows updated
```

The example in the slide updates the COPY_EMP table based on the values from the EMPLOYEES table. It changes the department number of all employees with employee 200‘s job ID to employee 100‘s current department number.

DELETE Statement Syntax

You can remove existing rows from a table by using the DELETE statement. The syntax is as follows:

```
DELETE  [FROM]   table
[WHERE           condition];
```

In the syntax:

table	is the name of the table
condition	identifies the rows to be deleted, and is composed of column names, expressions, constants, subqueries, and comparison operators

Note: If no rows are deleted, the message ―0 rows deleted‖ is returned.

Deleting Rows from a Table

You can delete specific rows by specifying the WHERE clause in the DELETE statement. The following example deletes the Accounting department from the DEPARTMENTS table. You can confirm the delete operation by displaying the deleted rows using the SELECT statement.

Example:

DELETE FROM departments

WHERE department_name = ‘Finance';

Output:

```
1 rows deleted
```

All rows in the table are deleted if you omit the WHERE clause:

Example:

DELETE FROM copy_emp;

Output:

```
1 rows updated
```

Example:

DELETE FROM departments WHERE department_id IN (30, 40);

Deleting Rows Based on Another Table

You can use the subqueries to delete rows from a table based on values from another table.

Example:

```
DELETE FROM employees
WHERE  department_id =
          (SELECT department_id
          FROM   departments
           WHERE  department_name
               LIKE '%Public%');
```

Output:

```
1 rows deleted
```

The above example deletes all the employees in a department, where the department name contains the string Public.

The subquery searches the DEPARTMENTS table to find the department number based on the department name containing the string Public. The subquery then feeds the department number to the main query, which deletes rows of data from the EMPLOYEES table based on this department number.

TRUNCATE Statement

A more efficient method of emptying a table is by using the TRUNCATE statement. You can use the TRUNCATE statement to quickly remove all rows from a table or cluster. Removing rows with the TRUNCATE statement is faster than removing them with the DELETE statement for the following reasons:

- The TRUNCATE statement is a data definition language (DDL) statement and generates no rollback information. Rollback information is covered later in this lesson.
- Truncating a table does not fire the delete triggers of the table.

If the table is the parent of a referential integrity constraint, you cannot truncate the table. You need to disable the constraint before issuing the TRUNCATE statement.

Syntax:

```
TRUNCATE TABLE table_name;
```

Example:

TRUNCATE TABLE copy_emp;

Database Transactions

Transactions give you more flexibility and control when changing data, and they ensure data consistency in the event of user process failure or system failure.

Transactions consist of DML statements that constitute one consistent change to the data. For example, a transfer of funds between two accounts should include the debit in one account and the credit to another account of the same amount. Both actions should either fail or succeed together; the credit should not be committed without the debit.

A transaction begins when the first DML statement is encountered and ends when one of the following occurs:

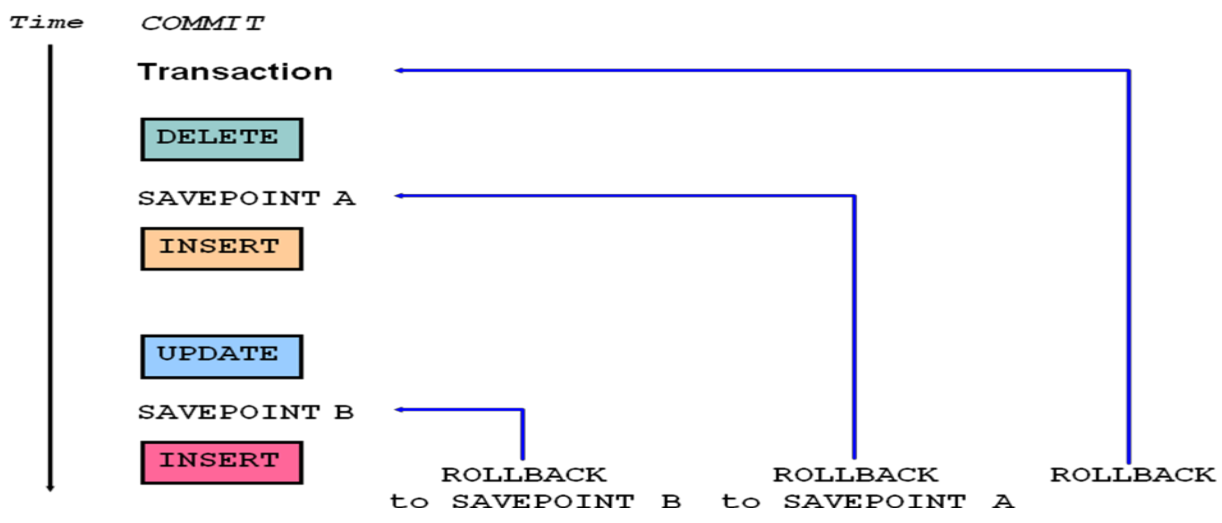
- A COMMIT or ROLLBACK statement is issued.
- A DDL statement, such as CREATE, is issued.
- A DCL statement is issued.
- The user exits SQL Developer or SQL*Plus.
- A machine fails or the system crashes.

After one transaction ends, the next executable SQL statement automatically starts the next transaction.

A DDL statement or a DCL statement is automatically committed and therefore implicitly ends a transaction.

Explicit Transaction Control Statements

You can control the logic of transactions by using the COMMIT, SAVEPOINT, and ROLLBACK statements.



Rolling Back Changes to a Marker

You can create a marker in the current transaction by using the SAVEPOINT statement, which divides the transaction into smaller sections. You can then discard pending changes up to that marker by using the ROLLBACK TO SAVEPOINT statement.

Example:

UPDATE...

SAVEPOINT update_done;

Output:

```
SAVEPOINT update_done succeeded.
```

Example:

INSERT...

ROLLBACK TO update_done;

Output:

```
ROLLBACK TO succeeded.
```

Implicit Transaction Processing

- An automatic commit occurs in the following circumstances:
  - A DDL statement is issued

– A DCL statement is issued
– Normal exit from SQL Developer or SQL*Plus, without explicitly issuing COMMIT or ROLLBACK statements

System Failures

When a transaction is interrupted by a system failure, the entire transaction is automatically rolled back. This prevents the error from causing unwanted changes to the data and returns the tables to the state at the time of the last commit. In this way, the Oracle server protects the integrity of the tables.

State of the Data Before COMMIT or ROLLBACK

Every data change made during the transaction is temporary until the transaction is committed.

The state of the data before COMMIT or ROLLBACK statements are issued can be described as follows:

- Data manipulation operations primarily affect the database buffer; therefore, the previous state of the data can be recovered.
- The current user can review the results of the data manipulation operations by querying the tables.
- Other users cannot view the results of the data manipulation operations made by the current user. The Oracle server institutes read consistency to ensure that each user sees data as it existed at the last commit.
- The affected rows are locked; other users cannot change the data in the affected rows.

State of the Data After COMMIT

Make all pending changes permanent by using the COMMIT statement. Here is what happens after a COMMIT statement:

- Data changes are written to the database.
- The previous state of the data is no longer available with normal SQL queries.
- All users can view the results of the transaction.
- The locks on the affected rows are released; the rows are now available for other users to perform new data changes.
- All savepoints are erased.

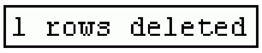
Committing Data

<u>Example:</u>

DELETE FROM employees

WHERE employee_id = 99999;

<u>Outpu</u>:



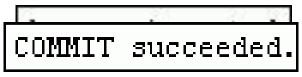
```
1 rows deleted
```

<u>Example:</u>

INSERT INTO departments

VALUES (290, 'Corporate Tax', NULL, 1700); <u>Output</u>:

COMMI; <u>Output</u>:



```
COMMIT succeeded.
```

State of the Data After ROLLBACK

Discard all pending changes by using the ROLLBACK statement, which results in the following:

- Data changes are undone.
- The previous state of the data is restored.
- Locks on the affected rows are released.

<u>Exampl:</u>

DELETE FROM copy_emp;

ROLLBACK ;

Database Objects

The Oracle database can contain multiple data structures. Each structure should be outlined in the database design so that it can be created during the build stage of database development.

- **Table:** Stores data
- **View:** Subset of data from one or more tables
- **Sequence:** Generates numeric values
- **Index:** Improves the performance of some queries
- **Synonym:** Gives alternative name to an object

Naming Rules

You name database tables and columns according to the standard rules for naming any Oracle database object:

- Table names and column names must begin with a letter and be 1–30 characters long.
- Names must contain only the characters A–Z, a–z, 0–9, _ (underscore), $, and # (legal characters, but their use is discouraged).
- Names must not duplicate the name of another object owned by the same Oracle server user.
- Names must not be an Oracle server–reserved word.

-You may also use quoted identifiers to represent the name of an object. A quoted identifier begins and ends with double quotation marks (–). If you name a schema object using a quoted identifier, then you must use the double quotation marks whenever you refer to that object. Quoted identifiers can be reserved words, although this is not recommended.

Naming Guidelines

Use descriptive names for tables and other database objects.

Note: Names are not case-sensitive. For example, EMPLOYEES is treated to be the same name as eMPloyees or eMpLOYEES. However, quoted identifiers are case-sensitive.

CREATE TABLE Statement

You create tables to store data by executing the SQL CREATE TABLE statement. This statement is one of the DDL statements that are a subset of the SQL statements used to create, modify, or remove Oracle database structures. These statements have an immediate effect on the database and they also record information in the data dictionary.

To create a table, a user must have the CREATE TABLE privilege and a storage area in which to create objects. The database administrator (DBA) uses data control language (DCL) statements to grant privileges to users.

Syntax:

```
CREATE TABLE [schema.]table
          (column datatype [DEFAULT expr][, ...]);
```

In the syntax:

schema	Is the same as the owner‘s name
table	Is the name of the table
DEFAULT *expr*	Specifies a default value if a value is omitted in the INSERT statement
column	Is the name of the column
datatype	Is the column‘s data type and length

Referencing Another User’s Tables

A schema is a collection of logical structures of data or *schema objects*. A schema is owned by a database user and has the same name as that user. Each user owns a single schema.

Schema objects can be created and manipulated with SQL and include tables, views, synonyms, sequences, stored procedures, indexes, clusters, and database links.

If a table does not belong to the user, the owner‘s name must be prefixed to the table. For example, if there are schemas named USERA and USERB, and both have an EMPLOYEES table, then if USERA wants to access the EMPLOYEES table that belongs to USERB, USERA must prefix the table name with the schema name:

```
SELECT *

FROM   userb.employees;
```

If USERB wants to access the EMPLOYEES table that is owned by USERA, USERB must prefix the table name with the schema name:

```
SELECT *

FROM   usera.employees;
```

DEFAULT Option

When you define a table, you can specify that a column should be given a default value by using the DEFAULT option. This option prevents null values from entering the columns when a row is inserted without a value for the column. The default value can be a literal, an expression, or a SQL function (such as SYSDATE or USER), but the value cannot be the name of another column or a pseudocolumn (such as NEXTVAL or CURRVAL). The default expression must match the data type of the column.

Example:

```
CREATE TABLE hire_dates (
id         NUMBER(8) ,
hire_date  DATE DEFAULT SYSDATE);
```

Consider the following examples:

```
INSERT INTO hire_dates
 values(45, NULL);
```

The above statement will insert the null value rather than the default value.

```
INSERT INTO hire_dates(id)
 values(35);
```

The above statement will insert SYSDATE for the HIRE_DATE column.

Creating Tables

Example:

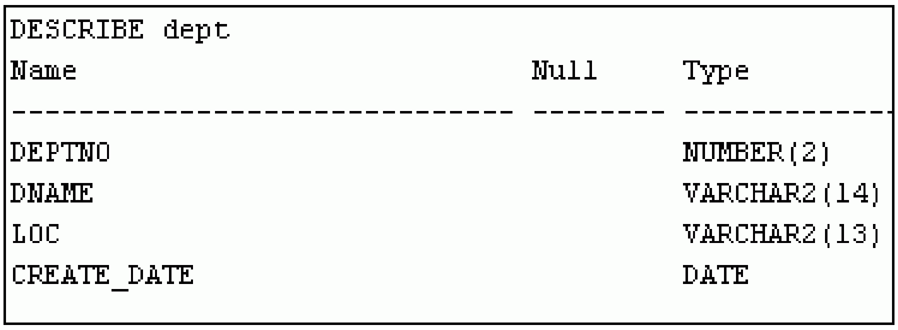
```
CREATE TABLE dept
       (deptno     NUMBER(2),

        dname      VARCHAR2(14),

        loc       VARCHAR2(13),
```

create_date DATE DEFAULT SYSDATE)

The above example creates the DEPT table with four columns: DEPTNO, DNAME, LOC, and CREATE_DATE. The CREATE_DATE column has a default value. If a value is not provided for an INSERT statement, the system date is automatically inserted.

To confirm that the table was created, run the DESCRIBE command.

DESCRIBE dept

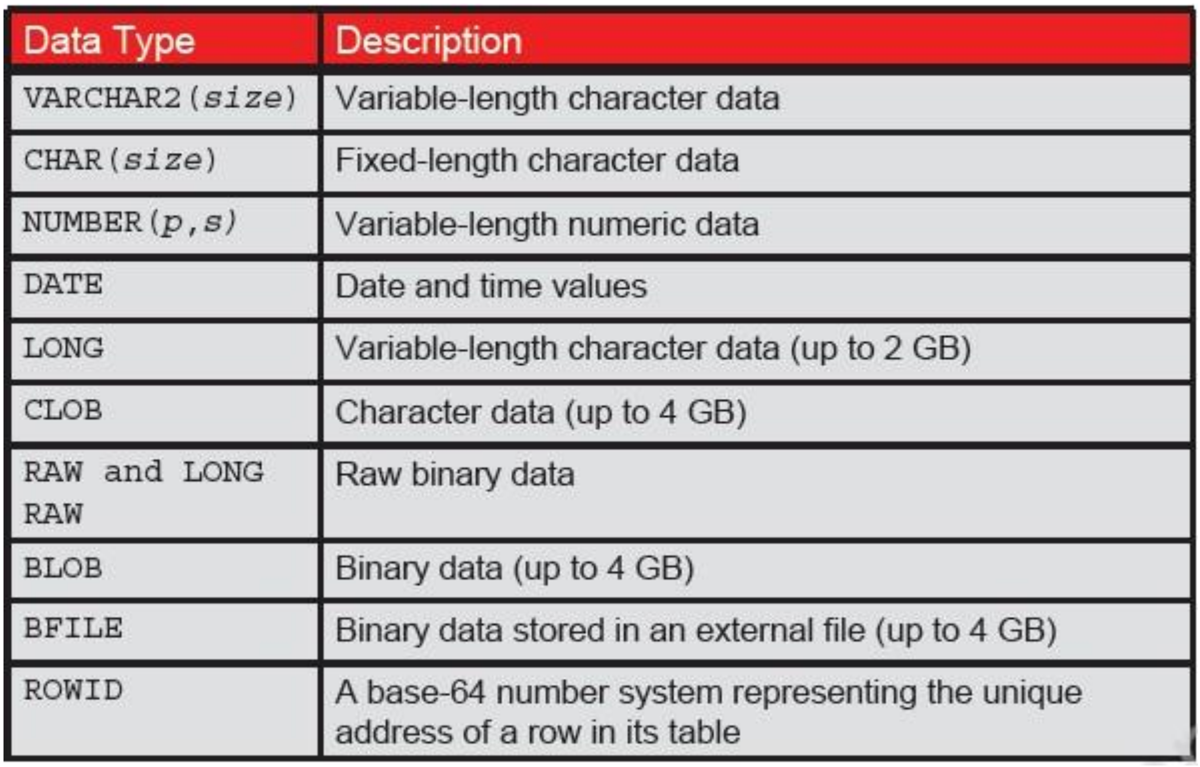


```
DESCRIBE dept
Name                           Null     Type
------------------------------ -------- ------------
DEPTNO                                  NUMBER(2)
DNAME                                   VARCHAR2(14)
LOC                                     VARCHAR2(13)
CREATE_DATE                             DATE
```

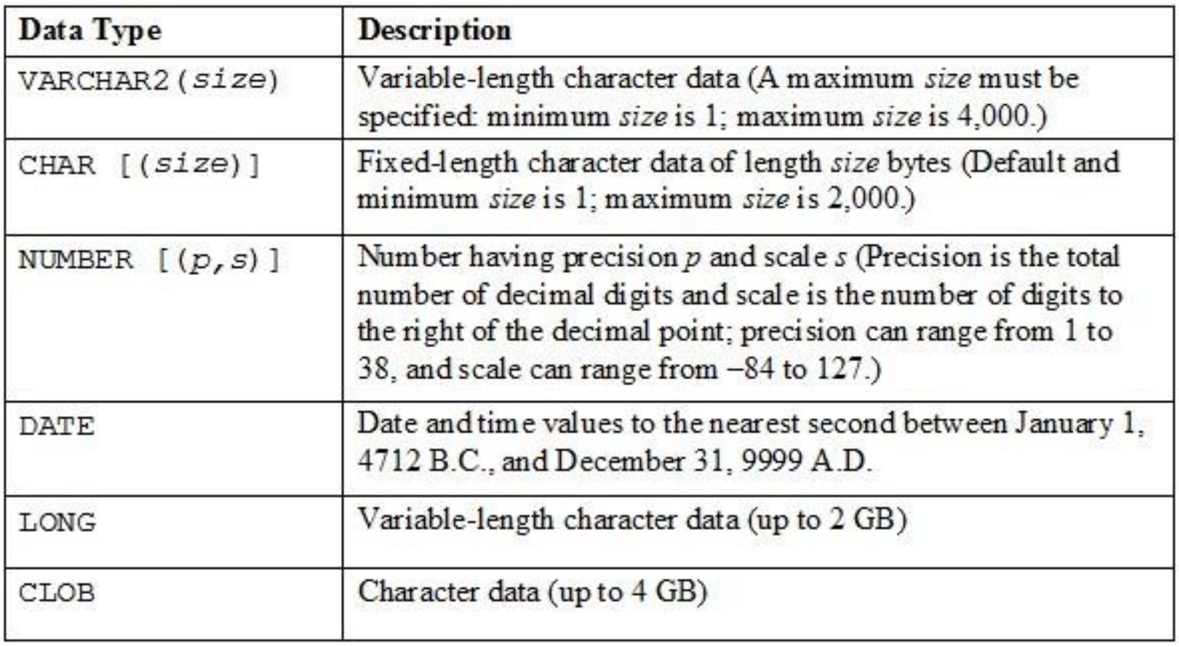
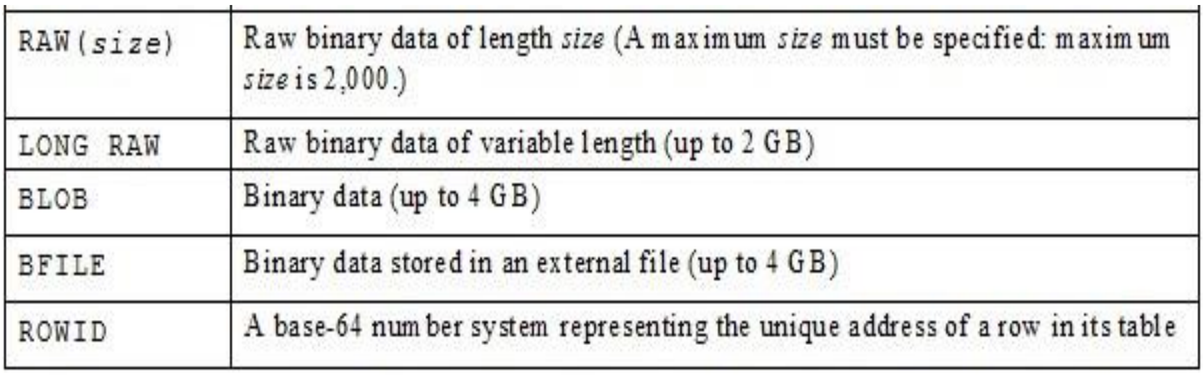
Because creating a table is a DDL statement, an automatic commit takes place when this statement is executed.

Data Types

When you identify a column for a table, you need to provide a data type for the column. There are several data types available:

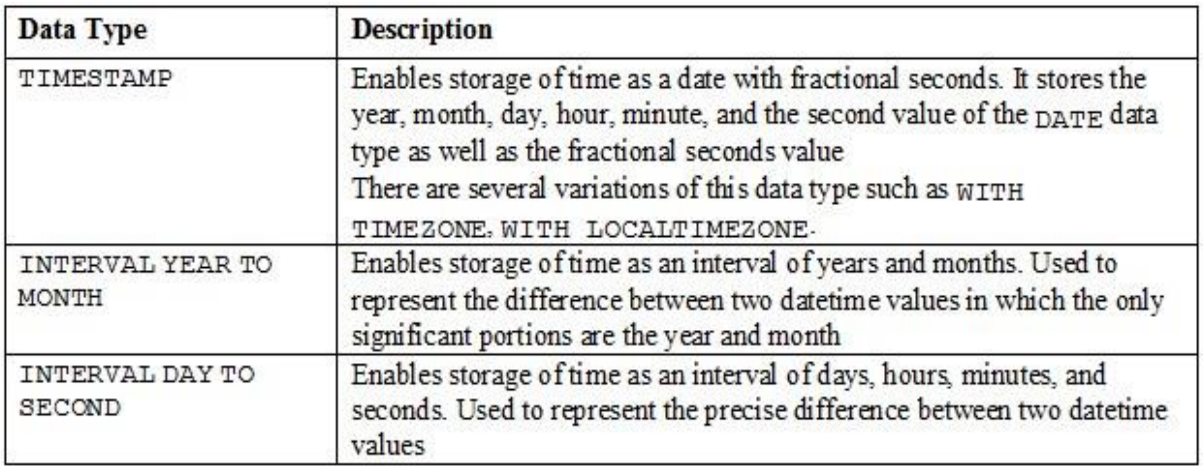


Data Type	Description
VARCHAR2(*size*)	Variable-length character data
CHAR(*size*)	Fixed-length character data
NUMBER(*p,s*)	Variable-length numeric data
DATE	Date and time values
LONG	Variable-length character data (up to 2 GB)
CLOB	Character data (up to 4 GB)
RAW and LONG RAW	Raw binary data
BLOB	Binary data (up to 4 GB)
BFILE	Binary data stored in an external file (up to 4 GB)
ROWID	A base-64 number system representing the unique address of a row in its table

Data Type	Description
`VARCHAR2(`*`size`*`)`	Variable-length character data (A maximum *size* must be specified: minimum *size* is 1; maximum *size* is 4,000.)
`CHAR [(`*`size`*`)]`	Fixed-length character data of length *size* bytes (Default and minimum *size* is 1; maximum *size* is 2,000.)
`NUMBER [(`*`p,s`*`)]`	Number having precision *p* and scale *s* (Precision is the total number of decimal digits and scale is the number of digits to the right of the decimal point; precision can range from 1 to 38, and scale can range from −84 to 127.)
`DATE`	Date and time values to the nearest second between January 1, 4712 B.C., and December 31, 9999 A.D.
`LONG`	Variable-length character data (up to 2 GB)
`CLOB`	Character data (up to 4 GB)
`RAW(`*`size`*`)`	Raw binary data of length *size* (A maximum *size* must be specified: maximum *size* is 2,000.)
`LONG RAW`	Raw binary data of variable length (up to 2 GB)
`BLOB`	Binary data (up to 4 GB)
`BFILE`	Binary data stored in an external file (up to 4 GB)
`ROWID`	A base-64 number system representing the unique address of a row in its table

Datetime Data Types



Data Type	Description
`TIMESTAMP`	Enables storage of time as a date with fractional seconds. It stores the year, month, day, hour, minute, and the second value of the `DATE` data type as well as the fractional seconds value There are several variations of this data type such as `WITH TIMEZONE`, `WITH LOCALTIMEZONE`.
`INTERVAL YEAR TO MONTH`	Enables storage of time as an interval of years and months. Used to represent the difference between two datetime values in which the only significant portions are the year and month
`INTERVAL DAY TO SECOND`	Enables storage of time as an interval of days, hours, minutes, and seconds. Used to represent the precise difference between two datetime values

Constraints

The Oracle server uses constraints to prevent invalid data entry into tables.

You can use constraints to do the following:

- Enforce rules on the data in a table whenever a row is inserted, updated, or deleted from that table. The constraint must be satisfied for the operation to succeed.
- Prevent the deletion of a table if there are dependencies from other tables.
- Provide rules for Oracle tools, such as Oracle Developer.

Data Integrity Constraints

Constraint	**Description**
`NOT NULL`	Specifies that the column cannot contain a null value
`UNIQUE`	Specifies a column or combination of columns whose values must be unique for all rows in the table
`PRIMARY KEY`	Uniquely identifies each row of the table
`FOREIGN KEY`	Establishes and enforces a referential integrity between the column and a column of the referenced table such that values in one table match values in another table.
`CHECK`	Specifies a condition that must be true

```
Create st (
Name …. NOT NULL,
ROLL_NO …. Primary key,
Class … UNIQUE);
```

Constraint Guidelines

All constraints are stored in the data dictionary. Constraints are easy to reference if you give them a meaningful name. Constraint names must follow the standard object-naming rules, except that the name cannot be the same as another object owned by the same user. If you do not name your constraint, the Oracle server generates a name with the format SYS_C*n*, where *n* is an integer so that the constraint name is unique.

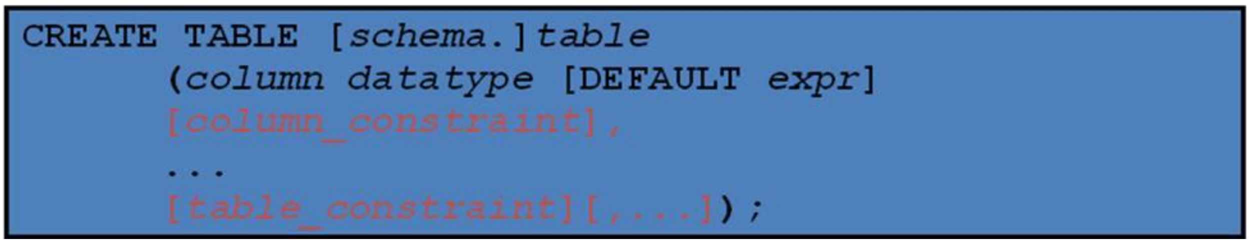
Constraints can be defined at the time of table creation or after the creation of the table. You can define a constraint at the column or table level. Functionally, a table-level constraint is the same as a column-level constraint.

Defining Constraints

You can create constraints at either the column level or table level. Constraints defined at the column level are included when the column is defined. Table-level constraints are defined at the end of the table definition and must refer to the column or columns on which the constraint pertains in a set of parentheses. It is mainly the syntax that differentiates the two; otherwise, functionally, a column-level constraint is the same as a table-level constraint.

NOT NULL constraints must be defined at the column level.

Constraints that apply to more than one column must be defined at the table level.
Syntax:



```
CREATE TABLE [schema.]table
      (column datatype [DEFAULT expr]
      [column_constraint],
      ...
      [table_constraint][,...]);
```

In the syntax:

schema	Is the same as the owner‘s name
table	Is the name of the table
DEFAULT expr	Specifies a default value to be used if a value is omitted in the INSERT statement
column	Is the name of the column
datatype	Is the column‘s data type and length
column_constraint	Is an integrity constraint as part of the column definition
table_constraint	Is an integrity constraint as part of the table definition

Example of a column-level constraint:

```
CREATE TABLE employees(
 employee_id  NUMBER(6)
   CONSTRAINT emp_emp_id_pk PRIMARY KEY,
 first_name   VARCHAR2(20),
 ...);
```

The above example uses the column-level syntax to define the constraint.

Example of a table-level constraint:

```
CREATE TABLE employees(
 employee_id  NUMBER(6),
 first_name   VARCHAR2(20),
 ...
job_id      VARCHAR2(10) NOT NULL,
CONSTRAINT emp_emp_id_pk
PRIMARY KEY (EMPLOYEE_ID));
```

This example uses the table-level syntax to define the constraint.

NOT NULL Constraint

The NOT NULL constraint ensures that the column contains no null values. Columns without the NOT NULL constraint can contain null values by default. NOT NULL constraints must be defined at the column level.

In the EMPLOYEES table, the EMPLOYEE_ID column inherits a NOT NULL constraint as it is defined as a primary key. Otherwise, the LAST_NAME, EMAIL, HIRE_DATE, and JOB_ID columns have the NOT NULL constraint enforced on them.

UNIQUE Constraint

A UNIQUE key integrity constraint requires that every value in a column or a set of columns (key) be unique—that is, no two rows of a table can have duplicate values in a specified column or a set of columns. The column (or set of columns) included in the definition of the UNIQUE key constraint is called the *unique key*. If the UNIQUE constraint comprises more than one column, that group of columns is called a *composite unique key*.

UNIQUE constraints enable the input of nulls unless you also define NOT NULL constraints for the same columns. In fact, any number of rows can include nulls for columns without the NOT NULL constraints because nulls are not considered equal to anything. A null in a

PRIMARY KEY Constraint

A PRIMARY KEY constraint creates a primary key for the table. Only one primary key can be created for each table. The PRIMARY KEY constraint is a column or a set of columns that uniquely identifies each row in a table. This constraint enforces the uniqueness of the column or column combination and ensures that no column that is part of the primary key can contain a null value.

FOREIGN KEY Constraint

The FOREIGN KEY (or referential integrity) constraint designates a column or a combination of columns as a foreign key and establishes a relationship with a primary key or a unique key in the same table or a different table.

In the example in the slide, DEPARTMENT_ID has been defined as the foreign key in the EMPLOYEES table (dependent or child table); it references the DEPARTMENT_ID column of the DEPARTMENTS table (the referenced or parent table).

Guidelines

- A foreign key value must match an existing value in the parent table or be NULL.
- Foreign keys are based on data values and are purely logical, rather than physical, pointers

Example:

```
CREATE TABLE employees(
  employee_id     NUMBER(6),
  last_name       VARCHAR2(25) NOT NULL,
  email           VARCHAR2(25),
  salary          NUMBER(8,2),
  commission_pct  NUMBER(2,2),
  hire_date       DATE NOT NULL,
...
  department_id   NUMBER(4),
  CONSTRAINT emp_dept_fk FOREIGN KEY (department_id)
    REFERENCES departments(department_id),
  CONSTRAINT emp_email_uk UNIQUE(email));
```

FOREIGN KEY constraints can be defined at the column or table constraint level. A composite foreign key must be created by using the table-level definition.

The above example defines a FOREIGN KEY constraint on the DEPARTMENT_ID column of the EMPLOYEES table, using table-level syntax. The name of the constraint is EMP_DEPT_FK.

The foreign key can also be defined at the column level, provided that the constraint is based on a single column. The syntax differs in that the keywords FOREIGN KEY do not appear. For example:

CREATE TABLE employees

(...

department_id NUMBER(4) CONSTRAINT emp_deptid_fk

REFERENCES departments(department_id),

...

)

FOREIGN KEY Constraint: Keywords

The foreign key is defined in the child table and the table containing the referenced column is the parent table. The foreign key is defined using a combination of the following keywords:

- FOREIGN KEY is used to define the column in the child table at the table-constraint level.
- REFERENCES identifies the table and the column in the parent table.
- ON DELETE CASCADE indicates that when a row in the parent table is deleted, the dependent rows in the child table are also deleted.
- ON DELETE SET NULL indicates that when a row in the parent table is deleted, the foreign key values are set to null.

The default behavior is called the *restrict rule*, which disallows the update or deletion of referenced data.

Without the ON DELETE CASCADE or the ON DELETE SET NULL options, the row in the parent table cannot be deleted if it is referenced in the child table.

Creating a Table Using a Subquery

A second method for creating a table is to apply the AS *subquery* clause, which both creates the table and inserts rows returned from the subquery.

Syntax:

```
CREATE TABLE table
             [(column, column...)]
AS subquery;
```

In the syntax:

table is the name of the table

*column*is the name of the column, default value, and integrity constraint

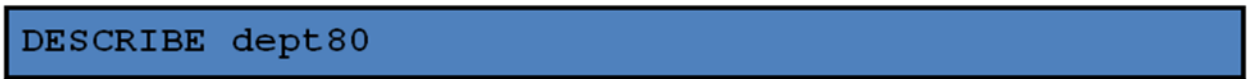
subquery is the SELECT statement that defines the set of rows to be inserted into the new table

Guidelines

- The table is created with the specified column names, and the rows retrieved by the SELECT statement are inserted into the table.
- The column definition can contain only the column name and default value.
- If column specifications are given, the number of columns must equal the number of columns in the subquery SELECT list.
- If no column specifications are given, the column names of the table are the same as the column names in the subquery.
- The column data type definitions and the NOT NULL constraint are passed to the new table. Note that only the explicit NOT NULL constraint will be inherited. The PRIMARY KEY column will not pass the NOT NULL feature to the new column. Any other constraint rules are not passed to the new table. However, you can add constraints in the column definition.

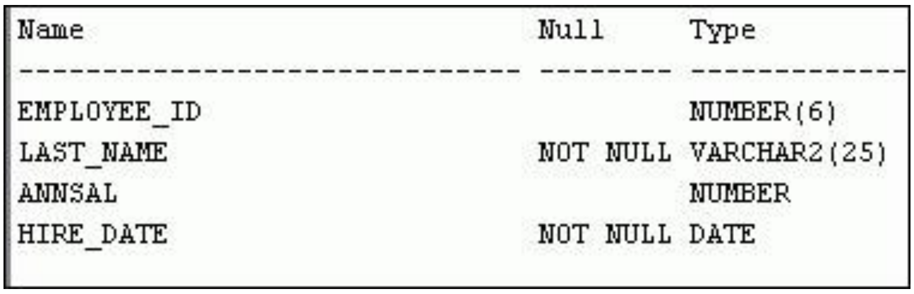
Example:

```
CREATE TABLE     dept80
 AS
  SELECT  employee_id, last_name,
      salary*12 ANNSAL,
      hire_date
  FROM    employees
  WHERE   department_id = 80;
```



```
DESCRIBE dept80
```

Output:



```
Name                           Null     Type
------------------------------ -------- -------------
EMPLOYEE_ID                             NUMBER(6)
LAST_NAME                      NOT NULL VARCHAR2(25)
ANNSAL                                  NUMBER
HIRE_DATE                      NOT NULL DATE
```

ALTER TABLE Statement

After you create a table, you may need to change the table structure for any of the following reasons:

- You omitted a column.
- Your column definition or its name needs to be changed.
- You need to remove columns.
- You want to put the table into the read-only mode

You can do this by using the ALTER TABLE statement.

```
CREATE TABLE members (
   member_id NUMBER GENERATED BY DEFAULT AS IDENTITY,
   first_name VARCHAR2(50),
   last_name VARCHAR2(50),
   PRIMARY KEY (member_id)
);
```

```
ALTER TABLE members
ADD birth_date VARCHAR2(50) NOT NULL.
```

Dropping a Table

The DROP TABLE statement moves a table to the recycle bin or removes the table and all its data from the database entirely. Unless you specify the PURGE clause, the DROP TABLE statement does not result in space being released back to the tablespace for use by other objects, and the space continues to count towards the user‘s space quota. Dropping a table invalidates the dependent objects and removes object privileges on the table.

When you drop a table, the database loses all the data in the table and all the indexes associated
with it.

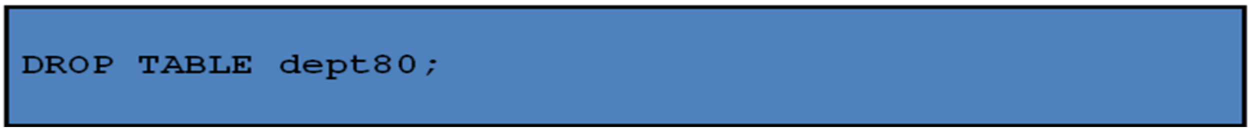
Syntax

DROP TABLE *table* [PURGE]

In the syntax, *table* is the name of the table.

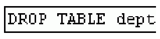
Guidelines

- All the data is deleted from the table.
- Any views and synonyms remain, but are invalid.
- Any pending transactions are committed.
- Only the creator of the table or a user with the DROP ANY TABLE privilege can remove a table



```
DROP TABLE dept80;
```

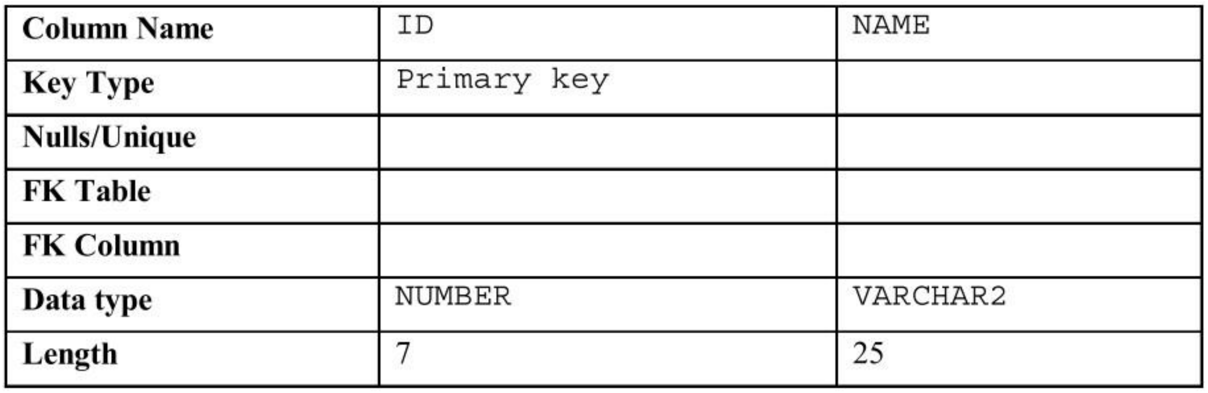
<u>Output:</u>



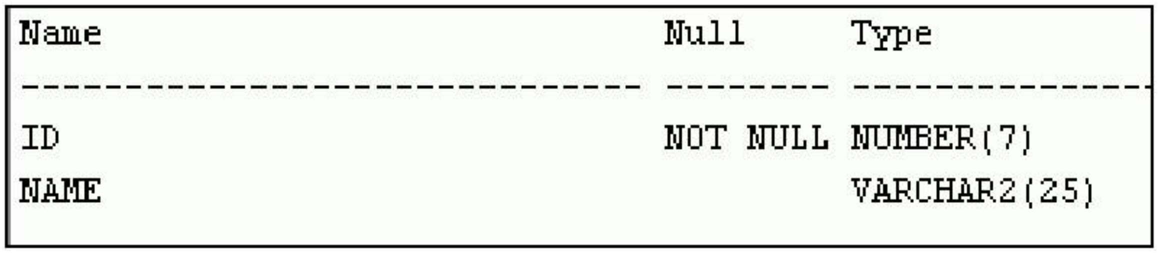
```
DROP TABLE dept
```

Lab Task

1. Create the DEPT table based on the following table instance chart. Confirm that the table is created.



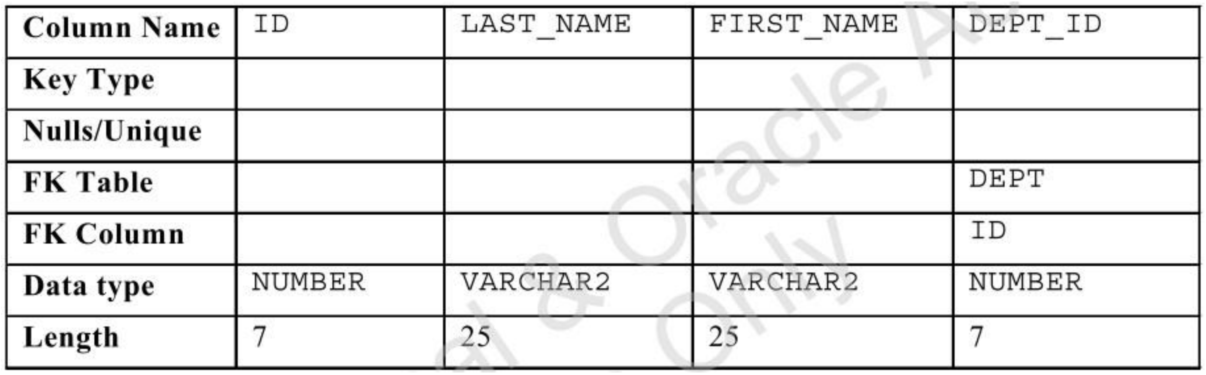
Column Name	ID	NAME
Key Type	Primary key	
Nulls/Unique		
FK Table		
FK Column		
Data type	NUMBER	VARCHAR2
Length	7	25



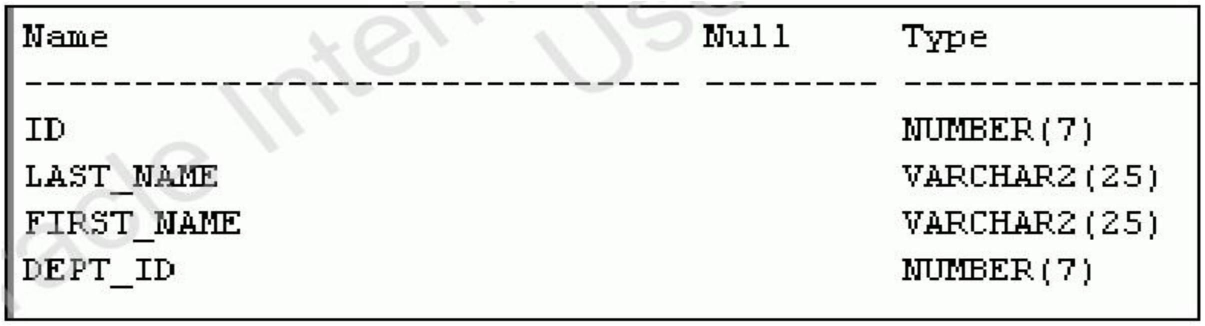
```
Name                           Null     Type
------------------------------ -------- -------------
ID                             NOT NULL NUMBER(7)
NAME                                    VARCHAR2(25)
```

2. Populate the DEPT table with data from the DEPARTMENTS table. Include only columns that you need.

3. Create the EMP table based on the following table instance chart. Confirm that the table is created.



Column Name	ID	LAST_NAME	FIRST_NAME	DEPT_ID
Key Type				
Nulls/Unique				
FK Table				DEPT
FK Column				ID
Data type	NUMBER	VARCHAR2	VARCHAR2	NUMBER
Length	7	25	25	7



```
Name                             Null     Type
-------------------------------- -------- -------------
ID                                        NUMBER(7)
LAST_NAME                                 VARCHAR2(25)
FIRST_NAME                                VARCHAR2(25)
DEPT_ID                                   NUMBER(7)
```

4. Add SAVEPOINT “Rever_Emp “and Create the EMPLOYEES2 table based on the structure of the EMPLOYEES table. Include only the EMPLOYEE_ID, FIRST_NAME, LAST_NAME, SALARY, and DEPARTMENT_ID columns. Name the columns in your new table ID, FIRST_NAME, LAST_NAME, SALARY, and DEPT_ID, respectively.

5. Try to insert the following row in the EMPLOYEES2 table:

ID	FIRST_NAME	LAST_NAME	SALARY	DEPT_ID
34	Grant	Marcie	5678	10

You get the error message.

6. Rollback to last SAVEPOINT and then insert a new row in the EMPLOYEES2 table.

7. Drop the DEPT table.

Evaluation:

Your Lab Work grade will depend *on your* ***active participation, individual efforts in solving Lab Problem (script exercise) and Seriousness during the lab.***

Exercise completion will be a part of evaluation.