Practical No. 01

Aim: Implementation of Data Partitioning through Range and List Partitioning

a) Range Partitioning

1.1 Create table sales with the following columns:

prod_id	Number
cust_id	Number
time_id	Date
channel_id	Char
promo_id	Number
quantity_sold	Number
amount_sold	Number

□ Partition this table into 4 using range partition and time_id as partitioning key. Give partition names as:
sales_q1_2006, sales_q2_2006, sales_q3_2006, sales_q4_2006.

Query:

✓ create table sales(

```
prod_id number(5),
cust_id number(5),
time_id date, channel_id
char(5), promo_id
number(5),
quantity_sold number(5),
amount_sold number(10))
partition by range(time_id)
(partition sales_q1_2006 values less than (to_date('31-MAR-2006','dd-MON-yyyy')),
partition sales_q2_2006 values less than (to_date('31-MAY-2006','dd-MON-yyyy')),
partition sales_q3_2006 values less than (to_date('30-SEP-2006','dd-MON-yyyy')),
partition sales_q4_2006 values less than (to_date('31-DEC-2006','dd-MON-yyyy')));
```

```
SQL> create table sales(
  2  prod_id number(5),
  3  cust_id number(5),
  4  time_id date,
  5  channel_id char(5),
  6  promo_id number(5),
  7  quantity_sold number(5),
  8  amount_sold number(10))
  9  partition by range(time_id)
 10  (partition sales_q1_2006 values less than (to_date('31-MAR-2006','dd-MON-yyyy')),
 11  partition sales_q2_2006 values less than (to_date('31-MAY-2006','dd-MON-yyyy')),
 12  partition sales_q3_2006 values less than (to_date('30-SEP-2006','dd-MON-yyyy')),
 13  partition sales_q4_2006 values less than (to_date('31-DEC-2006','dd-MON-yyyy')));

Table created.

SQL>
```

□ Store quarterly data into each partition. For example, partition sales_q1_2006 will store records for first quarter 01-jan-2006 to 01-mar-2006 sales_q1_2006 will store records for second quarter 01-apr-2006 to 01- jun2006. And so on.

Query:

✓ insert into sales values(2015,103,'15-Mar-2006',101,234,23,1029);

insert into sales values(3013,204,'03-Apr-2006',103,456,56,2938);

insert into sales values(6016,302,'27-Jun-2006',105,567,43,3847);

insert into sales values(8101,404,'05-Aug-2006',204,678,95,4756);

insert into sales values(4106,501,'17-Nov-2006',206,789,62,2374);

insert into sales values(8014,603,'23-Feb-2006',303,901,83,6358);

insert into sales values(2761,625,'13-Sep-2006',403,432,57,9341);

Output:

```
SQL> insert into sales values(2015,103,'15-Mar-2006',101,234,23,1029);

1 row created.

SQL> insert into sales values(3013,204,'03-Apr-2006',103,456,56,2938);

1 row created.

SQL> insert into sales values(6016,302,'27-Jun-2006',105,567,43,3847);

1 row created.

SQL> insert into sales values(8101,404,'05-Aug-2006',204,678,95,4756);

1 row created.

SQL> insert into sales values(4106,501,'17-Nov-2006',206,789,62,2374);

1 row created.

SQL> insert into sales values(8014,603,'23-Feb-2006',303,901,83,6358);

1 row created.

SQL> insert into sales values(2761,625,'13-Sep-2006',403,432,57,9341);

1 row created.

SQL>
```

□ Write a command to view records in each partition.

Query:

✓ select * from sales partition (sales_q1_2006);

select * from sales partition (sales_q2_2006);
select * from sales partition (sales_q3_2006);
select * from sales partition (sales_q4_2006);

Output:

```
SQL> select * from sales partition (sales_q1_2006);

   PROD_ID    CUST_ID TIME_ID   CHANN   PROMO_ID QUANTITY_SOLD AMOUNT_SOLD
---------- ---------- --------- ----- ---------- ------------- -----------
      2015        103 15-MAR-06 101          234            23        1029
      8014        603 23-FEB-06 303          901            83        6358

SQL> select * from sales partition (sales_q2_2006);

   PROD_ID    CUST_ID TIME_ID   CHANN   PROMO_ID QUANTITY_SOLD AMOUNT_SOLD
---------- ---------- --------- ----- ---------- ------------- -----------
      3013        204 03-APR-06 103          456            56        2938

SQL> select * from sales partition (sales_q3_2006);

   PROD_ID    CUST_ID TIME_ID   CHANN   PROMO_ID QUANTITY_SOLD AMOUNT_SOLD
---------- ---------- --------- ----- ---------- ------------- -----------
      6016        302 27-JUN-06 105          567            43        3847
      8101        404 05-AUG-06 204          678            95        4756
      2761        625 13-SEP-06 403          432            57        9341

SQL> select * from sales partition (sales_q4_2006);

   PROD_ID    CUST_ID TIME_ID   CHANN   PROMO_ID QUANTITY_SOLD AMOUNT_SOLD
---------- ---------- --------- ----- ---------- ------------- -----------
      4106        501 17-NOV-06 206          789            62        2374
```

□ Write a command to display the partition structure.

Query:

✓ select table_name,partition_name,high_value,num_rows from user_tab_partitions where table_name='SALES';

```
SQL> select table_name,partition_name,high_value,num_rows from user_tab_partitions where table_name=
'SALES';

TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
SALES                          SALES_Q1_2006
TO_DATE(' 2006-03-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA


SALES                          SALES_Q2_2006
TO_DATE(' 2006-05-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA


TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------

SALES                          SALES_Q3_2006
TO_DATE(' 2006-09-30 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA


SALES                          SALES_Q4_2006
TO_DATE(' 2006-12-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA

TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
```

□ Write a command to add a new partition called sales_q1_2007 for the next quarter value.

Query:

✓ alter table sales add partition sales_q1_2007 values less than(TO_DATE('31-MAR-2007','dd-MON-yyyy'));

Output:

```
SQL> alter table sales add partition sales_q1_2007 values less than(TO_DATE('31-MAR-2007','dd-MON-yy
yy'));

Table altered.
```

```
SQL> select table_name,partition_name,high_value,num_rows from user_tab_partitions where table_name=
'SALES';

TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
SALES                          SALES_Q1_2006
TO_DATE(' 2006-03-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA
         0

SALES                          SALES_Q1_2007
TO_DATE(' 2007-03-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA

TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------

SALES                          SALES_Q2_2006
TO_DATE(' 2006-05-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA
         0

SALES                          SALES_Q3_2006
TO_DATE(' 2006-09-30 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA

TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
         0

SALES                          SALES_Q4_2006
TO_DATE(' 2006-12-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA
```

□ Write a command to delete all records from partition sales_q1_2006.

Query:

✓ alter table sales truncate partition sales_q1_2006;

```
SQL> alter table sales truncate partition sales_q1_2006;

Table truncated.

SQL> select * from sales partition (sales_q1_2006);

no rows selected

SQL>
```

□ Write a command to delete a partition.

Query:

✓ alter table sales drop partition sales_q3_2006;

Output:

```
SQL> alter table sales drop partition sales_q3_2006;

Table altered.

SQL> select table_name,partition_name,high_value,num_rows from user_tab_partitions where table_name=
'SALES';

TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
SALES                          SALES_Q1_2006
TO_DATE(' 2006-03-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA
         0

SALES                          SALES_Q1_2007
TO_DATE(' 2007-03-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA


TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------

SALES                          SALES_Q2_2006
TO_DATE(' 2006-05-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA
         0

SALES                          SALES_Q4_2006
TO_DATE(' 2006-12-31 00:00:00', 'SYYYY-MM-DD HH24:MI:SS', 'NLS_CALENDAR=GREGORIA

TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
```

b) List Partitioning

1.2 Create table Student with the following columns:

Student_id	Number
Student_name	Number
Student_dob	Date

□ Create list partition with student_name as partition key. Create following two partitions.
stu_divA with values 'a','b','c','d','e','f','g','h','i','j','k'
stu_divB with values 'n','o','p','q','r','s','t','u','v','w','x','y','z'

Query:

✓ create table Student(
student_id number(5),
student_name varchar2(20),
student_dob date)
partition by list(student_name)
(partition stu_divA values('a','b','c','d','e','f','g','h','i','j','k'),
partition stu_divB values('n','o','p','q','r','s','t','u','v','w','x','y','z'));

Output:

```
SQL> create table Student(
  2  student_id number(5),
  3  student_name varchar2(20),
  4  student_dob date)
  5  partition by list(student_name)
  6  (partition stu_divA values('a','b','c','d','e','f','g','h','i','j','k'),
  7  partition stu_divB values('n','o','p','q','r','s','t','u','v','w','x','y','z'));

Table created.

SQL>
```

Query:

✓ insert into Student values(0121,'m',to_date('23-AUG-1963','dd-MON-yyyy'));

insert into Student values(0221,'j',to_date('15-SEP-1958','dd-MON-yyyy'));

insert into Student values(0321,'a',to_date('19-AUG-1992','dd-MON-yyyy'));

insert into Student values(0421,'h',to_date('10-JUL-1991','dd-MON-yyyy'));

insert into Student values(0521,'p',to_date('27-JUN-1965','dd-MON-yyyy'));

insert into Student values(0621,'z',to_date('18-MAR-1968','dd-MON-yyyy'));

```
SQL> insert into Student values(0221,'j',to_date('15-SEP-1958','dd-MON-yyyy'));

1 row created.

SQL> insert into Student values(0321,'a',to_date('19-AUG-1992','dd-MON-yyyy'));

1 row created.

SQL> insert into Student values(0421,'h',to_date('10-JUL-1991','dd-MON-yyyy'));

1 row created.

SQL> insert into Student values(0521,'p',to_date('27-JUN-1965','dd-MON-yyyy'));

1 row created.

SQL> insert into Student values(0621,'z',to_date('18-MAR-1968','dd-MON-yyyy'));

1 row created.
```

□ Write a command to view records in each partitions.

Query:

✓ select * from Student partition(stu_divA);

select * from Student partition(stu_divB);

Output:

```
SQL> select * from Student partition(stu_divA);

STUDENT_ID STUDENT_NAME          STUDENT_D
---------- -------------------- ---------
       221 j                    15-SEP-58
       321 a                    19-AUG-92
       421 h                    10-JUL-91

SQL> select * from Student partition(stu_divB);

STUDENT_ID STUDENT_NAME          STUDENT_D
---------- -------------------- ---------
       521 p                    27-JUN-65
       621 z                    18-MAR-68
```

□ Write a command to display the partition structure.

Query:

✓ SELECT TABLE_NAME, PARTITION_NAME,HIGH_VALUE, NUM_ROWS FROM USER_TAB_PARTITIONS
WHERE TABLE_NAME='STUDENT';

Output:

```
SQL> SELECT TABLE_NAME, PARTITION_NAME,HIGH_VALUE, NUM_ROWS FROM USER_TAB_PARTITIONS
  2  WHERE TABLE_NAME='STUDENT';

TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
STUDENT                        STU_DIVA
'a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j', 'k'


STUDENT                        STU_DIVB
'n', 'o', 'p', 'q', 'r', 's', 't', 'u', 'v', 'w', 'x', 'y', 'z'


TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
```

□ Write a command to add a new partition called stu_null for the null values.

Query:

✓ alter table student add partition stu_null values(NULL);

Output:

```
SQL> alter table Student add partition stu_null values(NULL);

Table altered.

SQL> SELECT TABLE_NAME, PARTITION_NAME,NUM_ROWS FROM USER_TAB_PARTITIONS WHERE
  2  TABLE_NAME='STUDENT';

TABLE_NAME                     PARTITION_NAME                   NUM_ROWS
------------------------------ ------------------------------ ----------
STUDENT                        STU_DIVA
STUDENT                        STU_DIVB
STUDENT                        STU_NULL
```

□ Write a command to display records from stu_null partition.

Query:

✓ select * from Student partition(stu_null);

Output:

```
SQL> select * from Student partition(stu_null);

no rows selected

SQL> SELECT TABLE_NAME, PARTITION_NAME,NUM_ROWS FROM USER_TAB_PARTITIONS WHERE
  2  TABLE_NAME='STUDENT';

TABLE_NAME                     PARTITION_NAME                  NUM_ROWS
------------------------------ ------------------------------ ----------
STUDENT                        STU_DEFAULT
STUDENT                        STU_DIVA
STUDENT                        STU_DIVB
STUDENT                        STU_NULL
```

□ Write a command to add a new partition called stu_default for the default
□ values.

Write a command to display records from stu_default partition.

Query:

✓ alter table Student add partition stu_default values(DEFAULT);

✓ select * from Student partition(stu_default);

Output:

```
SQL> alter table Student add partition stu_default values(DEFAULT);

Table altered.

SQL> SELECT TABLE_NAME, PARTITION_NAME,NUM_ROWS FROM USER_TAB_PARTITIONS WHERE
  2  TABLE_NAME='STUDENT';

TABLE_NAME                     PARTITION_NAME                  NUM_ROWS
------------------------------ ------------------------------ ----------
STUDENT                        STU_DEFAULT
STUDENT                        STU_DIVA
STUDENT                        STU_DIVB
STUDENT                        STU_NULL
```

```
SQL> SELECT TABLE_NAME, PARTITION_NAME,HIGH_VALUE, NUM_ROWS FROM USER_TAB_PARTITIONS
  2  WHERE TABLE_NAME='STUDENT';

TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
STUDENT                        STU_DEFAULT
DEFAULT


STUDENT                        STU_DIVA
'a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j', 'k'


TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------

STUDENT                        STU_DIVB
'n', 'o', 'p', 'q', 'r', 's', 't', 'u', 'v', 'w', 'x', 'y', 'z'


STUDENT                        STU_NULL
NULL

TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
```

□ Write a command to add values ‘l’ and ‘m’ in a partition stu_divA

Query:

✓ alter table Student modify partition stu_divA add values('l','m');

Output:

```
SQL> alter table Student modify partition stu_divA add values('l','m');

Table altered.
```

```
TABLE_NAME                     PARTITION_NAME
------------------------------ ------------------------------
HIGH_VALUE
--------------------------------------------------------------------------------
  NUM_ROWS
----------
STUDENT                        STU_DEFAULT
DEFAULT


STUDENT                        STU_DIVA
'a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j', 'k', 'l', 'm'
```

□ Write a command to display records from stu_divA partition.

Query:

✓ select * from Student partition(stu_divA);

Output:

```
SQL> select * from Student partition(stu_divA);

STUDENT_ID STUDENT_NAME          STUDENT_D
---------- --------------------- ---------
       221 j                     15-SEP-58
       321 a                     19-AUG-92
       421 h                     10-JUL-91
       521 l                     02-JUL-65
       621 m                     08-MAY-68

SQL>
```

Practical No. 02

Aim: Implementation of Analytical Queries like Roll_Up, CUBE, First, Last, Lead, Lag, Row_number, Rank and Dense Rank.

□ Creating a Table: Employee Table and Inserting values in the Table.

Query:

✓ create table Employee(
EmpNo number(6), Name
varchar(10), Position
varchar(6), Manager
number(6), JoinDate date,
Salary number(7),
DeptNo number(3));

✓ insert into Employee values(1632,'Sam','Asstt',131632,to_date('9-6-1963','dd-mm-yyyy'),11370,102);
insert into Employee values(1461,'Lark','Asstt',131461,to_date('2-4-1965','dd-mm-yyyy'),25410,203);
insert into Employee values(2345,'Herman','Oficer',130245,to_date('19-4-1978','dd-mm-yyyy'),37520,102);
insert into Employee values(2893,'Daniel','Oficer',131461,to_date('3-12-1988','dd-mm-yyyy'),8230,203);
insert into Employee values(5845,'Park','Mngr',130245,to_date('17-12-1991','dd-mm-yyyy'),45840,203);
insert into Employee values(6459,'Muel','Mngr',131461,to_date('20-2-1993','dd-mm-yyyy'),64559,304);
insert into Employee values(7583,'Shane','SrMngr',130245,to_date('22-2-1995','dd-mm-yyyy'),77580,304);
insert into Employee values(9534,'Murr','SrMngr',131632,to_date('25-2-1989','dd-mm-yyyy'),95450,304);

Output:

```
SQL> select * from Employee;

     EMPNO NAME       POSITI    MANAGER JOINDATE      SALARY     DEPTNO
---------- ---------- ------ ---------- --------- ---------- ----------
      1632 Sam        Asstt      131632 09-JUN-63      11370        102
      1461 Lark       Asstt      131461 02-APR-65      25410        203
      5845 Park       Mngr       130245 17-DEC-91      45840        203
      6459 Muel       Mngr       131461 20-FEB-93      64559        304
      7583 Shane      SrMngr     130245 22-FEB-95      77580        304
      9534 Murr       SrMngr     131632 25-FEB-89      95450        304
      2345 Herman     Oficer     130245 19-APR-78      37520        102
      2893 Daniel     Oficer     131461 03-DEC-88       8230        203

8 rows selected.
```

□ **Roll_Up**

Syntax:

✓ select c1, c2, aggregate_function(c3)

from table_name
GROUP BY ROLLUP (c1, c2);

✓ **Roll_Up** is a modifier used to produce the summary output, including extra rows that represent super-aggregate (higher-level) summary operations. It enables us to sum-up the output at multiple levels of analysis using a single query.

Query:

✓ Without RollUp:

select DeptNo, sum(Salary) as
Total from Employee group by
DeptNo
order by DeptNo;

Output:

```
SQL> select DeptNo, sum(Salary)
  2  as Total from Employee
  3  group by DeptNo
  4  order by DeptNo;

    DEPTNO       TOTAL
---------- ----------
       102       48890
       203       79480
       304      237589
```

✓ With RollUp:

select DeptNo, sum(Salary) as
Total from Employee group by
rollup(DeptNo) order by
DeptNo;

Output:

```
SQL> select DeptNo, sum(Salary)
  2  as Total from Employee
  3  group by rollup(DeptNo)
  4  order by DeptNo;

    DEPTNO       TOTAL
---------- ----------
       102       48890
       203       79480
```

✓ Multiple Column without RollUp:

```
select DeptNo, Position, sum(Salary) as
Total from Employee
group by DeptNo, Position
order by 1,2;
```

Output:

```
SQL> select DeptNo,Position,sum(Salary)
  2  as Total from Employee
  3  group by DeptNo,Position
  4  order by 1,2;

    DEPTNO POSITI       TOTAL
---------- ------ ----------
       102 Asstt        11370
       102 Oficer       37520
       203 Asstt        25410
       203 Mngr         45840
       203 Oficer        8230
       304 Mngr         64559
       304 SrMngr      173030

7 rows selected.
```

✓ Multiple Column with RollUp:

```
select DeptNo, Position, sum(Salary) as
Total from Employee
group by rollup(DeptNo, Position) order
by 1,2;
```

Output:

```
SQL> select DeptNo,Position,sum(Salary)
  2  as Total from Employee
  3  group by rollup(DeptNo,Position)
  4  order by 1,2;

    DEPTNO POSITI       TOTAL
---------- ------ ----------
       102 Asstt       11370
       102 Oficer      37520
       102             48890
       203 Asstt       25410
       203 Mngr        45840
       203 Oficer       8230
       203             79480
       304 Mngr        64559
       304 SrMngr     173030
       304            237589
                      365959

11 rows selected.
```

□ **CUBE**

Syntax:

✓ select c1, c2, aggregate_function(c3)

from table_name
GROUP BY CUBE (c1, c2);

✓ **CUBE** is an extension similar to ROLLUP, enabling a single statement to calculate all possible combinations of subtotals. CUBE can generate the information needed in cross-tab reports with a single query.

Query:

✓ Without CUBE:

select DeptNo, sum(Salary) as
Total from Employee group by
DeptNo
order by DeptNo;

Output:

```
SQL> select DeptNo, sum(Salary)
  2  as Total from Employee
  3  group by DeptNo
  4  order by DeptNo;

    DEPTNO       TOTAL
---------- ----------
       102       48890
       203       79480
       304      237589
```

✓ With CUBE:

select DeptNo, sum(Salary) as
Total from Employee group by
cube(DeptNo) order by
DeptNo;

Output:

```
SQL> select DeptNo, sum(Salary)
  2  as Total from Employee
  3  group by cube(DeptNo)
  4  order by DeptNo;

    DEPTNO       TOTAL
---------- ----------
       102       48890
       203       79480
       304      237589
                365959
```

✓ Multiple Column without Cube:

```
select DeptNo, Position, sum(Salary) as
Total from Employee
group by DeptNo, Position
order by 1,2;
```

Output:

```
SQL> select DeptNo,Position,sum(Salary)
  2  as Total from Employee
  3  group by DeptNo,Position
  4  order by 1,2;

    DEPTNO POSITI       TOTAL
---------- ------ ----------
       102 Asstt       11370
       102 Oficer      37520
       203 Asstt       25410
       203 Mngr        45840
       203 Oficer       8230
       304 Mngr        64559
       304 SrMngr     173030

7 rows selected.
```

✓ Multiple Column with Cube:

```
select DeptNo,Position,sum(Salary) as
Total from Employee
group by cube(DeptNo,Position) order
by 1,2;
```

Output:

```
SQL> select DeptNo,Position,sum(Salary)
  2  as Total from Employee
  3  group by cube(DeptNo,Position)
  4  order by 1,2;

    DEPTNO POSITI       TOTAL
---------- ------ ----------
       102 Asstt       11370
       102 Oficer      37520
       102             48890
       203 Asstt       25410
       203 Mngr        45840
       203 Oficer       8230
       203             79480
       304 Mngr        64559
       304 SrMngr     173030
       304            237589
           Asstt       36780

    DEPTNO POSITI       TOTAL
---------- ------ ----------
           Mngr       110399
           Oficer      45750
           SrMngr     173030
                      365959

15 rows selected.
```

□ **Rank**

Syntax:

✓ select c1, c2, c3 rank()
over(order by c1) RANK
from table_name;

✓ **Rank** function assigns a rank to each row within a partition such that each row's rank is one more than total number of rows that have been ranked in that partition.

Query:

✓ select Salary, rank() over(order by Salary) RANK from Employee;

Output:

```
SQL> select Salary, rank()
  2  over(order by Salary) RANK
  3  from Employee;

    SALARY         RANK
---------- ----------
      8230          1
     11370          2
     25410          3
     37520          4
     45840          5
     64559          6
     77580          7
     95450          8

8 rows selected.
```

✓ select EmpNo, DeptNo, Salary, JoinDate, rank() over(order by Salary) RANK

```
SQL> select EmpNo, DeptNo, Salary, JoinDate, rank()
  2  over(order by Salary) RANK
  3  from Employee;

     EMPNO      DEPTNO      SALARY JOINDATE         RANK
---------- ---------- ---------- --------- ----------
      2893         203       8230 03-DEC-88          1
      1632         102      11370 09-JUN-63          2
      1461         203      25410 02-APR-65          3
      2345         102      37520 19-APR-78          4
      5845         203      45840 17-DEC-91          5
      6459         304      64559 20-FEB-93          6
      7583         304      77580 22-FEB-95          7
      9534         304      95450 25-FEB-89          8

8 rows selected.
```

□ **Dense Rank**

Syntax:

✓ select c1, c2, c3 dense_rank()

over(order by c1) DENSE_RANK
from table_name;

✓ **DENSE_RANK()** is a window function that assigns a rank to each row within a partition or result set with no gaps in ranking values. The rank of a row is increased by one from the number of distinct rank values which come before the row. **Query:**

✓ select Salary, dense_rank()

over(order by Salary) DENSE_RANK from
Employee;

Output:

```
SQL> select Salary, dense_rank()
  2  over(order by Salary) DENSE_RANK
  3  from Employee;

    SALARY DENSE_RANK
---------- ----------
      8230          1
     11370          2
     25410          3
     37520          4
     45840          5
     64559          6
     77580          7
     95450          8

8 rows selected.
```

✓ select EmpNo, DeptNo, Salary, JoinDate, dense_rank()

over(order by Salary) DENSE_RANK
from Employee;

```
SQL> select EmpNo, DeptNo, Salary, JoinDate, dense_rank()
  2  over(order by Salary) DENSE_RANK
  3  from Employee;

     EMPNO      DEPTNO      SALARY JOINDATE   DENSE_RANK
---------- ---------- ---------- --------- ----------
      2893         203       8230 03-DEC-88          1
      1632         102      11370 09-JUN-63          2
      1461         203      25410 02-APR-65          3
      2345         102      37520 19-APR-78          4
      5845         203      45840 17-DEC-91          5
      6459         304      64559 20-FEB-93          6
      7583         304      77580 22-FEB-95          7
      9534         304      95450 25-FEB-89          8

8 rows selected.
```

□ **Row_Number**

Syntax:

✓ select column_name, row_number()

over (order by col)
ROW_NUM from table_name;

✓ **ROW_NUMBER()** function is a type of function that returns a number for each row in sequence or serial, beginning from 1 for the first record of the result set to the end in ascending order.

Query:

✓ select EmpNo, row_number()

over (order by Salary)
ROW_NUM from Employee;

Output:

```
SQL> select EmpNo, row_number()
  2  over (order by Salary)
  3  ROW_NUM from Employee;

     EMPNO     ROW_NUM
---------- ----------
      2893          1
      1632          2
      1461          3
      2345          4
      5845          5
      6459          6
      7583          7
      9534          8

8 rows selected.
```

✓ select EmpNo, DeptNo, Salary, JoinDate,

row_number() over (order by Salary)

```
SQL> select EmpNo,DeptNo,Salary,JoinDate,
  2  row_number() over (order by Salary)
  3  ROW_NUM from Employee;

     EMPNO     DEPTNO     SALARY JOINDATE     ROW_NUM
---------- ---------- ---------- --------- ----------
      2893        203       8230 03-DEC-88          1
      1632        102      11370 09-JUN-63          2
      1461        203      25410 02-APR-65          3
      2345        102      37520 19-APR-78          4
      5845        203      45840 17-DEC-91          5
      6459        304      64559 20-FEB-93          6
      7583        304      77580 22-FEB-95          7
      9534        304      95450 25-FEB-89          8

8 rows selected.
```

□ **LEAD**

Syntax:

✓ LEAD(<sql expr>, <offset>, <default>)
OVER(<analytic_clause>)

✓ **LEAD()** function is a window function that allows you to look forward a number of rows and access data of that row from the current row. It is very useful for calculating the difference between the current row and the subsequent row within the same result set.

Query:

✓ select DeptNo, EmpNo, Salary,

LEAD(Salary,1,0)
over(partition by DeptNo order by Salary desc) next_low_sal from
Employee
where DeptNo in(203,304) order
by DeptNo, Salary desc;

```
SQL> select DeptNo, EmpNo, Salary,
  2  LEAD(Salary,1,0)
  3  over(partition by DeptNo order by Salary desc) next_low_sal
  4  from Employee
  5  where DeptNo in(203,304)
  6  order by DeptNo, Salary desc;

    DEPTNO      EMPNO     SALARY NEXT_LOW_SAL
---------- ---------- ---------- ------------
       203       5845      45840        25410
       203       1461      25410         8230
       203       2893       8230            0
       304       9534      95450        77580
       304       7583      77580        64559
       304       6459      64559            0

6 rows selected.
```

□ **LAG**

Syntax:

✓ LAG(<sql expr>, <offset>, <default>)

OVER(<analytic_clause>)

✓ **LAG()** function is a window function that allows you to look back a number of rows and access data of that row from the current row. It returns the value of the expression from the row that precedes the current row by offset number of rows within its partition or result set.

Query:

✓ select DeptNo, EmpNo, Salary,

LAG(Salary,1,0)

over(partition by DeptNo order by Salary desc) next_high_sal from

Employee

where DeptNo in(203,304) order

by DeptNo, Salary desc;

```
SQL> select DeptNo, EmpNo, Salary,
  2  LAG(Salary,1,0)
  3  over(partition by DeptNo order by Salary desc) next_high_sal
  4  from Employee
  5  where DeptNo in(203,304)
  6  order by DeptNo, Salary desc;

    DEPTNO      EMPNO     SALARY NEXT_HIGH_SAL
---------- ---------- ---------- -------------
       203       5845      45840             0
       203       1461      25410         45840
       203       2893       8230         25410
       304       9534      95450             0
       304       7583      77580         95450
       304       6459      64559         77580

6 rows selected.
```

□ **FIRST**

Syntax:

✓ Function() KEEP(DENSE_RANK FIRST

ORDER BY<expr>)OVER(<partitioning clause>)

✓ **FIRST** function is used to return the first value of the selected column. Here, we use limit clause to select first record or more.

Query:

✓ select DeptNo, EmpNo, Salary,

min(Salary)keep(dense_rank FIRST order by Salary)
over(partition by DeptNo) as lowest
from Employee
order by DeptNo,Salary;

```
SQL> select DeptNo, EmpNo, Salary,
  2  min(Salary)keep(dense_rank FIRST order by Salary)
  3  over(partition by DeptNo) as lowest
  4  from Employee
  5  order by DeptNo,Salary;

    DEPTNO      EMPNO     SALARY     LOWEST
---------- ---------- ---------- ----------
       102       1632      11370      11370
       102       2345      37520      11370
       203       2893       8230       8230
       203       1461      25410       8230
       203       5845      45840       8230
       304       6459      64559      64559
       304       7583      77580      64559
       304       9534      95450      64559

8 rows selected.
```

□ **LAST**

Syntax:

✓ Function() KEEP(DENSE_RANK LAST ORDER

BY<expr>)OVER(<partitioning clause>)

✓ **LAST** function is used to return the last value of the selected column.

Query:

✓ select DeptNo, EmpNo, Salary,

min(Salary)keep(dense_rank LAST order by Salary)
over(partition by DeptNo) as highest
from Employee
order by DeptNo,Salary;

```
SQL> select DeptNo, EmpNo, Salary,
  2  min(Salary)keep(dense_rank LAST order by Salary)
  3  over(partition by DeptNo) as highest
  4  from Employee
  5  order by DeptNo,Salary;

    DEPTNO      EMPNO     SALARY    HIGHEST
---------- ---------- ---------- ----------
       102       1632      11370      37520
       102       2345      37520      37520
       203       2893       8230      45840
       203       1461      25410      45840
       203       5845      45840      45840
       304       6459      64559      95450
       304       7583      77580      95450
       304       9534      95450      95450

8 rows selected.
```

Practical No. 03

Aim: Implementation of ORDBMS using ADT (Abstract Data Type), Reference.

c) Abstract Data Type

□ Create Object Type 'data_type1' with Object Attribute 'Year' and Function 'Prod(Invest number)', use this function to return the Sum of Year and Invest value.

Query:

✓ create type data_type1 as

```
object(Year number,
member function Prod(Invest number)
return number);
/
```

✓ create type body data_type1 is member

```
function Prod(Invest number) return
number is
begin return(Year+Invest);
end;
end;
/
```

Output:

```
SQL> create type data_type1 as
  2  object(Year number,
  3  member function Prod(Invest number)
  4  return number);
  5  /

Type created.

SQL> create type body data_type1 is
  2  member function Prod(Invest number)
  3  return number is
  4  begin
  5  return(Year+Invest);
  6  end;
  7  end;
  8  /

Type body created.
```

□ Create Table ‘Data’ with Attribute ‘Col’ of type ‘data_type1’. Insert a value in the table. Display the result using Select statement.

Query:

✓ create table Data(Col data_type1); insert

into Data values(data_type1(2)); select

d.Col.Prod(12) from Data d;

Output:

```
SQL> create table Data(Col data_type1);

Table created.

SQL> insert into Data values(data_type1(2));

1 row created.

SQL> select d.Col.Prod(12) from Data d;

D.COL.PROD(12)
--------------
            14
```

□ Create Object Type ‘Name’ with Object Attributes ‘FName’ and ‘LName’. Display the First and Last Name of a Person using Table ‘Person’.

Query:

✓ create type Name as
object(
FName varchar(10),
LName varchar(10));
/

Output:

```
SQL> create type Name as
  2  object(
  3  FName varchar(10),
  4  LName varchar(10));
  5  /

Type created.
```

- □ Creating Table ‘Person’ with Attribute ‘PName’ of type ‘Name’.
- □ Inserting values in the table ‘Person’.
- □ Displaying the Description of table ‘Person’.

Query:

✓ create table
Person(PName Name);

✓ insert into Person values(Name('Lekha','Naik'));

✓ desc Person;

Output:

```
SQL> create table
  2  Person(PName Name);
Table created.

SQL>
SQL> insert into Person values(Name('Lekha','Naik'));

1 row created.

SQL> desc Person;
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------------------
 PNAME                                               NAME
```

- □ Displaying First Name.
- □ Displaying First and Last Name.

Query:

✓ select p.PName.FName from Person p;

✓ select p.PName.FName || ' ' || p.PName.LName from Person p;

Output:

```
SQL> select p.PName.FName from Person p;

PNAME.FNAM
----------
Lekha

SQL> select p.PName.FName || ' ' || p.PName.LName from Person p;

P.PNAME.FNAME||''||P.
---------------------
Lekha Naik
```

□ Create Object Type ‘Address’ with Object Attributes ‘Street’ and ‘City’. Display the Street and City of a person using Table ‘People’, also Display the Person ‘Name’ and ‘DOB’ using ‘Name’ and ‘Date’ Object Type.

Query:

✓ Creating Object Type ‘Address’ with Attributes ‘Street’ and ‘City’:

```
create type Address as
object(
Street varchar(10),
City varchar(10));
/
```

✓ Creating Table ‘People’:

```
create table
People(Name Name,
Addrs Address, DOB
Date);
```

✓ Inserting values in Table:

```
insert into People values(Name('Lekha','Naik'),
Address('Mira Road','Thane'),
to_date('02-06-1997','dd-mm-yyyy'));
```

```
SQL> create type Address as
  2  object(
  3  Street varchar(10),
  4  City varchar(10));
  5  /

Type created.

SQL>
SQL> create table
  2  People(Name Name,
  3  Addrs Address,
  4  DOB Date);

Table created.

SQL>
SQL> insert into People values(Name('Lekha','Naik'),
  2  Address('Mira Road','Thane'),
  3  to_date('02-06-1997','dd-mm-yyyy'));

1 row created.
```

✓ Displaying the Table:

select * from People;

✓ Displaying the First and Last Name:

select pd.Name.FName || ' ' || pd.Name.LName from People pd;

✓ Displaying the ‘Street’ and ‘City’:

select pd.Addrs.Street || ' ' || pd.Addrs.City from People pd;

✓ Displaying the ‘Date of Birth(DOB)’:

select DOB from People;

```
SQL> select * from People;

NAME(FNAME, LNAME)
--------------------------------------------------------------------------------
ADDRS(STREET, CITY)
--------------------------------------------------------------------------------
DOB
---------
NAME('Lekha', 'Naik')
ADDRESS('Mira Road', 'Thane')
02-JUN-97


SQL>
SQL> select pd.Name.FName || ' ' || pd.Name.LName from People pd;

PD.NAME.FNAME||''||PD
---------------------
Lekha Naik

SQL>
SQL> select pd.Addrs.Street || ' ' || pd.Addrs.City from People pd;

PD.ADDRS.STREET||''||
---------------------
Mira Road Thane

SQL>
SQL> select DOB from People;

DOB
---------
02-JUN-97
```

□ Create Object Type ‘Demo’ with Object Attribute ‘ID’ and Function ‘get_square’. Use this Function to return the Square of ID attribute value.

Query:

✓ Creating Object Type ‘Demo’ with Attribute ‘ID’ and Function ‘get_square’:

```
create type Demo as
object(ID number,
member function get_square
return number);
/
```

✓ Creating Table ‘Demo_Tbl’ with Attribute ‘Col’ of type ‘Demo’:

```
create table
Demo_Tbl(Col Demo);
```

✓ Inserting Values in the Table:

```
insert into Demo_Tbl values(Demo(3));
```

□ **Output:**

```
SQL> create type Demo as
  2  object(ID number,
  3  member function get_square
  4  return number);
  5  /

Type created.

SQL>
SQL> create table
  2  Demo_Tbl(Col Demo);

Table created.

SQL>
SQL> insert into Demo_Tbl values(Demo(3));

1 row created.
```

✓ Creating type body to return the ‘Square of ID’ using ‘get_square’ function:

```
create type body Demo
is member function get_square
return number
is n number;
begin
select s.Col.ID*s.Col.ID into n
from Demo_Tbl s;
return(n); end;
end;
/
```

✓ Displaying the Square of ID attribute value:

```
select v.Col.get_square() from Demo_Tbl v;
```

Output:

```
SQL> create type body Demo
  2  is member function get_square
  3  return number
  4  is n number;
  5  begin
  6  select s.Col.ID*s.Col.ID into n
  7  from Demo_Tbl s;
  8  return(n);
  9  end;
 10  end;
 11  /

Type body created.

SQL>
SQL> select v.Col.get_square() from Demo_Tbl v;

V.COL.GET_SQUARE()
------------------
                 9
```

Practical No. 04

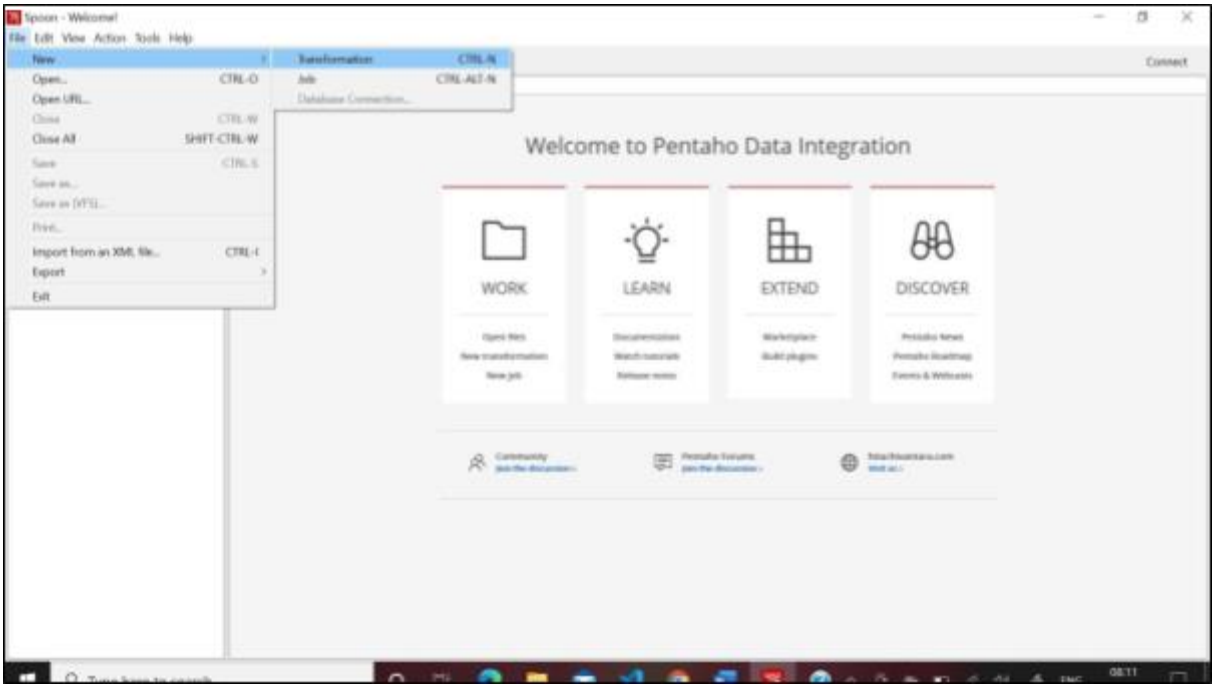
Aim: Implementation of ETL Transformation with Pentaho.

□ Transforming Source Table and Storing to Output Table in SQL.

Steps:

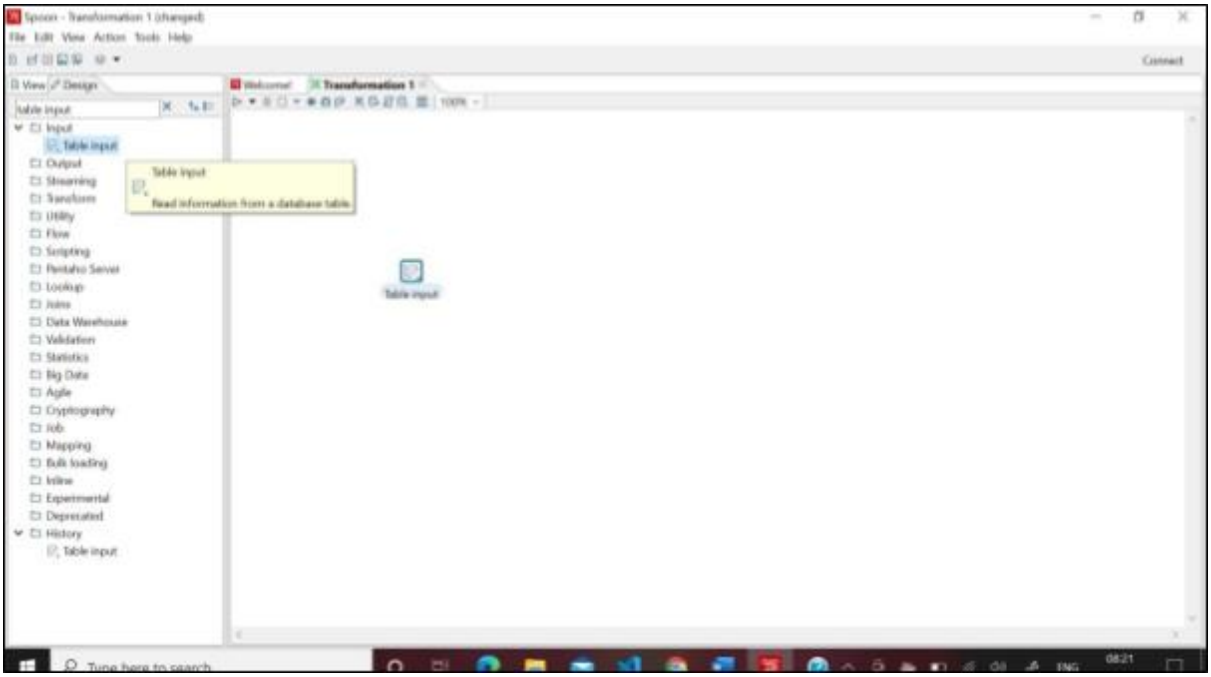
✓ Creating a **New Transformation**:

Open Pentaho Spoon -> File -> New -> Transformation (or CTRL-N)



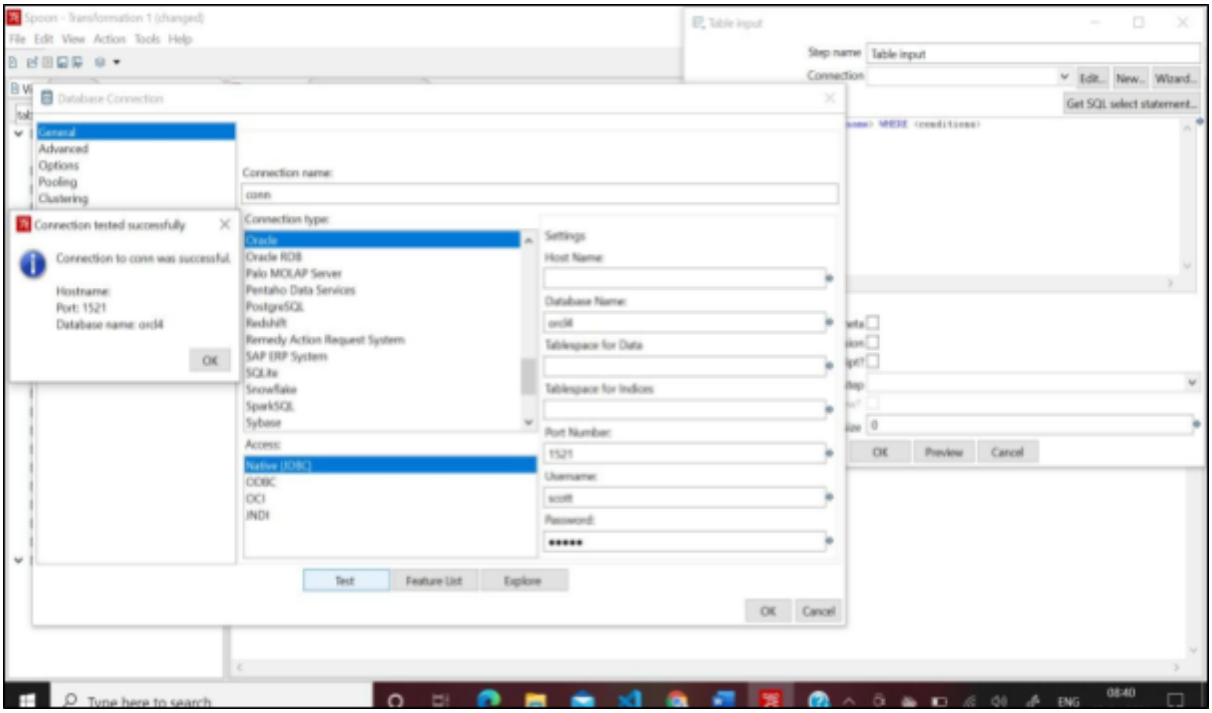
✓ Inserting **Table Input** into the Transformation:

Design -> Input -> Table Input (Drag & Drop in Transformation)



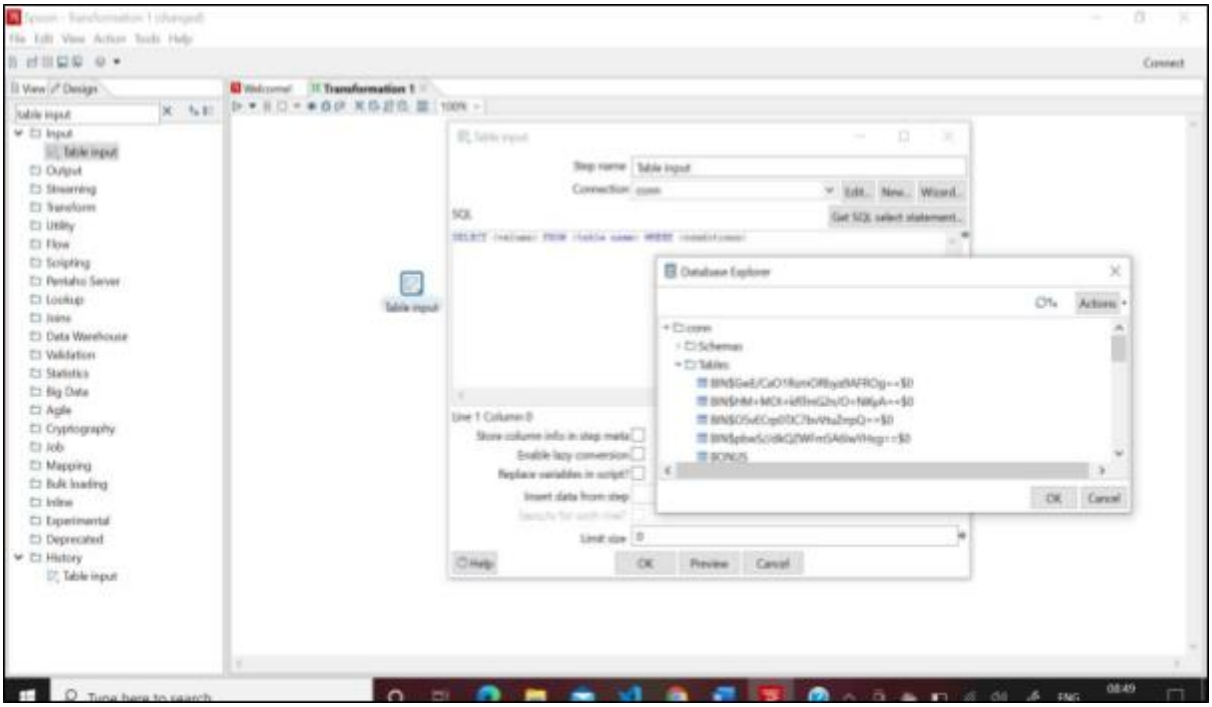
✓ Establishing **Database Connection**:

Double Click Table Input -> New -> Enter following respective Details in *General*: Connection name: *conn* Connection Type: *Oracle* Access: *Native (JDBC)* Database Name: *orcl4* Port Number: *1521* Username: *scott* Password: *tiger* Click Test -> OK -> OK



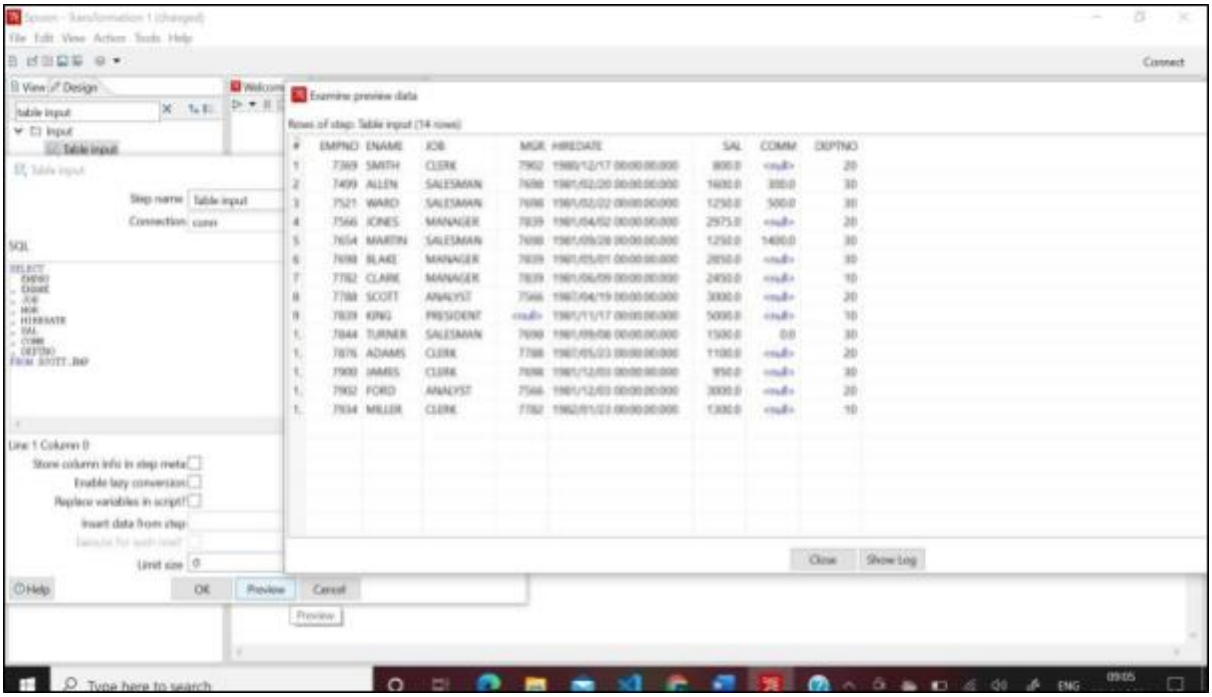
✓ Getting **Source Table**:

Table Input -> Get SQL Select Statement -> Data Explorer -> *conn* -> Tables -> *Click on desired Table* -> OK -> Yes



✓ **View** Input Table:

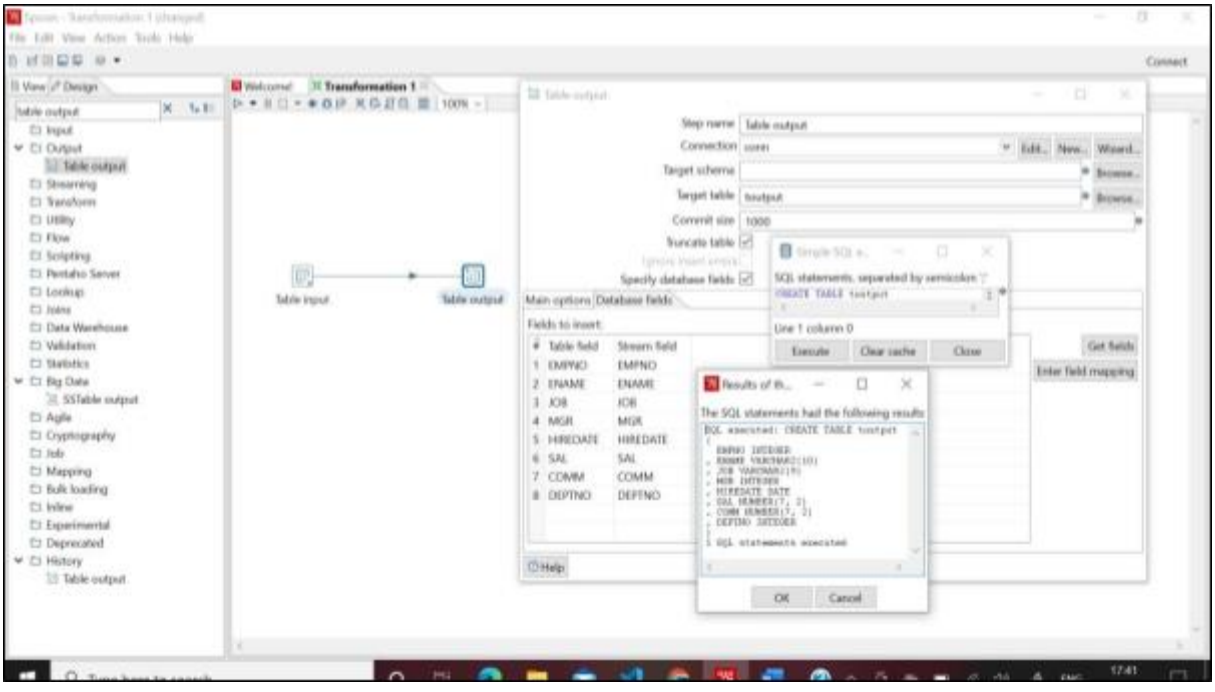
Table Input -> Preview -> OK -> Close -> OK



✓ Storing to **Output Table**:

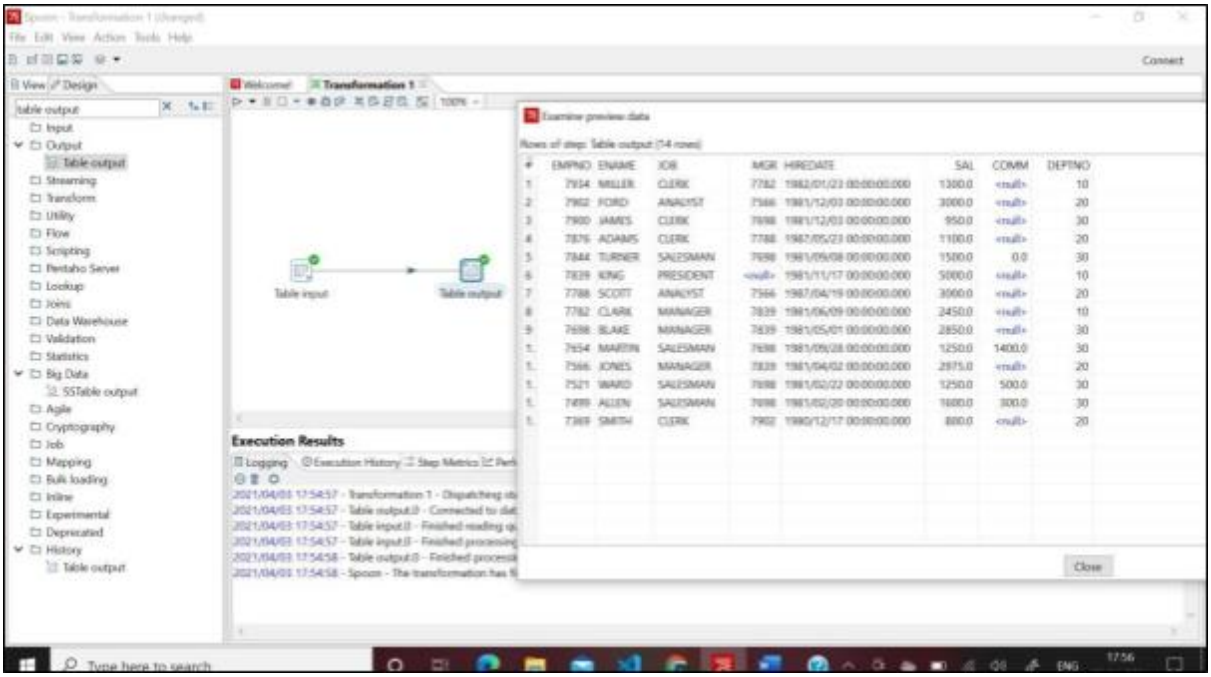
Design -> Output -> Table Output (Drag & Drop in Transformation) -> Create Hop Connection with Output Table (Click on Output Connector arrow in Input Table)

Double Click Table Output -> Target Table: *output* -> Truncate table ☑ -> Specify database fields ☑ -> Database fields -> Get fields -> SQL -> Execute -> OK -> Close



✓ **Debug** Transformation:

Click Table Output -> Debug -> Quick Launch -> Yes



✓ **View** Output Table in **SQL**:

SQL Plus -> select * from output;

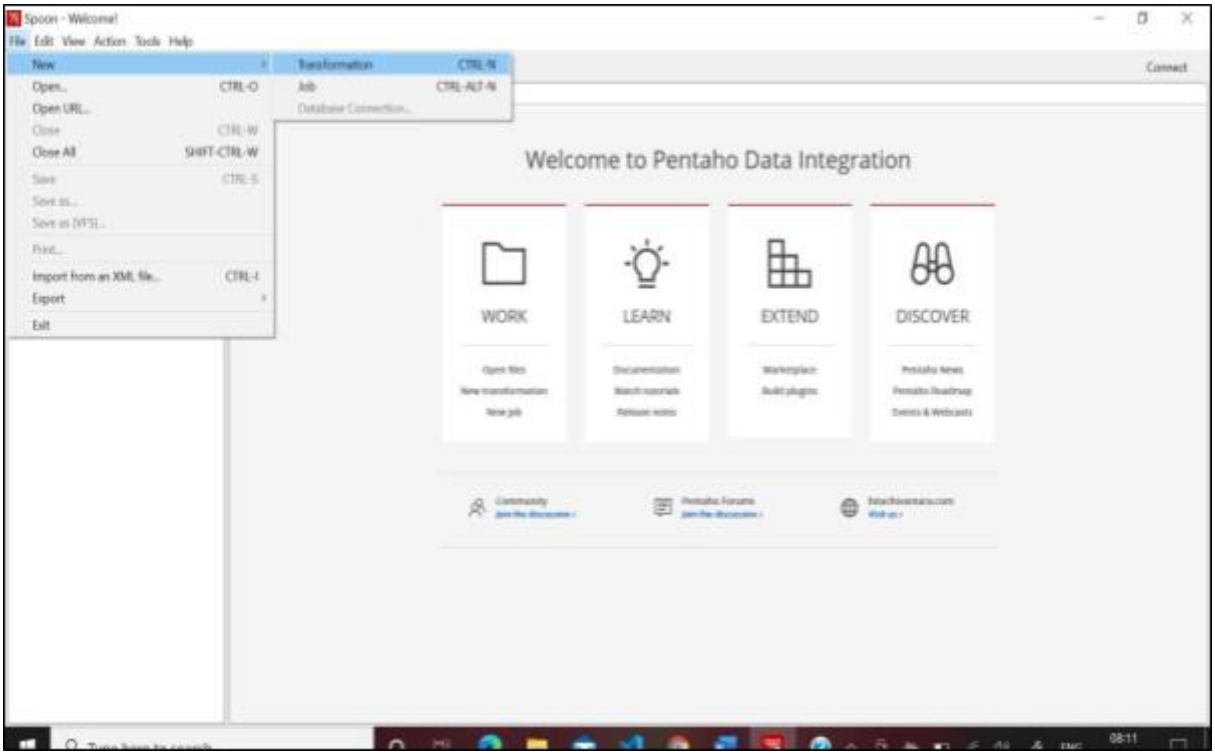
```
Oracle SQL*Plus
File  Edit  Search  Options  Help
SQL> select * from toutput;

     EMPNO ENAME      JOB              MGR HIREDATE          SAL       COMM
---------- ---------- --------- ---------- --------- ---------- ----------
    DEPTNO
----------
      7369 SMITH      CLERK           7902 17-DEC-80        800
        20

      7499 ALLEN      SALESMAN        7698 20-FEB-81       1600        300
        30

      7521 WARD       SALESMAN        7698 22-FEB-81       1250        500
        30


     EMPNO ENAME      JOB              MGR HIREDATE          SAL       COMM
---------- ---------- --------- ---------- --------- ---------- ----------
    DEPTNO
----------
      7566 JONES      MANAGER         7839 02-APR-81       2975
        20

      7654 MARTIN     SALESMAN        7698 28-SEP-81       1250       1400
        30

      7698 BLAKE      MANAGER         7839 01-MAY-81       2850
        30


     EMPNO ENAME      JOB              MGR HIREDATE          SAL       COMM
---------- ---------- --------- ---------- --------- ---------- ----------
    DEPTNO
----------
      7782 CLARK      MANAGER         7839 09-JUN-81       2450
        10

      7788 SCOTT      ANALYST         7566 19-APR-87       3000
        20

      7839 KING       PRESIDENT            17-NOV-81       5000
```

□ Implementation of Sorting Operation and Adding Sequence.

Steps:

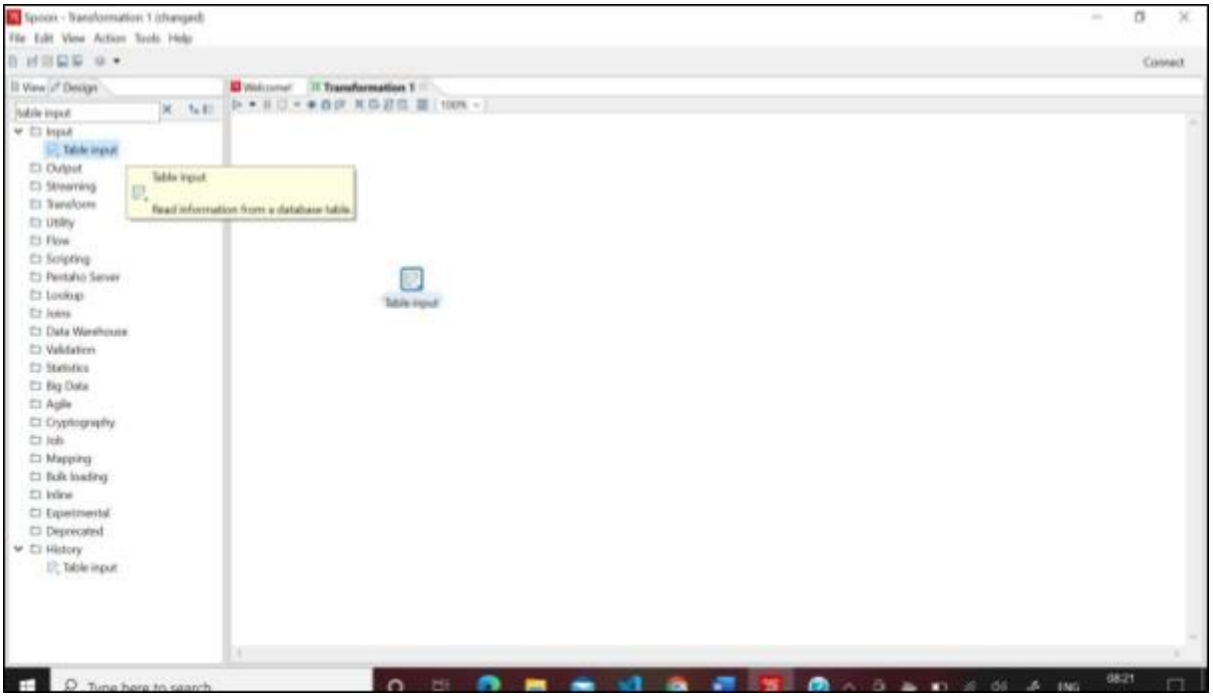
✓ Creating a **New Transformation**:

Open Pentaho Spoon -> File -> New -> Transformation (or CTRL-N)



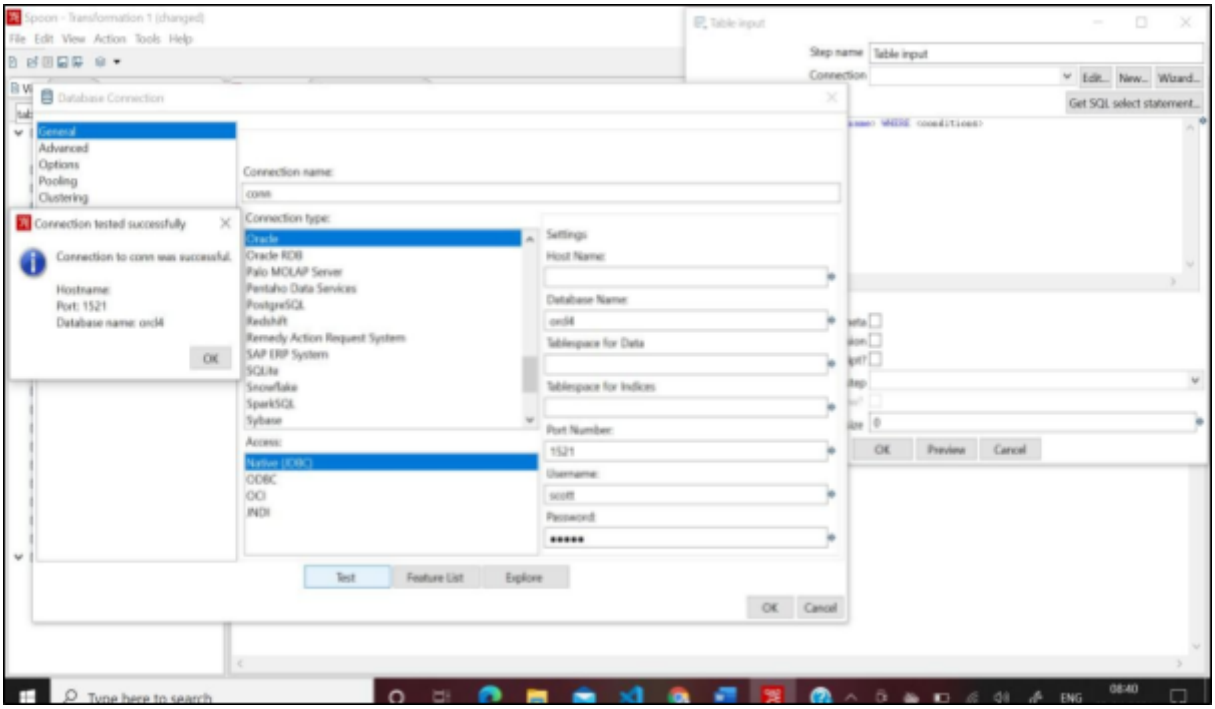
✓ Inserting **Table Input** into the Transformation:

Design -> Input -> Table Input (Drag & Drop in Transformation)



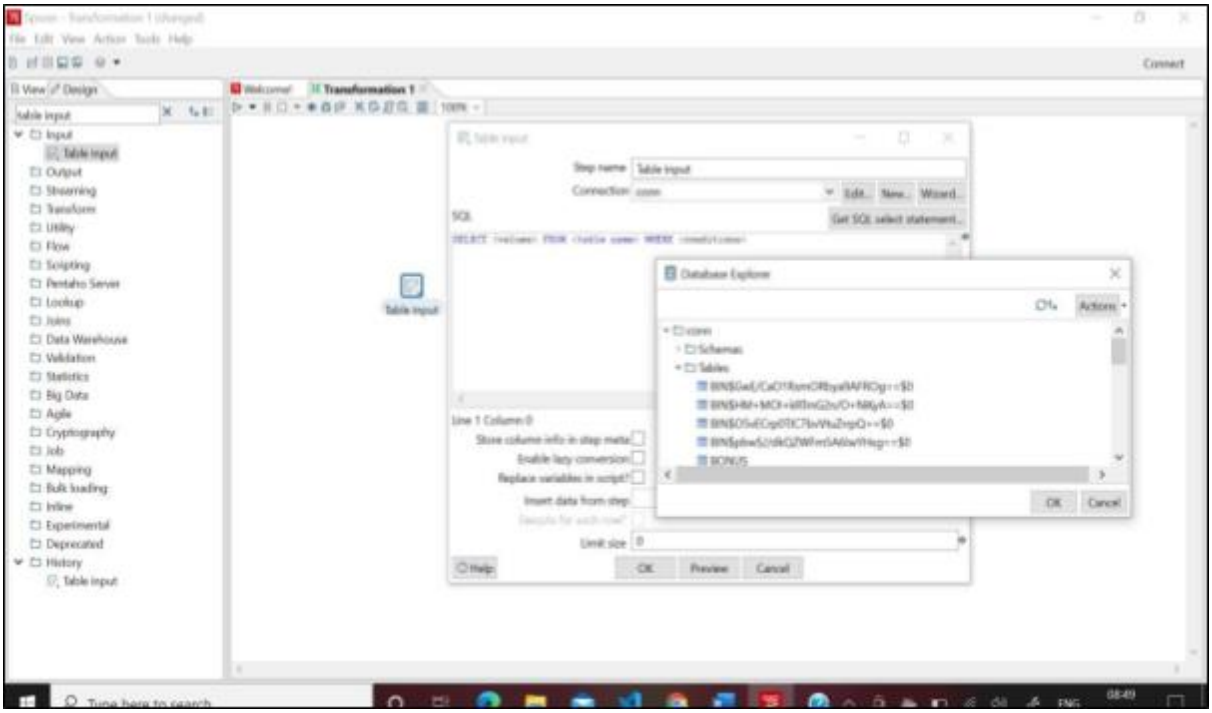
✓ Establishing **Database Connection**:

Double Click Table Input -> New -> Enter following respective Details in *General*: Connection name: *conn* Connection Type: *Oracle* Access: *Native (JDBC)* Database Name: *orcl4* Port Number: *1521* Username: *scott* Password: *tiger* Click Test -> OK -> OK



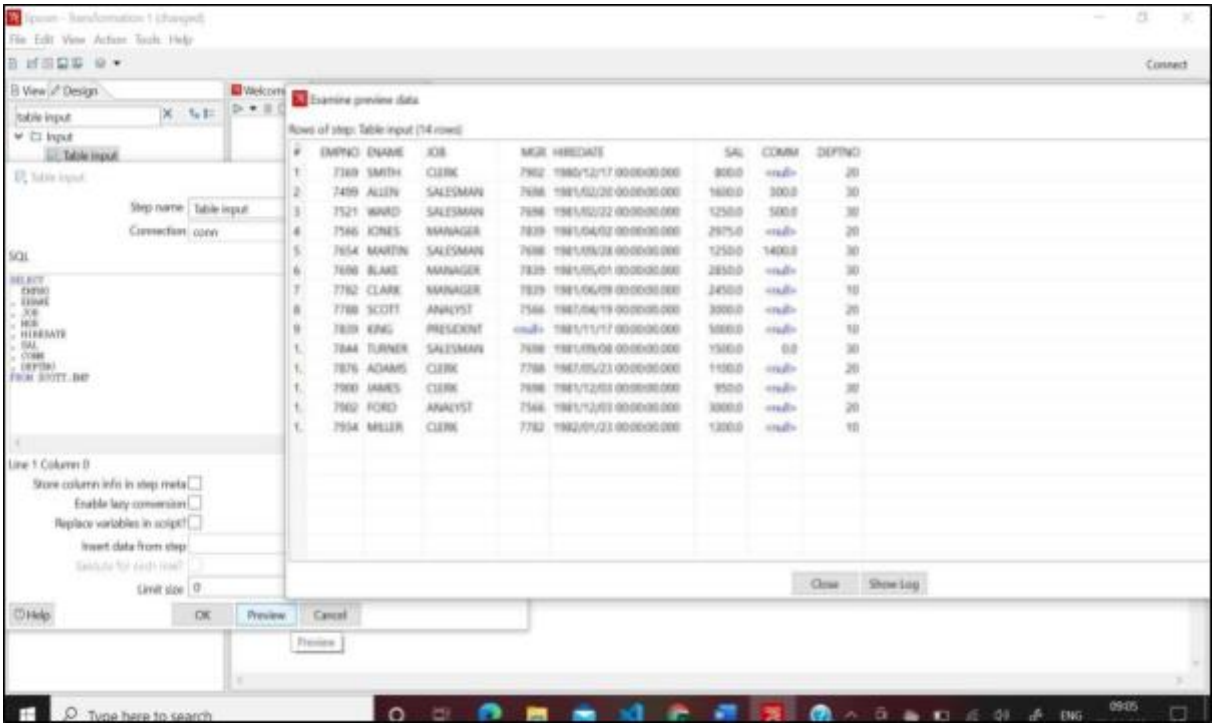
✓ Getting **Source Table**:

Table Input -> Get SQL Select Statement -> Data Explorer -> *conn* -> Tables -> *Click on desired Table* -> OK -> Yes



✓ **View** Input Table:

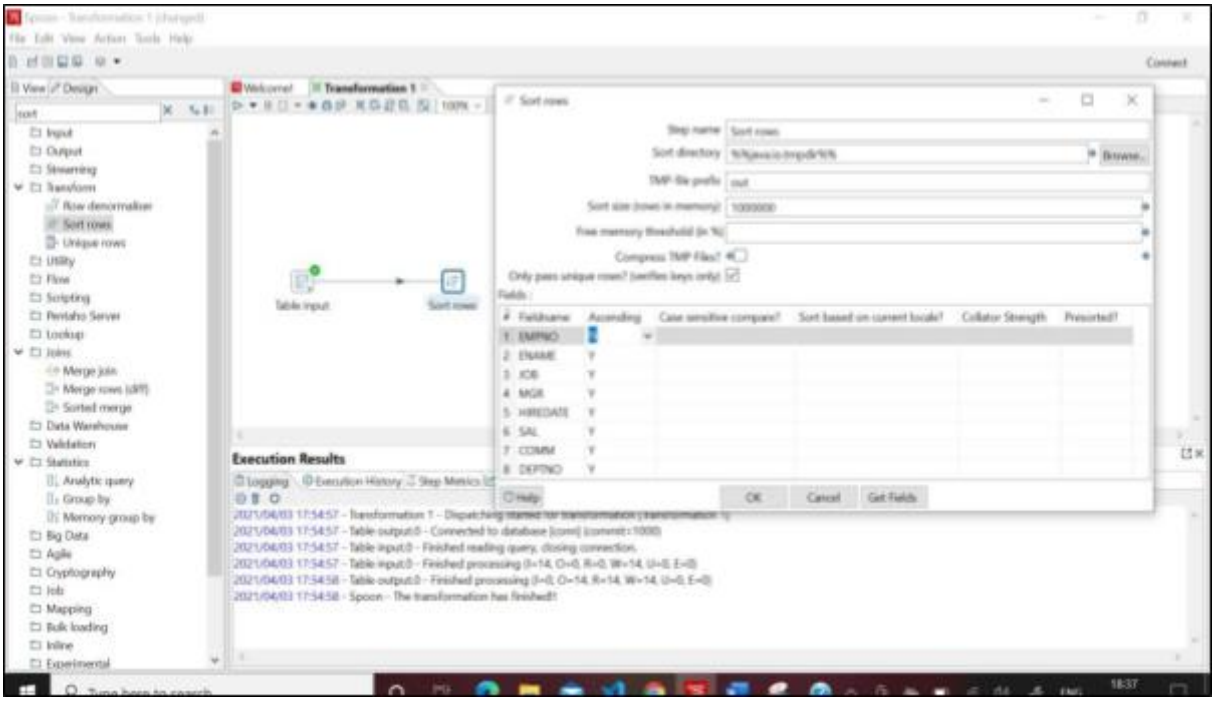
Table Input -> Preview -> OK -> Close -> OK



✓ **Sorting Operation**:

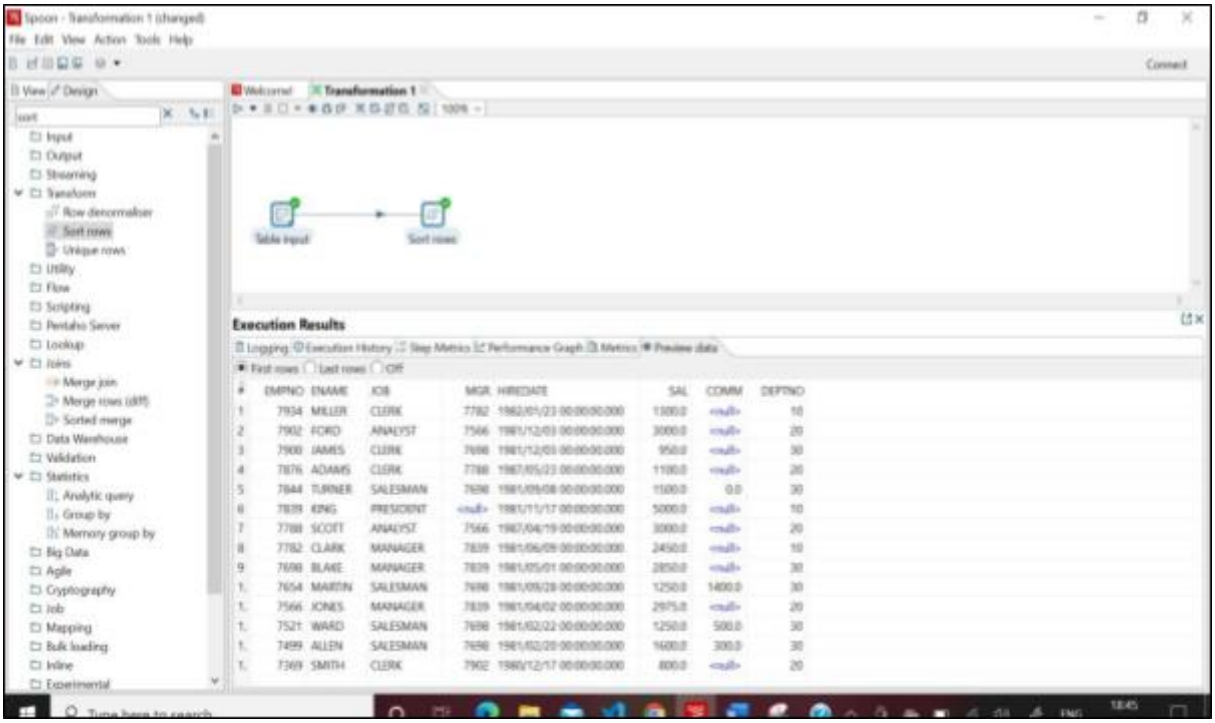
Design -> Transform -> Sort Rows (Drag & Drop in Transformation) -> Create Hop Connection with Sort Rows (Click on Output Connector arrow in Input Table)

Double Click Sort Rows -> Only pass unique rows? ☑ -> Get Fields -> Set desired Order in Fields -> OK



✓ **Debug** Transformation:

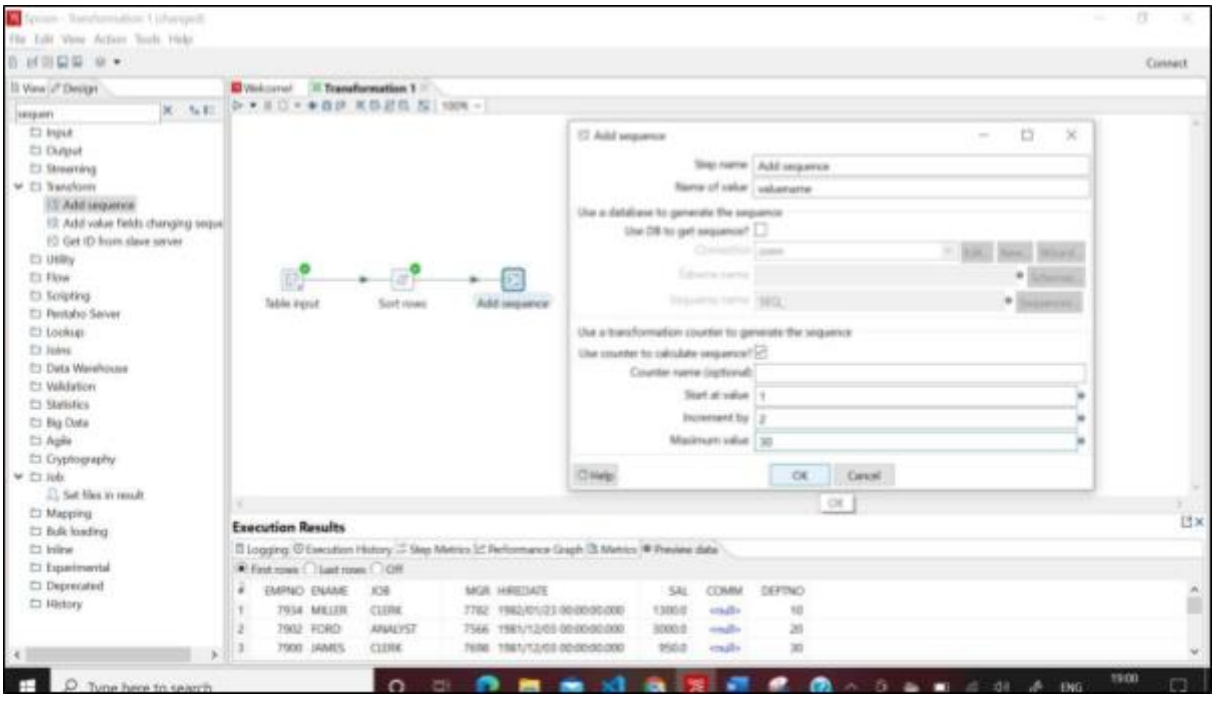
Click Sort Rows -> Debug -> Quick Launch -> Yes



✓ **Adding Sequence**:

Design -> Transform -> Add Sequence (Drag & Drop in Transformation) -> Create Hop Connection with Add Sequence (Click on Output Connector arrow in Sort Rows)

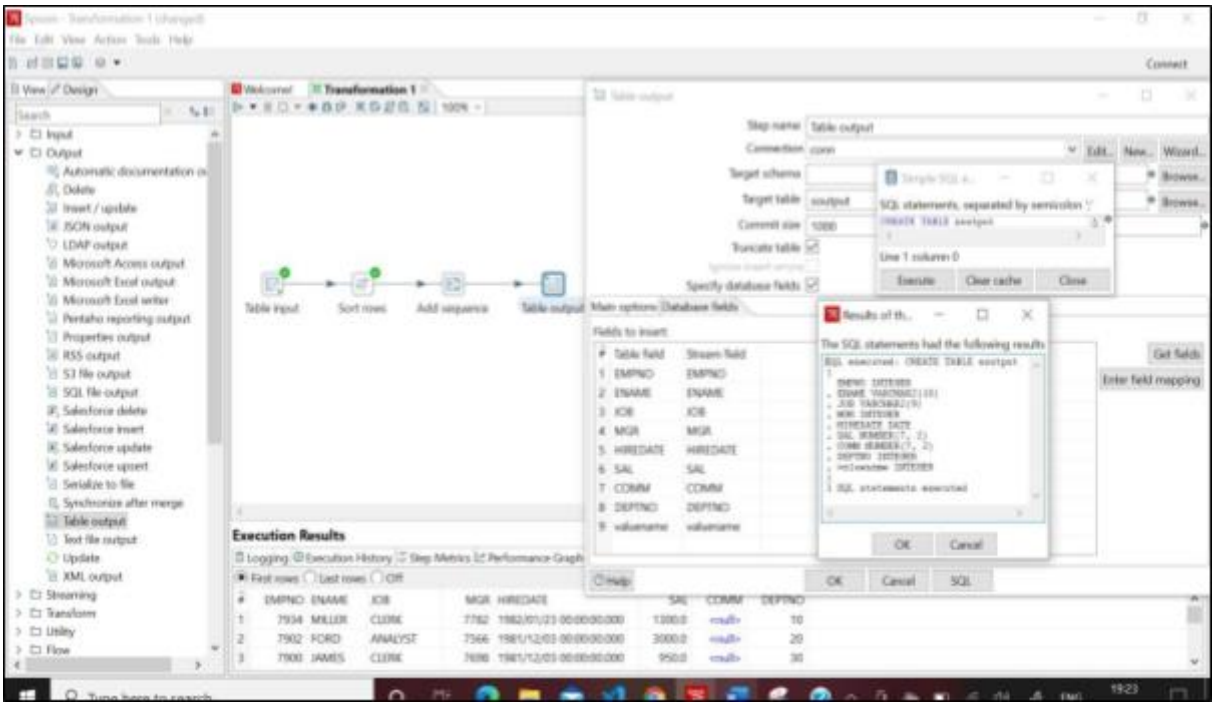
Double Click Add Sequence -> Start at value: *1* -> Increment by: *2* -> Maximum value: *30* -> OK



✓ Storing to **Output Table**:

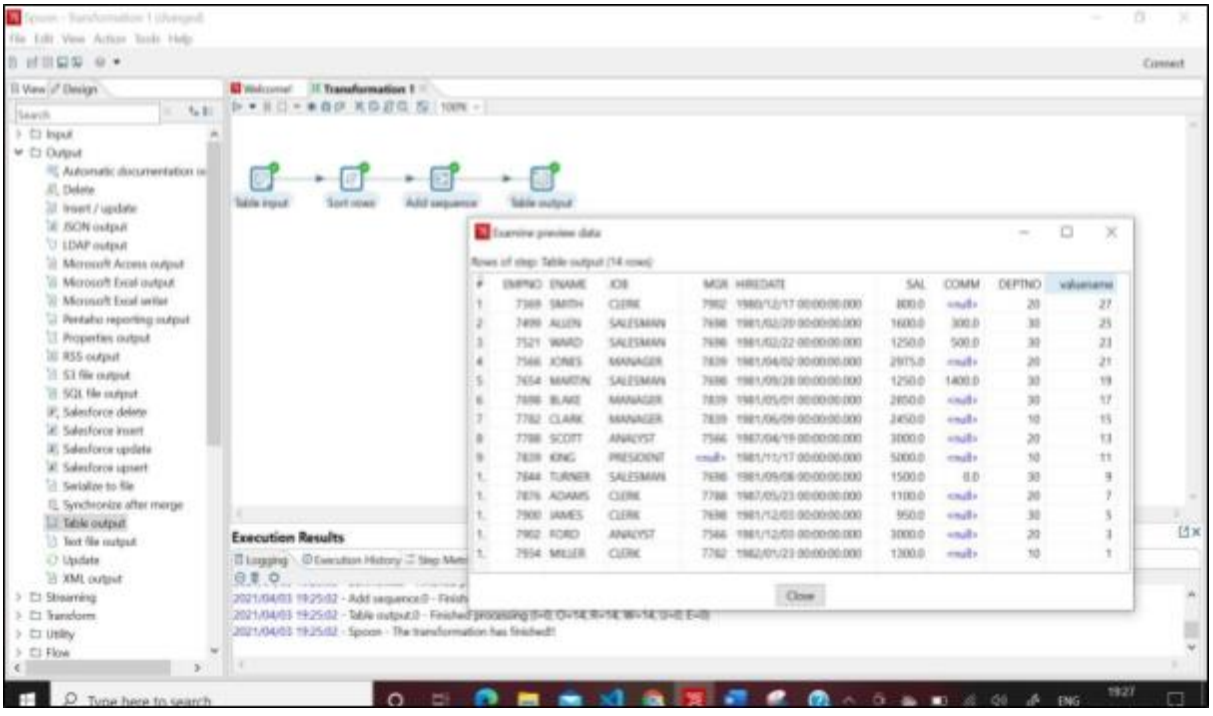
Design -> Output -> Table Output (Drag & Drop in Transformation) -> Create Hop Connection with Output Table (Click on Output Connector arrow in Add Sequence)

Double Click Table Output -> Target Table: *output* -> Truncate table ☑ -> Specify database fields ☑ -> Database fields -> Get fields -> SQL -> Execute -> OK -> Close



✓ **Debug** Transformation:

Click Sort Rows -> Debug -> Quick Launch -> Yes

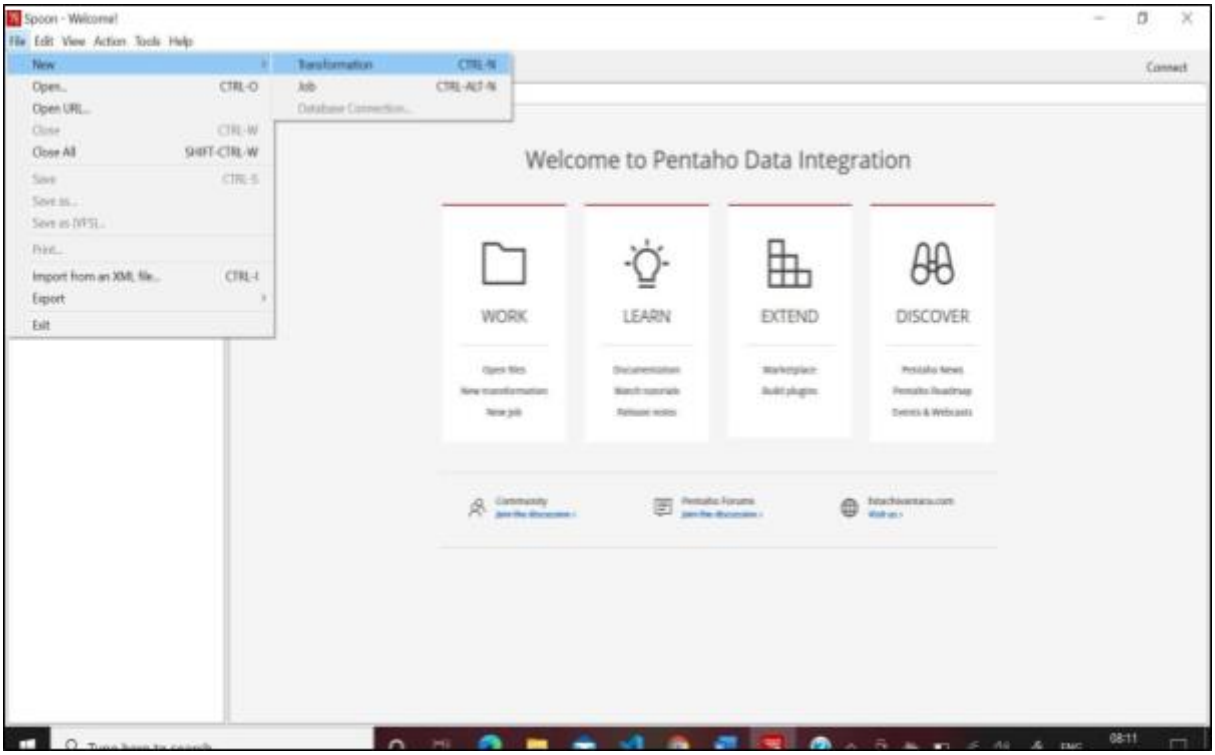


□ Implementation of Calculator Operation.

Steps:

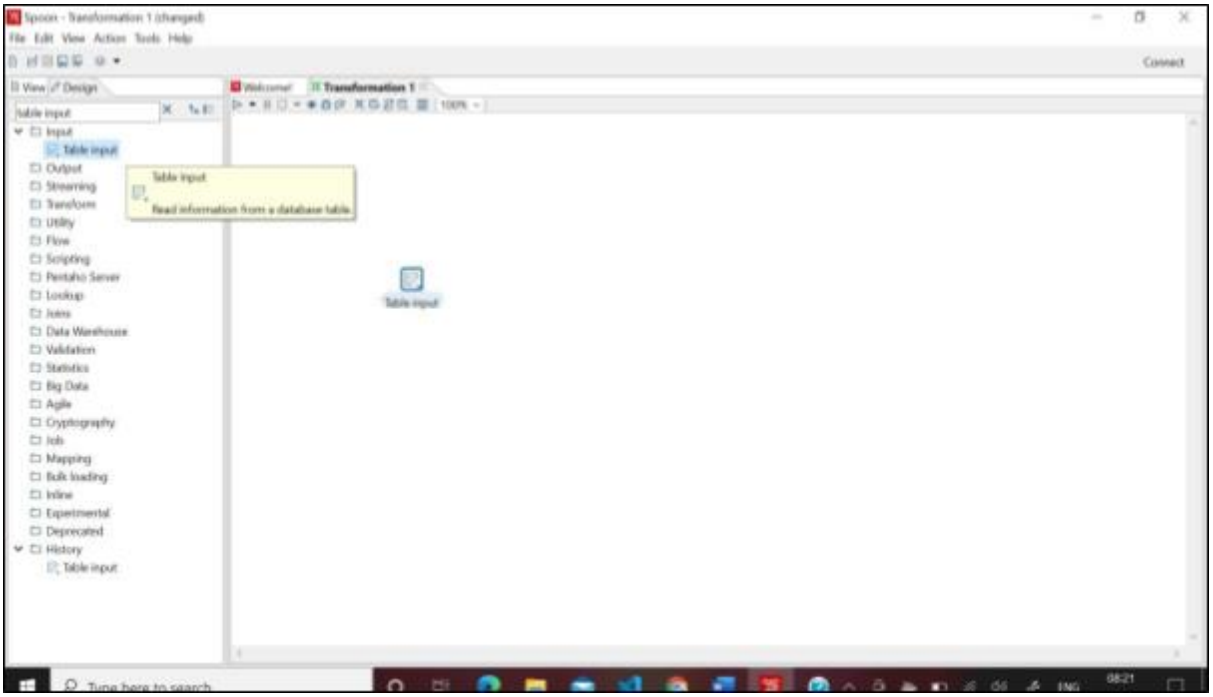
✓ Creating a **New Transformation**:

Open Pentaho Spoon -> File -> New -> Transformation (or CTRL-N)



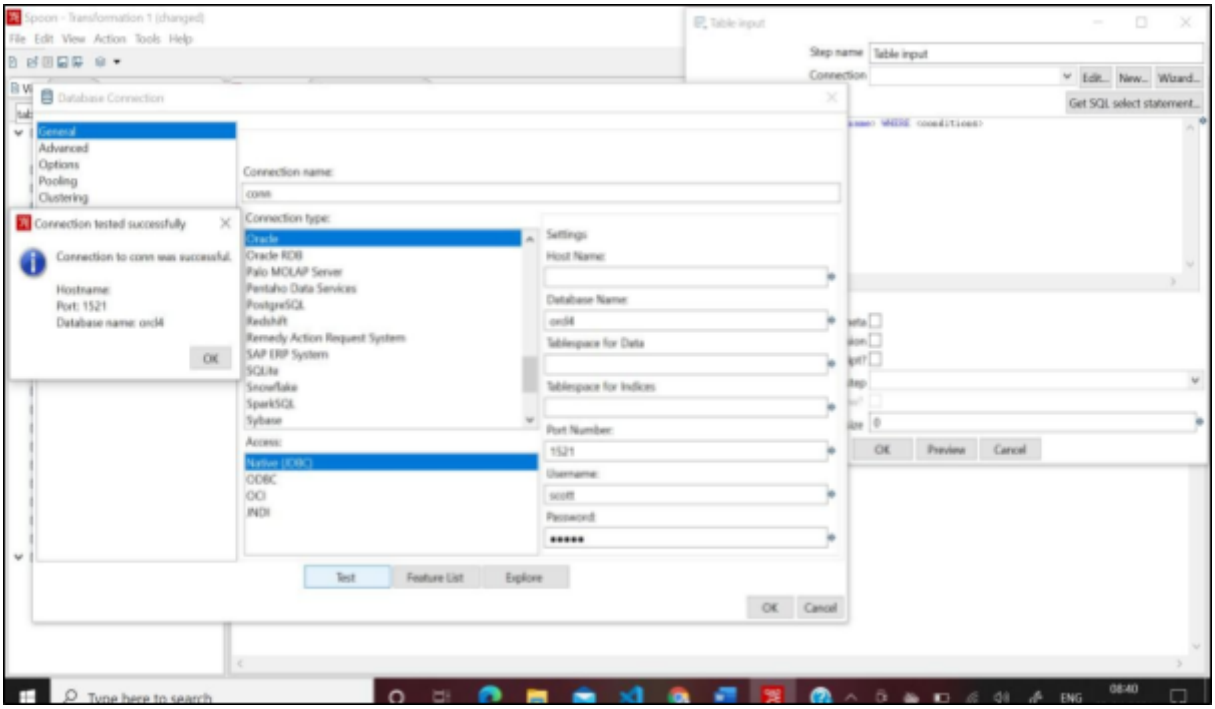
✓ Inserting **Table Input** into the Transformation:

Design -> Input -> Table Input (Drag & Drop in Transformation)



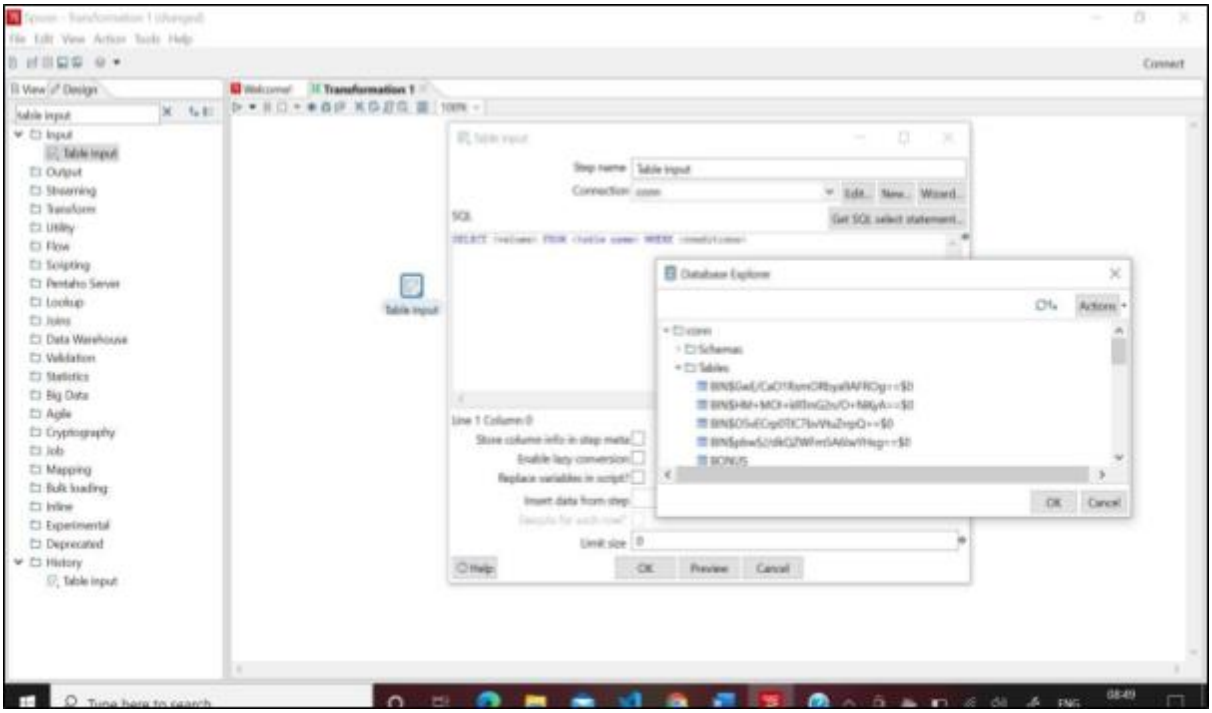
✓ Establishing **Database Connection**:

Double Click Table Input -> New -> Enter following respective Details in *General*: Connection name: *conn* Connection Type: *Oracle* Access: *Native (JDBC)* Database Name: *orcl4* Port Number: *1521* Username: *scott* Password: *tiger* Click Test -> OK -> OK



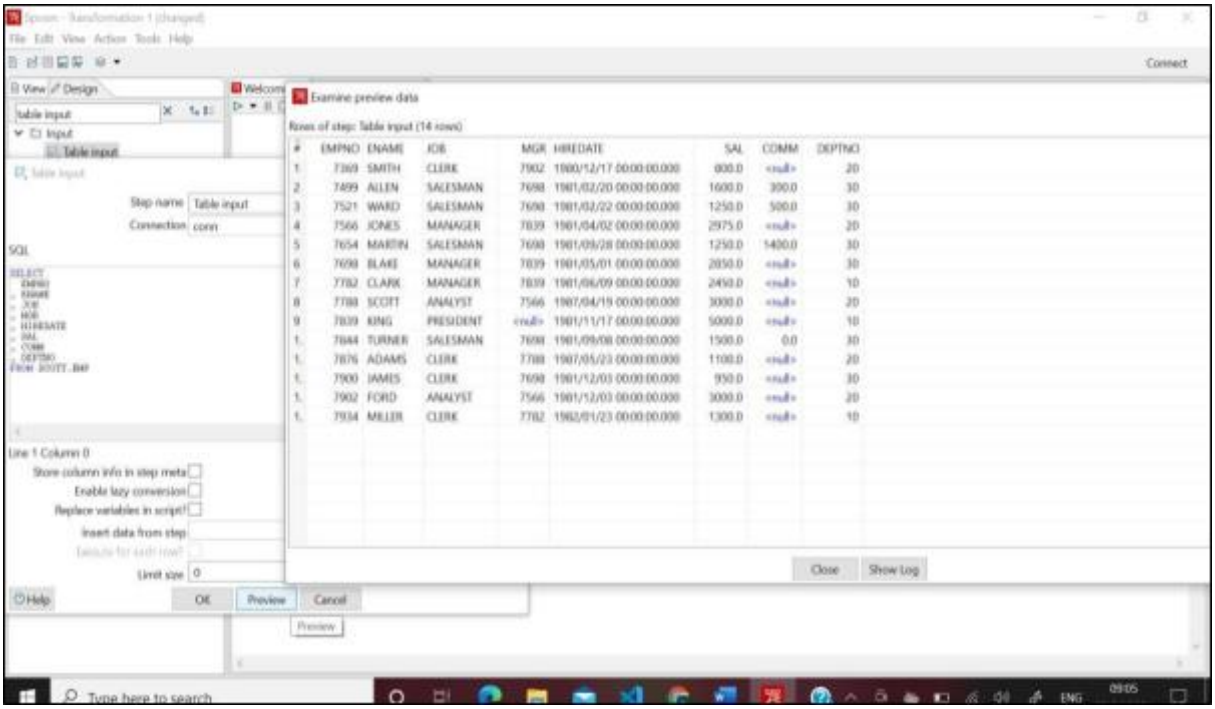
✓ Getting **Source Table**:

Table Input -> Get SQL Select Statement -> Data Explorer -> *conn* -> Tables -> *Click on desired Table* -> OK -> Yes



✓ **View** Input Table:

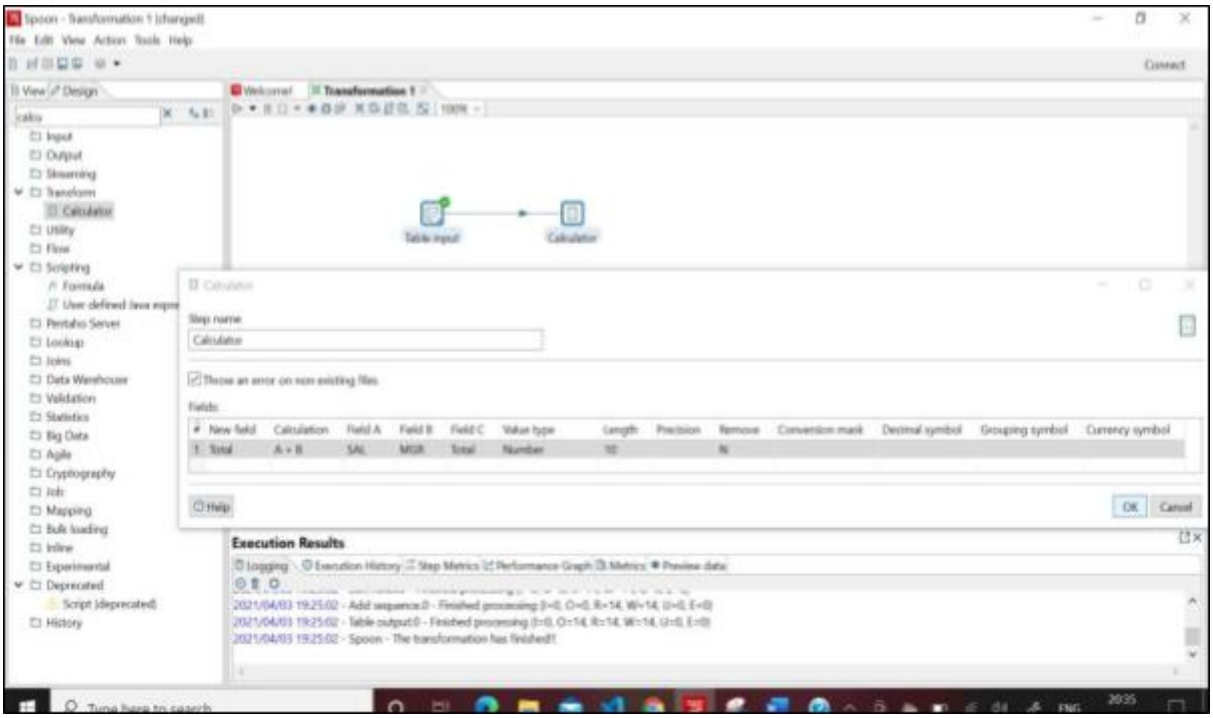
Table Input -> Preview -> OK -> Close -> OK



✓ **Calculator Operation**:

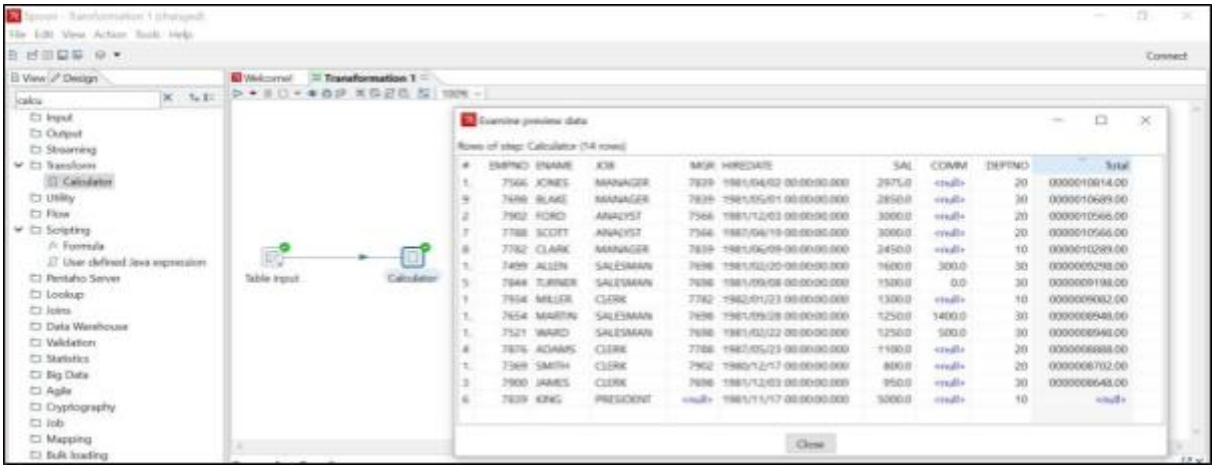
Design -> Transform -> Calculator (Drag & Drop in Transformation) -> Create Hop Connection with Calculator (Click on Output Connector arrow in Input Table)

Double Click Calculator -> New field: *Total* -> Calculation: *A+B* -> Field A: *SAL* -> Field B: *MGR* -> Field C: *Total* -> Value type: Number -> Length: *10* -> Remove: N -> OK



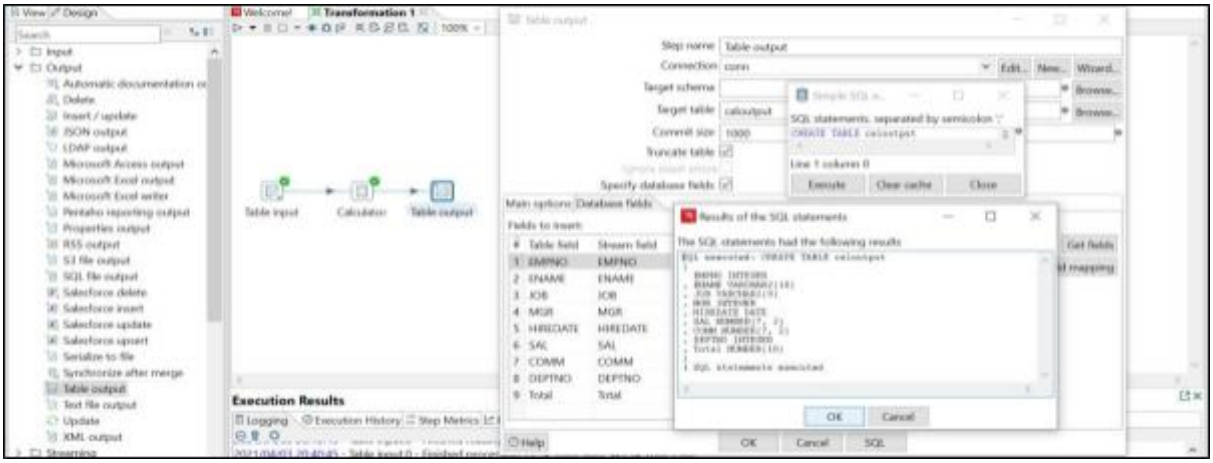
✓ **Debug** Transformation:

Click Calculator -> Debug -> Quick Launch -> Yes



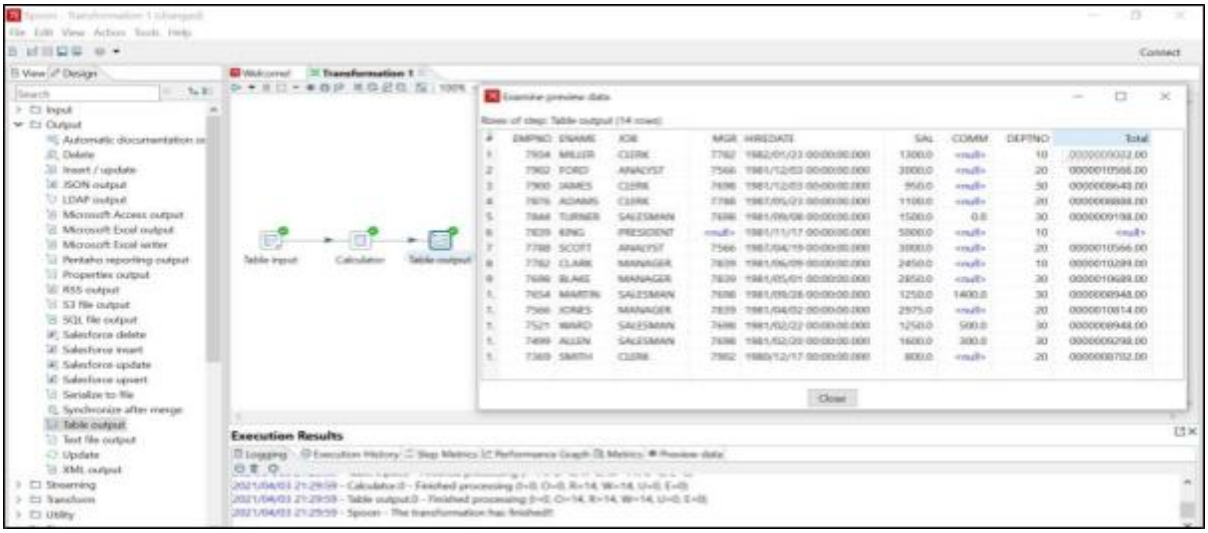
✓ Storing to **Output Table**:

Design -> Output -> Table Output (Drag & Drop in Transformation) -> Create Hop Connection with Output Table (Click on Output Connector arrow in Calculator) Double Click Table Output -> Target Table: *output* -> Truncate table ☑ -> Specify database fields ☑ -> Database fields -> Get fields -> SQL -> Execute -> OK -> Close



✓ **Debug** Transformation:

Click Table Output -> Debug -> Quick Launch -> Yes

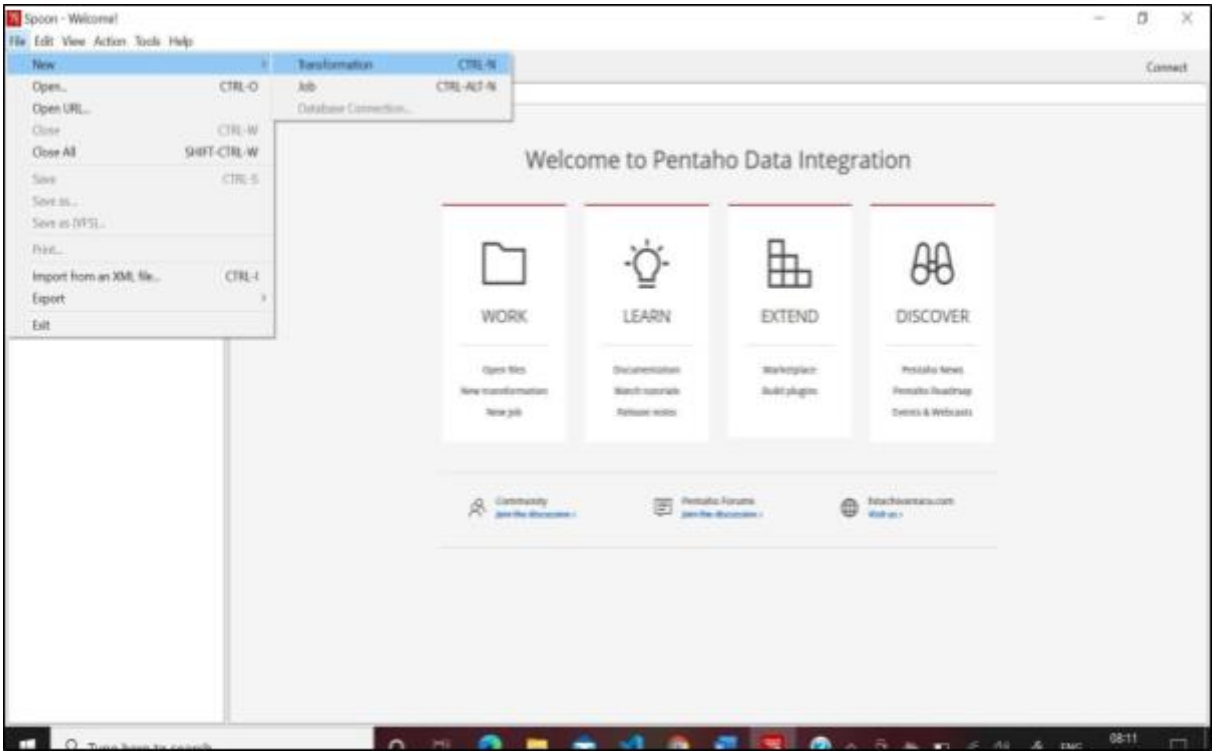


□ Implementation of Concatenation Operation.

Steps:

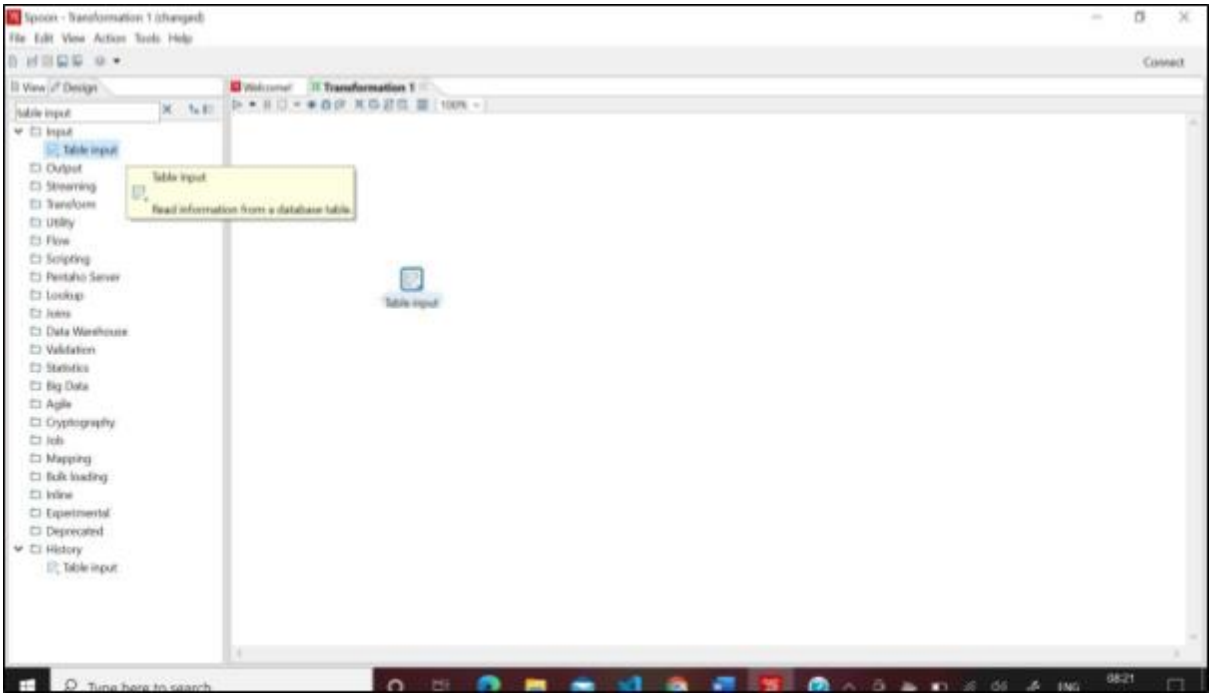
✓ Creating a **New Transformation**:

Open Pentaho Spoon -> File -> New -> Transformation (or CTRL-N)



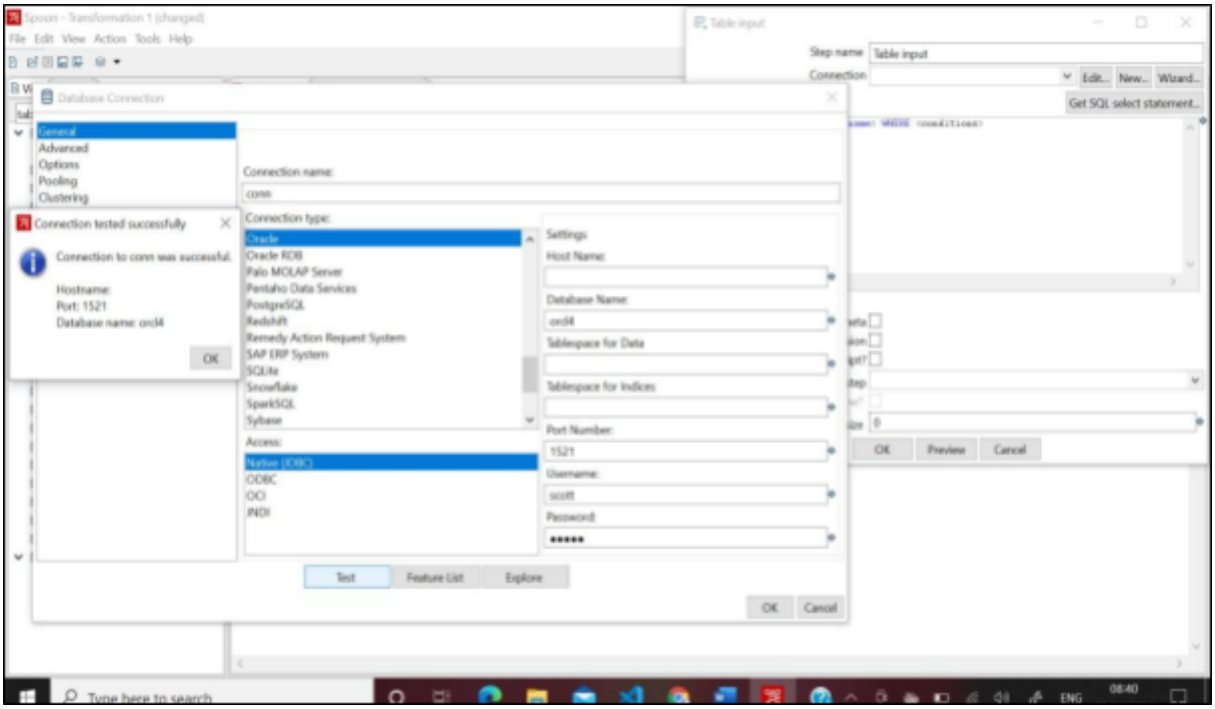
✓ Inserting **Table Input** into the Transformation:

Design -> Input -> Table Input (Drag & Drop in Transformation)



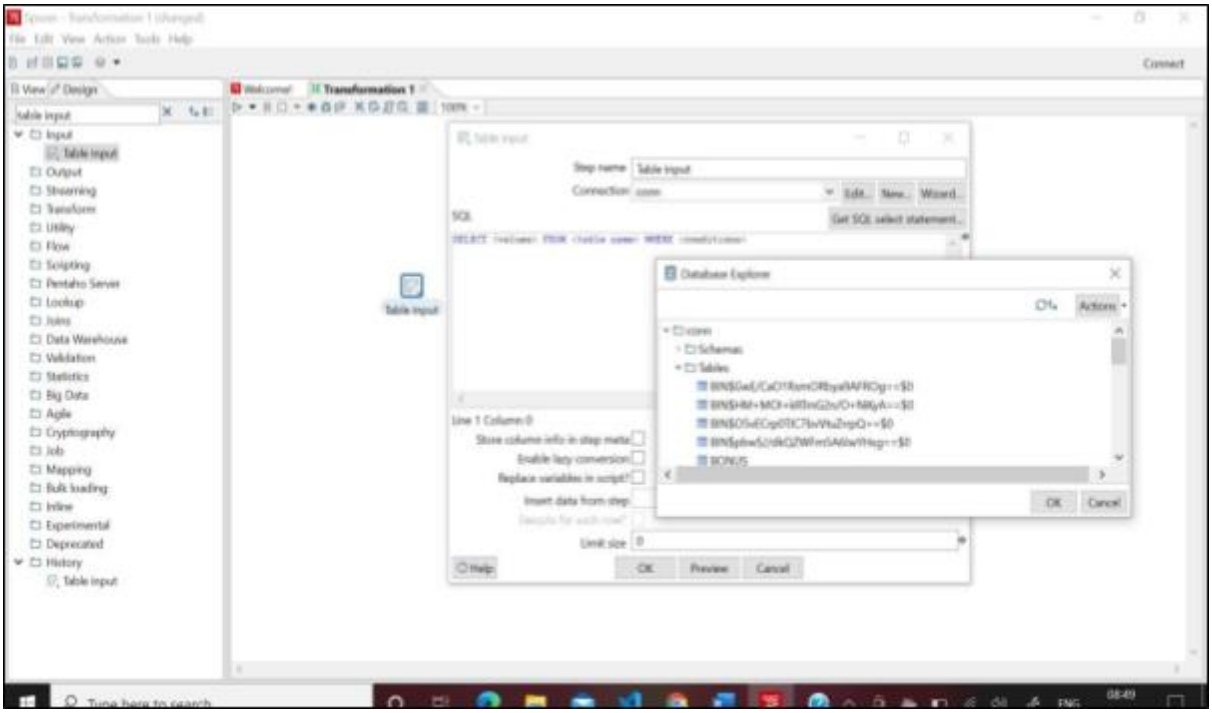
✓ Establishing **Database Connection**:

Double Click Table Input -> New -> Enter following respective Details in *General*: Connection name: *conn* Connection Type: *Oracle* Access: *Native (JDBC)* Database Name: *orcl4* Port Number: *1521* Username: *scott* Password: *tiger* Click Test -> OK -> OK



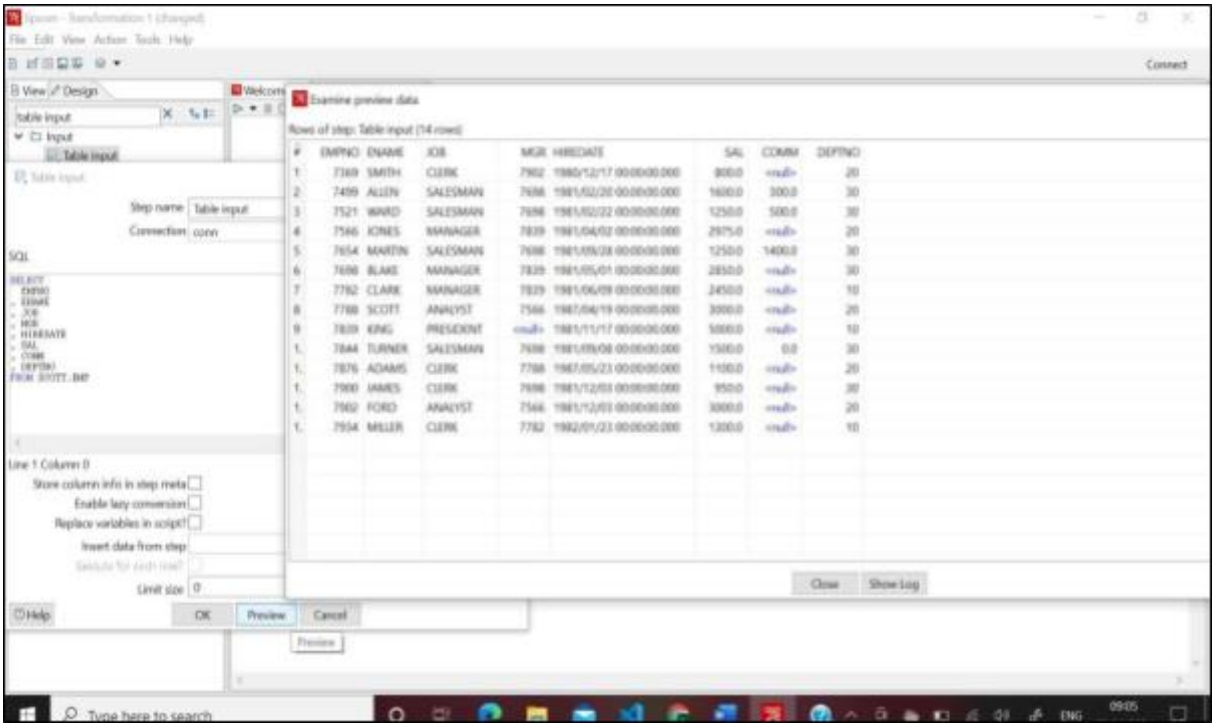
✓ Getting **Source Table**:

Table Input -> Get SQL Select Statement -> Data Explorer -> *conn* -> Tables -> *Click on desired Table* -> OK -> Yes



✓ **View** Input Table:

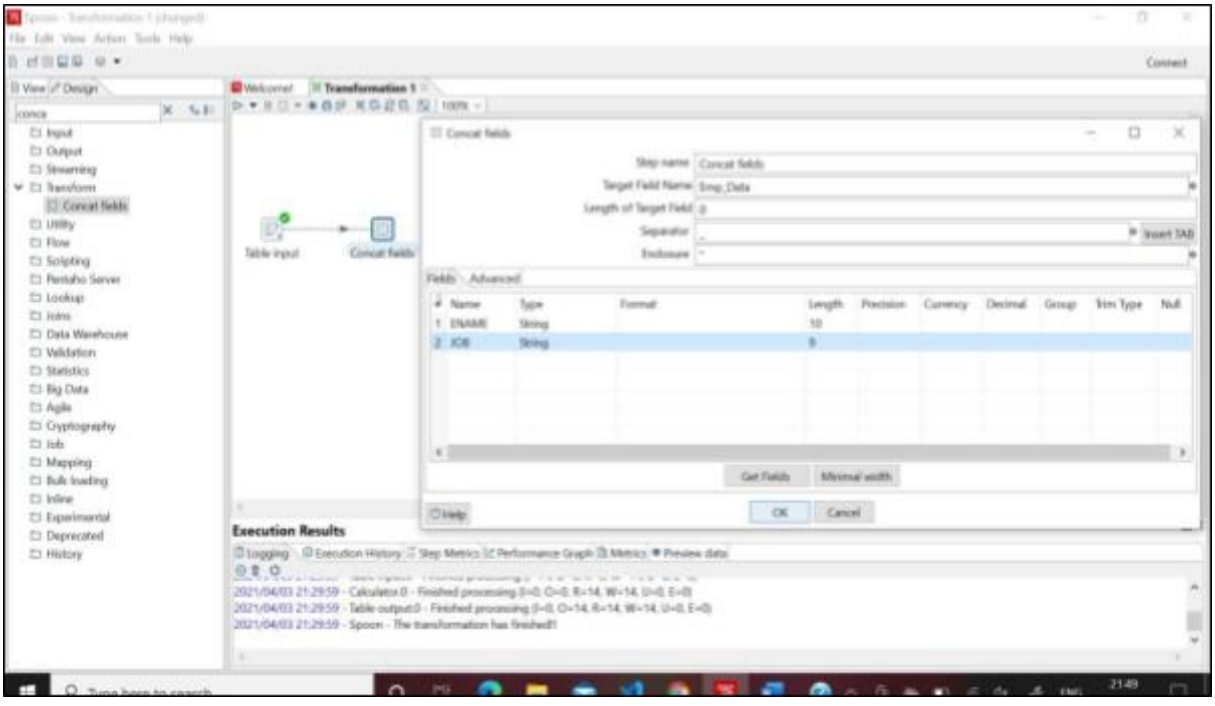
Table Input -> Preview -> OK -> Close -> OK



✓ **Concatenation Operation**:

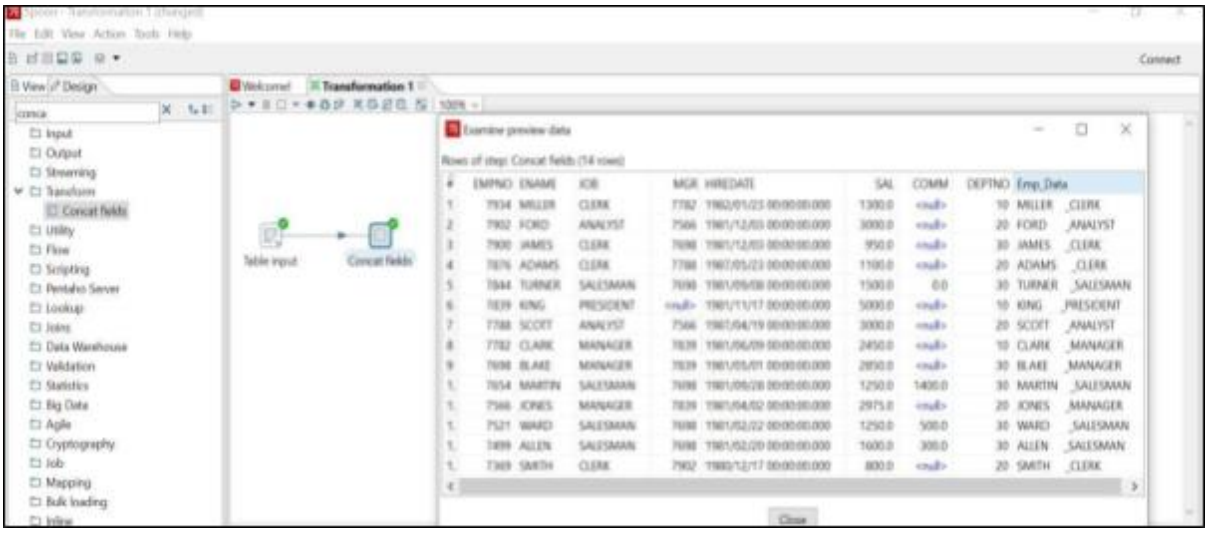
Design-> Transform-> Concat Fields (Drag & Drop in Transformation) -> Create Hop Connection with Concat Fields (Click on Output Connector arrow in Input Table)

Double Click Concat Fields -> Target Field Name: *Emp_Data* -> Separator: _ -> Get Fields (Discard unwanted Fields) -> OK



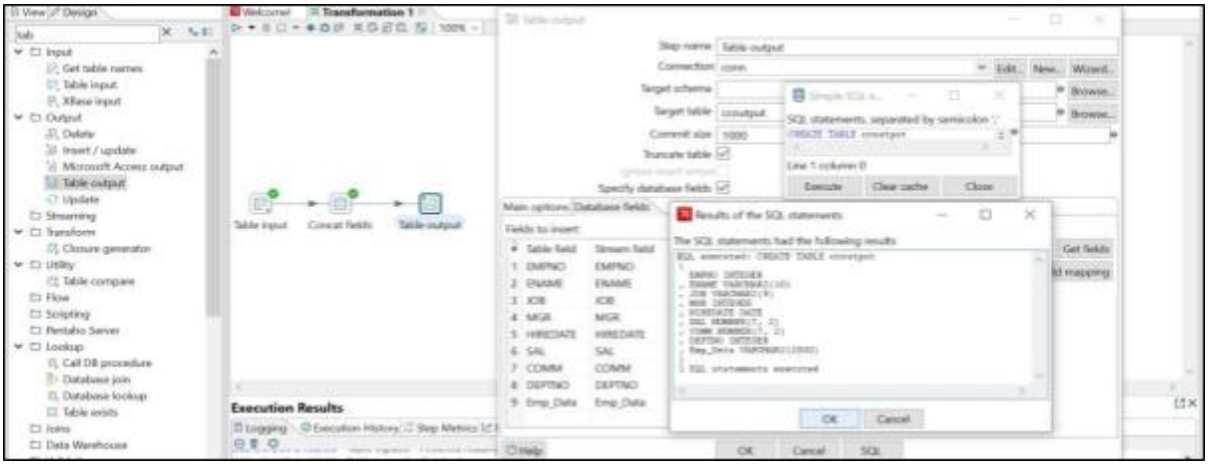
✓ **Debug** Transformation:

Click Concat fields -> Debug -> Quick Launch -> Yes



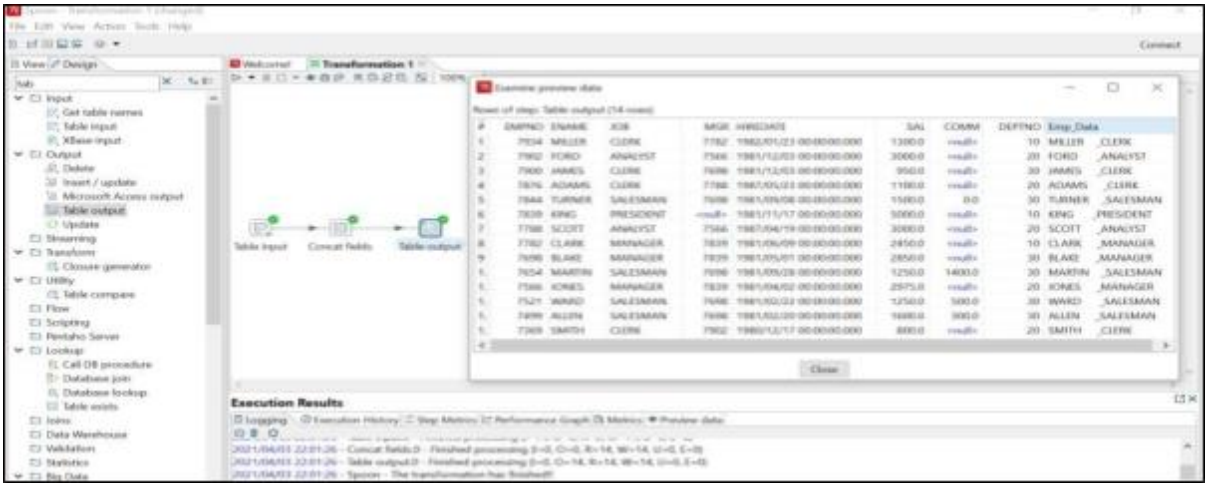
✓ Storing to **Output Table**:

Design -> Output -> Table Output (Drag & Drop in Transformation) -> Create Hop Connection with Output Table (Click on Output Connector arrow in Concat Fields) Double Click Table Output -> Target Table: *output* -> Truncate table ☑ -> Specify database fields ☑ -> Database fields -> Get fields -> SQL -> Execute -> OK -> Close



✓ **Debug** Transformation:

Click Table Output -> Debug -> Quick Launch -> Yes

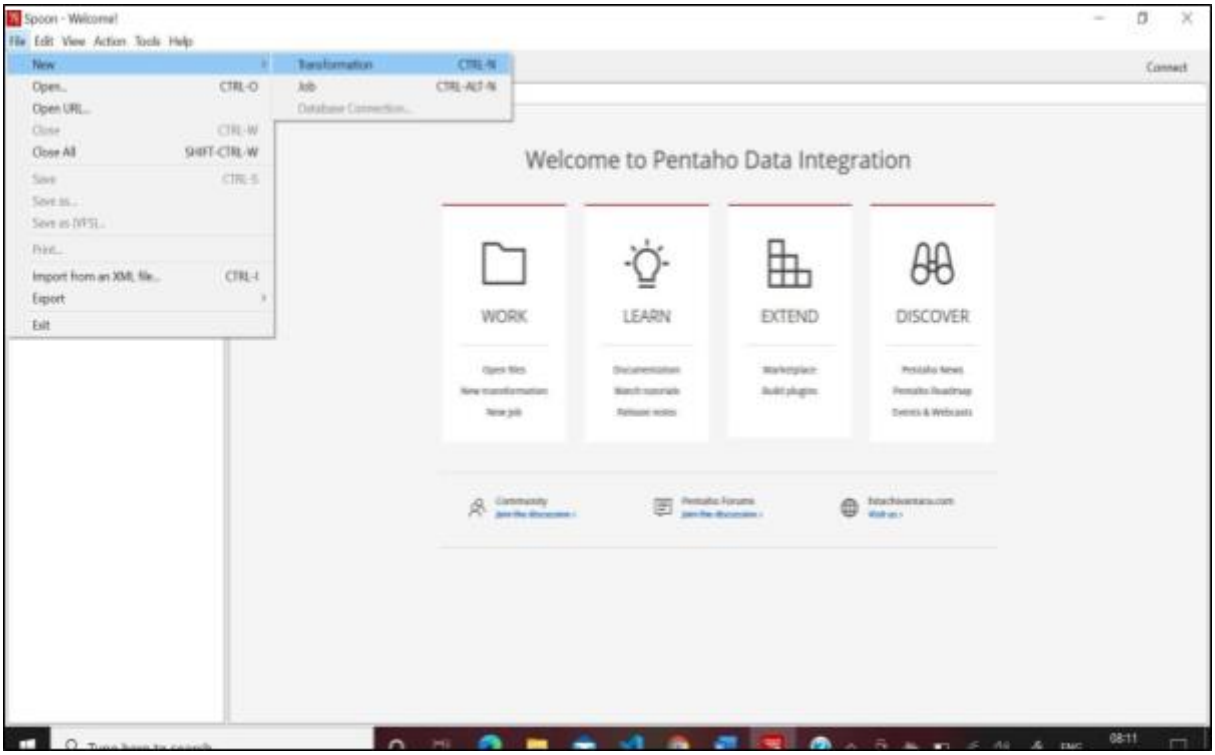


□ Implementation of Splitting Operation.

Steps:

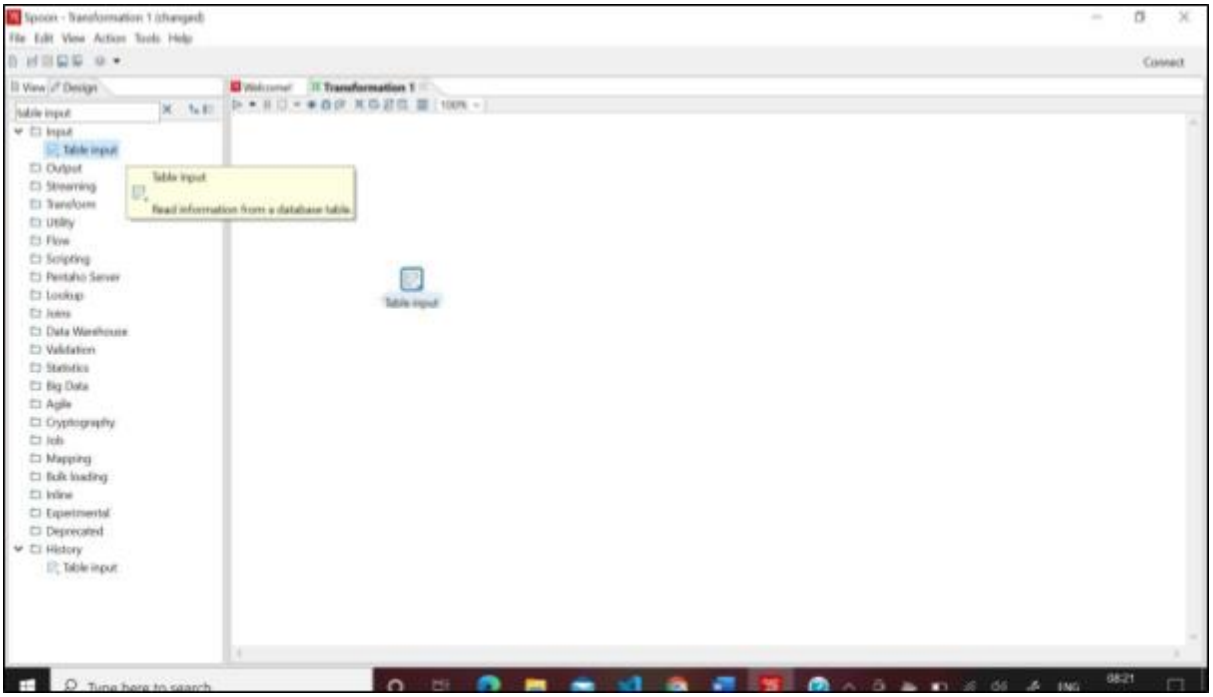
✓ Creating a **New Transformation**:

Open Pentaho Spoon -> File -> New -> Transformation (or CTRL-N)



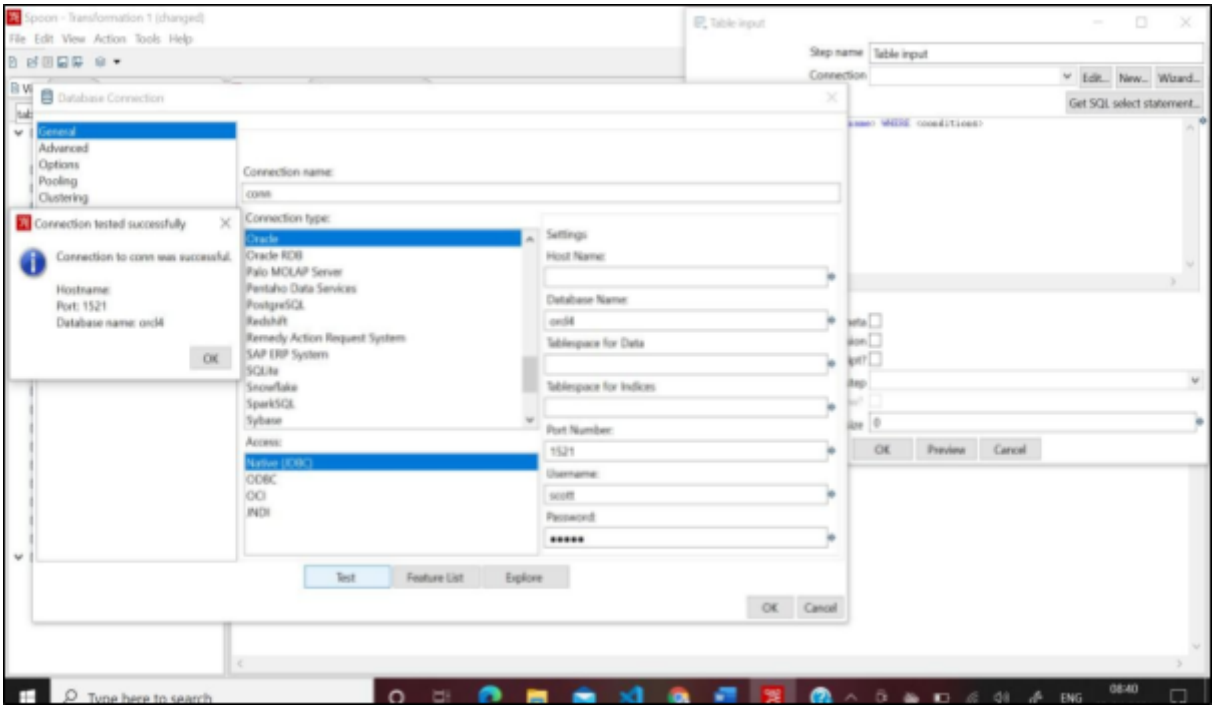
✓ Inserting **Table Input** into the Transformation:

Design -> Input -> Table Input (Drag & Drop in Transformation)



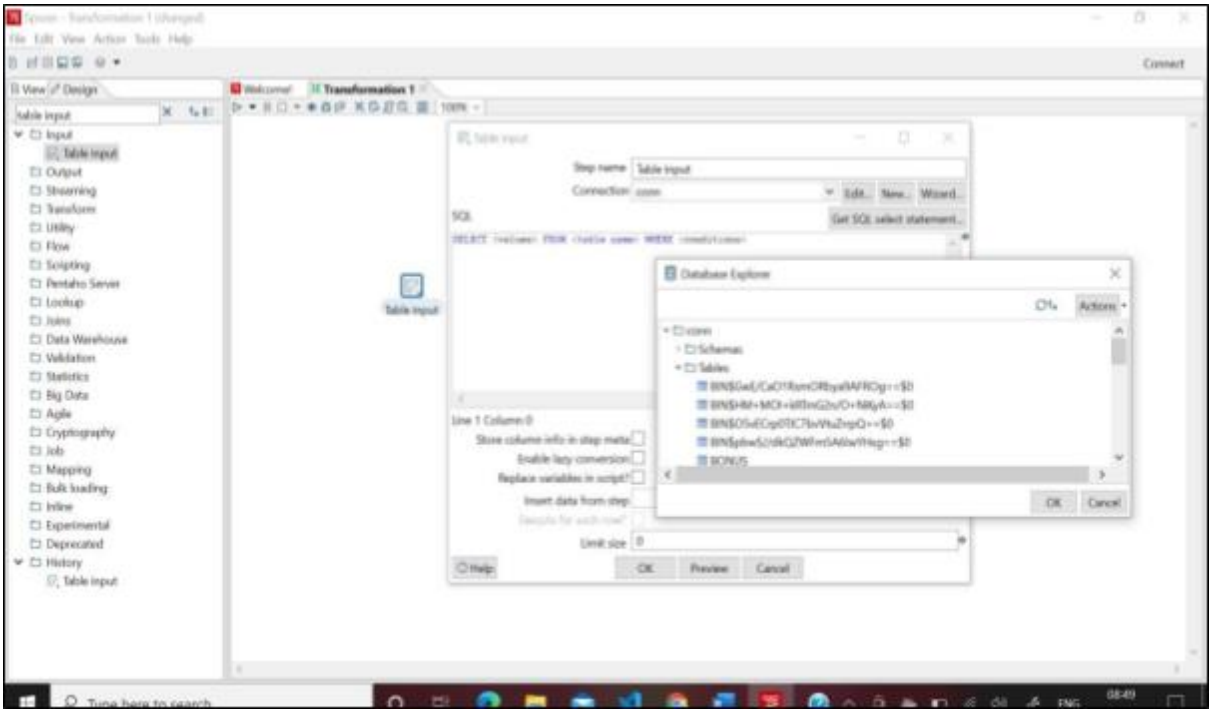
✓ Establishing **Database Connection**:

Double Click Table Input -> New -> Enter following respective Details in *General*: Connection name: *conn* Connection Type: *Oracle* Access: *Native (JDBC)* Database Name: *orcl4* Port Number: *1521* Username: *scott* Password: *tiger* Click Test -> OK -> OK



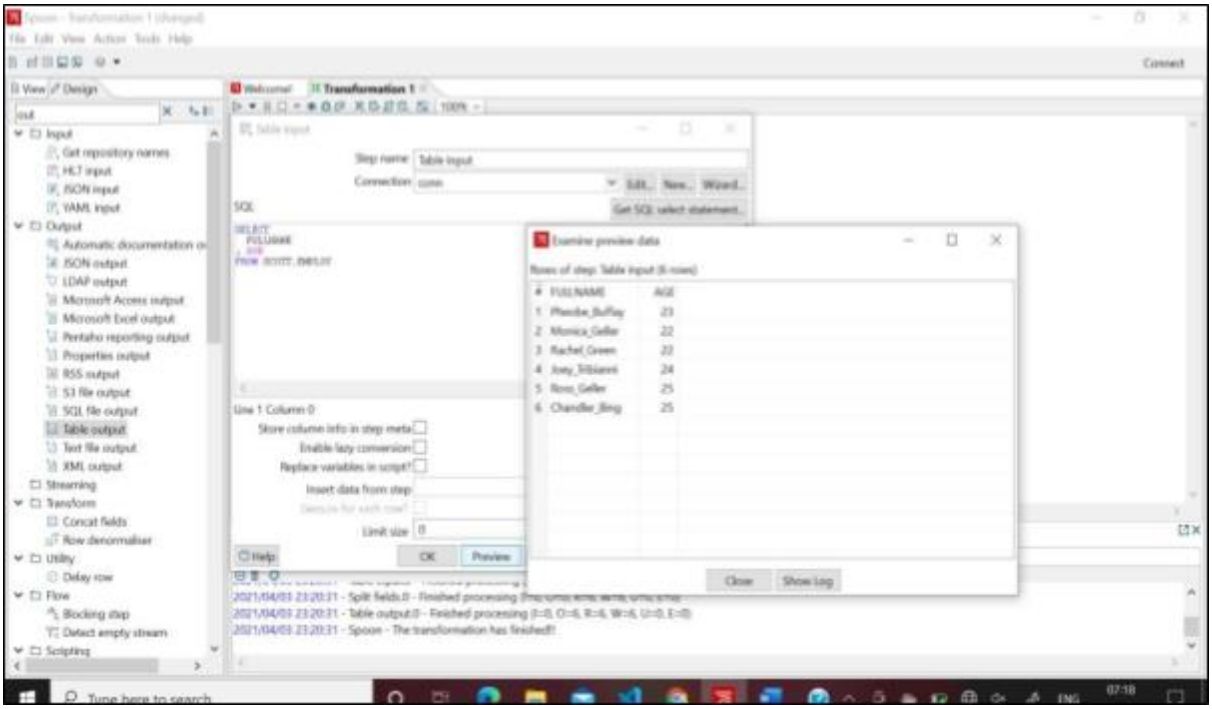
✓ Getting **Source Table**:

Table Input -> Get SQL Select Statement -> Data Explorer -> *conn* -> Tables -> *Click on desired Table* -> OK -> Yes



✓ **View** Input Table:

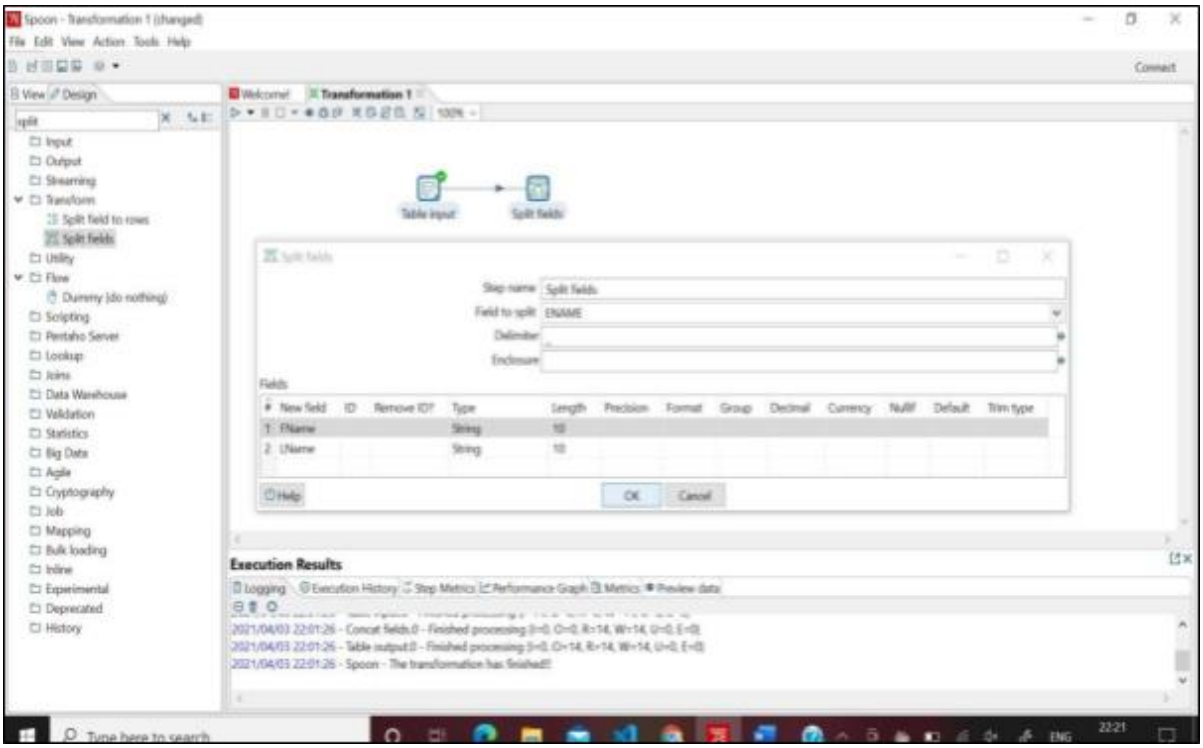
Table Input -> Preview -> OK -> Close -> OK



✓ **Splitting Operation**:

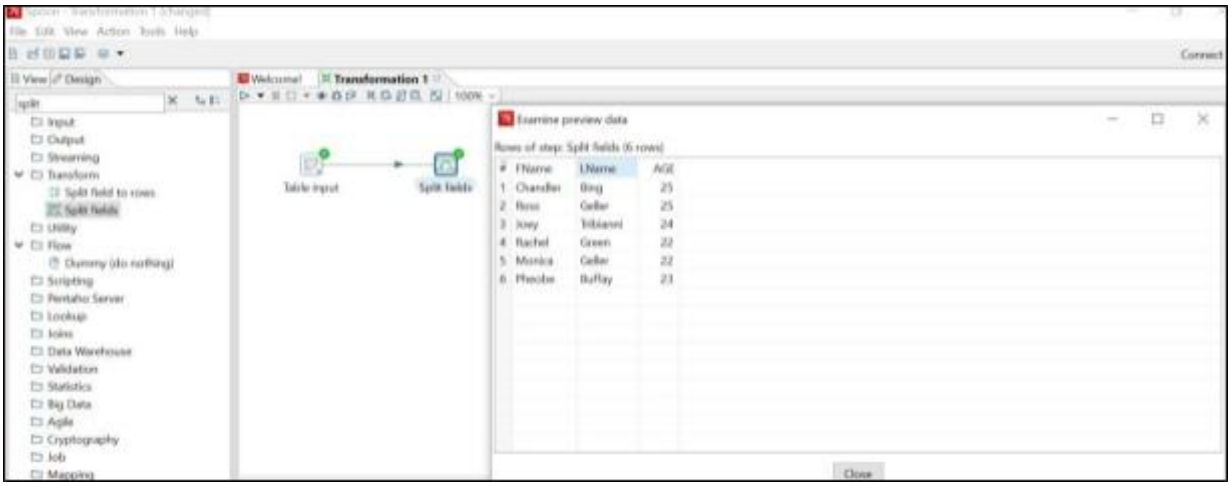
Design -> Transform -> Split Fields (Drag & Drop in Transformation) -> Create Hop Connection with Split Fields (Click on Output Connector arrow in Input Table)

Double Click Split Fields -> Field to split: *ENAME* -> Delimiter: _ -> New field: *FName, LName* -> Type: *String* -> Length: *10* -> OK



✓ **Debug** Transformation:

Click Split Fields -> Debug -> Quick Launch -> Yes

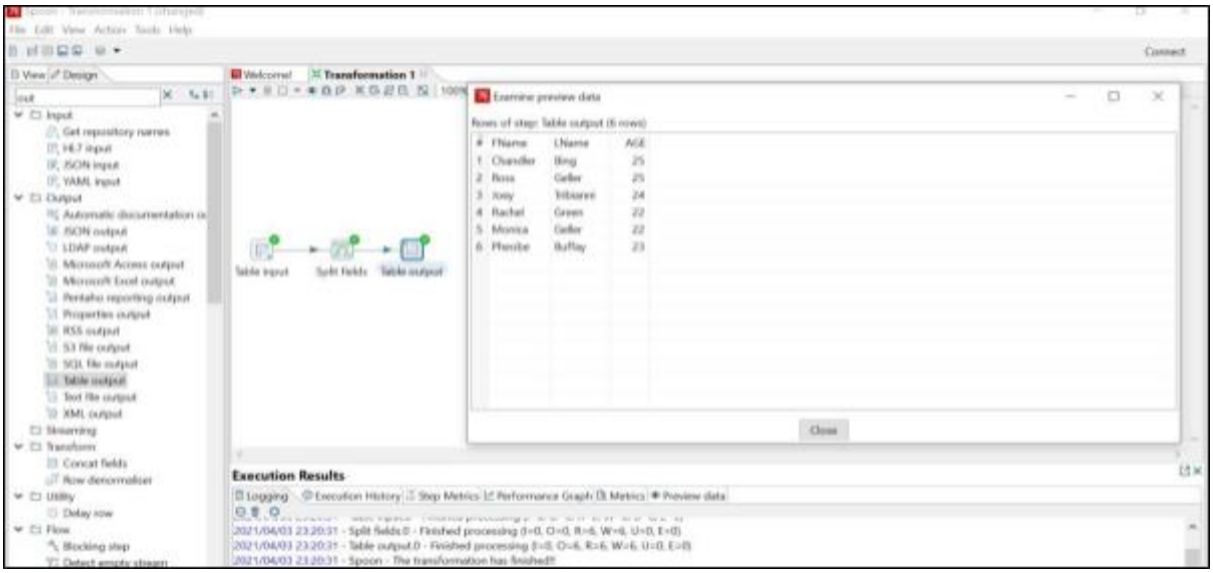


✓ Storing to **Output Table**:

Design -> Output -> Table Output (Drag & Drop in Transformation) -> Create Hop Connection with Output Table (Click on Output Connector arrow in Split Fields) Double Click Table Output -> Target Table: *output* -> Truncate table ☑ -> Specify database fields ☑ -> Database fields -> Get fields -> SQL -> Execute -> OK -> Close

✓ **Debug** Transformation:

Click Table Output -> Debug -> Quick Launch -> Yes

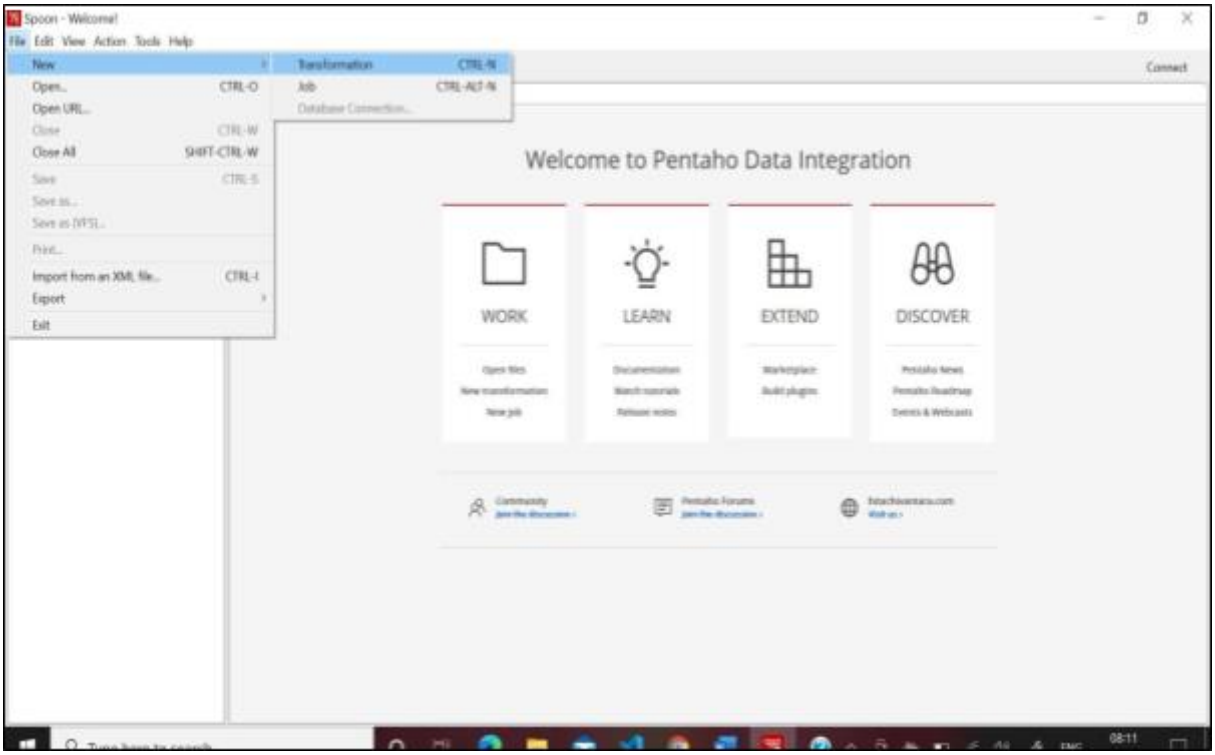


□ Implementation of Number Range.

Steps:

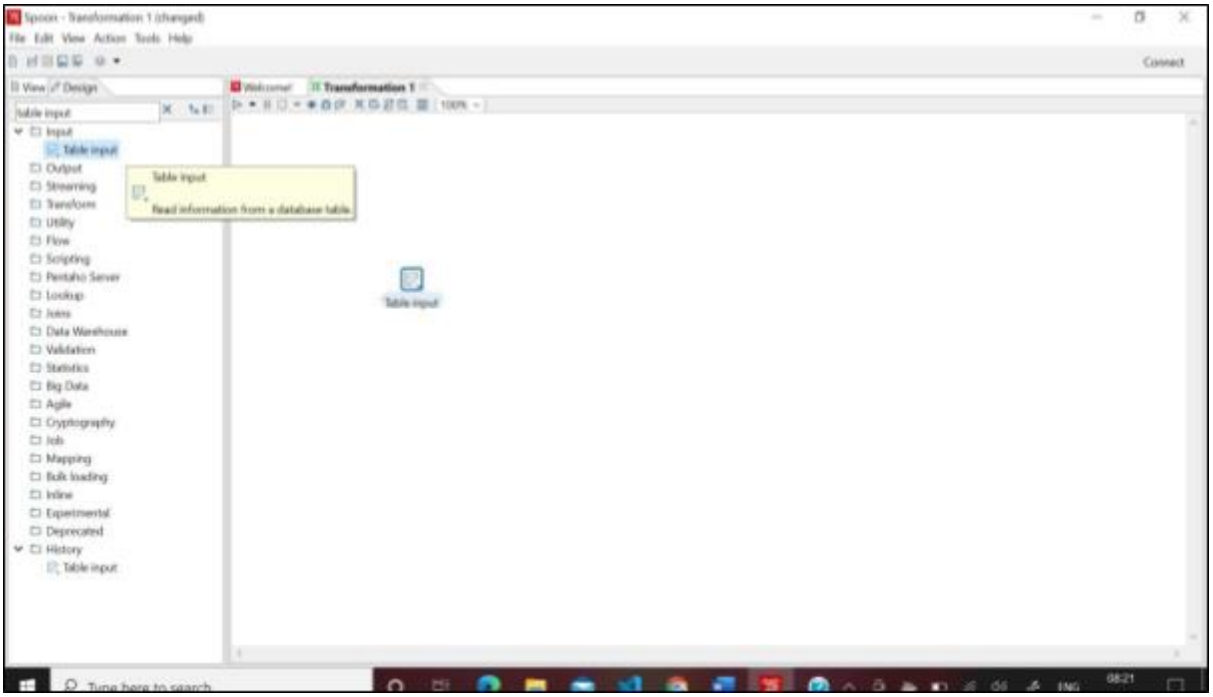
✓ Creating a **New Transformation**:

Open Pentaho Spoon -> File -> New -> Transformation (or CTRL-N)



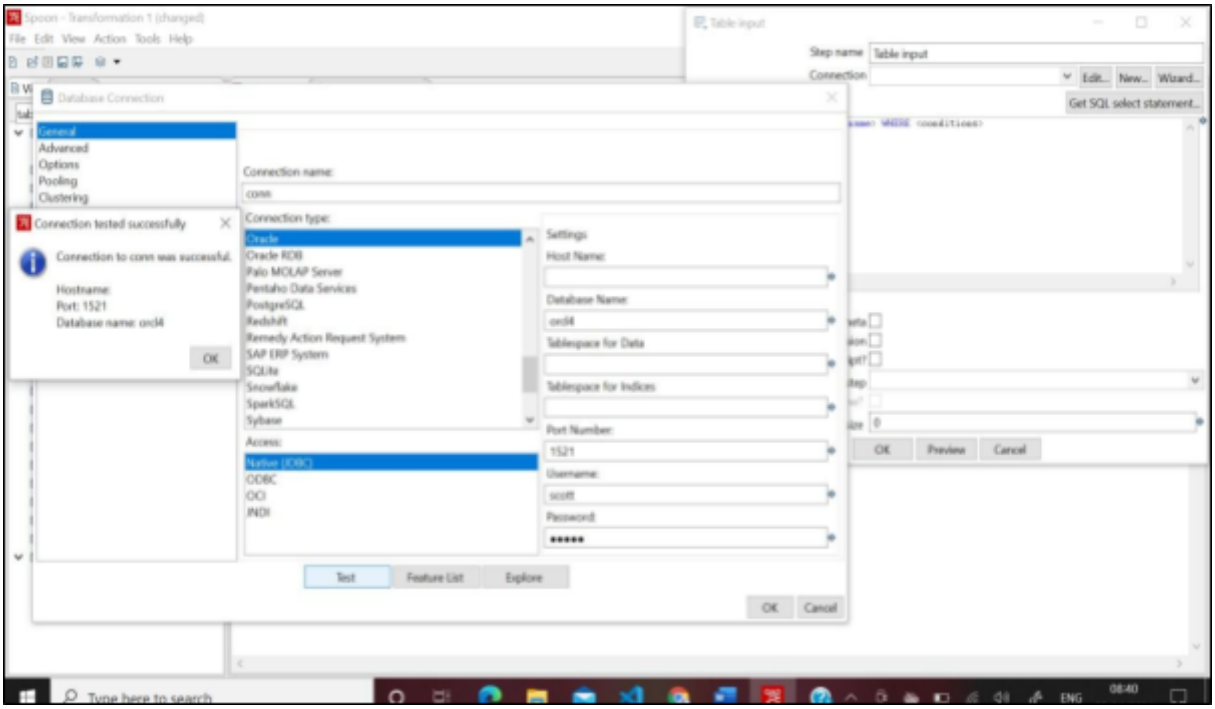
✓ Inserting **Table Input** into the Transformation:

Design -> Input -> Table Input (Drag & Drop in Transformation)



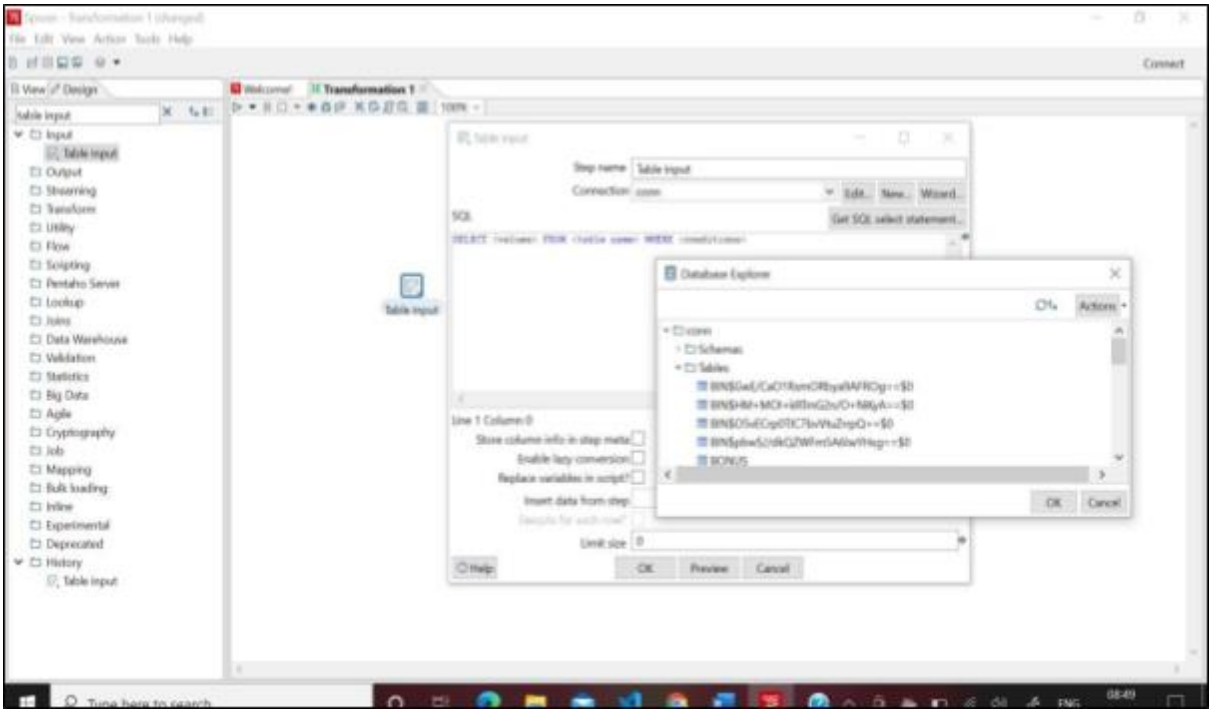
✓ Establishing **Database Connection**:

Double Click Table Input -> New -> Enter following respective Details in *General*: Connection name: *conn* Connection Type: *Oracle* Access: *Native (JDBC)* Database Name: *orcl4* Port Number: *1521* Username: *scott* Password: *tiger* Click Test -> OK -> OK



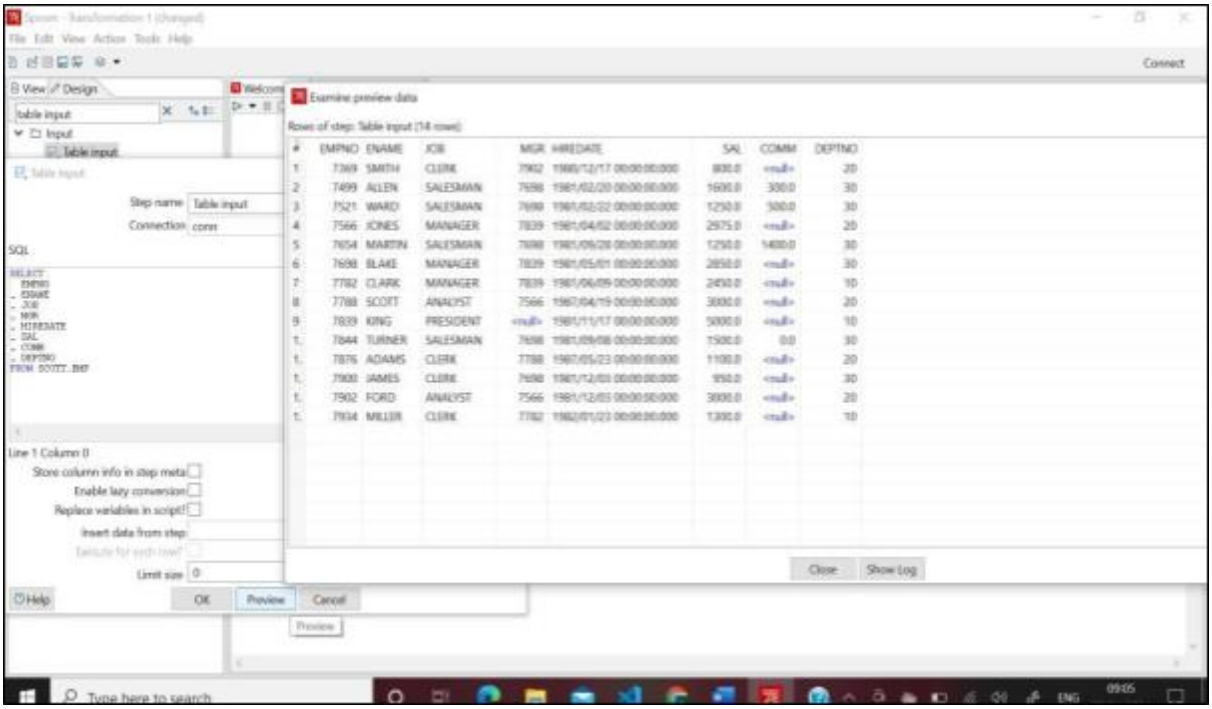
✓ Getting **Source Table**:

Table Input -> Get SQL Select Statement -> Data Explorer -> *conn* -> Tables -> *Click on desired Table* -> OK -> Yes



✓ **View** Input Table:

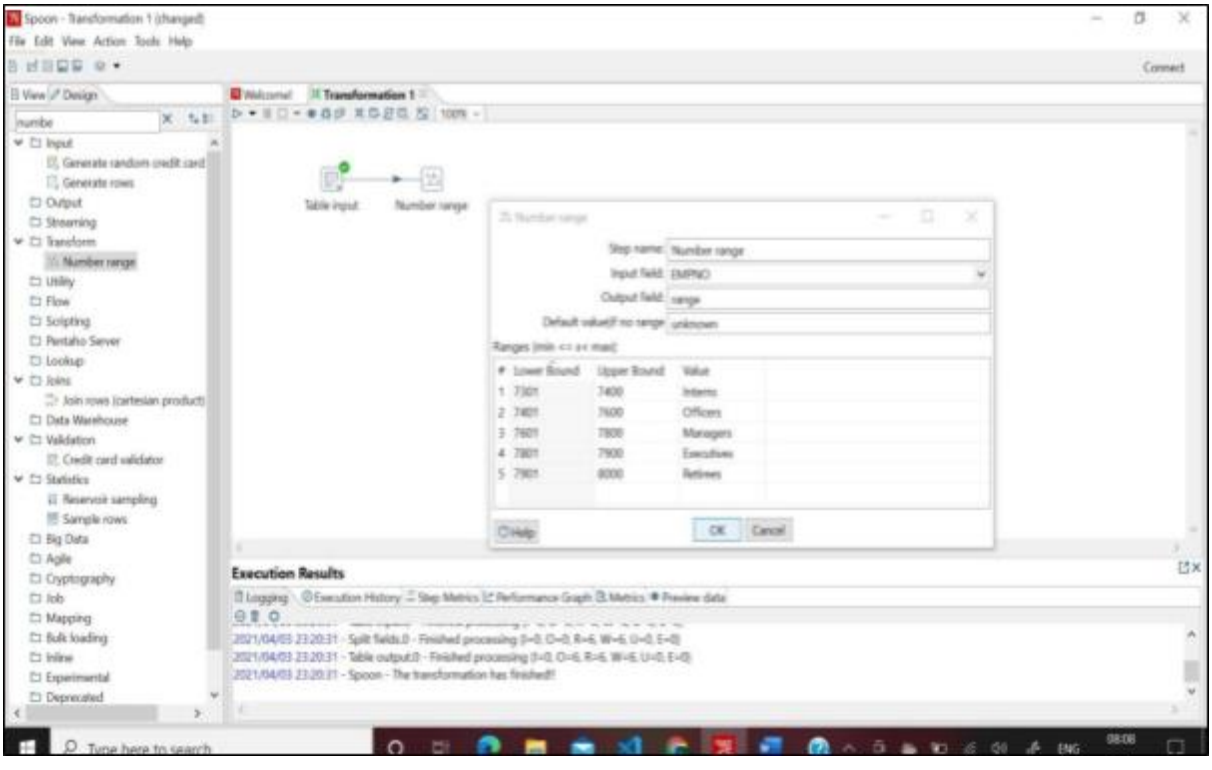
Table Input -> Preview -> OK -> Close -> OK



✓ **Number Range**:

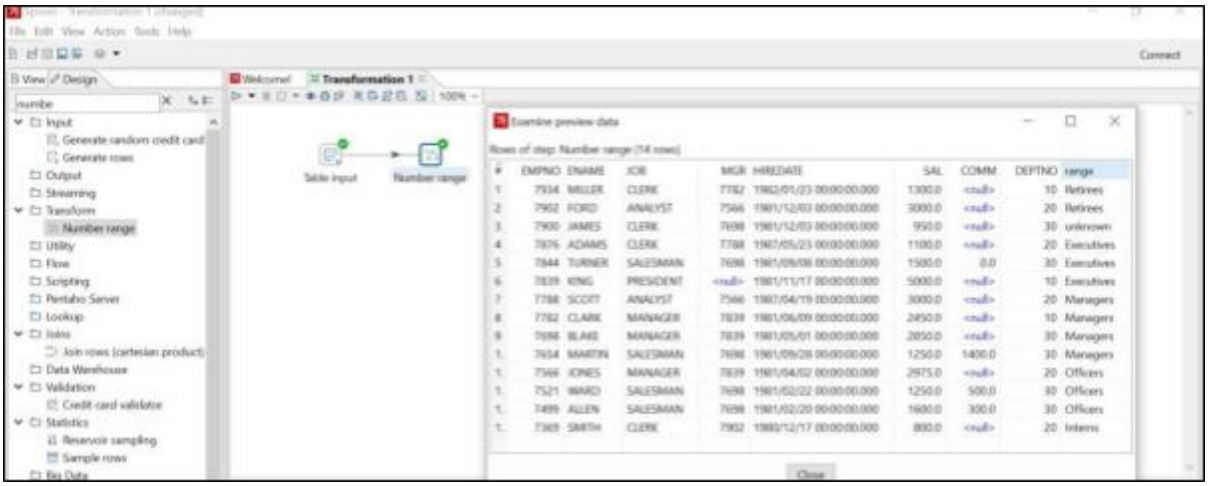
Design-> Transform-> Number Range(Drag & Drop in Transformation)->Create Hop Connection with Number Range (Click on Output Connector arrow in Input Table)

Double Click Number Range -> Input field: *EMPNO* -> Lower Bound: *7301, 7401, 7601, 7801, 7901* -> Upper Bound: *7400, 7600, 7800, 7900, 8000* -> Value: *Interns, Officers, Managers, Executives, Retirees* -> OK



✓ **Debug** Transformation:

Click Number Range -> Debug -> Quick Launch -> Yes

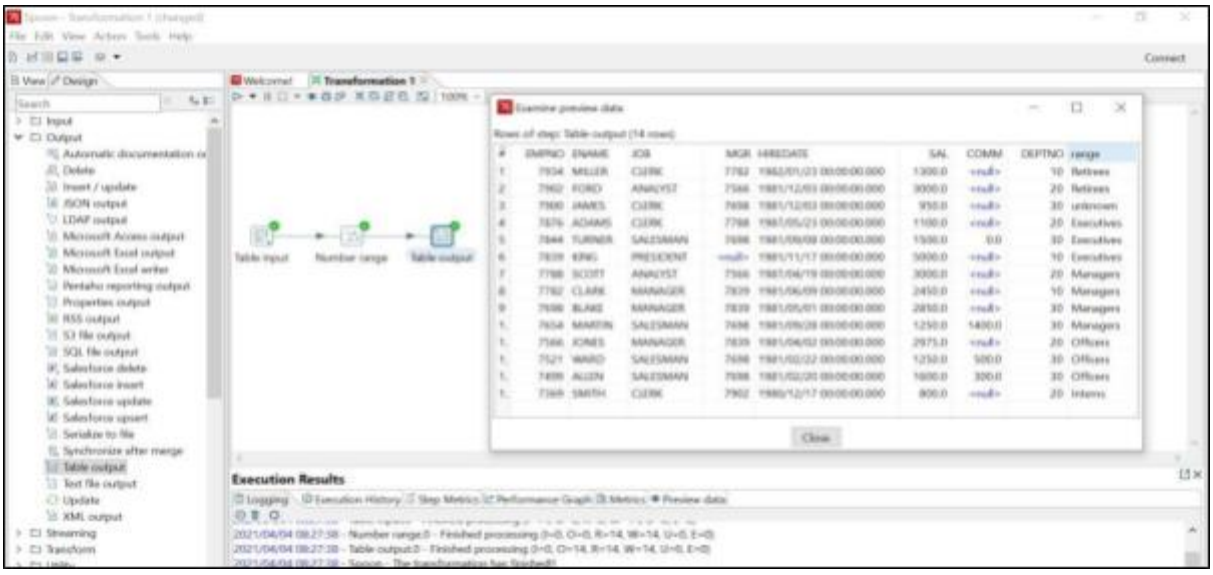


✓ Storing to **Output Table**:

Design -> Output -> Table Output (Drag & Drop in Transformation) -> Create Hop Connection with Output Table(Connector arrow Number Range)>Main output of step Double Click Table Output -> Target Table: *output* -> Truncate table ☑ -> Specify database fields ☑ -> Database fields -> Get fields -> SQL -> Execute -> OK -> Close

✓ **Debug** Transformation:

Click Table Output -> Debug -> Quick Launch -> Yes

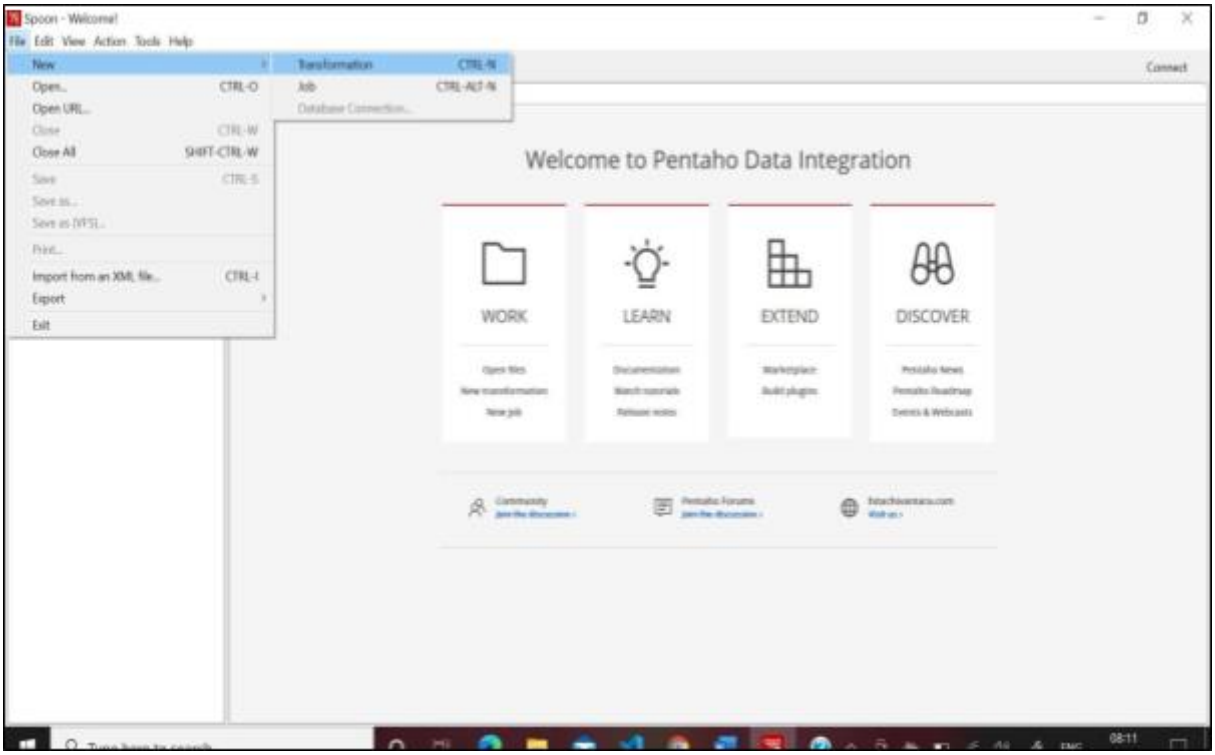


□ Implementation of String Operation.

Steps:

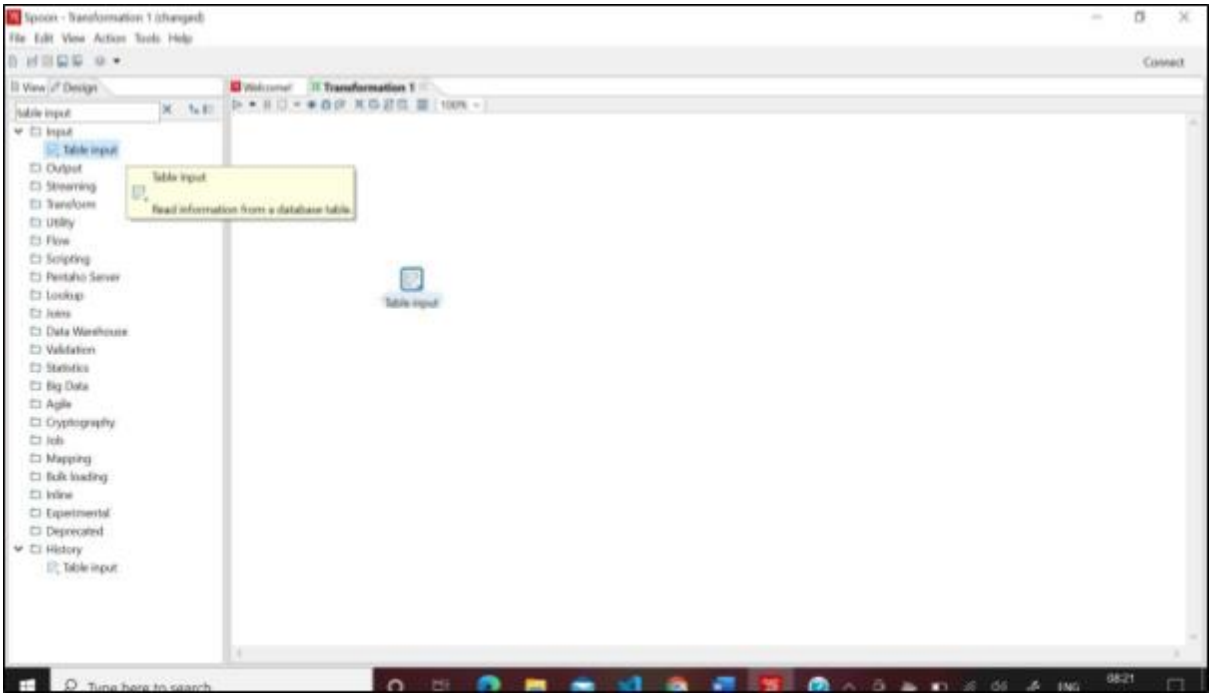
✓ Creating a **New Transformation**:

Open Pentaho Spoon -> File -> New -> Transformation (or CTRL-N)



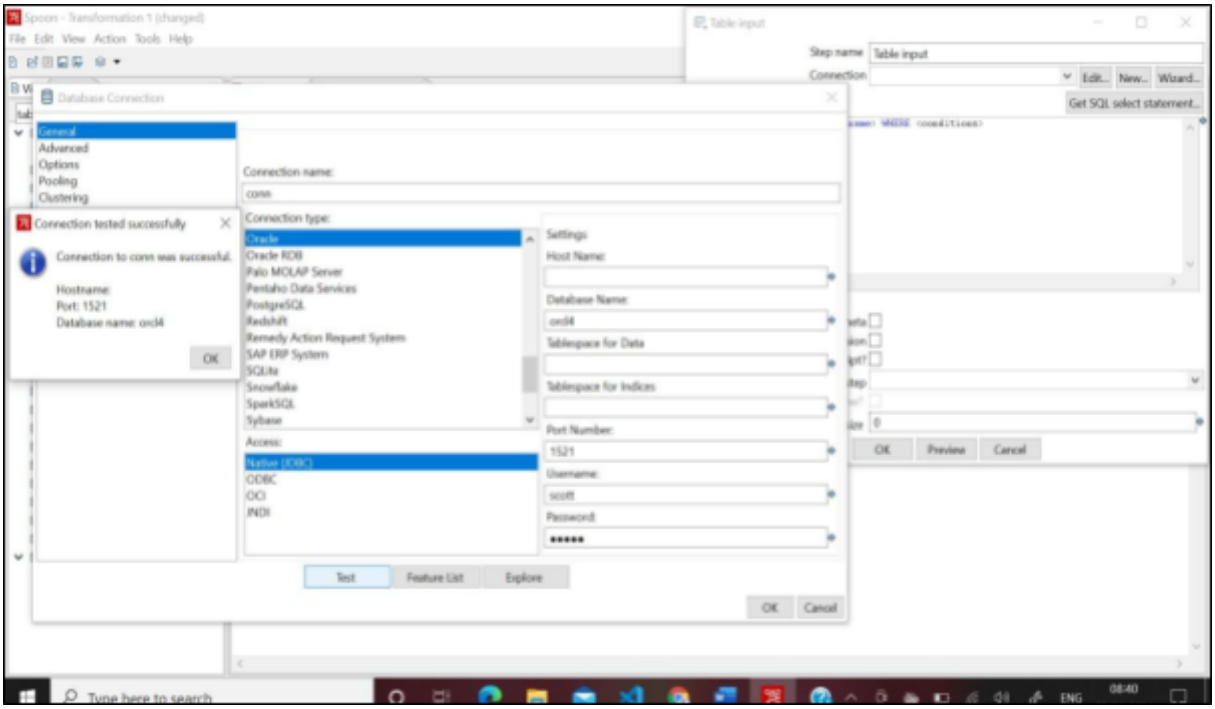
✓ Inserting **Table Input** into the Transformation:

Design -> Input -> Table Input (Drag & Drop in Transformation)



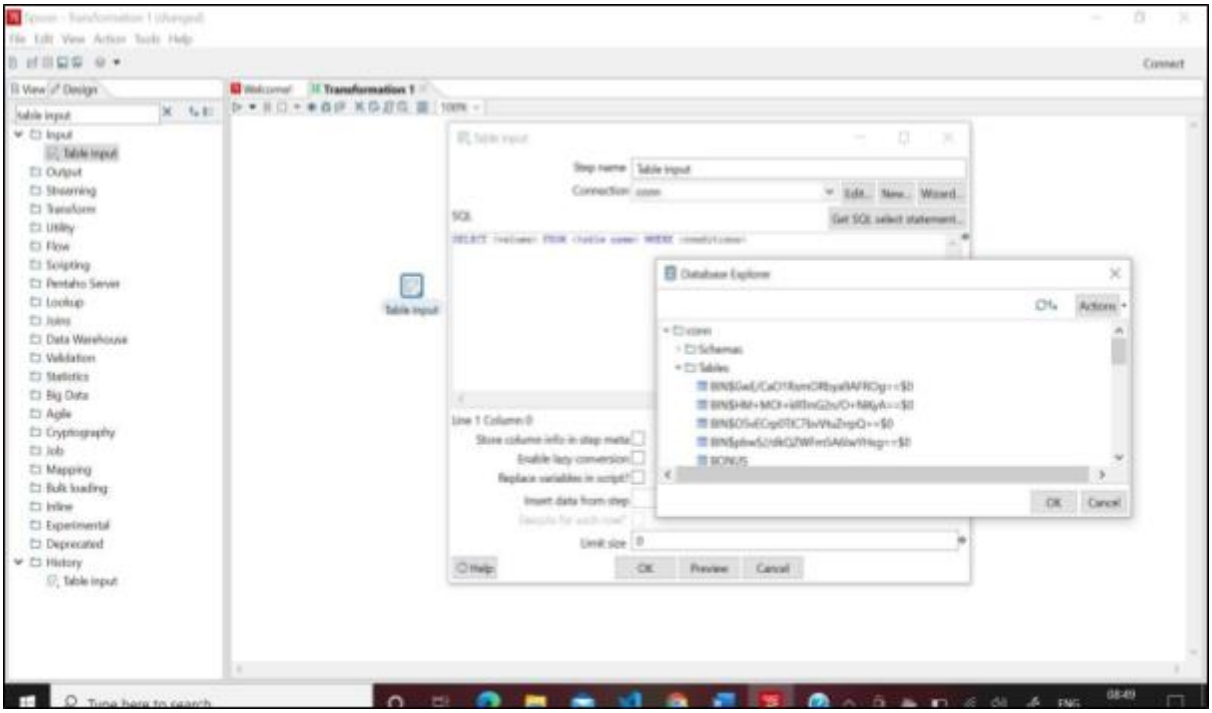
✓ Establishing **Database Connection**:

Double Click Table Input -> New -> Enter following respective Details in *General*: Connection name: *conn* Connection Type: *Oracle* Access: *Native (JDBC)* Database Name: *orcl4* Port Number: *1521* Username: *scott* Password: *tiger* Click Test -> OK -> OK



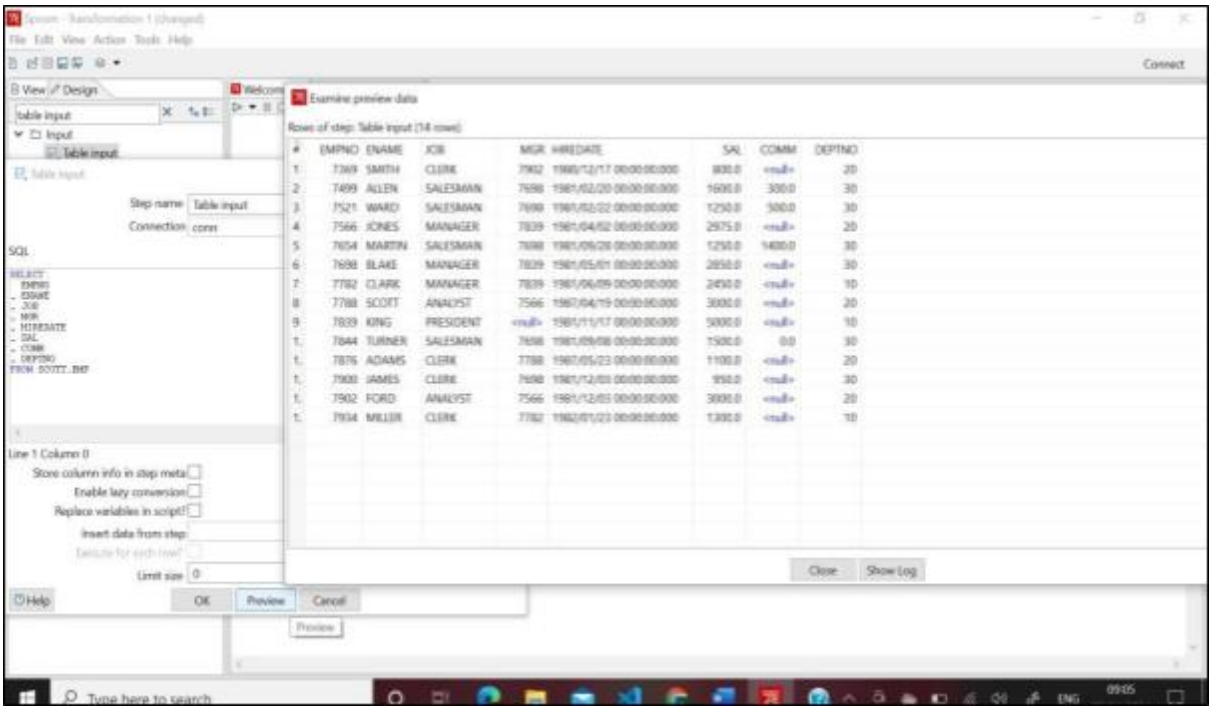
✓ Getting **Source Table**:

Table Input -> Get SQL Select Statement -> Data Explorer -> *conn* -> Tables -> *Click on desired Table* -> OK -> Yes



✓ **View** Input Table:

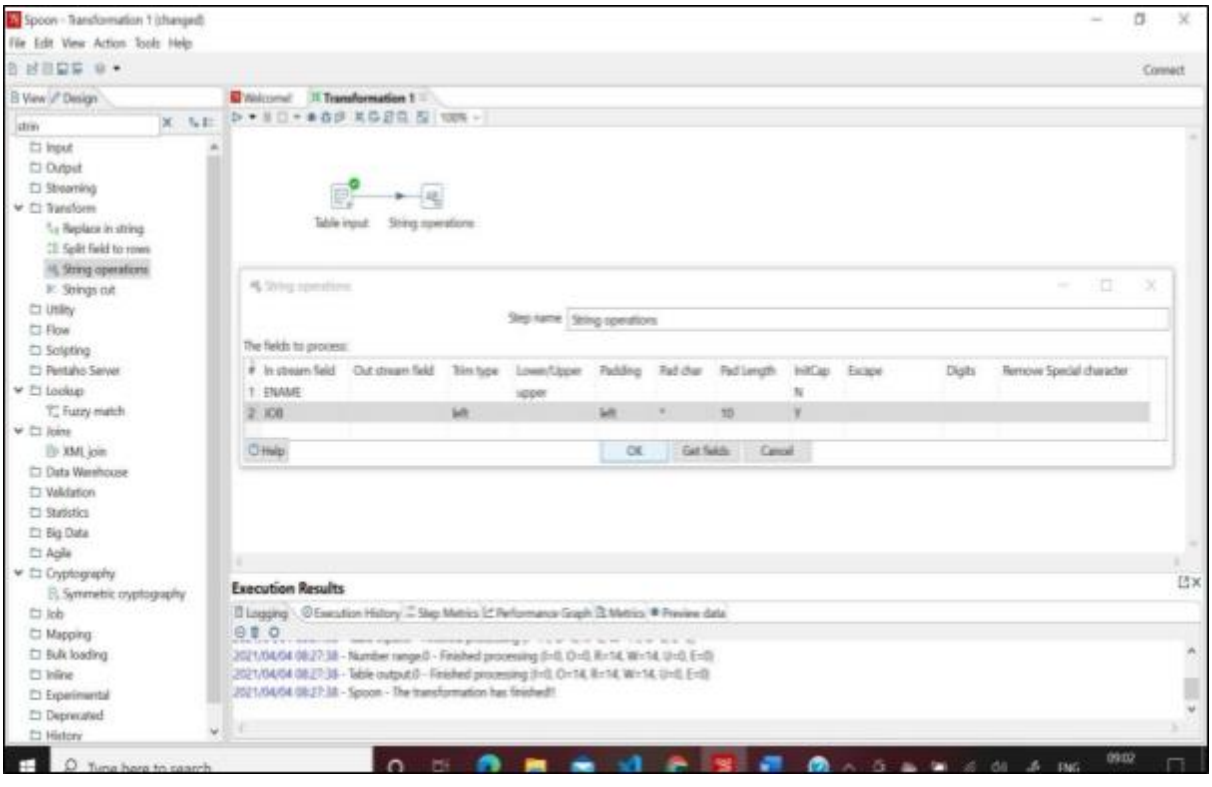
Table Input -> Preview -> OK -> Close -> OK



✓ **String Operations**:

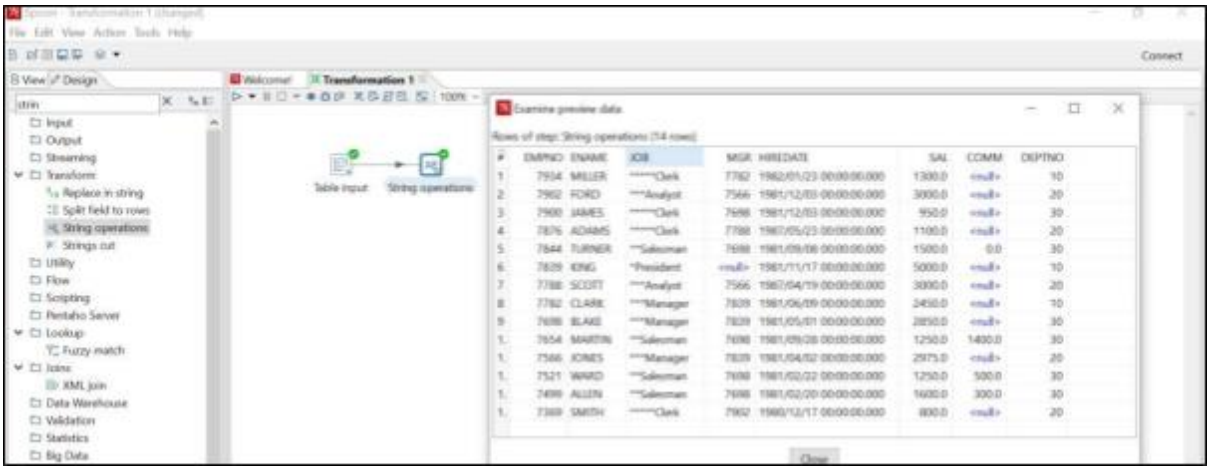
Design->Transform->String Operations(Drag / Drop in Transformation)->Create Hop Connection with String Operations (Click on Output Connector arrow in Input Table)

Double Click String Operations -> In stream field: *ENAME* -> Lower/Upper: *upper* -> InitCap: *N* -> In stream field: *JOB* -> Trim type: *left* -> Padding: *left* -> Pad char: * -> Pad Length: *10* -> InitCap: *Y* ->OK



✓ **Debug** Transformation:

Click String Operations -> Debug -> Quick Launch -> Yes

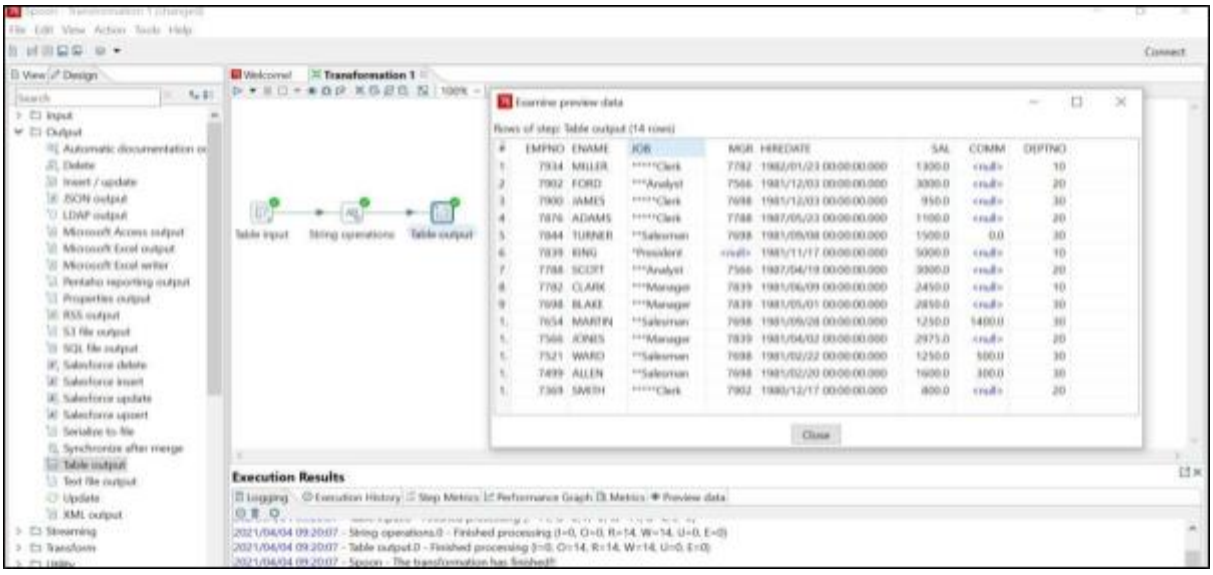


✓ Storing to **Output Table**:

Design -> Output -> Table Output (Drag & Drop in Transformation) -> Create Hop Connection to Output Table(Connector arrow String Operation)->Main output of step Double Click Table Output -> Target Table: *output* -> Truncate table ☑ -> Specify database fields ☑ -> Database fields -> Get fields -> SQL -> Execute -> OK -> Close

✓ **Debug** Transformation:

Click Table Output -> Debug -> Quick Launch -> Yes

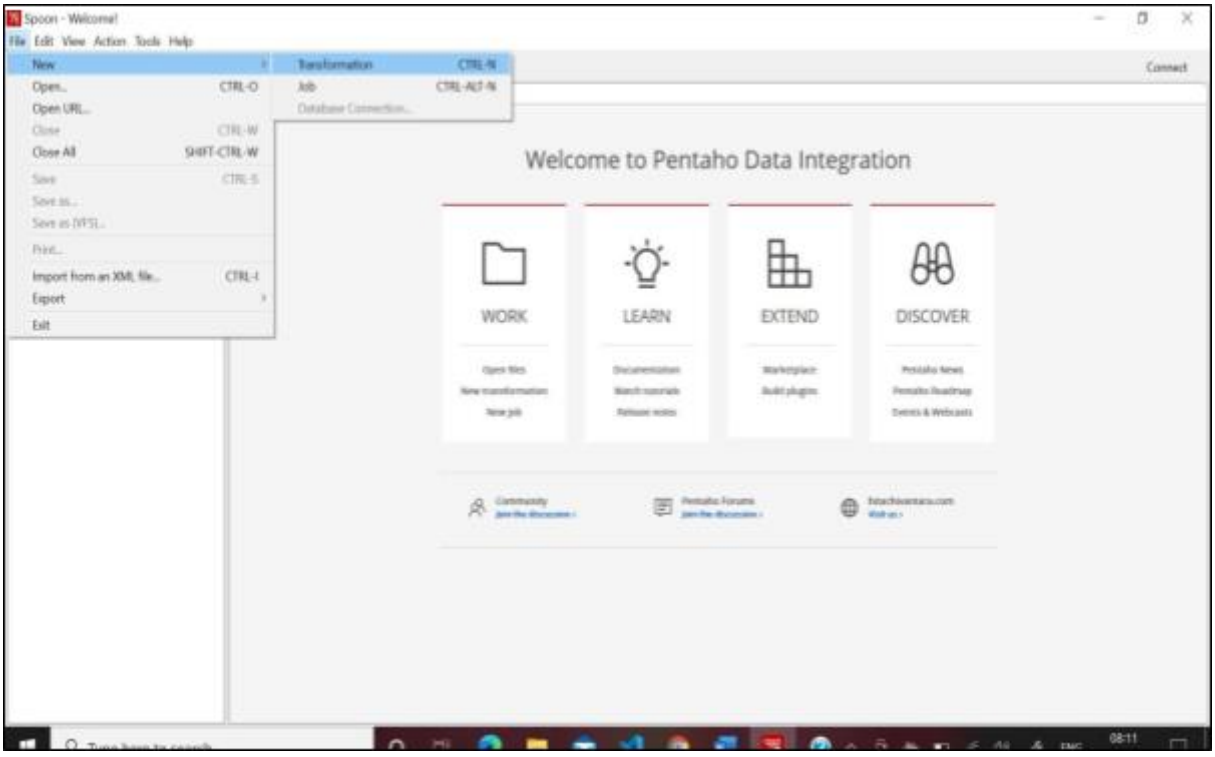


☐ Importing .CSV file to the target table.

Steps:

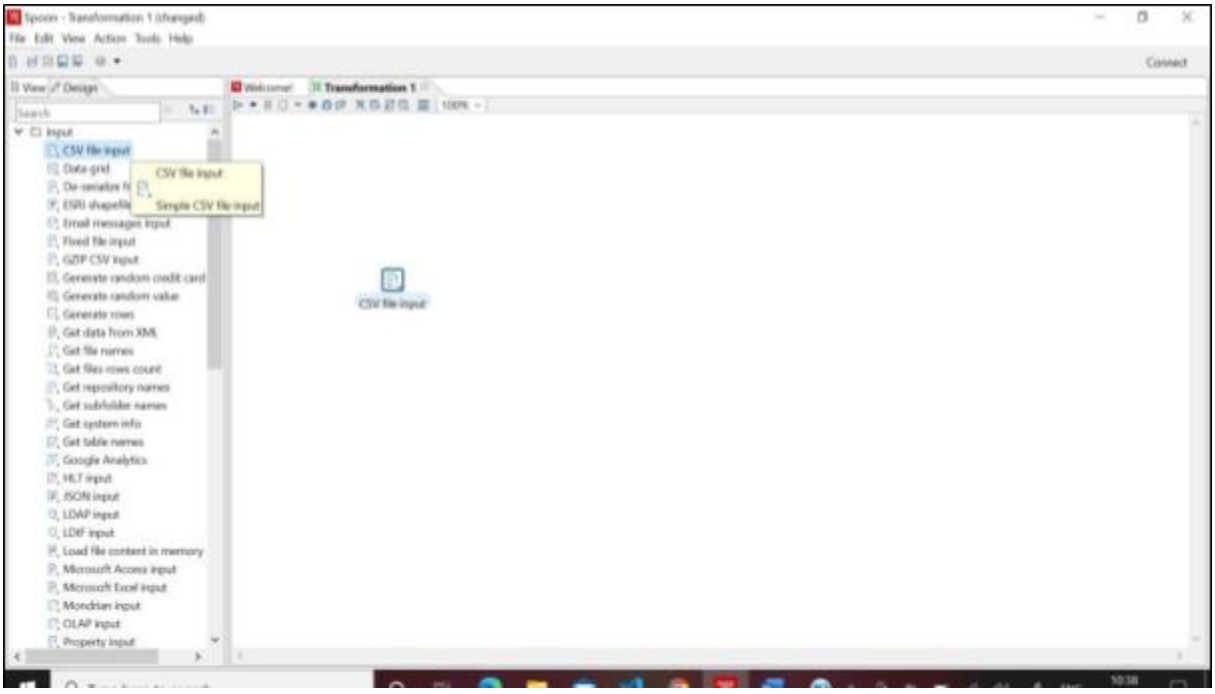
✓ Creating a **New Transformation**:

Open Pentaho Spoon -> File -> New -> Transformation (or CTRL-N)



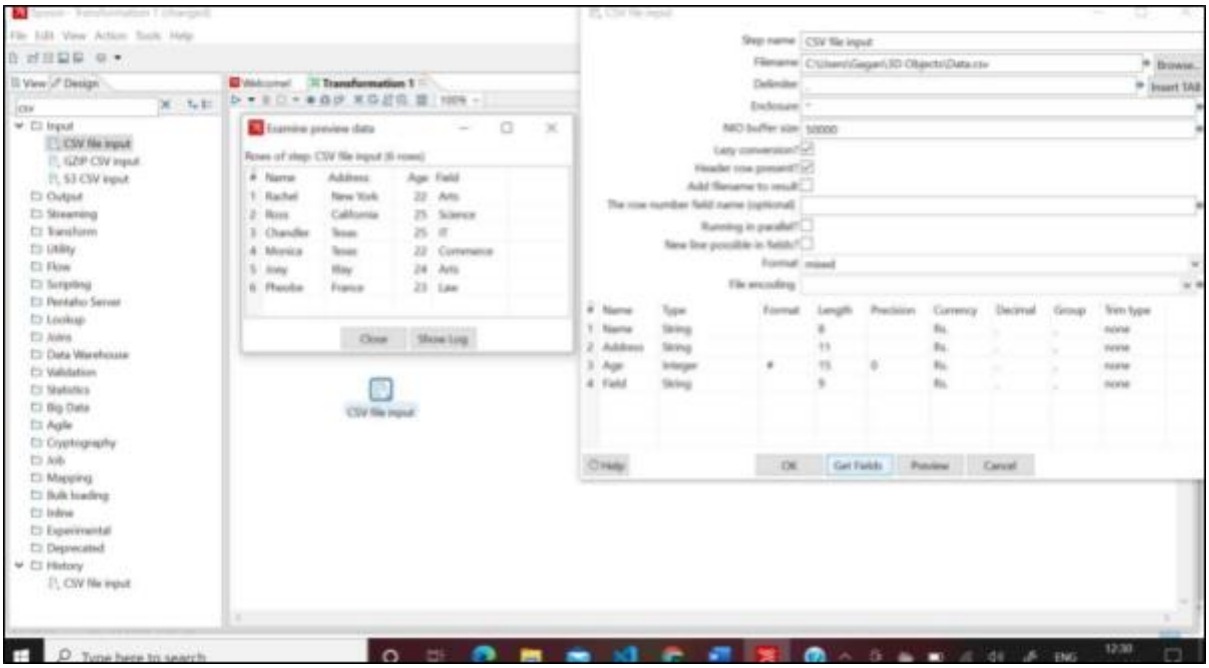
✓ Inserting **CSV File Input** into the Transformation:

Design -> Input -> CSV File Input (Drag & Drop in Transformation)



✓ Importing .**CSV File**:

Double Click CSV File Input -> Filename (Browse): *Data.csv* -> Get Fields -> OK -> Preview -> OK -> Close -> OK

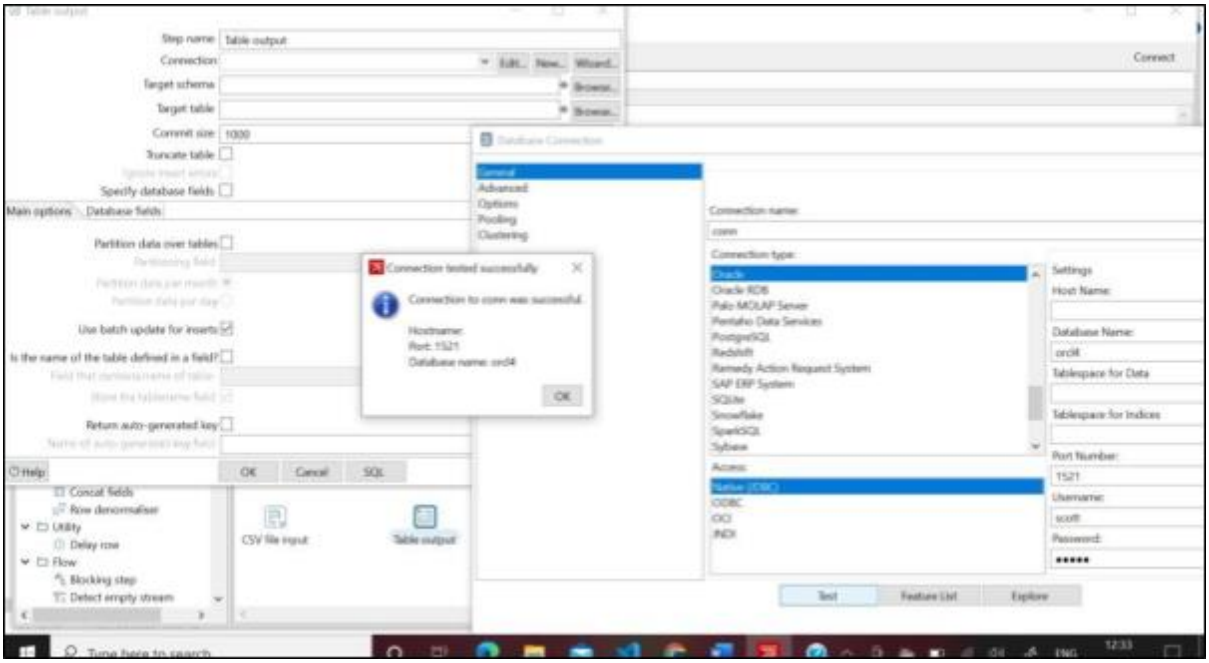


✓ Storing to **Target Table**:

Design -> Output -> Table Output (Drag & Drop in Transformation) -> Create Hop Connection to Output Table (Connector arrow CSV file input) -> Main output of step

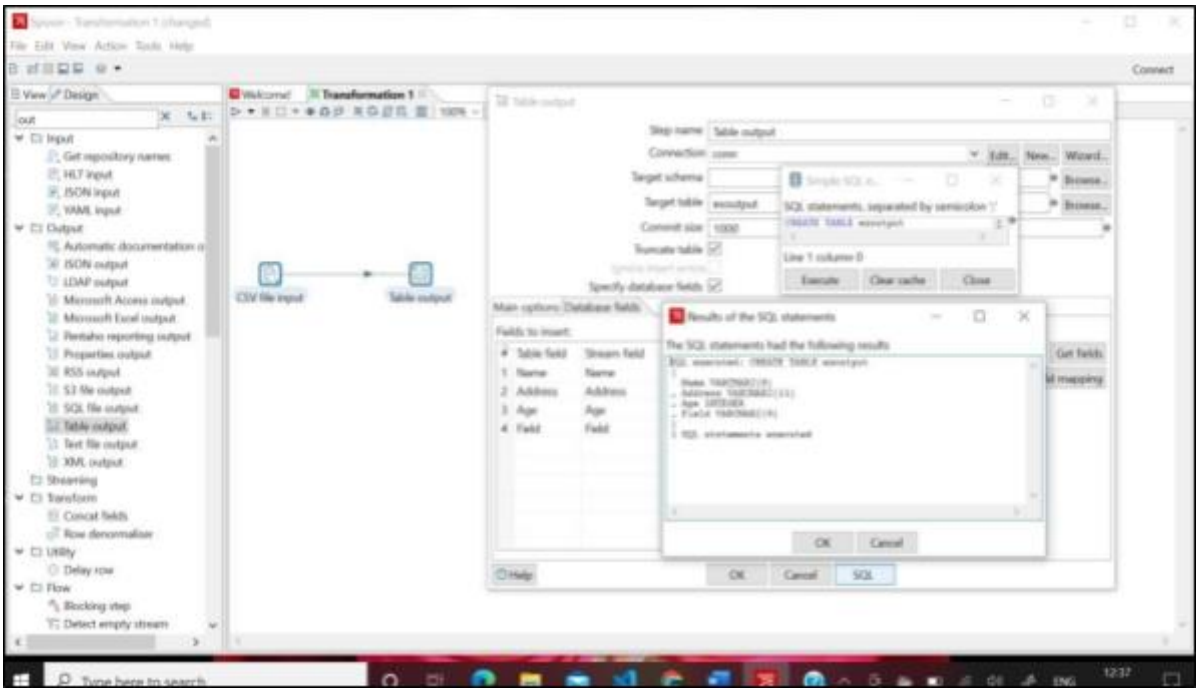
✓ Establishing **Database Connection**:

New -> Enter following respective Details in *General*:
Connection name: *conn* Connection Type: *Oracle* Access: *Native (JDBC)* Database Name: *orcl4* Port Number: *1521* Username: *scott* Password: *tiger* Click Test -> OK -> OK



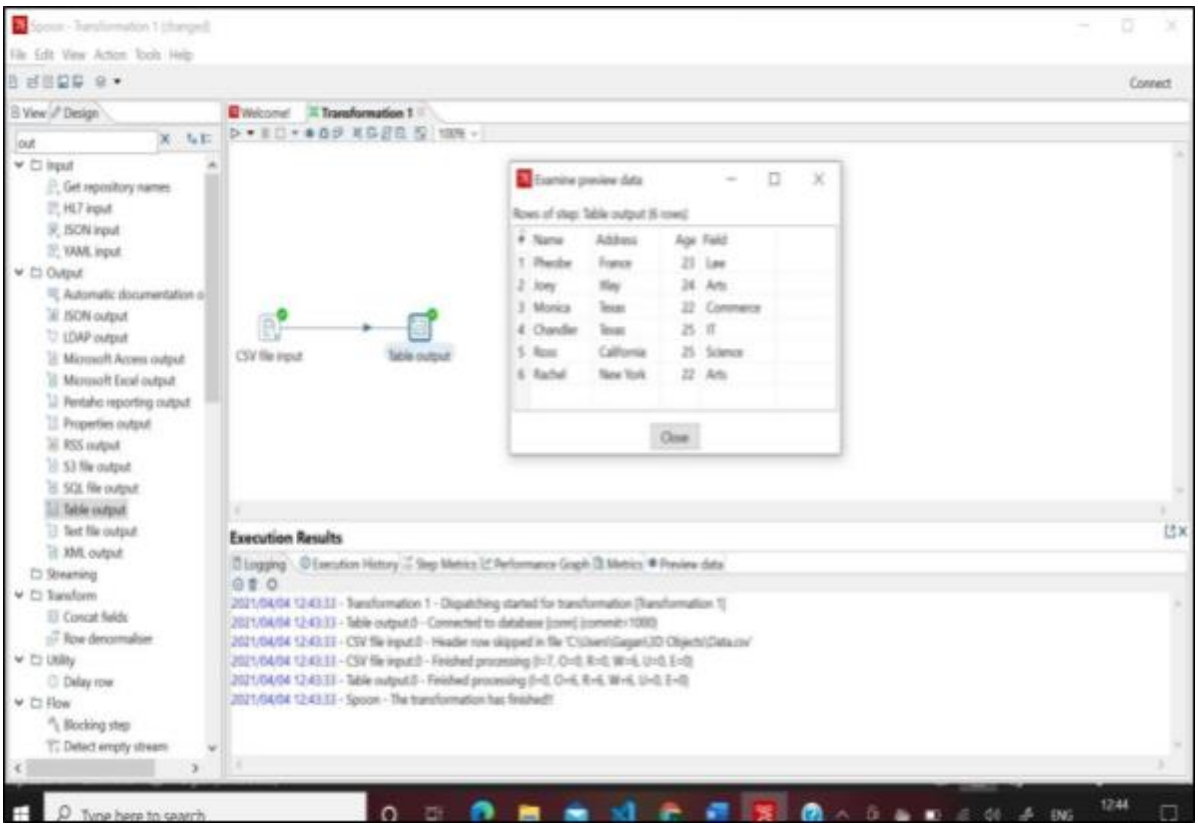
✓ Importing to **Target Table**:

Double Click Table Output -> Target Table: *output* -> Truncate table ☑ -> Specify database fields ☑ -> Database fields -> Get fields -> SQL -> Execute -> OK -> Close



✓ **Debug** Transformation (View Target Table):

Click Table Output -> Debug -> Quick Launch -> Yes

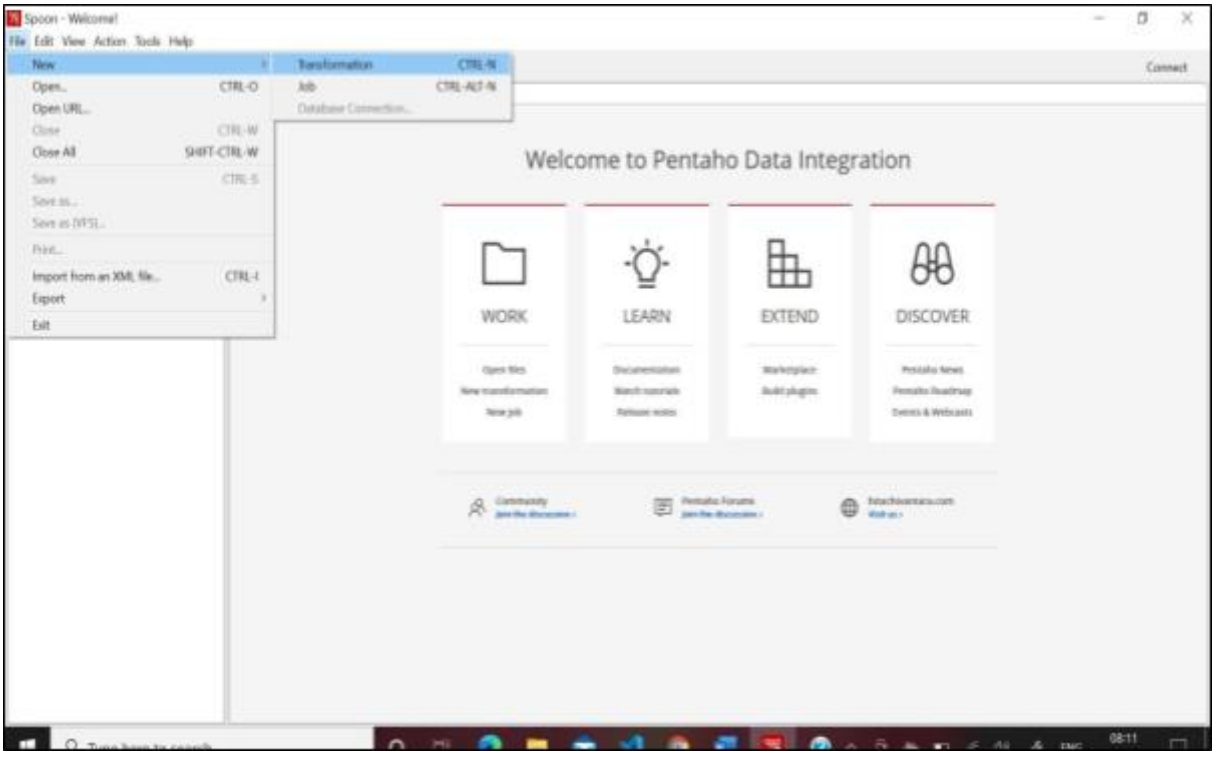


☐ Implement the Merge Join Transformation on Tables.

Steps:

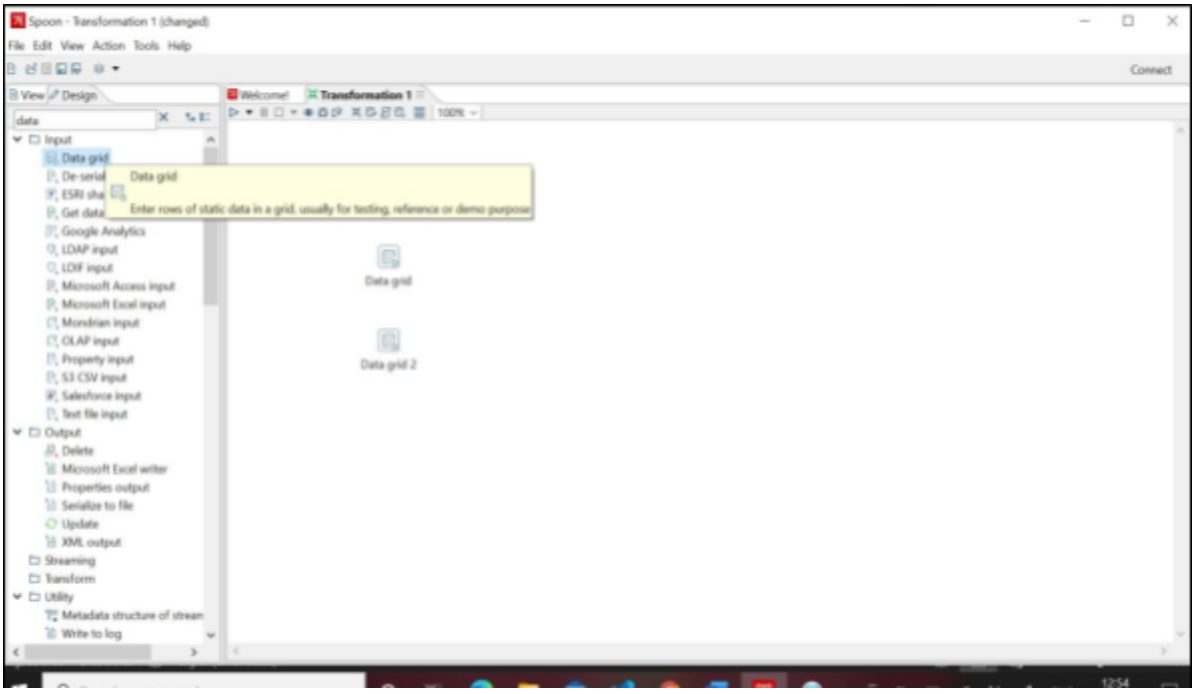
✓ Creating a **New Transformation**:

Open Pentaho Spoon -> File -> New -> Transformation (or CTRL-N)



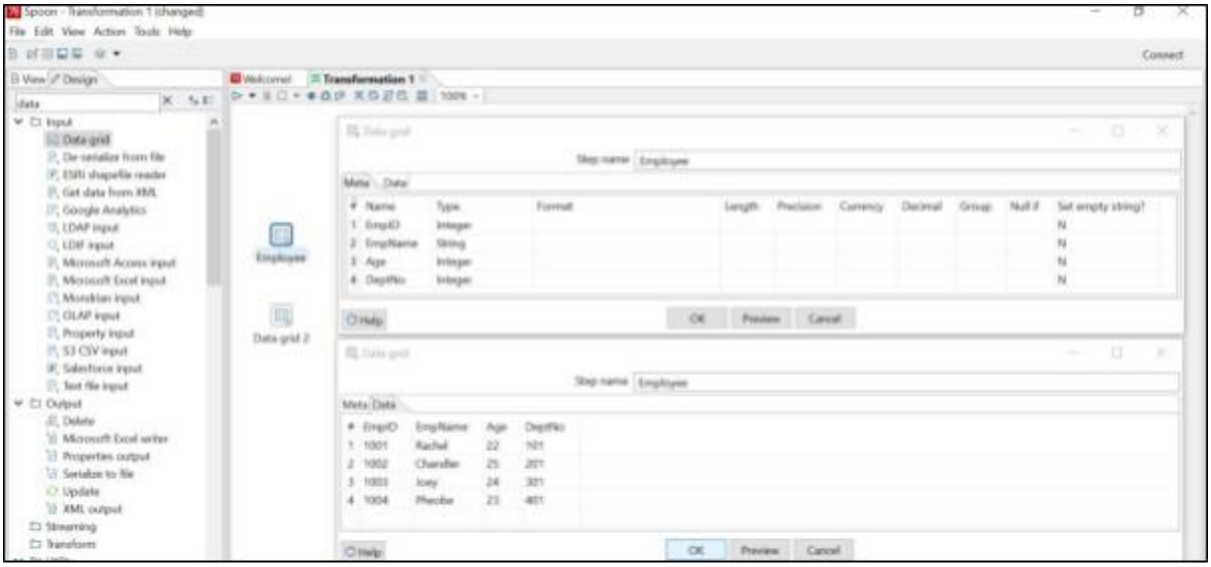
✓ Inserting **Data Grid** into the Transformation:

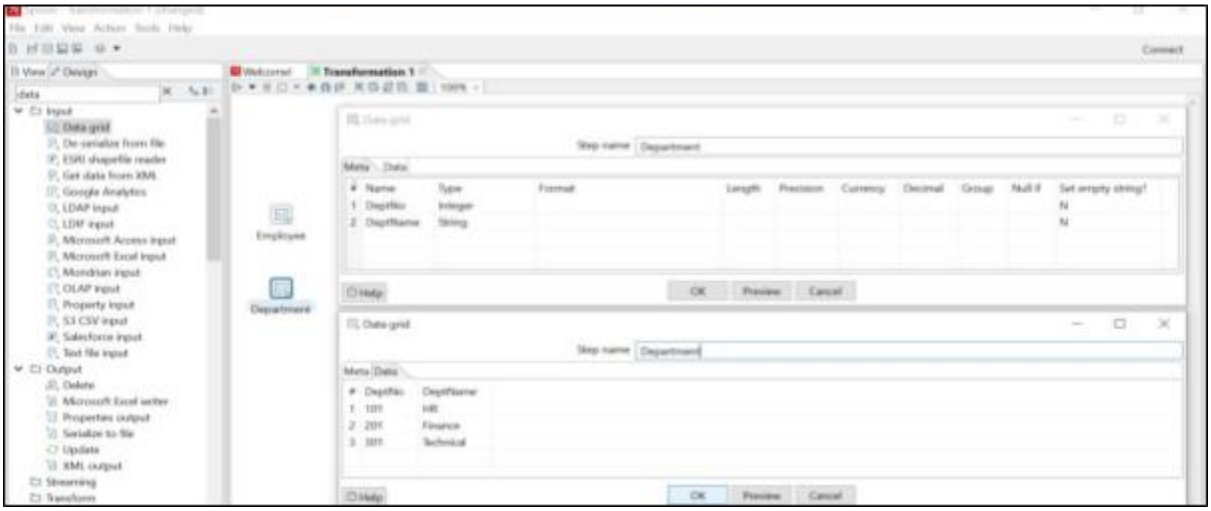
Design -> Input -> Data Grid (Twice Drag & Drop in Transformation)



✓ Inserting **Data in Data Grid**:

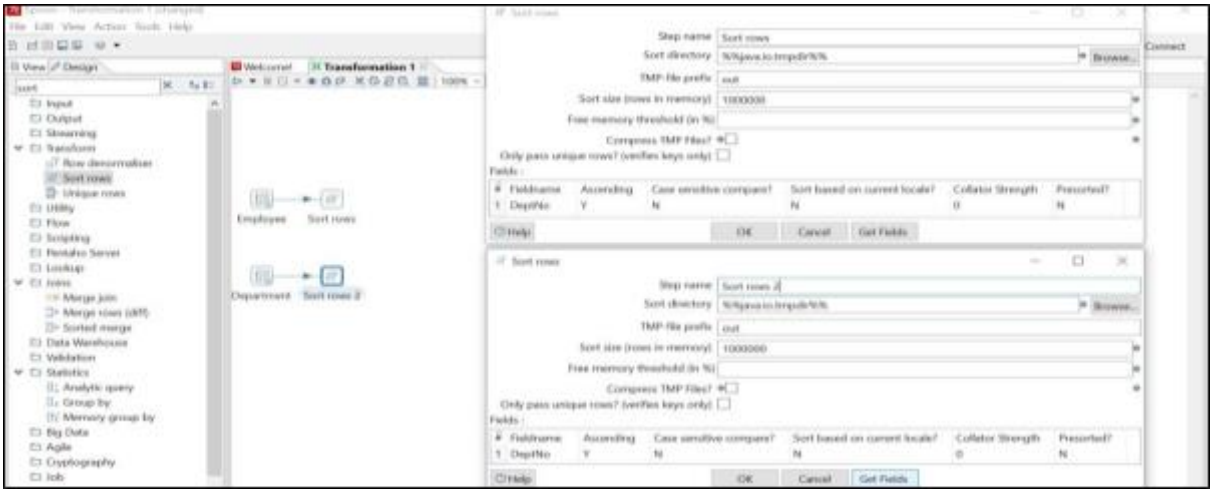
Double Click Data Grids -> Step name : *Employee/ Department* -> Meta: *Enter Fields Details* -> Data: *Enter actual Data* -> OK





✓ Inserting **Sort Rows**:

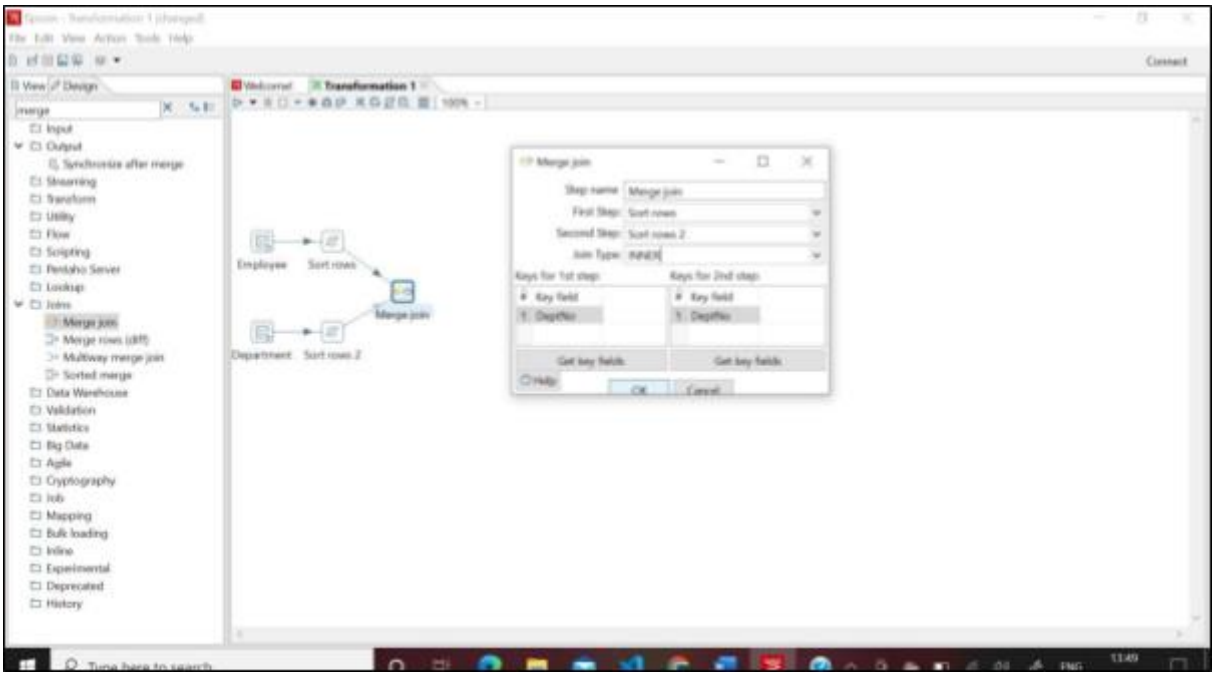
Design -> Transform -> Sort Rows (Twice Drag & Drop in Transformation) -> Create Hop Connection with Sort Rows (Click on Output Connector arrow in Data Grids) Double Click Sort Rows -> Get Fields (Discard unwanted Fields) -> OK


Input
Output
Streaming
Transform
Row denormaliser
Sort rows
Unique rows
Utility
Flow
Scripting
Pentaho Server
Lookup
Joins
Merge join
Merge rows (diff)
Sorted merge
Data Warehouse
Validation
Statistics
Analytic query
Group by
Memory group by
Big Data
Agile
Cryptography
Job
Web.xml
Transformation 1
Employee
Sort rows
Department
Sort rows 2
Step name
Sort rows
Sort directory
%%java.io.tmpdir%%
Browse...
TMP file prefix
out
Sort size (rows in memory)
1000000
Free memory threshold (in %)
Compress TMP Files?
Only pass unique rows? (verifies keys only)
Fields :
Fieldname Ascending Case sensitive compare? Sort based on current locale? Collator Strength Presorted?
1 DeptNo Y N N 0 N
Help
OK
Cancel
Get Fields
Step name
Sort rows 2
Sort directory
%%java.io.tmpdir%%
Browse...
TMP file prefix
out
Sort size (rows in memory)
1000000
Free memory threshold (in %)
Compress TMP Files?
Only pass unique rows? (verifies keys only)
Fields :
Fieldname Ascending Case sensitive compare? Sort based on current locale? Collator Strength Presorted?
1 DeptNo Y N N 0 N
Help
OK
Cancel
Get Fields
Connect

✓ Inserting **Merge Join** into the Transformation:

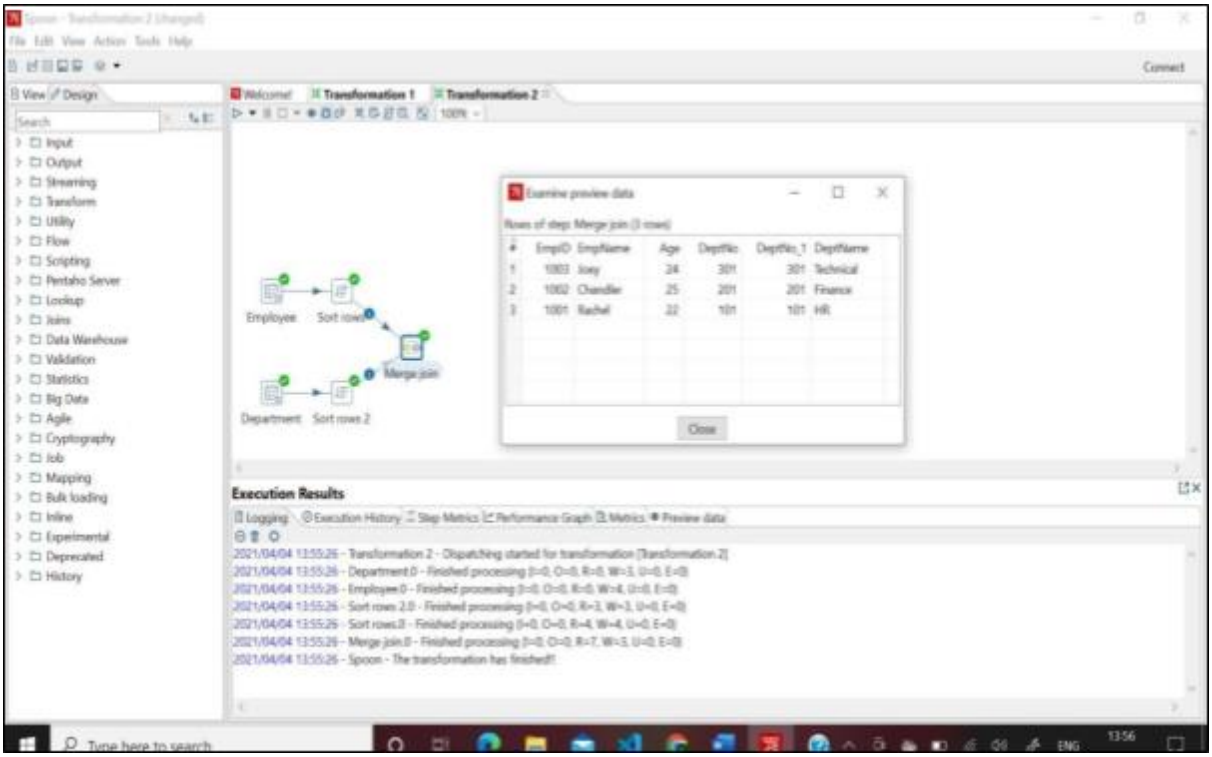
Design -> Joins -> Merge Join (Drag & Drop in Transformation) -> Create Hop Connection with Merge Join (Click on Output Connector arrow in Sort Rows)

Double Click Merge Join -> First Step: *Sort rows* -> Second Step: *Sort Rows 2* -> Join Type: *INNER* -> Get key fields (Both, Discard unwanted Fields) -> OK -> Close



✓ **Debug** Transformation:

Click Merge Join -> Debug -> Quick Launch -> Yes

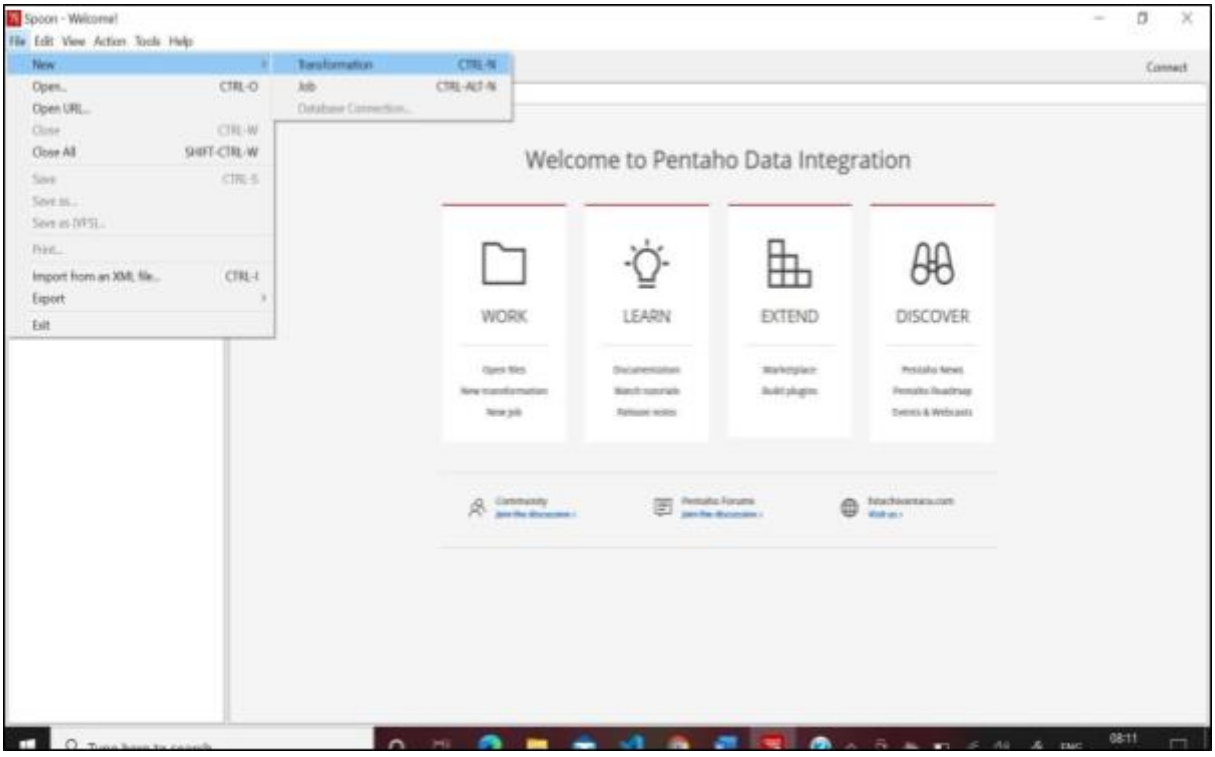


☐ Implement different Data Validations on Table.

Steps:

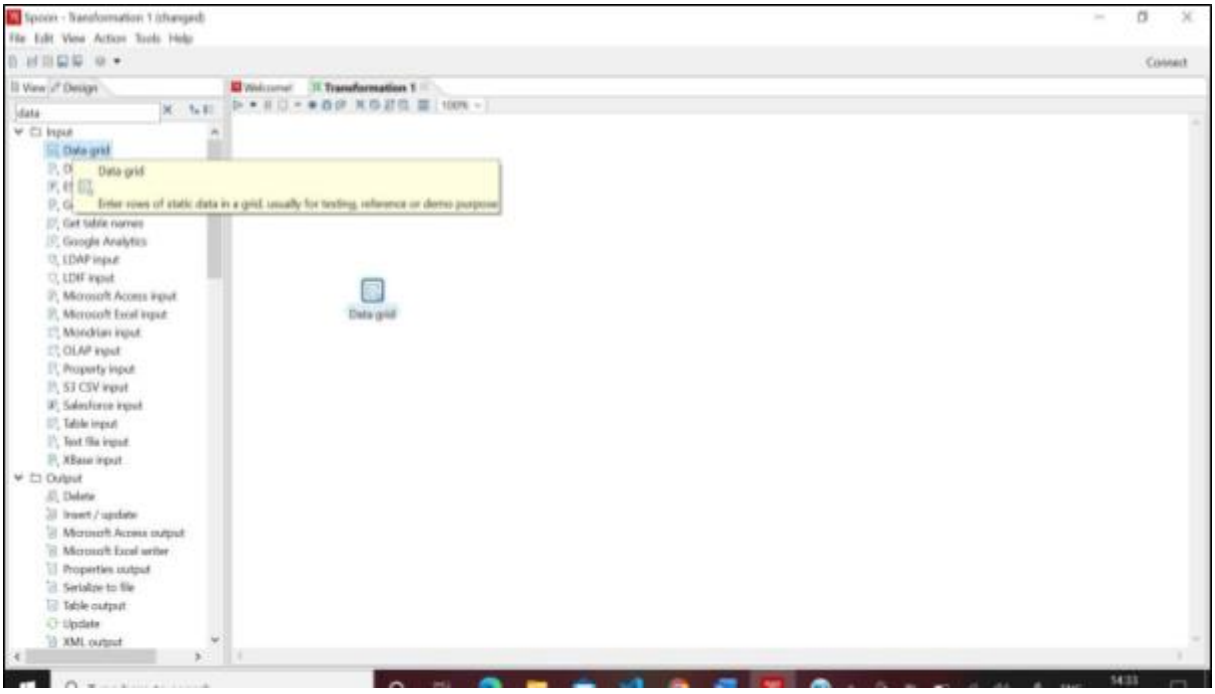
✓ Creating a **New Transformation**:

Open Pentaho Spoon -> File -> New -> Transformation (or CTRL-N)



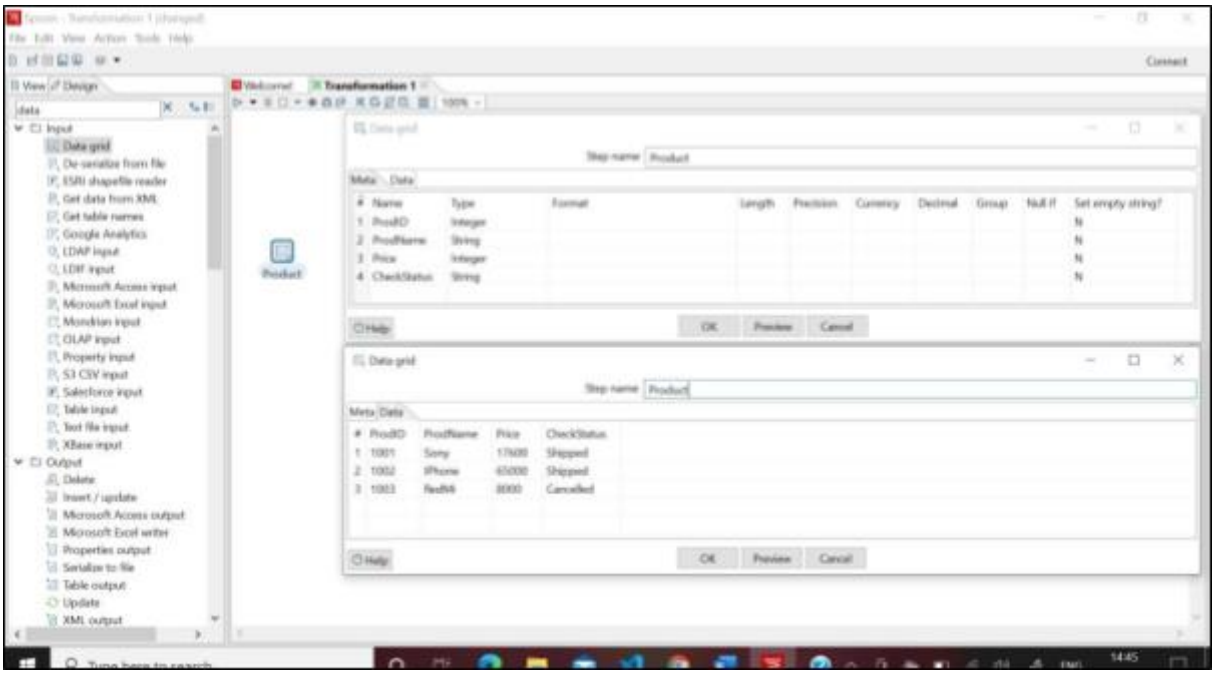
✓ Inserting **Data Grid** into the Transformation:

Design -> Input -> Data Grid (Drag & Drop in Transformation)



✓ Inserting **Data in Data Grid**:

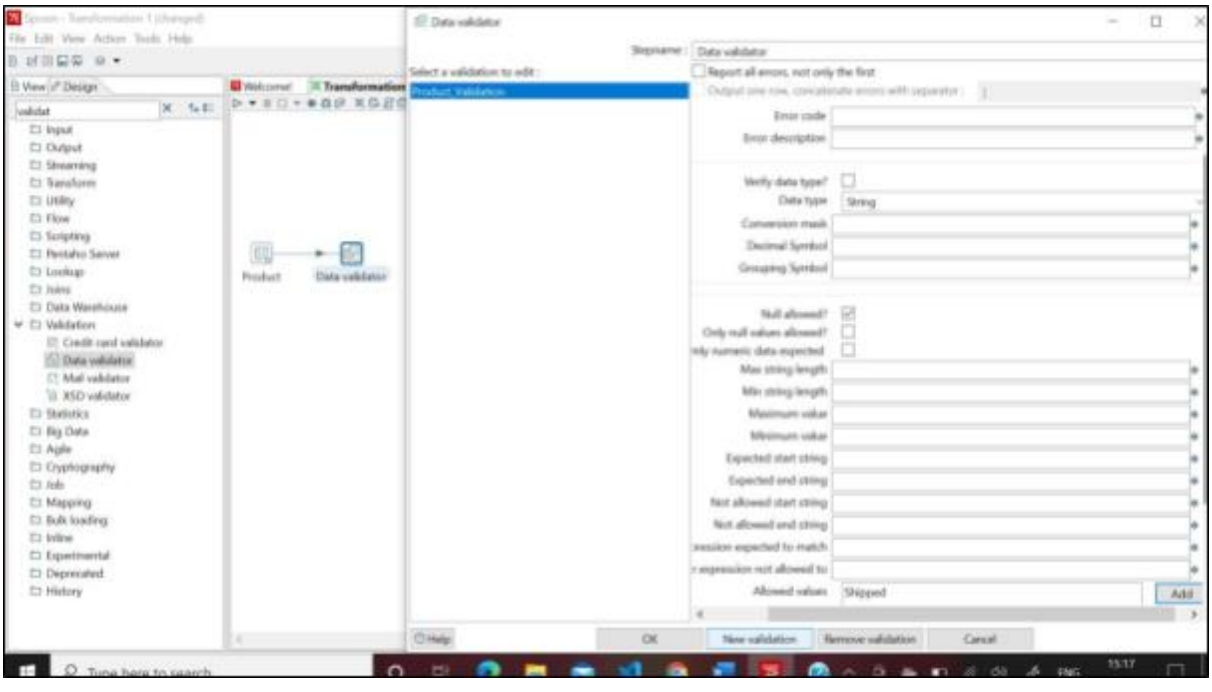
Double Click Data Grid -> Step name : *Product* ->
Meta: *Enter Fields Details* -> Data: *Enter actual Data* -> OK



✓ Inserting **Data Validator** into the Transformation:

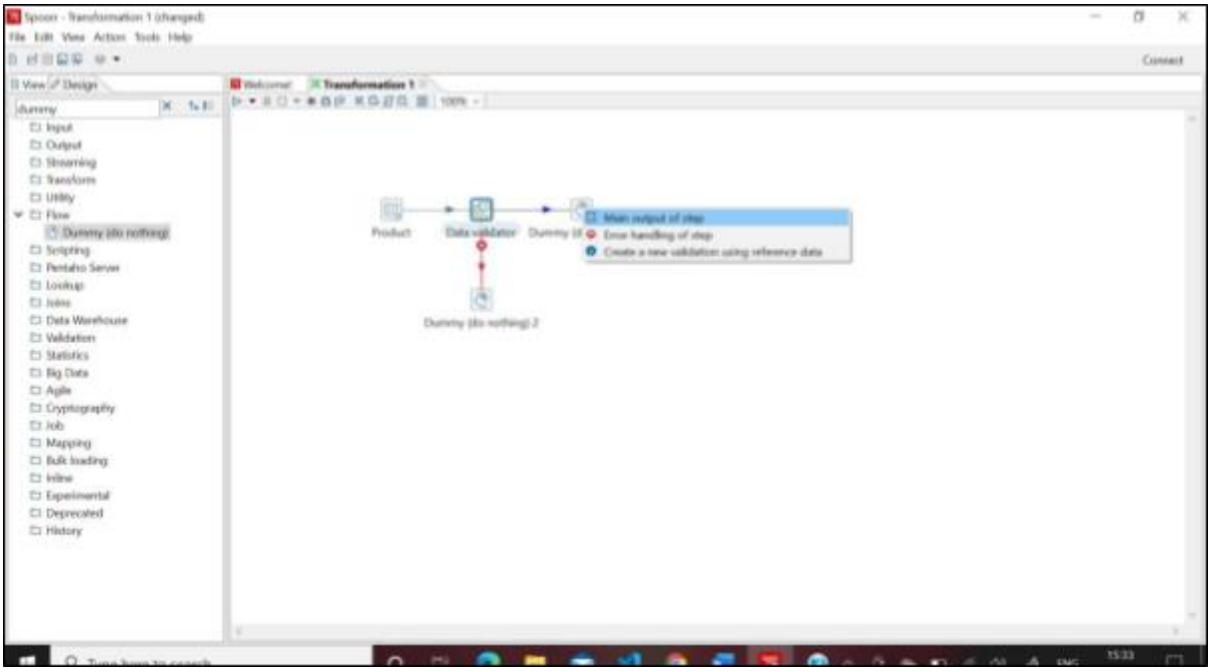
Design -> Validation -> Data Validator (Drag & Drop in Transformation) -> Create Hop Connection with Data Validator (Click on Output Connector arrow in Data Grid)

Double Click Data Validator -> Step Name: *Product*_Validation -> New validation -> Enter validation name: *Product_Validation* -> OK -> Select a validation to edit: *Click Product_Validation* -> Name of field to validate: *CheckStatus* -> Data type: *String* -> Add Button -> Enter the allowed value to add: *Shipped* -> OK -> OK



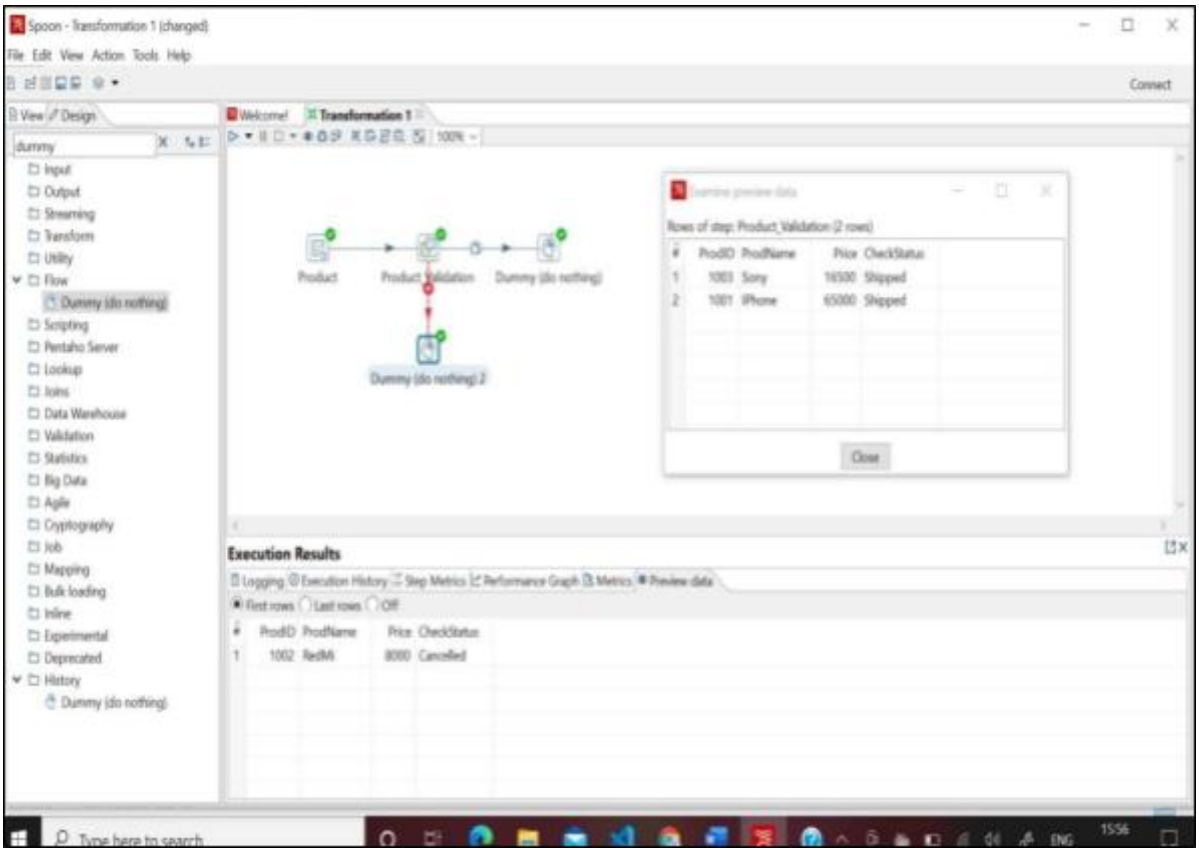
✓ Inserting **Dummy** (do nothing) into the Transformation:

Design -> Flow -> Dummy (Twice Drag & Drop in Transformation) -> Create Hop Connection with Dummy (Click on Output Connector arrow in Data Validator) -> Dummy: *Main output of step* -> Dummy 2: *Error Handling of Step* -> Copy



✓ **Debug** Transformation:

Click Data Validator -> Debug -> Quick Launch -> Yes



Practical No. 05

Aim: Basic R Commands.

- ☐ Setting working directory, getting current working directory, listing contents of current working directory.

Commands:

✓ **Setting Working Directory**

setwd("C:/Users/Gagan/Documents")

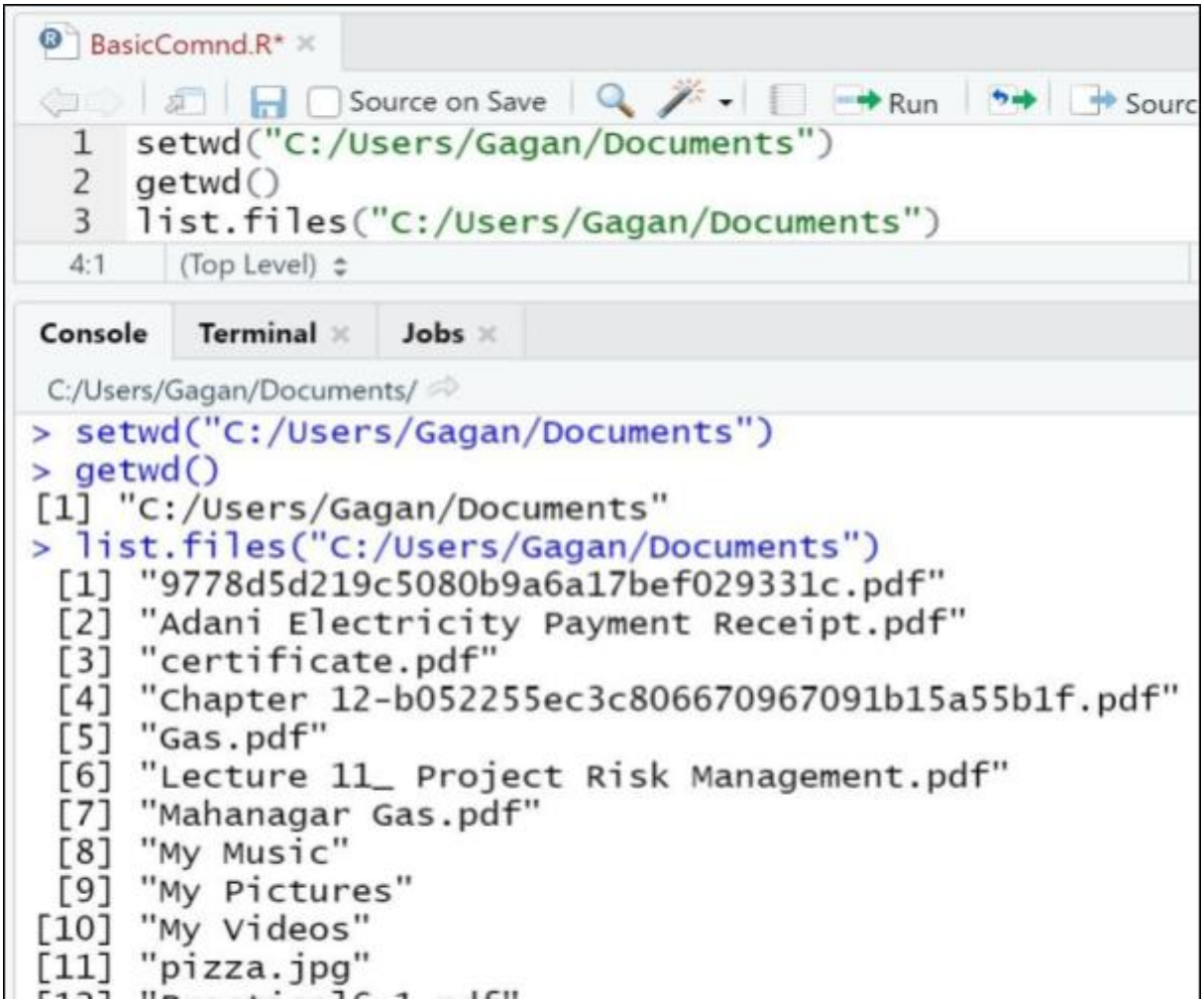
✓ **Getting Current Working Directory**

getwd()

✓ **Listing Contents of Current Working Directory**

list.files("C:/Users/Gagan/Documents")

Output:

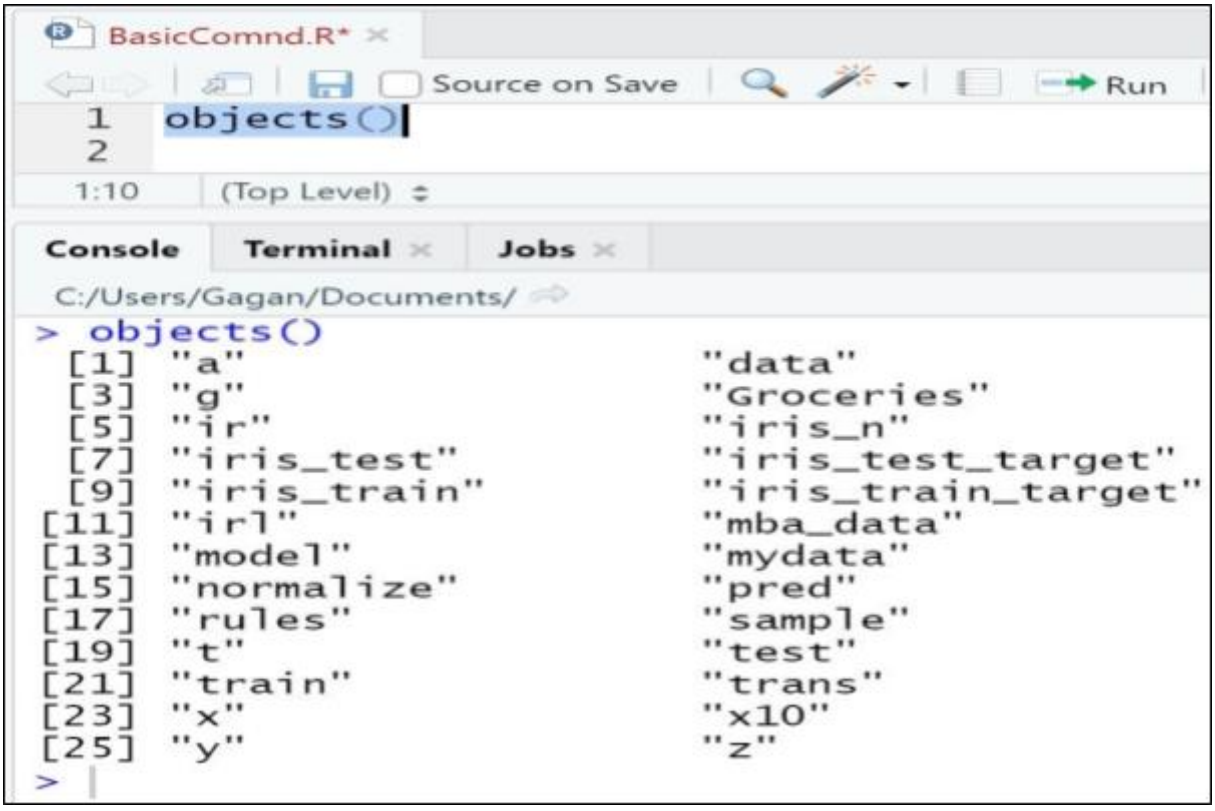


☐ List Names of Objects in R Environment

Command:

✓ objects()

Output:



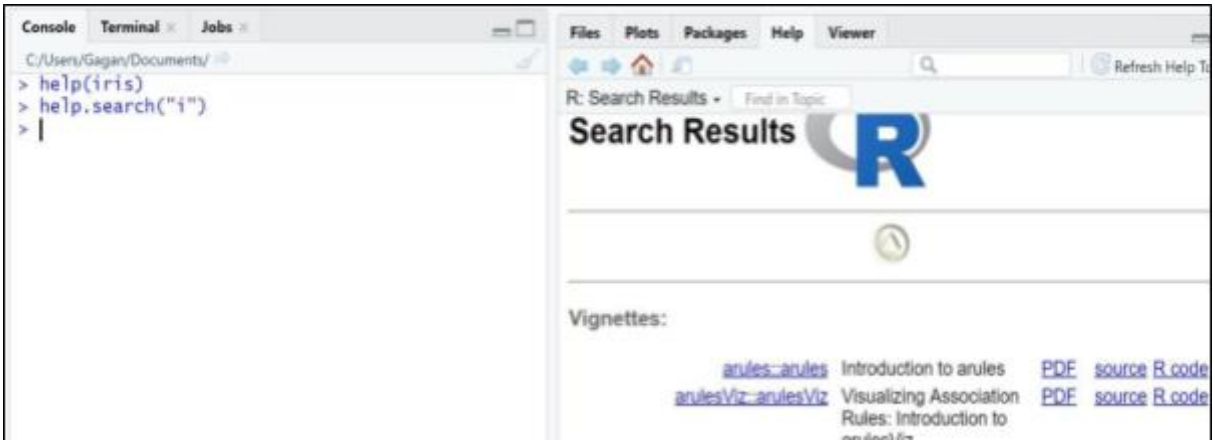
☐ Different Help Commands

Command:

✓ help(iris)

help.search("i")

Output:



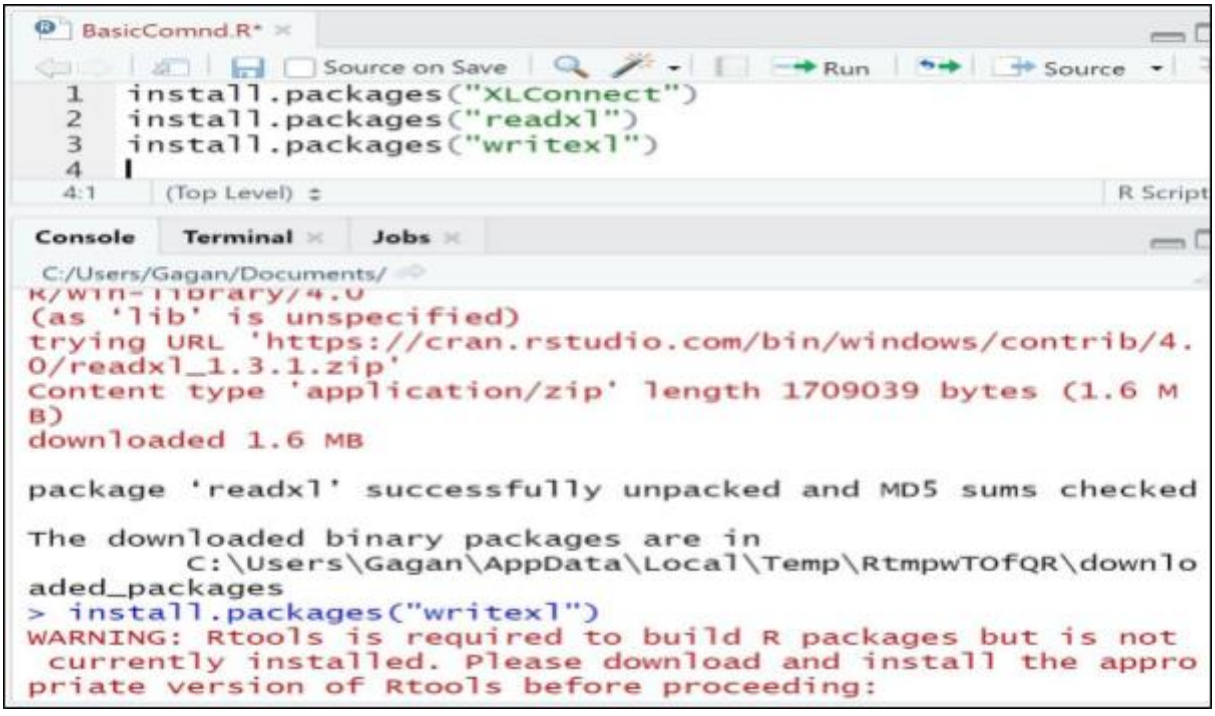
- Installing Packages (XLConnect, readxl, writexl), Displaying Installed Packages, Loading a Package

Command:

✓ **Installing Packages (XLConnect, readxl, writexl)**

```
install.packages("XLConnect")
install.packages("readxl")
install.packages("writexl")
```

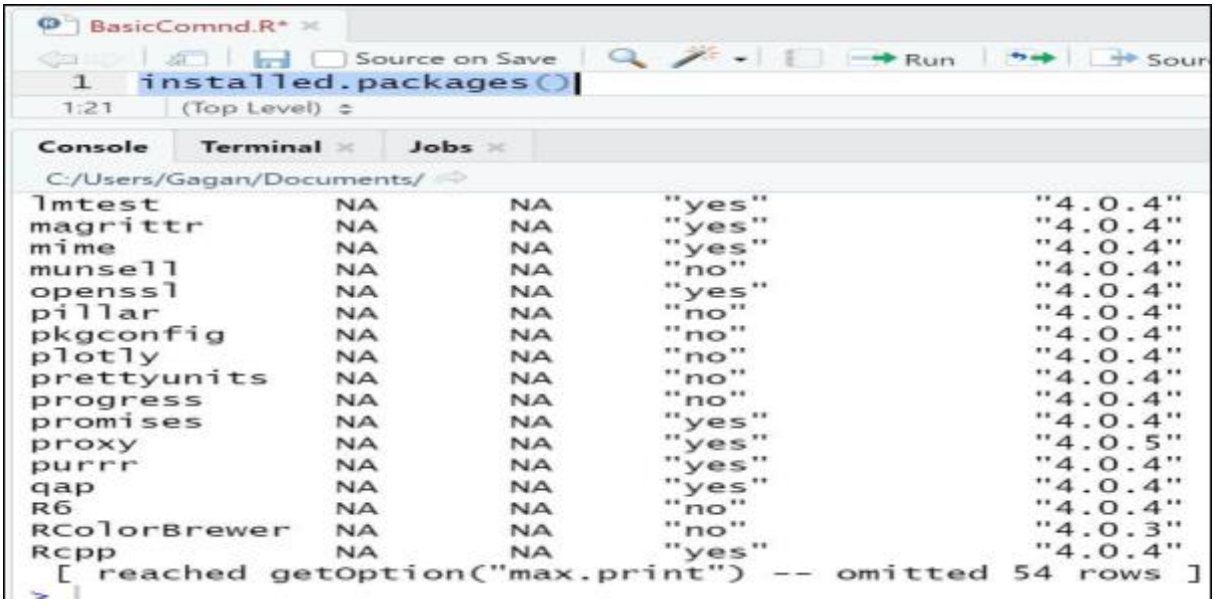
Output:



✓ **Displaying Installed Packages**

```
installed.packages()
```

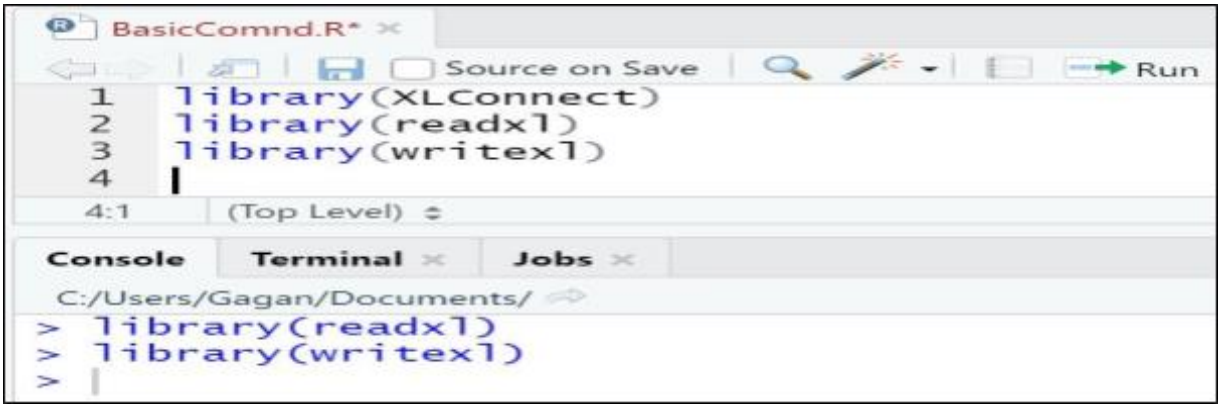
Output:



✓ **Loading a Package**

```
library(XLConnect)
library(readxl)
library(writexl)
```

Output:



- Creating a Variable, Assigning Values to a Variable, Printing Variable Value

Command:

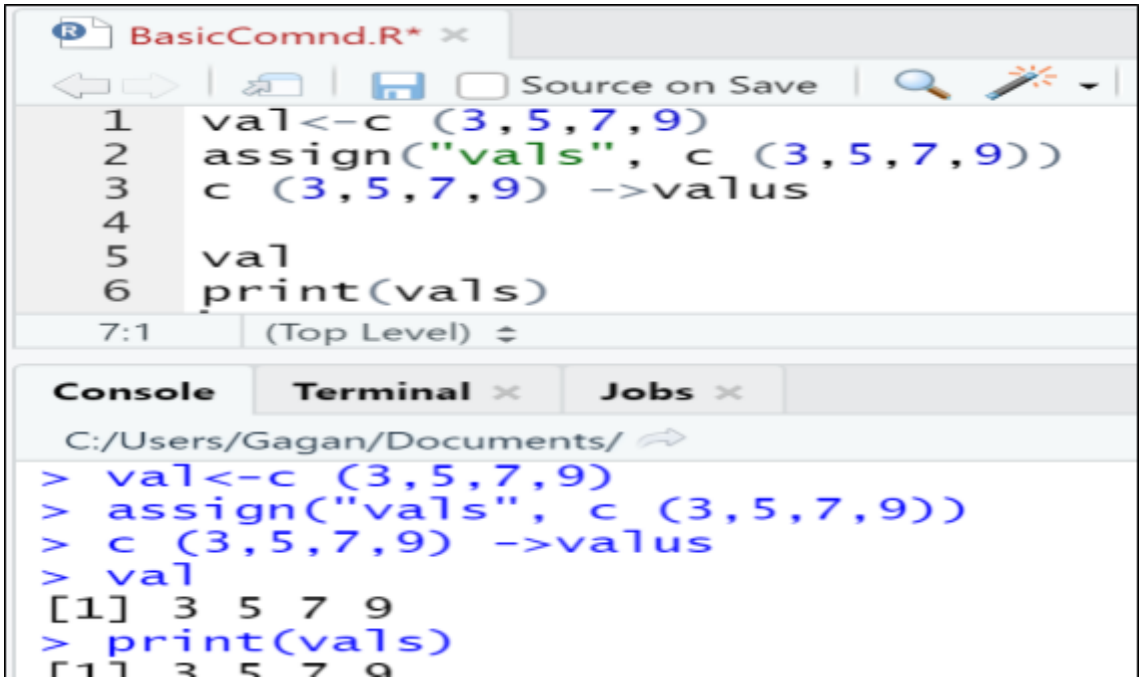
✓ **Creating a Variable, Assigning Values to a Variable**

```
val<-c (3,5,7,9)                OR
assign("vals", c (3,5,7,9))     OR c
(3,5,7,9) ->valus
```

✓ **Printing Variable Value**

```
val                             #Auto Printing
print(vals)                     #External Printing
```

Output:



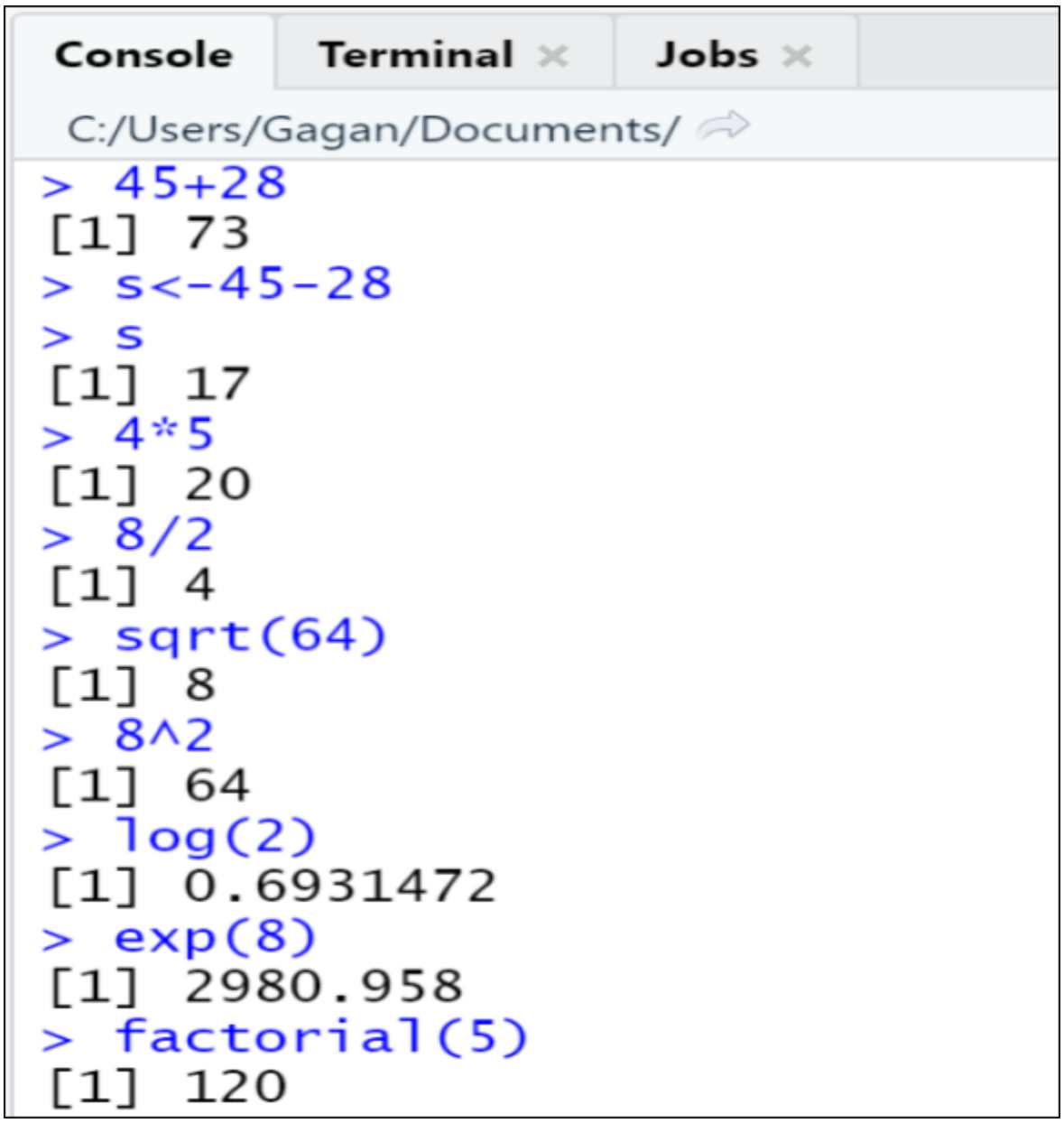
- Performing various Calculations in R (Addition, Subtraction, Multiplication, Division, Square Root, Square, etc..)

Command:

✔

```
45+28                #Addition
 s<-45-28            #Subtraction
s
4*5                  #Multiplication
8/2                  #Division
sqrt(64)             #Square Root
 8^2                  #Square
log(2)               #Logarithm
exp(8)               #Exponent
factorial(5)         #Factorial
```

Output:

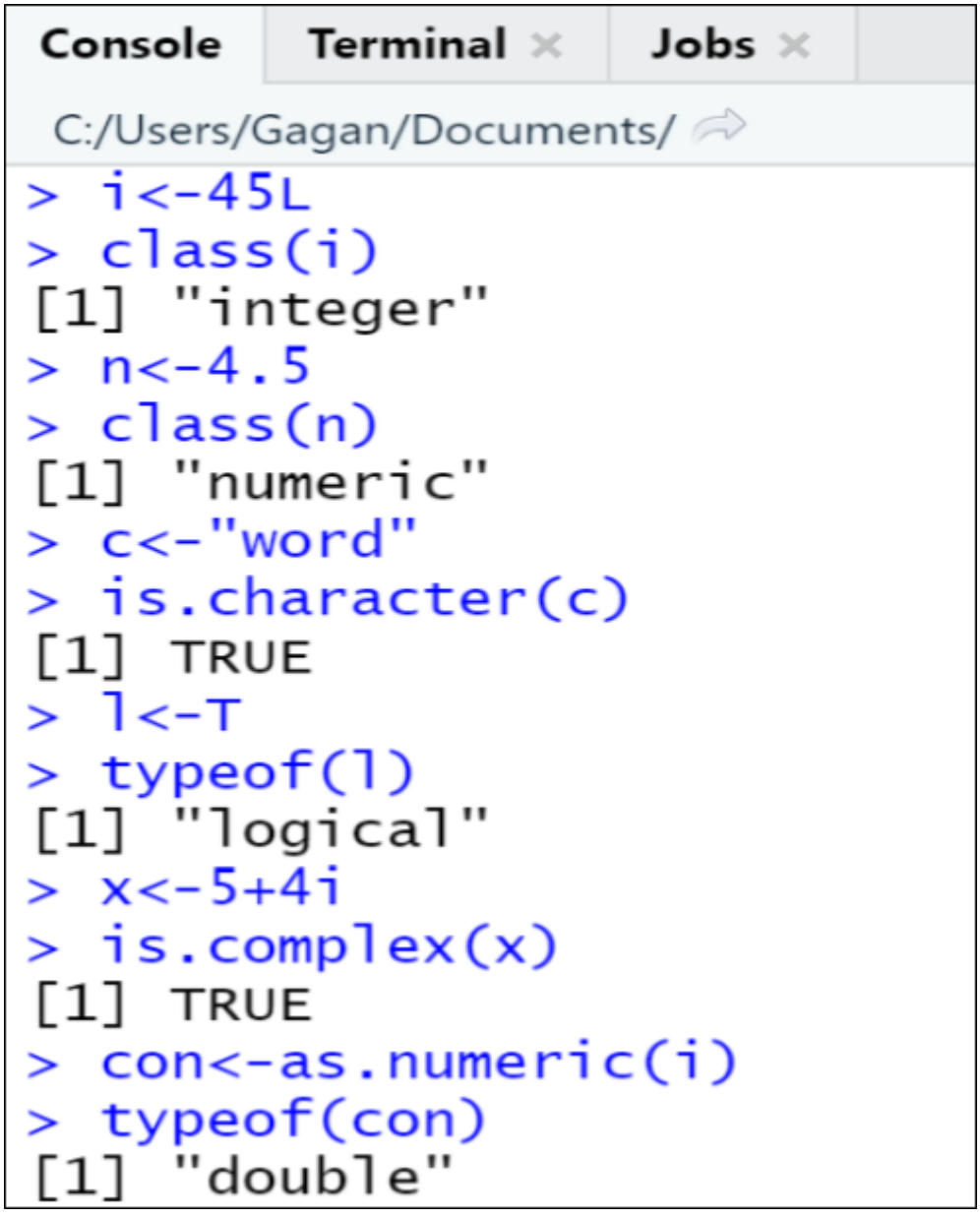


- Data Types in R (Integer, Numeric, Character, Logical, Complex), Checking Type of a Variable (using typeof() and Class()), Converting a Variable from one type to another.

Command:

✔
```
i<-45L                  #Integer
class(i)                #Checking Type
n<-4.5                  #Numeric
c<-"word"               #Character
is.character(c)         #Checking Type
l<-T                    #Logical
typeof(l)               #CheckingType
x<-5+4i                 #Complex
con<-as.numeric(i)      #Converting Type
```

Output:



- Creating Vectors and Performing Vector Operations.

Command:

✓ v<-c(3,5,8,9) #Creating Vector
vt<-vector(mode="logical",45) #Creating Vector print(v)
#Accessing vector
sort.vt<-sort(v,decreasing = TRUE) #Manipulating Vector

Output:

```
> v<-c(3,5,8,9)
> vt<-vector(mode="logical",45)
> typeof(vt)
[1] "logical"
> print(v)
[1] 3 5 8 9
> sort.vt<-sort(v,decreasing = TRUE)
> print(sort.vt)
[1] 9 8 5 3
```

- Creating Matrix, using different Methods like matrix(), cbind() and rbind(), Checking Dimension and Attributes of Matrix, Showing Matrix by Row, Performing various Matrix Operations (Mathematical Operations using Scalar Values, Matrix Addition, Subtraction, Multiplication, Division, Transpose of Matrix)

Command:

✓ **Creating Matrix, using different Methods like matrix(), cbind() and rbind()**

m<-matrix(c(1,2,3,4,5,6,7,8,9),nrow = 3,ncol = 3) #Creating Matrix
matrix(m)
c<-cbind(m1,m2)
r<-rbind(m1,m2)

Output:

```
> m<-matrix(c(1,2,3,4,5,6,7,8,9),nrow = 3,ncol = 3)
> matrix(m)
     [,1]
[1,]    1
[2,]    2
[3,]    3
[4,]    4
[5,]    5
[6,]    6
[7,]    7
[8,]    8
[9,]    9
> m1<-c(12,24,35)
> m2<-c(56,67,78)
> c<-cbind(m1,m2)
> c
     m1 m2
[1,] 12 56
[2,] 24 67
[3,] 35 78
> r<-rbind(m1,m2)
> r
    [,1] [,2] [,3]
m1    12   24   35
```

✓ **Checking Dimension and Attributes of Matrix, Showing Matrix by Row, Performing various Matrix Operations**

```
dim(m)                  #Dimension
attributes(m)           #Attributes
mt<-matrix(c(18,24,33,56,65,68,10,26,44),nrow=3,ncol=3,byrow=TRUE)    #By Row
m+mt          #Matrix Addition          mt-m          #Matrix Subtraction
m*mt          #Matrix Multiplication    mt/m          #Matrix Division
                  t(mt)          #Matrix Transpose
```

Output:

```
> dim(m)
[1] 3 3
> attributes(m)
$dim
[1] 3 3

> mt<-matrix(c(18,24,33,56,65,68,10,26,44),nrow = 3,ncol =
 3,byrow = TRUE)
> mt
     [,1] [,2] [,3]
[1,]   18   24   33
[2,]   56   65   68
[3,]   10   26   44
> m+mt
     [,1] [,2] [,3]
[1,]   19   28   40
[2,]   58   70   76
[3,]   13   32   53
> mt-m
     [,1] [,2] [,3]
[1,]   17   20   26
[2,]   54   60   60
[3,]    7   20   35
```

```
> m*mt
     [,1] [,2] [,3]
[1,]   18   96  231
[2,]  112  325  544
[3,]   30  156  396
> mt/m
          [,1]      [,2]     [,3]
[1,] 18.000000  6.000000 4.714286
[2,] 28.000000 13.000000 8.500000
[3,]  3.333333  4.333333 4.888889
> t(mt)
     [,1] [,2] [,3]
[1,]   18   56   10
[2,]   24   65   26
[3,]   33   68   44
> t(m)
     [,1] [,2] [,3]
[1,]    1    2    3
[2,]    4    5    6
[3,]    7    8    9
```

- Creating List, Accessing List Element.

Command:

✓
```
list<-(c("mango","banana","others"))        #Creating List
print(list)                                 #Accessing List
print(list[2])                               Element
```

Output:

```
> list<-(c("mango","banana","others"))
> print(list)
[1] "mango"  "banana" "others"
> print(list[2])
[1] "banana"
>
```

- Creating Factors.

Command:

✓
```
data <- c ("mango", "West", "pear", "orange", "papaya", "rasberry", "grape",
"banana", "apple", "cherry", "jackfruit")        #Creating factors
print(data)
fact_data<-factor(data)
print(fact_data)
print(is.factor(fact_data))
```

- **Output:**

```
Console   Terminal   Jobs
C:/Users/Gagan/Documents/
> data <- c("mango","West","pear","orange","papaya","rasberr
y","grape","banana","apple","cherry","jackfruit")
> print(data)
 [1] "mango"     "West"      "pear"      "orange"
 [5] "papaya"    "rasberry"  "grape"     "banana"
 [9] "apple"     "cherry"    "jackfruit"
>
> fact_data<-factor(data)
> print(fact_data)
 [1] mango     West      pear      orange    papaya
 [6] rasberry  grape     banana    apple     cherry
[11] jackfruit
11 Levels: apple banana cherry grape ... West
> print(is.factor(fact_data))
[1] TRUE
```

- Creating Data Frames, Checking Number of Rows, Number of Columns, Giving Names to Columns and Rows.

Command:

✓
```
empid<-c(101,102,103)
empnm<-c("rach","pheebs","mon")
dtfrm<-data.frame(empid,empnm)          #Creating Data Frame
dtfrm
nrow(dtfrm)                             #Checking Number of Rows
ncol(dtfrm)                             #Checking Number of Columns
names(dtfrm)[1]<-"stdid"                #Giving Names to
names(dtfrm)[2]<-"stdnm"                 Columns
names(dtfrm)
```

Output:

```
> empid<-c(101,102,103)
> empnm<-c("rach","pheebs","mon")
>
> dtfrm<-data.frame(empid,empnm)
>
> dtfrm
  empid  empnm
1   101   rach
2   102 pheebs
3   103    mon
> dtfrm$empid
[1] 101 102 103
> dtfrm$empnm
[1] "rach"   "pheebs" "mon"
> nrow(dtfrm)
[1] 3
> ncol(dtfrm)
[1] 2
> names(dtfrm)
[1] "empid" "empnm"
> names(dtfrm)[1]<-"stdid"
> names(dtfrm)[2]<-"stdnm"
> names(dtfrm)
[1] "stdid" "stdnm"
```

☐ Creating Table.

Command:

✓ data<-matrix(c(123,234,345,456,567,678,890,901,098),ncol=3,byrow=TRUE)
colnames(data)<- c("Sci","Math","Lang")
rownames(data)<- c("T1","T1","T3")
data<-as.table(data) #Creating Table
data
View(data) #Accessing table

Output:

```
> data<-matrix(c(123,234,345,456,567,678,890,901,098),ncol=
3,byrow=TRUE)
> data
     [,1] [,2] [,3]
[1,]  123  234  345
[2,]  456  567  678
[3,]  890  901   98
> colnames(data)<- c("Sci","Math","Lang")
> rownames(data)<- c("T1","T1","T3")
> data<-as.table(data)
> data
   Sci Math Lang
T1 123  234  345
T1 456  567  678
T3 890  901   98
> View(data)
```

data

Filter

	Var1	Var2	Freq
1	T1	Sci	123
2	T1	Sci	456
3	T3	Sci	890
4	T1	Math	234
5	T1	Math	567
6	T3	Math	901
7	T1	Lang	345
8	T1	Lang	678
9	T3	Lang	98

- Reading and Writing Data from .CSV File, Showing Dimensions, Showing First 5 Rows, Showing Last 5 Rows.

Command:

✓ **Reading and Writing Data from .CSV File**

```
cpInfo<-read.csv("Info.csv")          #Reading from .csv
write.csv(data,"Info.csv")            #Writing to .csv
newInfo<-read.csv("Info.csv")
```

Output:

```
> cpInfo<-read.csv("Info.csv")
> print(cpInfo)
      Name Class     Add
1   Rachel     9      NY
2     Ross    12      NY
3   Monica     9      NY
4 Chandler    12      NY
5     Joey    11   Itlay
6   Pheobe    10   Texas
> write.csv(data,"Info.csv")
> newInfo<-read.csv("Info.csv")
> print(newInfo)
  X PR.Sl.no  Material
1 1        25 250006342
2 2         4 280005173
                                  Short.Text
1                                PISTON RINGS
2 CAPACITY CONTROL VALVE ASSEMBLY (FOR 5H*
  Manufacturer.Part.No. Quantity Unit.of.Measure Cutter
1             06EA500131       18             NO   5.51
2              5H121-417        1             NO 964.65
  Cutter.Total RC.Rates.
1        99.18       5.4
2       964.65     407.5
```

✓ **Showing Dimensions, Showing First 5 Rows, Showing Last 5 Rows**

```
cpInfo<-read.csv("Stud.csv")          dim(cpInfo)          #Dimensions
dtfrm<-data.frame(cpInfo)
head(dtfrm,5)          #First 5 Rows          tail(dtfrm,5)          #Last 5 Rows
```

Output:

```
> cpInfo<-read.csv("Stud.csv")
> dim(cpInfo)
[1] 11  3
> dtfrm<-data.frame(cpInfo)
> head(dtfrm,5)
      Name Year Profession
1     Ross   28   Teaching
2   Monica   25    Cooking
3     Joey   27      Actor
4   Pheobe   26  Physician
5 Chandler   28         IT
> tail(dtfrm,5)
      Name Year      Profession
7    Penny   26       Marketing
8  Sheldon   27       Physicist
9  Leonard   28       Physicist
10  Howard   28       Astronout
11     Raj   27 AstroPhysicist
```

- Reading and Writing Data from Excel using XLConnect.

Command:

✓ library(XLConnect)

```
xlFile=XLConnect::readWorksheetFromFile("Demo.xlsx",sheet=1)
xlFile
data=XLConnect::readWorksheetFromFile("About.xlsx",sheet=1)
writeFile=XLConnect::writeWorksheetToFile("Demo.xlsx",data,sheet = "About")
xlFile=XLConnect::readWorksheetFromFile("Demo.xlsx",sheet="About")
xlFile
```

Output:

```
  object 'csvFile1' not found
> library(XLConnect)
> xlFile=XLConnect::readWorksheetFromFile("Demo.xlsx",sheet=1)
> xlFile
   Name. Rollno
1 Pankaj     10
2  Sunil     20
3 Lekha      30
>
```

```
> writeFile=XLConnect::writeWorksheetToFile("Demo.xlsx",data,sheet = "About")
> xlFile=XLConnect::readWorksheetFromFile("Demo.xlsx",sheet="About")
> xlFile
  PR.Sl.no  Material                                  Short.Text
1       25 250006342                                PISTON RINGS
2        4 280005173 CAPACITY CONTROL VALVE ASSEMBLY (FOR 5H*
  Manufacturer.Part.No. Quantity Unit.of.Measure Cutter Cutter.Total
1            06EA500131       18              NO   5.51        99.18
2             5H121-417        1              NO 964.65       964.65
  RC.Rates.
1       5.4
2     407.5
>
```

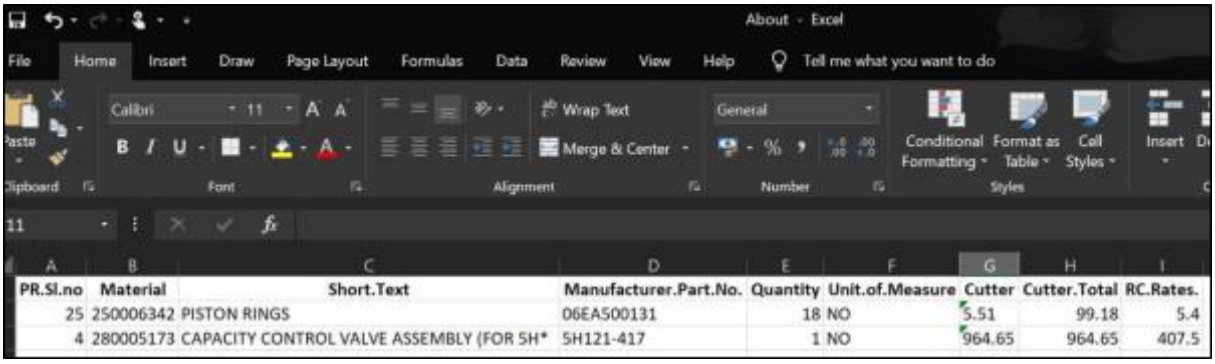
- Reading and Writing Data from Excel using readXL and writeXL.

Command:

✓ library(readxl) #Loading 'readxl' Package library(writexl) #Loading 'writexl'
xlsmp<-read_xlsx("About.xlsx",sheet=1) #Reading using readXL
wrxl<-write_xlsx(data,"About.xlsx") #Writing using writeXL

Output:

```
> library(readxl)
> library(writexl)
> xlsmp<-read_xlsx("About.xlsx",sheet = 1)
> print(xlsmp)
# A tibble: 11 x 3
   Name       Year Profession
   <chr>     <dbl> <chr>
 1 Ross         28 Teaching
 2 Monica       25 Cooking
 3 Joey         27 Actor
 4 Pheobe       26 Physician
 5 Chandler     28 IT
 6 Rachel       25 Fashion
 7 Penny        26 Marketing
 8 Sheldon      27 Physicist
 9 Leonard      28 Physicist
10 Howard       28 Astronout
11 Raj          27 AstroPhysicist
> wrxl<-write_xlsx(data,"About.xlsx")
```



PR.Sl.no	Material	Short.Text	Manufacturer.Part.No.	Quantity	Unit.of.Measure	Cutter	Cutter.Total	RC.Rates.
25	250006342	PISTON RINGS	06EA500131	18	NO	5.51	99.18	5.4
4	280005173	CAPACITY CONTROL VALVE ASSEMBLY (FOR SH*	SH121-417	1	NO	964.65	964.65	407.5

Practical No. 06

Aim: Implementation of Data pre-processing techniques like,

- **Naming and Renaming variables, adding a new variable.**
- **Dealing with missing data.**
- **Dealing with categorical data.**
- **Data reduction using sub-setting.**

Naming and Renaming variables, adding a new variable.

✓ my_data<-mtcars

```
> my_data<-mtcars
> head(mtcars,5)
                   mpg cyl disp  hp drat    wt  qsec vs am gear carb
Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
```

✔ my_data<-my_data[1:6,1:5]
require(dplyr)
my_data<-rename(my_data,horse_power=hp)
my_data$new_hp<-my_data$horse_power*0.5
colnames(my_data)

```
> my_data<-rename(my_data,horse_power=hp)
> # adding new variable
> my_data$new_hp<-my_data$horse_power*0.5
> colnames(my_data)
[1] "mpg"         "cyl"         "disp"        "horse_power" "drat"
[6] "new_hp"
> my_data
                   mpg cyl disp horse_power drat new_hp
Mazda RX4         21.0   6  160         110 3.90   55.0
Mazda RX4 Wag     21.0   6  160         110 3.90   55.0
Datsun 710        22.8   4  108          93 3.85   46.5
Hornet 4 Drive    21.4   6  258         110 3.08   55.0
Hornet Sportabout 18.7   8  360         175 3.15   87.5
Valiant           18.1   6  225         105 2.76   52.5
```

✔ data <- read.table(file="missing_col.csv", sep = ",")
data <- read.table(file="missing_col.csv", sep = ",",col.names=c("Sno","NAME","SALARY","Date_Of_Joining","Department"))
data

```
> data
   Sno       NAME  SALARY Date_Of_Joining Department
1    1       Rick  623.30      01/01/2012         IT
2    2        Dan  515.20      23/09/2013 Operations
3    3  Michelle   611.00      15/11/2014         IT
4    4       Ryan  729.00      11/05/2014         HR
5   NA       Gary  843.25      27/03/2015    Finance
6    6      Nina       NA      21/05/2013         IT
7    7    Simon    632.80      30/07/2013 Operations
8    8       Guru  722.50      17/06/2014   Finance
9    9      John       NA      21/05/2012
10  10       Rock  600.80      30/07/2013         HR
11  11      Brad  1032.80      30/07/2013 Operations
12  12       Ryan  729.00      11/05/2014         HR
```

 Dealing with missing data.

- Error Detection and Correction NA: Not Available - Known as missing values
- Works as a place holder for something that is 'missing'
- Most basic operations (addition, subtraction, multiplication, etc.) in R deal with it without crashing and return NA if one of the inputs is NA
- is.na(VALUE) is used to check if the input value is NA or not.
- Returns a TRUE/FALSE vector whereas in case of Excel like utilities for numeric computations it's assumed to be 0

 Using na.rm(): This will keep NA rows in data while removes them during calculation

✓ e.g. V <- c(1,2,NA,3) median(V, na.rm = T)

 Data reduction using subsetting

✓ **complete.cases()**

Return a logical vector indicating which cases are complete, i.e., have no missing values.
Syntax: complete.cases(…)
It takes a sequence of vectors, matrices and data frames as arguments.
E.g. V <- c (1,2,NA,3)
V [complete.cases(V)] [1] 1 2 3

✓ **is.na()** logical indexing: indicates which elements are missing

- e.g. naVals <- is.na(V) V[!naVals] [1] 1 2 3

Detect if there are any NAs: **any**(is.na(datan)) Identify positions of NAs: **which**(is.na(datan$v1))

 Imputation: The process of estimating or deriving missing values

Missing data imputation is a statistical method that replaces missing data points with substituted values.
There are various methods for imputation

– Imputation of the mean – Imputation of the median – Imputation using linear regression models

- Package Hmisc implments many imputation methods

✓ library(Hmisc)

x = c(1,2,3,NA,4,4,NA)

mean imputation - from package, mention name of function to be used

✓ v<-impute(x,fun=mean) v

```
> v<-impute(x,fun=mean)
> v
 1  2  3  4  5  6  7
 1  2  3 3*  4 3*  5
```

✓ v<-impute(x,fun=median) v

```
> v<-impute(x,fun=median)
> v
 1  2  3  4  5  6  7
 1  2  3 3*  4 3*  5
```

✓ v<-impute(data1$SRNO,fun=mean) v

```
> v<-impute(data1$SRNO,fun=mean)
> v
   1    2    3    4    5    6    7    8    9   10   11
 2.0  3.0  4.0 7.2*  6.0  7.0  8.0  9.0 10.0 11.0 12.0
```

✓ v<-impute(data1$SALARY,fun=median) v

```
> v<-impute(data1$SALARY,fun=median)
> v
      1       2       3       4       5       6       7       8       9
 515.20  611.00  729.00  843.25 722.50* 632.80  722.50 722.50* 600.80
     10      11
1032.80  729.00
```

 Dealing with categorical data.

✓ c1<-c("low","medium","high","medium","low")

c1<-factor(c1,levels =c("low","medium","high")) c1

```
> c1<-c("low","medium","high")
> c1<-factor(c1,levels=c("low","medium","high"))
> c1
[1] low    medium high
Levels: low medium high
```

- **Data reduction using sub-setting.**

✔ data1<-read.csv("missing_col.csv",sep=",",col.names = c("SRNO","NAME","SALARY","DOJ","DEPARTMENT"))

✔ View(data1)

	SRNO	NAME	SALARY	DOJ	DEPARTMENT
1	2	Dan	515.20	23/09/2013	Operations
2	3	Michelle	611.00	15/11/2014	IT
3	4	Ryan	729.00	11/05/2014	HR
4	NA	Gary	843.25	27/03/2015	Finance
5	6	Nina	NA	21/05/2013	IT
6	7	Simon	632.80	30/07/2013	Operations
7	8	Guru	722.50	17/06/2014	Finance
8	9	John	NA	21/05/2012	
9	10	Rock	600.80	30/07/2013	HR
10	11	Brad	1032.80	30/07/2013	Operations
11	12	Ryan	729.00	11/05/2014	HR

✔ x<-c(1,2,3,NA,4,NA,5)

x

```
> x<-c(1,2,3,NA,4,NA,5)
> x
[1]  1  2  3 NA  4 NA  5
```

✔ xn<-is.na(x)

x[!xn]

NA+4

```
> xn<-is.na(x)
> x[!xn]
[1] 1 2 3 4 5
> NA+4
[1] NA
```

✔ median(x,na.rm=T)

```
> median(x,na.rm=T)
[1] 3
```

✔ complete.cases(x)

```
> complete.cases(x)
[1]  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE
```

✔ is.na(data1)

```
> is.na(data1)
      SRNO  NAME SALARY   DOJ DEPARTMENT
 [1,] FALSE FALSE  FALSE FALSE       FALSE
 [2,] FALSE FALSE  FALSE FALSE       FALSE
 [3,] FALSE FALSE  FALSE FALSE       FALSE
 [4,]  TRUE FALSE  FALSE FALSE       FALSE
 [5,] FALSE FALSE   TRUE FALSE       FALSE
 [6,] FALSE FALSE  FALSE FALSE       FALSE
 [7,] FALSE FALSE  FALSE FALSE       FALSE
 [8,] FALSE FALSE   TRUE FALSE       FALSE
 [9,] FALSE FALSE  FALSE FALSE       FALSE
[10,] FALSE FALSE  FALSE FALSE       FALSE
[11,] FALSE FALSE  FALSE FALSE       FALSE
```

✔ datacompletecases<-data1[complete.cases(data1),]

datacompletecases

```
> datacompletecases<-data1[complete.cases(data1),]
> datacompletecases
   SRNO        NAME SALARY         DOJ DEPARTMENT
1     2         Dan  515.2 23/09/2013 Operations
2     3   Michelle   611.0 15/11/2014         IT
3     4        Ryan  729.0 11/05/2014         HR
6     7       Simon  632.8 30/07/2013 Operations
7     8        Guru  722.5 17/06/2014    Finance
9    10        Rock  600.8 30/07/2013         HR
10   11       Brad  1032.8 30/07/2013 Operations
11   12        Ryan  729.0 11/05/2014         HR
```

✔ any(is.na(x))

which(is.na(data1$SRNO))

```
> any(is.na(x))
[1] TRUE
> which(is.na(data1$SRNO))
[1] 4
```

✔ Na.omit(x)

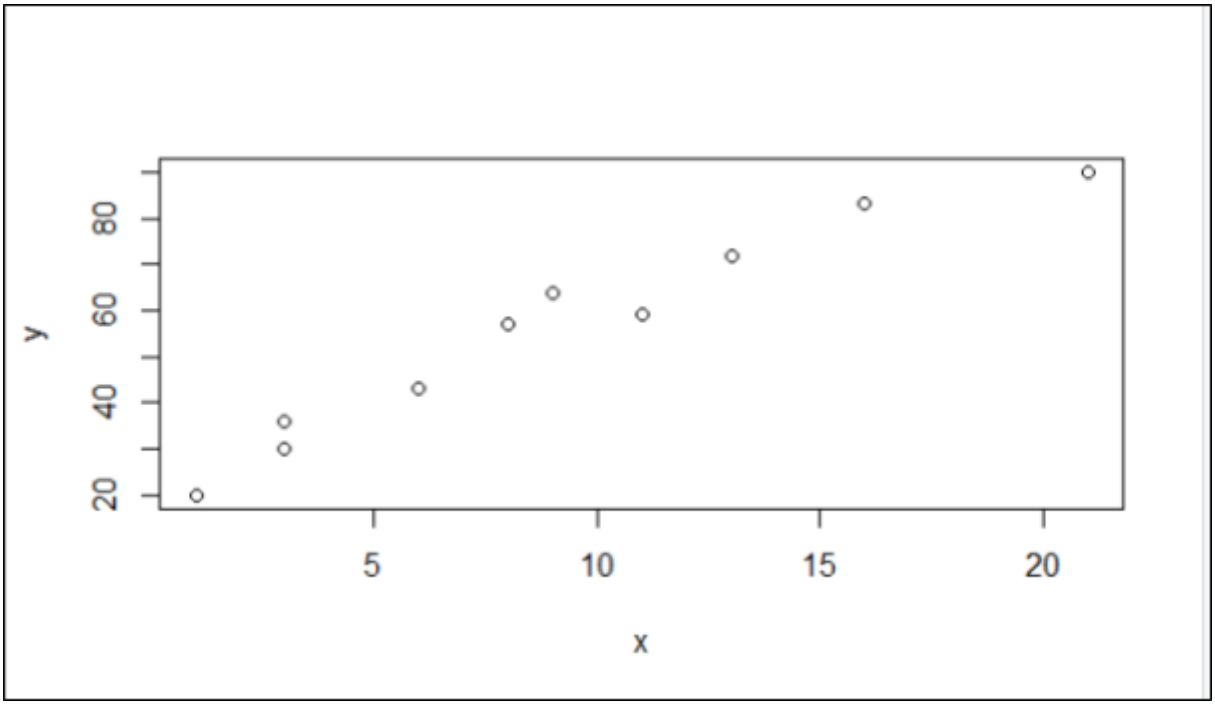
```
> na.omit(x)
[1] 1 2 3 4 5
attr(,"na.action")
[1] 4 6
attr(,"class")
[1] "omit"
```

Practical No. 07

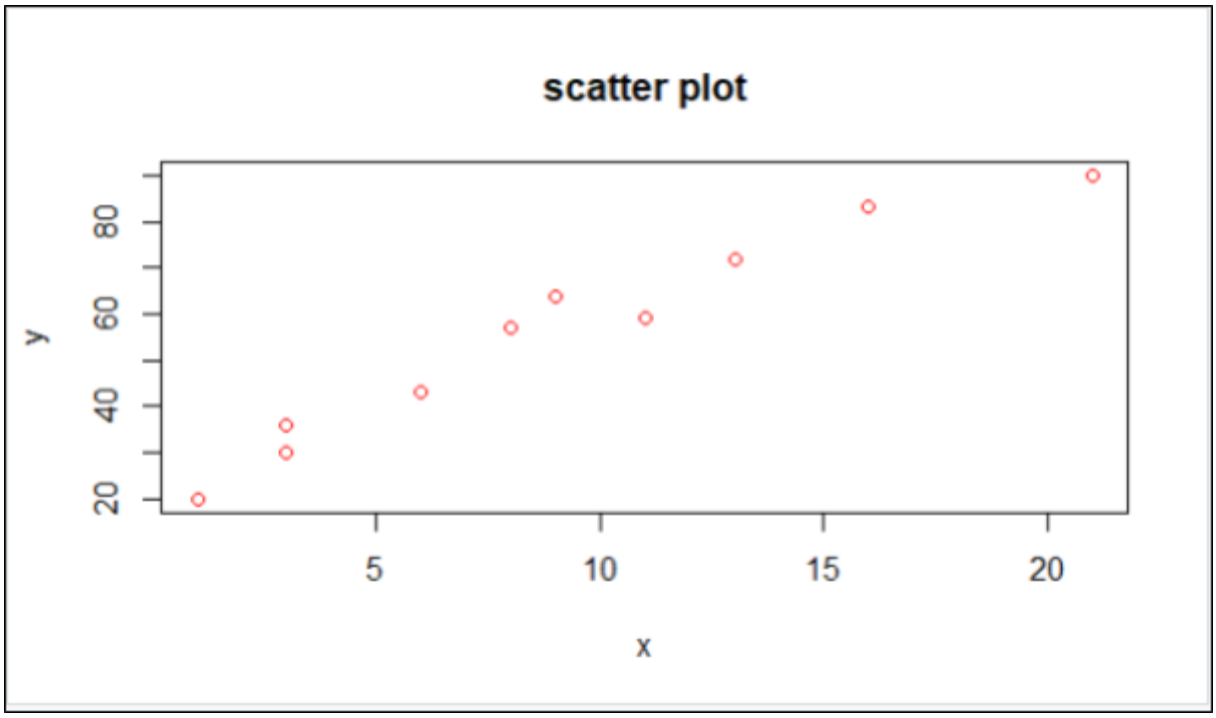
Aim: Implementation and analysis of Linear regression through graphical methods.

✓ x<-c(3,8,9,13,3,6,11,21,1,16)

#response variable
y<-c(30,57,64,72,36,43,59,90,20,83)
plot(x,y)



✓ plot(x,y, col='red',main="scatter plot")


scatter plot
y
20
40
60
80
5
10
15
20
x

Linear Regression Model

✓ model=lm(y~x)

```
> model=lm(y~x)
> model

Call:
lm(formula = y ~ x)

Coefficients:
(Intercept)            x
     23.209        3.537
```

model

✓ attributes(model)

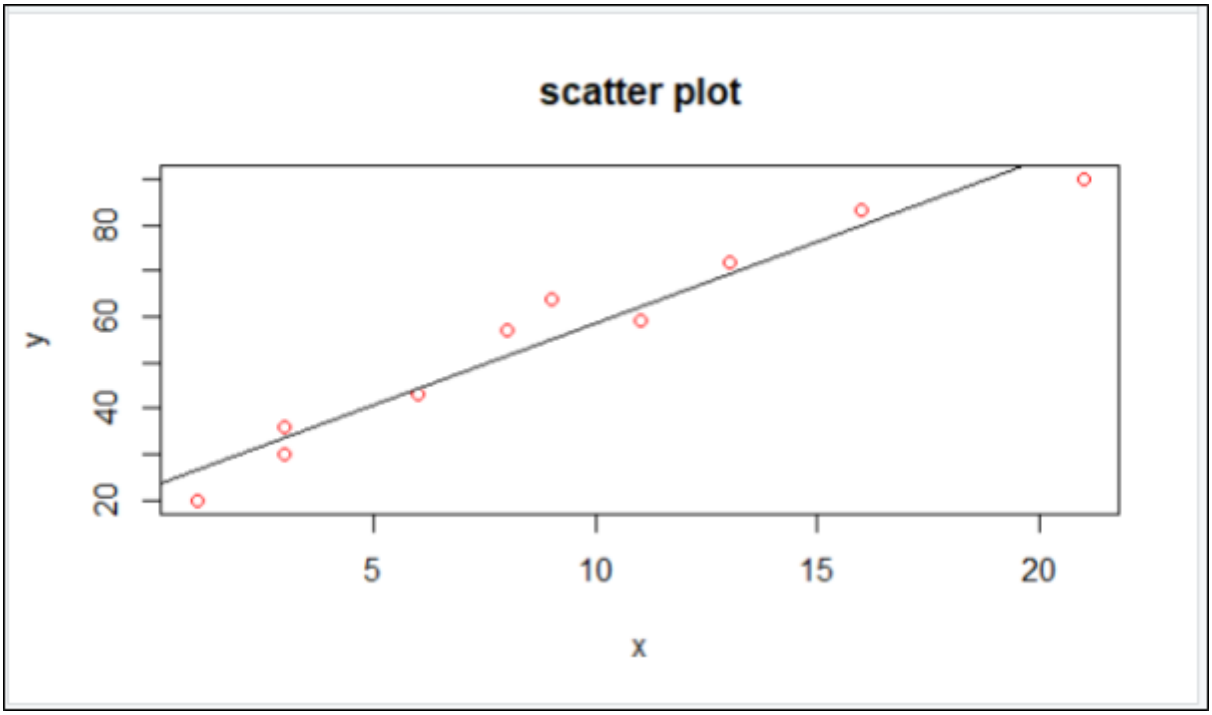
coef(model)
residuals(model)

```
> attributes(model)
$names
 [1] "coefficients"  "residuals"     "effects"       "rank"          "fitted.values"
 [6] "assign"        "qr"            "df.residual"   "xlevels"       "call"
[11] "terms"         "model"

$class
[1] "lm"

> coef(model)
(Intercept)           x
  23.208972    3.537476
> residuals(model)
        1         2         3         4         5         6         7         8
-3.821399  5.491223  8.953748  2.803845  2.178601 -1.433826 -3.121204 -7.495960
        9        10
-6.746447  3.191418
```

✓ summary(model)

```
> summary(model)

Call:
lm(formula = y ~ x)

Residuals:
    Min      1Q  Median      3Q     Max
-7.4960 -3.6463  0.3724  3.0945  8.9537

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  23.2090     3.2862   7.062 0.000106 ***
x             3.5375     0.3016  11.728 2.55e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 5.714 on 8 degrees of freedom
Multiple R-squared:  0.945,     Adjusted R-squared:  0.9382
F-statistic: 137.5 on 1 and 8 DF,  p-value: 2.553e-06
```

- abline(model)



- **Predicting values manually y=a+bx**

✓ x10<-model$coefficients[[1]]+model$coefficients[[2]]*10

x10

```
> #predicting values manually y=a+bx
> x10<-model$coefficients[[1]]+model$coefficients[[2]]*10
> x10
[1] 58.58373
```

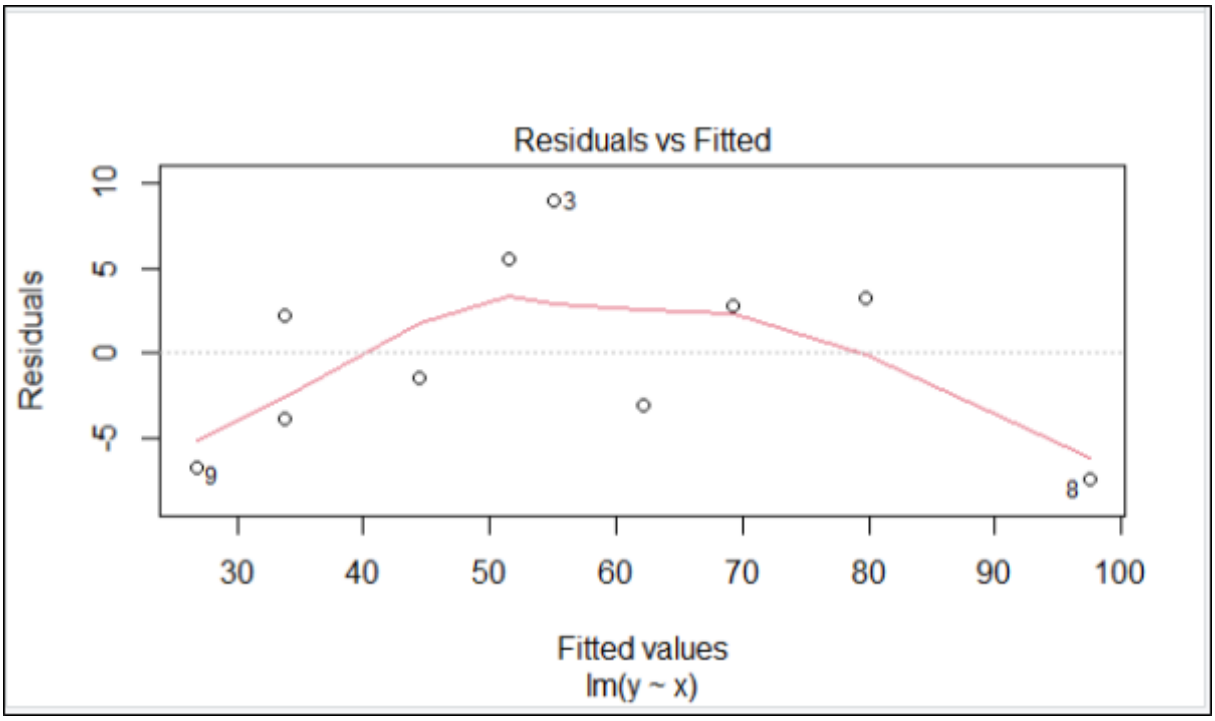
- **Using Predict ()**

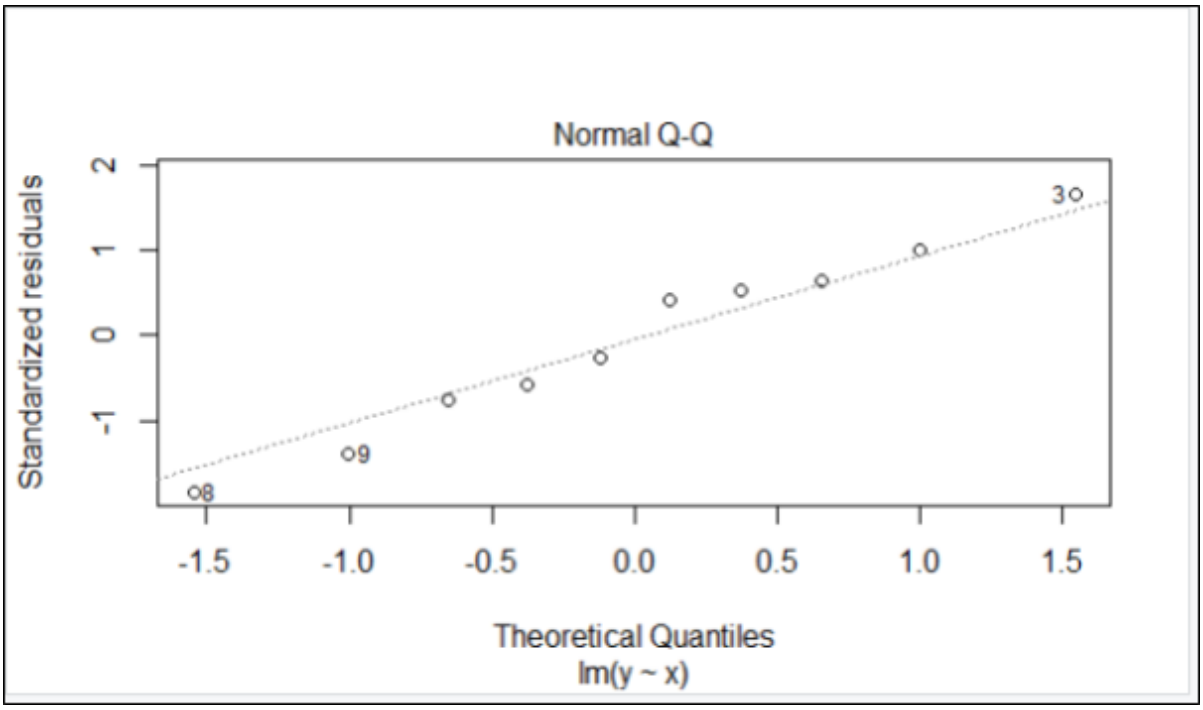
✓ a<-data.frame(x=10) a

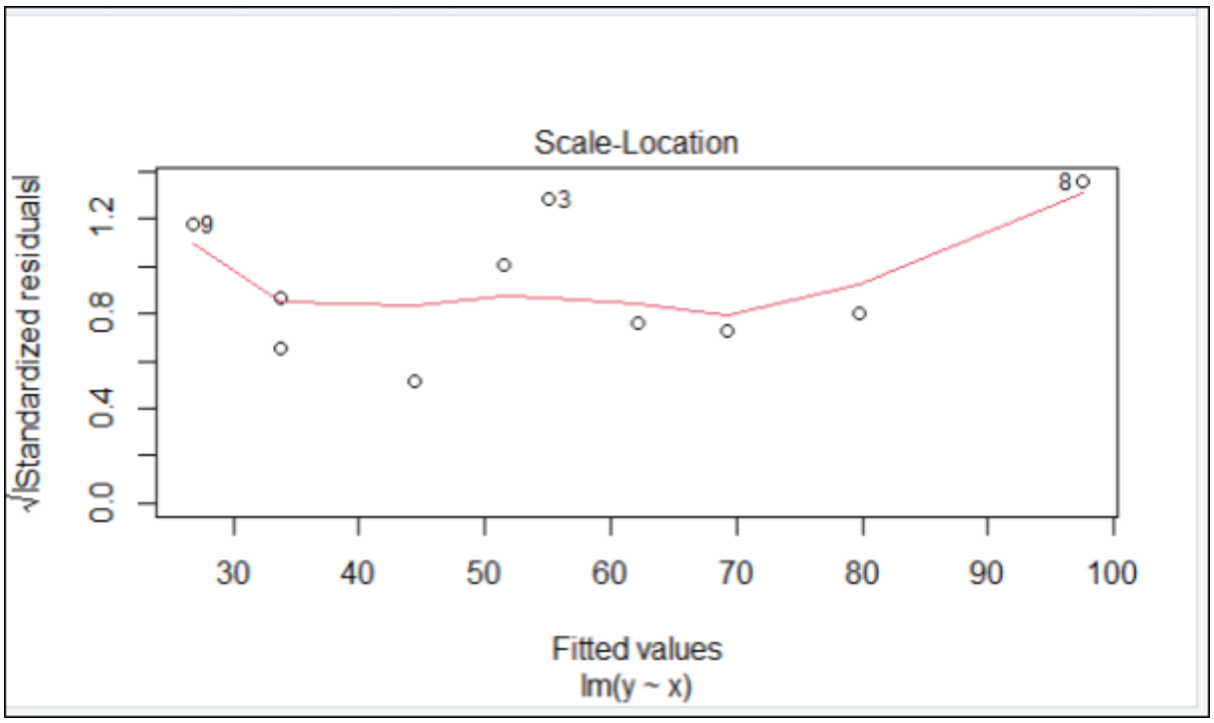
pred<-predict(model,a) pred

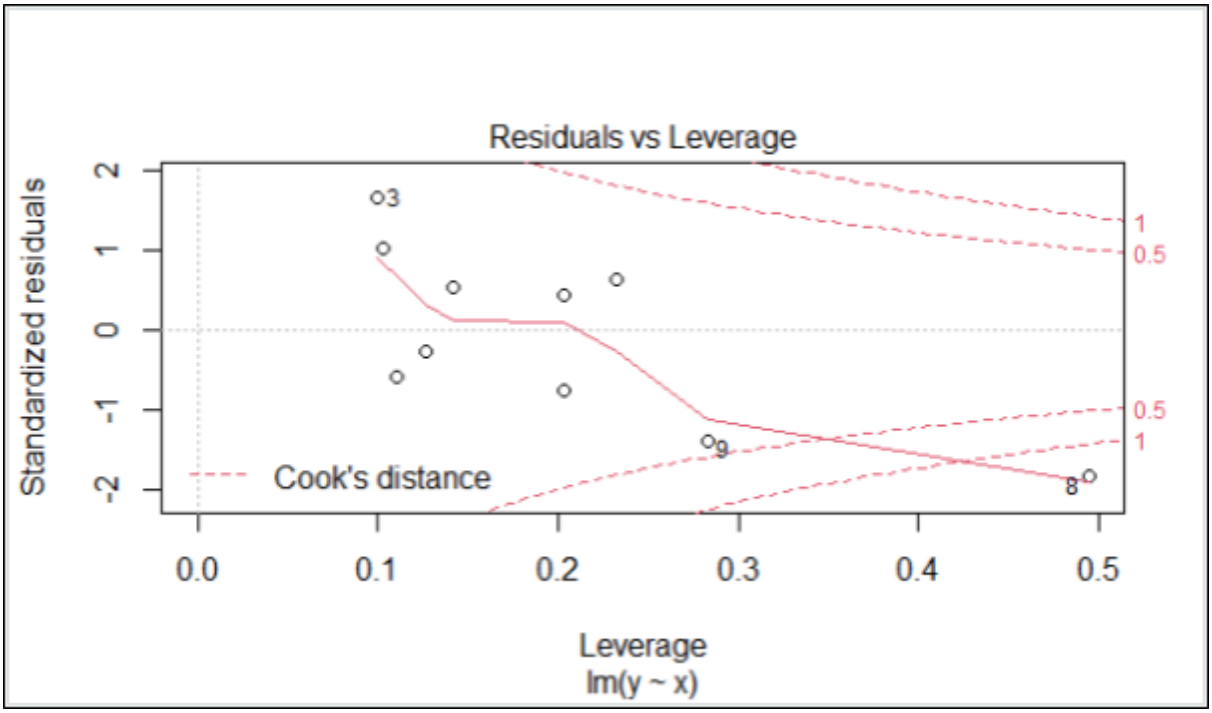
```
> #using Predict()
> a<-data.frame(x=10)
> a
   x
1 10
> pred<-predict(model,a)
> pred
       1
58.58373
```

- plot(model)


Residuals vs Fitted
Residuals
10
5
0
-5
3
9
8
30
40
50
60
70
80
90
100
Fitted values
lm(y ~ x)


Normal Q-Q
Standardized residuals
2
1
0
-1
3
9
8
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles
lm(y ~ x)


Scale-Location
√|Standardized residuals|
0.0
0.4
0.8
1.2
9
3
8
30
40
50
60
70
80
90
100
Fitted values
lm(y ~ x)


Residuals vs Leverage
Standardized residuals
-2
-1
0
1
2
3
Cook's distance
1
0.5
0.5
1
9
8
0.0
0.1
0.2
0.3
0.4
0.5
Leverage
lm(y ~ x)

Practical No. 08

Aim: Implementation and analysis of Classification algorithms like Naive Bayesian, K-Nearest Neighbour.

- **Naive Bayesian**

✓ View(iris)

	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
1	5.1	3.5	1.4	0.2	setosa
2	4.9	3.0	1.4	0.2	setosa
3	4.7	3.2	1.3	0.2	setosa
4	4.6	3.1	1.5	0.2	setosa
5	5.0	3.6	1.4	0.2	setosa
6	5.4	3.9	1.7	0.4	setosa
7	4.6	3.4	1.4	0.3	setosa
8	5.0	3.4	1.5	0.2	setosa
9	4.4	2.9	1.4	0.2	setosa
10	4.9	3.1	1.5	0.1	setosa
11	5.4	3.7	1.5	0.2	setosa
12	4.8	3.4	1.6	0.2	setosa
13	4.8	3.0	1.4	0.1	setosa
14	4.3	3.0	1.1	0.1	setosa
15	5.8	4.0	1.2	0.2	setosa
16	5.7	4.4	1.5	0.4	setosa
17	5.4	3.9	1.3	0.4	setosa
18	5.1	3.5	1.4	0.3	setosa
19	5.7	3.8	1.7	0.3	setosa
20	5.1	3.8	1.5	0.3	setosa
21	5.4	3.4	1.7	0.2	setosa

✓ ir=iris

train=ir[1:100,] train

```
> ir=iris
> train=ir[1:100,]
> train
    Sepal.Length Sepal.Width Petal.Length Petal.Width    Species
1            5.1         3.5          1.4         0.2     setosa
2            4.9         3.0          1.4         0.2     setosa
3            4.7         3.2          1.3         0.2     setosa
4            4.6         3.1          1.5         0.2     setosa
5            5.0         3.6          1.4         0.2     setosa
6            5.4         3.9          1.7         0.4     setosa
7            4.6         3.4          1.4         0.3     setosa
8            5.0         3.4          1.5         0.2     setosa
9            4.4         2.9          1.4         0.2     setosa
10           4.9         3.1          1.5         0.1     setosa
11           5.4         3.7          1.5         0.2     setosa
12           4.8         3.4          1.6         0.2     setosa
```

✓ test=ir[101:150,]

test

```
> test=ir[101:150,]
> test
    Sepal.Length Sepal.Width Petal.Length Petal.Width   Species
101          6.3         3.3          6.0         2.5 virginica
102          5.8         2.7          5.1         1.9 virginica
103          7.1         3.0          5.9         2.1 virginica
104          6.3         2.9          5.6         1.8 virginica
105          6.5         3.0          5.8         2.2 virginica
106          7.6         3.0          6.6         2.1 virginica
107          4.9         2.5          4.5         1.7 virginica
108          7.3         2.9          6.3         1.8 virginica
109          6.7         2.5          5.8         1.8 virginica
110          7.2         3.6          6.1         2.5 virginica
111          6.5         3.2          5.1         2.0 virginica
112          6.4         2.7          5.3         1.9 virginica
113          6.8         3.0          5.5         2.1 virginica
114          5.7         2.5          5.0         2.0 virginica
115          5.8         2.8          5.1         2.4 virginica
```

✓ model=naiveBayes(Species ~.,data=train)

```
> model=naiveBayes(Species ~.,data=train)
> model

Naive Bayes Classifier for Discrete Predictors

Call:
naiveBayes.default(x = X, y = Y, laplace = laplace)

A-priori probabilities:
Y
    setosa versicolor  virginica
       0.5        0.5        0.0

Conditional probabilities:
            Sepal.Length
Y             [,1]      [,2]
  setosa     5.006 0.3524897
  versicolor 5.936 0.5161711
  virginica     NA        NA

            Sepal.Width
Y             [,1]      [,2]
  setosa     3.428 0.3790644
  versicolor 2.770 0.3137983
  virginica     NA        NA
```

model

✓ test$Species

```
> test$Species
 [1] virginica virginica virginica virginica virginica virginica virginica virginica
 [9] virginica virginica virginica virginica virginica virginica virginica virginica
[17] virginica virginica virginica virginica virginica virginica virginica virginica
[25] virginica virginica virginica virginica virginica virginica virginica virginica
[33] virginica virginica virginica virginica virginica virginica virginica virginica
[41] virginica virginica virginica virginica virginica virginica virginica virginica
[49] virginica virginica
Levels: setosa versicolor virginica
```

✓ train$Species

```
> train$Species
  [1] setosa     setosa     setosa     setosa     setosa     setosa     setosa
  [8] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [15] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [22] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [29] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [36] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [43] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [50] setosa     versicolor versicolor versicolor versicolor versicolor versicolor
 [57] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [64] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [71] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [78] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [85] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [92] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [99] versicolor versicolor
Levels: setosa versicolor virginica
```

✓ pred=predict(model,test)

table(pred)
table(test$Species)
table(train$Species)

```
> pred=predict(model,test)
> table(pred)
pred
    setosa versicolor  virginica
         0         50          0
> table(test$Species)

    setosa versicolor  virginica
         0          0         50
> table(train$Species)

    setosa versicolor  virginica
        50         50          0
```

- **Shuffle Iris File**

✓ ir1=ir[sample(nrow(ir)),]

View(ir1)

	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
61	5.0	2.0	3.5	1.0	versicolor
118	7.7	3.8	6.7	2.2	virginica
33	5.2	4.1	1.5	0.1	setosa
34	5.5	4.2	1.4	0.2	setosa
96	5.7	3.0	4.2	1.2	versicolor
54	5.5	2.3	4.0	1.3	versicolor
145	6.7	3.3	5.7	2.5	virginica
51	7.0	3.2	4.7	1.4	versicolor
28	5.2	3.5	1.5	0.2	setosa
43	4.4	3.2	1.3	0.2	setosa
74	6.1	2.8	4.7	1.2	versicolor
132	7.9	3.8	6.4	2.0	virginica
52	6.4	3.2	4.5	1.5	versicolor
13	4.8	3.0	1.4	0.1	setosa
39	4.4	3.0	1.3	0.2	setosa
64	6.1	2.9	4.7	1.4	versicolor
104	6.3	2.9	5.6	1.8	virginica

✓ train=ir1[1:100,]

test=ir1[101:150,]
model=model=naiveBayes(Species ~.,data=train)
pred=predict(model,test)
table(pred)

```
> train=ir1[1:100,]
> test=ir1[101:150,]
> model=model=naiveBayes(Species ~.,data=train)
> pred=predict(model,test)
> table(pred)
pred
    setosa versicolor  virginica
        18         16         16
```

✓ table(train$Species)

table(test$Species)

```
> table(train$Species)

    setosa versicolor  virginica
        32         34         34
> table(test$Species)

    setosa versicolor  virginica
        18         16         16
```

- **K-Nearest Neighbour**

✓ table(iris$Species)

str(iris$Species)
head(iris)

```
> table(iris$Species)

    setosa versicolor  virginica
        50         50         50
> str(iris$Species)
 Factor w/ 3 levels "setosa","versicolor",..: 1 1 1 1 1 1 1 1 1 1 ...
> head(iris)
  Sepal.Length Sepal.Width Petal.Length Petal.Width Species
1          5.1         3.5          1.4         0.2  setosa
2          4.9         3.0          1.4         0.2  setosa
3          4.7         3.2          1.3         0.2  setosa
4          4.6         3.1          1.5         0.2  setosa
5          5.0         3.6          1.4         0.2  setosa
6          5.4         3.9          1.7         0.4  setosa
```

✓ ir1=ir[sample(nrow(ir)),]

head(ir1)

```
> #Shuffle data
> ir1=ir[sample(nrow(ir)),]
> #check Shuffling
> head(ir1)
    Sepal.Length Sepal.Width Petal.Length Petal.Width    Species
72           6.1         2.8          4.0         1.3 versicolor
40           5.1         3.4          1.5         0.2     setosa
75           6.4         2.9          4.3         1.3 versicolor
32           5.4         3.4          1.5         0.4     setosa
141          6.7         3.1          5.6         2.4  virginica
122          5.6         2.8          4.9         2.0  virginica
```

✓ normalize<-function(x){

return((x-min(x)/(max(x)-min(x))))
}
iris_n<-as.data.frame(lapply(ir1[,c(1,2,3,4)],normalize))
str(iris_n)

```
> normalize<-function(x){
+   return((x-min(x)/(max(x)-min(x))))
+ }
> #normalize iris data
> iris_n<-as.data.frame(lapply(ir1[,c(1,2,3,4)],normalize))
> str(iris_n)
'data.frame':   150 obs. of  4 variables:
 $ Sepal.Length: num  4.91 3.91 5.21 4.21 5.51 ...
 $ Sepal.Width : num  1.97 2.57 2.07 2.57 2.27 ...
 $ Petal.Length: num  3.83 1.33 4.13 1.33 5.43 ...
 $ Petal.Width : num  1.258 0.158 1.258 0.358 2.358 ...
```

✓ iris_train<-iris_n[1:129,]

iris_test<-iris_n[130:150,]
iris_train_target<-iris[1:129,5]
iris_test_target<-iris[130:150,5]
iris_train_target

```
> iris_train<-iris_n[1:129,]
> iris_test<-iris_n[130:150,]
> iris_train_target<-iris[1:129,5]
> iris_test_target<-iris[130:150,5]
> iris_train_target
  [1] setosa     setosa     setosa     setosa     setosa     setosa     setosa
  [8] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [15] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [22] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [29] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [36] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [43] setosa     setosa     setosa     setosa     setosa     setosa     setosa
 [50] setosa     versicolor versicolor versicolor versicolor versicolor versicolor
 [57] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [64] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [71] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [78] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [85] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [92] versicolor versicolor versicolor versicolor versicolor versicolor versicolor
 [99] versicolor versicolor virginica  virginica  virginica  virginica  virginica
[106] virginica  virginica  virginica  virginica  virginica  virginica  virginica
[113] virginica  virginica  virginica  virginica  virginica  virginica  virginica
[120] virginica  virginica  virginica  virginica  virginica  virginica  virginica
[127] virginica  virginica  virginica
Levels: setosa versicolor virginica
```

✓ dim(iris_train)

dim(iris_test)
model<-knn(iris_train,iris_test,cl=iris_train_target,k=13) model
table(iris_test_target,model)

```
> dim(iris_train)
[1] 129   4
> dim(iris_test)
[1] 21  4
> model<-knn(iris_train,iris_test,cl=iris_train_target,k=13)
> model
 [1] versicolor versicolor setosa     setosa     setosa     setosa     versicolor
 [8] virginica  setosa     setosa     setosa     setosa     versicolor versicolor
[15] versicolor setosa     versicolor setosa     versicolor versicolor setosa
Levels: setosa versicolor virginica
> table(iris_test_target,model)
                model
iris_test_target setosa versicolor virginica
      setosa          0          0         0
      versicolor      0          0         0
      virginica      11          9         1
```

Practical No. 09

Aim: Implementation and analysis of Apriori Algorithm using Market Basket Analysis.

✓ mba_data<-read.csv("data_apriori.csv")
View(mba_data)

	Customer_Id	Products
1	1	bread
2	1	butter
3	1	eggs
4	1	milk
5	4	bread
6	4	butter
7	4	eggs
8	4	milk

 class(mba_data)

```
> class(mba_data)
[1] "data.frame"
```

 Method 1: Convert Data Frame into Transactions

✓ t<-as(mba_data,"transactions")
class(t)
inspect(t)

```
> class(t)
[1] "transactions"
attr(,"package")
[1] "arules"
> inspect(t)
     items                                  transactionID
[1]  {Customer_Id=[1,6),Products=bread}     1
[2]  {Customer_Id=[1,6),Products=butter}    2
[3]  {Customer_Id=[1,6),Products=eggs}      3
[4]  {Customer_Id=[1,6),Products=milk}      4
[5]  {Customer_Id=[1,6),Products=bread}     5
[6]  {Customer_Id=[1,6),Products=butter}    6
[7]  {Customer_Id=[1,6),Products=eggs}      7
[8]  {Customer_Id=[1,6),Products=milk}      8
[9]  {Customer_Id=[1,6),Products=soda}      9
[10] {Customer_Id=[1,6),Products=beer}      10
[11] {Customer_Id=[1,6),Products=bread}     11
[12] {Customer_Id=[1,6),Products=cheese}    12
[13] {Customer_Id=[1,6),Products=chips}     13
```

- **Method 2: Convert Data Frame into Transactions**

✓ trans<-split(mba_data$Customer_Id,mba_data$Products,"transactions")
trans

```
> trans<-split(mba_data$Customer_Id,mba_data$Products,"transactions")
> trans
$banana
[1]  7 11 13

$beer
[1]  2  5  8 13 15

$bread
 [1]  1  4  2  3  6  9  8 10 12 13 14 15

$buns
[1] 5 8

$butter
[1]  1  4  3  6  9 10 12 13 14

$cheese
[1]  2  8 13 15

$chips
[1]  2  5  8 11 15

$chocolate
[1]  6  7  8 10
```

✓ class(trans)

```
> class(trans)
[1] "list"
```

✓ trans<-split(mba_data$Products,mba_data$Customer_Id,"transactions")
head(trans)

```
> trans<-split(mba_data$Products,mba_data$Customer_Id,"transactions")
> head(trans)
$`1`
[1] "bread"  "butter" "eggs"   "milk"

$`2`
[1] "beer"   "bread"  "cheese" "chips"  "mayo"   "soda"

$`3`
[1] "bread"   "butter"  "eggs"    "milk"    "oranges"

$`4`
[1] "bread"  "butter" "eggs"   "milk"   "soda"

$`5`
[1] "buns"    "chips"   "beer"    "mustard" "pickels" "soda"

$`6`
[1] "bread"     "butter"    "chocolate" "eggs"      "milk"
```

✓ rules<-apriori(trans,parameter =
list(support=0.5,confidence=0.9,maxlen=3,minlen=2))

```
> rules<-apriori(trans,parameter = list(support=0.5,confidence=0.9,maxlen=3,minlen=2))
Apriori

Parameter specification:
 confidence minval smax arem  aval originalSupport maxtime support minlen maxlen
        0.9    0.1    1 none FALSE            TRUE       5     0.5      2      3
 target   ext
  rules TRUE

Algorithmic control:
 filter tree heap memopt load sort verbose
    0.1 TRUE TRUE  FALSE TRUE    2    TRUE

Absolute minimum support count: 7

set item appearances ...[0 item(s)] done [0.00s].
set transactions ...[15 item(s), 15 transaction(s)] done [0.00s].
sorting and recoding items ... [4 item(s)] done [0.00s].
creating transaction tree ... done [0.00s].
checking subsets of size 1 2 3 done [0.00s].
writing ... [11 rule(s)] done [0.00s].
creating S4 object  ... done [0.00s].
```

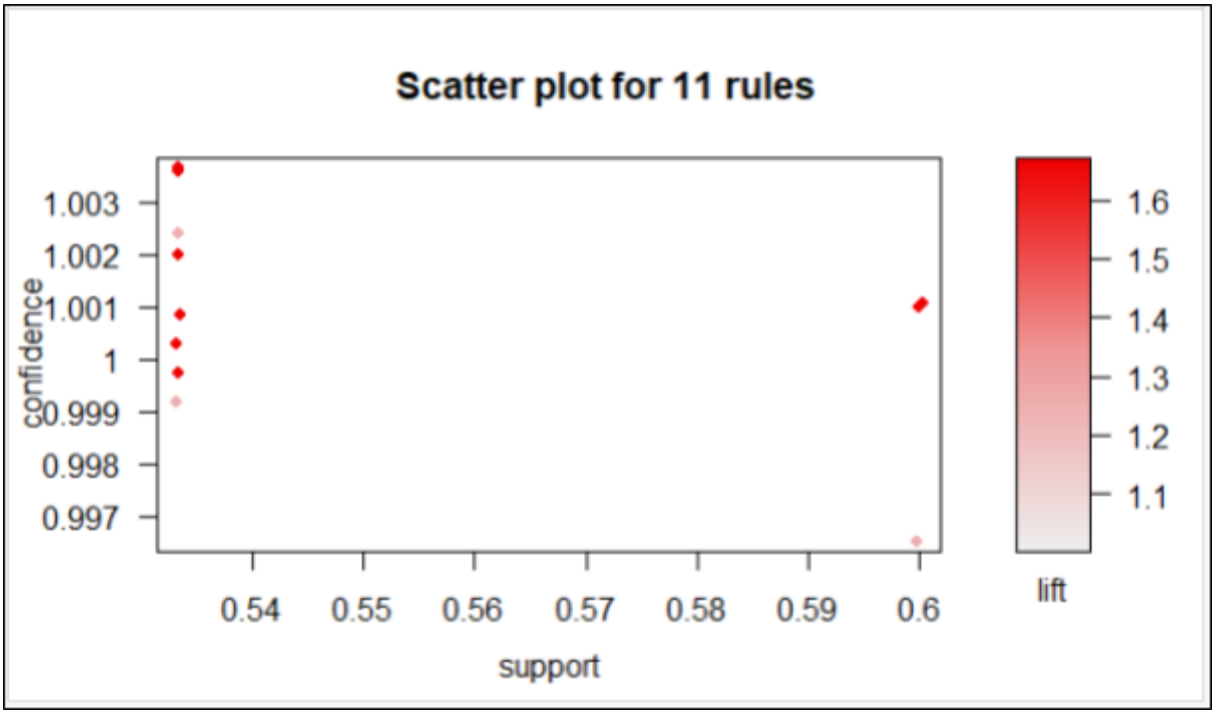
✓ rules

```
> rules
set of 11 rules
```

✓ inspect(head(rules,n=3, by="lift"))
summary(rules)

```
> inspect(head(rules,n=3, by="lift"))
    lhs              rhs    support   confidence coverage  lift     count
[1] {eggs}        => {milk} 0.6000000 1          0.6000000 1.666667 9
[2] {milk}        => {eggs} 0.6000000 1          0.6000000 1.666667 9
[3] {butter,eggs} => {milk} 0.5333333 1          0.5333333 1.666667 8
> summary(rules)
set of 11 rules

rule length distribution (lhs + rhs):sizes
2 3
3 8

   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  2.000   2.500   3.000   2.727   3.000   3.000

summary of quality measures:
    support         confidence    coverage          lift           count
 Min.   :0.5333   Min.   :1    Min.   :0.5333   Min.   :1.250   Min.   :8.000
 1st Qu.:0.5333   1st Qu.:1    1st Qu.:0.5333   1st Qu.:1.458   1st Qu.:8.000
 Median :0.5333   Median :1    Median :0.5333   Median :1.667   Median :8.000
 Mean   :0.5515   Mean   :1    Mean   :0.5515   Mean   :1.553   Mean   :8.273
 3rd Qu.:0.5667   3rd Qu.:1    3rd Qu.:0.5667   3rd Qu.:1.667   3rd Qu.:8.500
 Max.   :0.6000   Max.   :1    Max.   :0.6000   Max.   :1.667   Max.   :9.000

mining info:
  data ntransactions support confidence
 trans            15     0.5        0.9
```

✓ plot(rules)

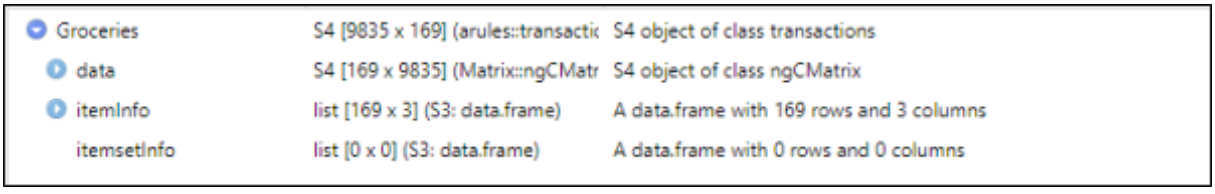


✓ data("Groceries")

inspect(head(Groceries,3))

```
> data("Groceries")
> inspect(head(Groceries,3))
    items
[1] {citrus fruit,semi-finished bread,margarine,ready soups}
[2] {tropical fruit,yogurt,coffee}
[3] {whole milk}
```

✓ View(Groceries)



✓ rules<-apriori(Groceries,parameter =
list(support=0.01,confidence=0.09,maxlen=3,minlen=2))

```
> rules<-apriori(Groceries,parameter = list(support=0.01,confidence=0.09,maxlen=3,minle
n=2))
Apriori

Parameter specification:
 confidence minval smax arem  aval originalSupport maxtime support minlen maxlen
       0.09    0.1    1 none FALSE            TRUE       5    0.01      2      3
 target  ext
  rules TRUE

Algorithmic control:
 filter tree heap memopt load sort verbose
    0.1 TRUE TRUE  FALSE TRUE    2    TRUE

Absolute minimum support count: 98

set item appearances ...[0 item(s)] done [0.00s].
set transactions ...[169 item(s), 9835 transaction(s)] done [0.00s].
sorting and recoding items ... [88 item(s)] done [0.00s].
creating transaction tree ... done [0.00s].
checking subsets of size 1 2 3 done [0.00s].
writing ... [445 rule(s)] done [0.00s].
creating S4 object  ... done [0.00s].
```

✓ rules

```
> rules
set of 445 rules
```

Practical No. 10

Aim: Implementation and Analysis of Clustering Algorithms like K-Means, Agglomerative.

- **K-Means**

✓ mydata<-select(iris,c(1,2,3,4))
model<-kmeans(mydata,3) model

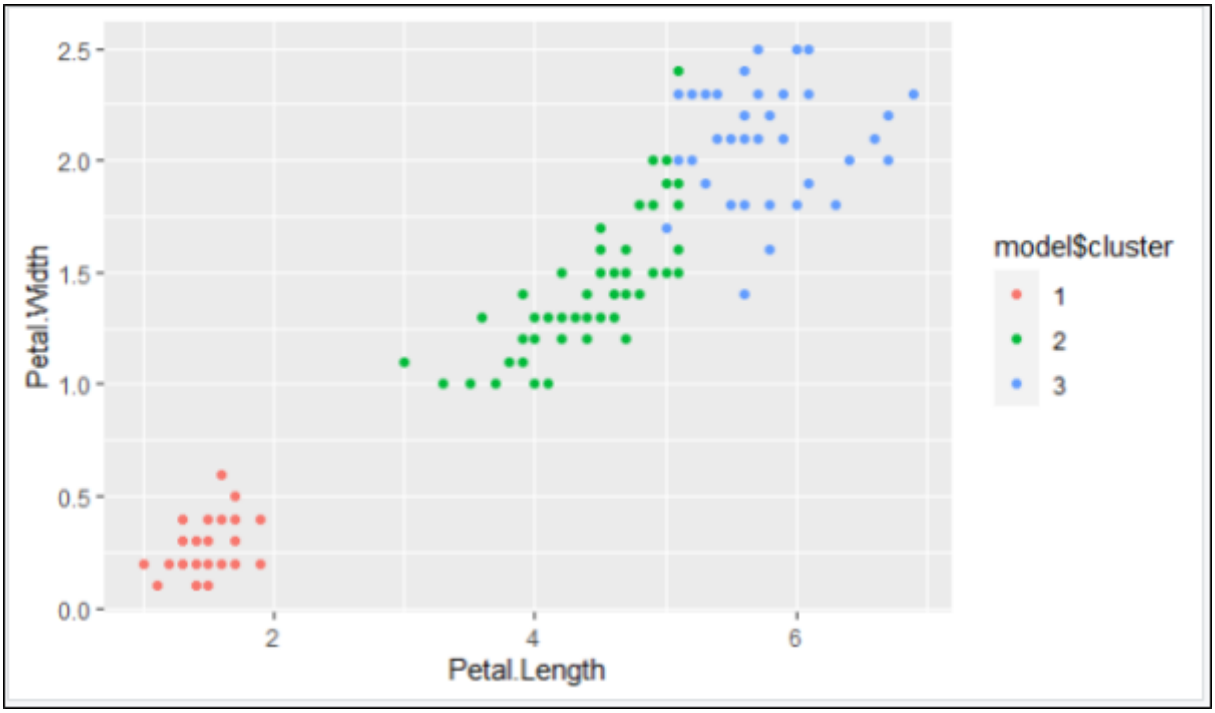
```
> mydata<-select(iris,c(1,2,3,4))
> model<-kmeans(mydata,3)
> model
K-means clustering with 3 clusters of sizes 50, 62, 38

Cluster means:
  Sepal.Length Sepal.Width Petal.Length Petal.Width
1     5.006000    3.428000     1.462000    0.246000
2     5.901613    2.748387     4.393548    1.433871
3     6.850000    3.073684     5.742105    2.071053

Clustering vector:
  [1] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 [40] 1 1 1 1 1 1 1 1 1 1 1 2 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3
 [79] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 2 3 3 3 3 2 3 3 3 3 3 3 2 2 3 3
[118] 3 3 2 3 2 3 2 3 3 2 2 3 3 3 3 3 2 3 3 3 3 2 3 3 3 2 3 3 3 2 3 3 2

within cluster sum of squares by cluster:
[1] 15.15100 39.82097 23.87947
 (between_SS / total_SS =  88.4 %)

Available components:

[1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
[6] "betweenss"    "size"         "iter"         "ifault"
```

✓ model$size
table(model$cluster,iris$Species)

```
> model$size
[1] 50 62 38
> table(model$cluster,iris$Species)

    setosa versicolor virginica
  1     50          0         0
  2      0         48        14
  3      0          2        36
```

✓ model$cluster<-as.factor(model$cluster)

ggplot(iris,aes(Petal.Length,Petal.Width,color=model$cluster))+geom_point()



- **Agglomerative**

✓ df<-USArrests

View(df)

	Murder	Assault	UrbanPop	Rape
Alabama	13.2	236	58	21.2
Alaska	10.0	263	48	44.5
Arizona	8.1	294	80	31.0
Arkansas	8.8	190	50	19.5
California	9.0	276	91	40.6
Colorado	7.9	204	78	38.7
Connecticut	3.3	110	77	11.1
Delaware	5.9	238	72	15.8
Florida	15.4	335	80	31.9
Georgia	17.4	211	60	25.8
Hawaii	5.3	46	83	20.2
Idaho	2.6	120	54	14.2

- **Pre-processing**

✓ #Remove NA Values

df<-na.omit(df)

df

```
> df<-na.omit(df)
> df
               Murder Assault UrbanPop Rape
Alabama          13.2     236       58 21.2
Alaska           10.0     263       48 44.5
Arizona           8.1     294       80 31.0
Arkansas          8.8     190       50 19.5
California        9.0     276       91 40.6
Colorado          7.9     204       78 38.7
Connecticut       3.3     110       77 11.1
Delaware          5.9     238       72 15.8
Florida          15.4     335       80 31.9
Georgia          17.4     211       60 25.8
Hawaii            5.3      46       83 20.2
Idaho             2.6     120       54 14.2
Illinois         10.4     249       83 24.0
Indiana           7.2     113       65 21.0
Iowa              2.2      56       57 11.3
Kansas            6.0     115       66 18.0
Kentucky          9.7     109       52 16.3
Louisiana        15.4     249       66 22.2
Maine             2.1      83       51  7.8
Maryland         11.3     300       67 27.8
Massachusetts     4.4     149       85 16.3
Michigan         12.1     255       74 35.1
Minnesota         2.7      72       66 14.9
Mississippi      16.1     259       44 17.1
Missouri          9.0     178       70 28.2
Montana           6.0     109       53 16.4
Nebraska          4.3     102       62 16.5
Nevada           12.2     252       81 46.0
New Hampshire     2.1      57       56  9.5
New Jersey        7.4     159       89 18.8
```

✓ #scale (normalizing or Standadizing)

d<-scale(df)

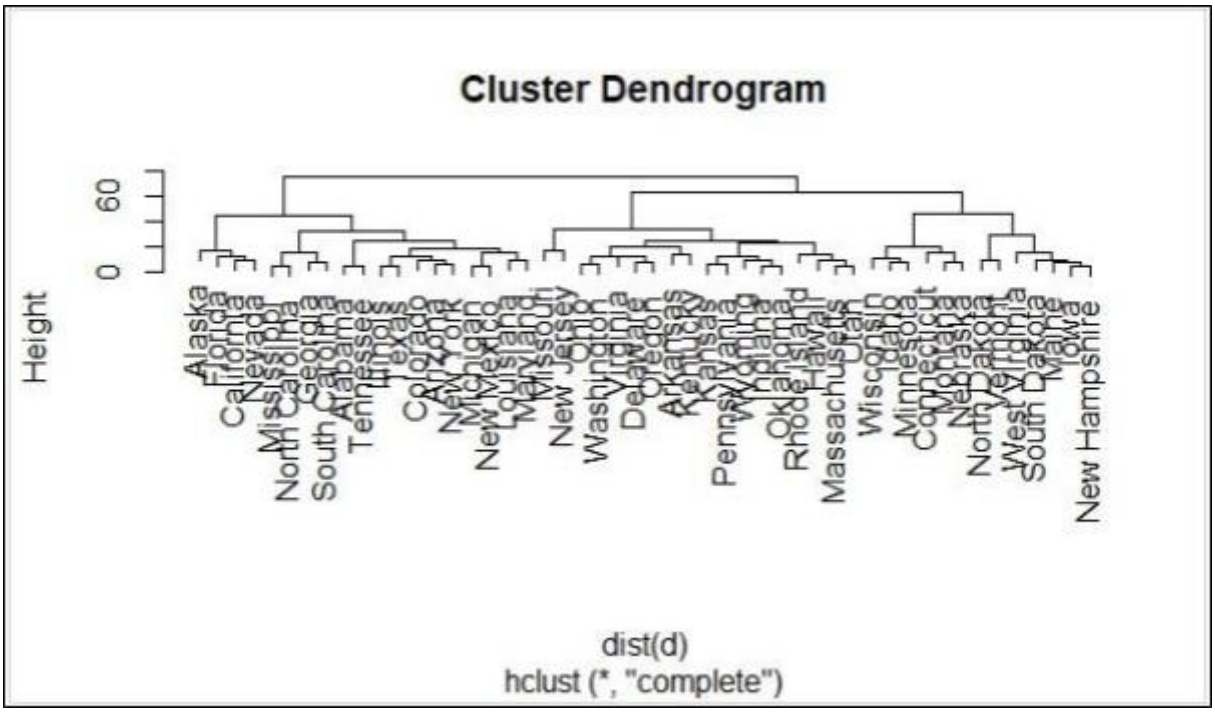
head(d)

```
> #scale (normalizing or Standadizing)
> d<-scale(df)
> head(d)
               Murder   Assault   UrbanPop         Rape
Alabama    1.24256408 0.7828393 -0.5209066 -0.003416473
Alaska     0.50786248 1.1068225 -1.2117642  2.484202941
Arizona    0.07163341 1.4788032  0.9989801  1.042878388
Arkansas   0.23234938 0.2308680 -1.0735927 -0.184916602
California 0.27826823 1.2628144  1.7589234  2.067820292
```

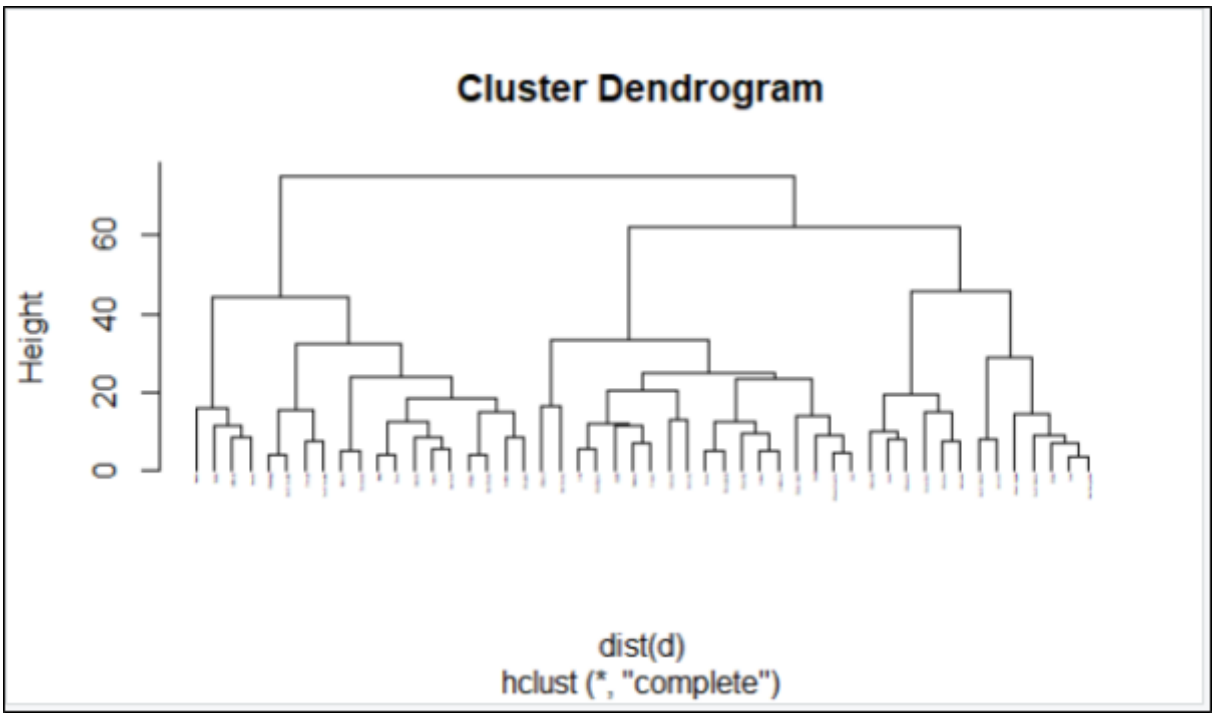
✓ d<-dist(d,method = "euclidean")

hc<-hclust(d,method = "complete")

plot(hc)

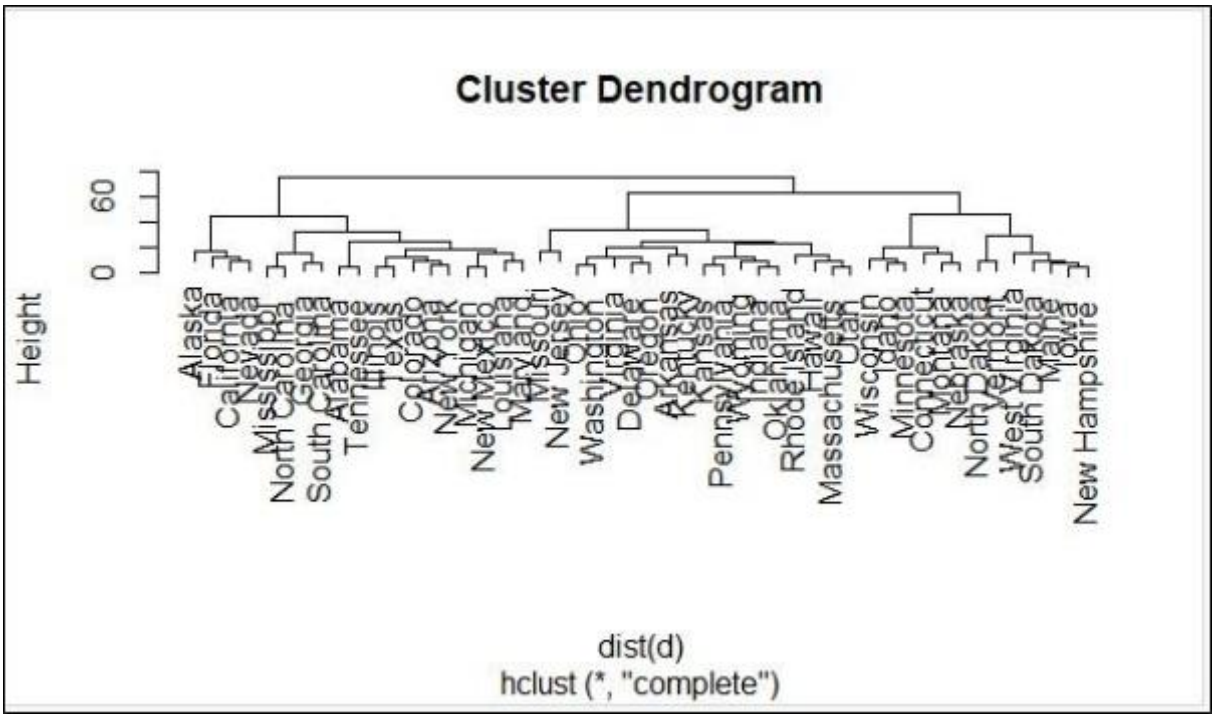


✓ plot(hc,cex=0.1,hang=-1)

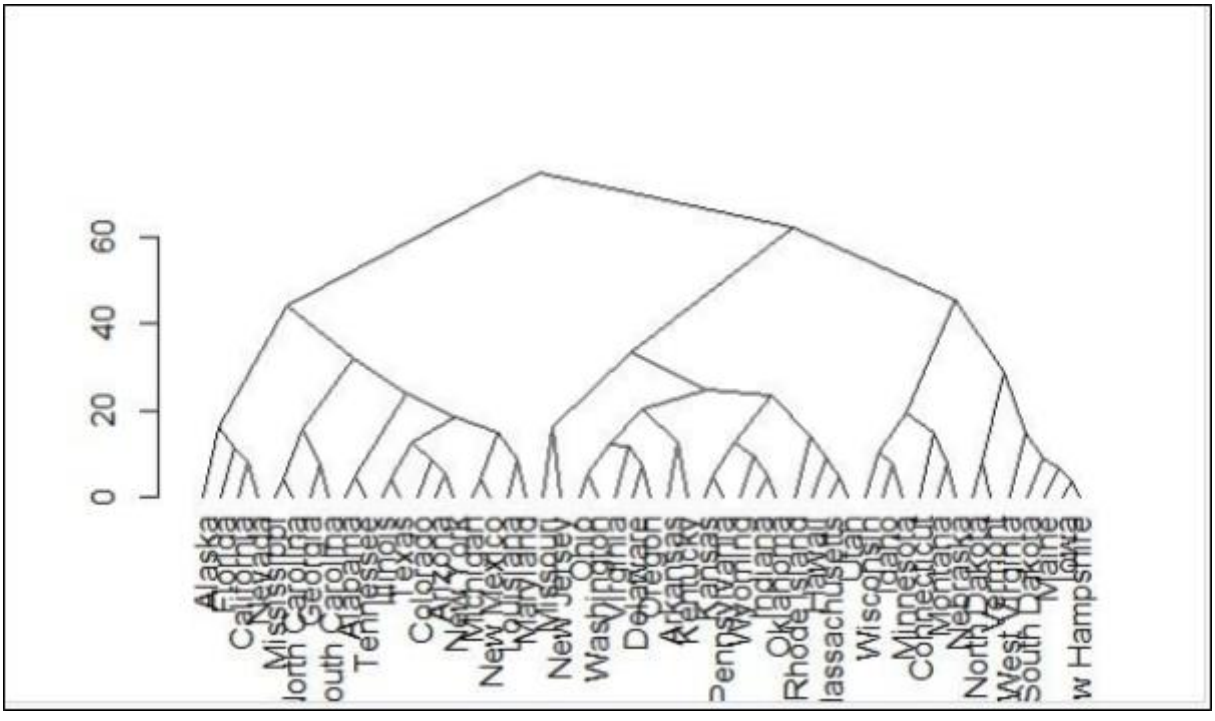


✓ hc<-hclust(dist(d))

plot(hc)

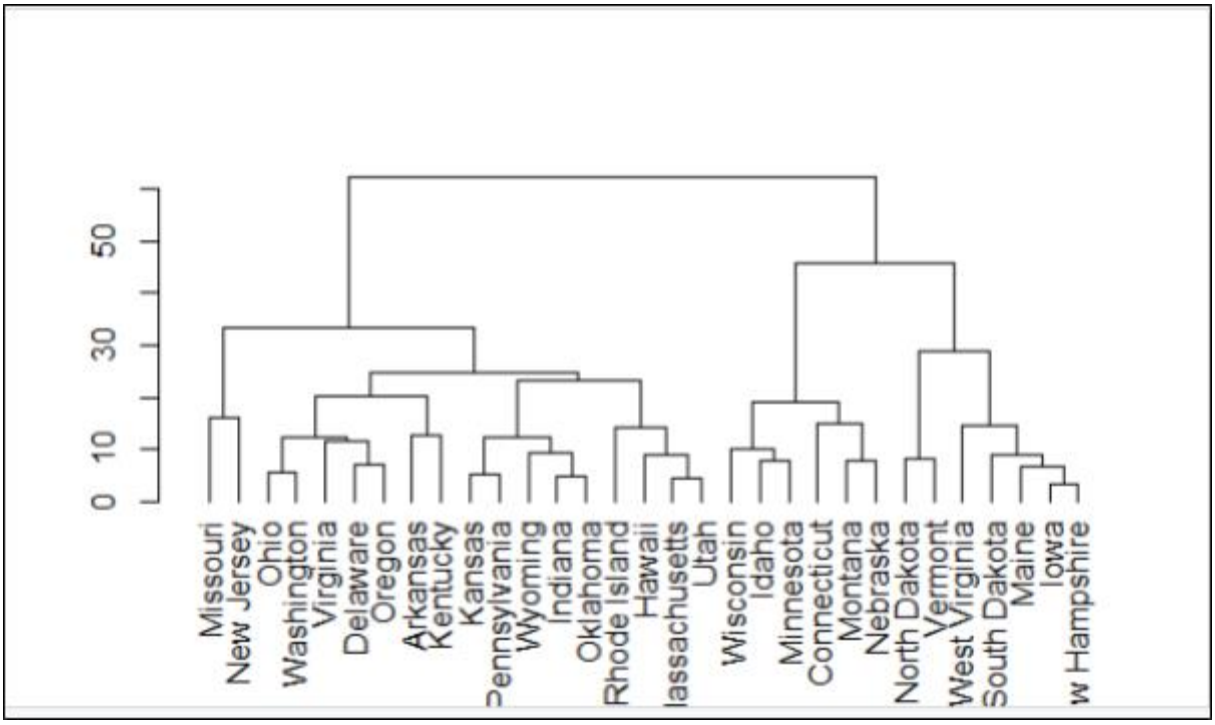


✓ hcd=as.dendrogram(hc)



```
plot(hcd,type="triangle")
```

✓ plot(cut(hcd,h=75)$upper)



✓ plot(cut(hcd,h=75)$lower[[2]])