Experiment No.2

Title: Implementation of Distributed Database.

Batch:A1 **Roll No.:16010422013** **Experiment No.: 2**

Aim: To Implement Distributed Database.

Resources needed: PostgreSQL 9.3

Theory

A distributed database system allows applications to access and manipulate data from local and remote databases. It partitions the data and stores at different physical locations. Partitioning refers to splitting what is logically one large table into smaller physical pieces. Partitioning can provide several benefits:

- ☐ Query performance can be improved dramatically for certain kinds of queries.
- ☐ Update performance can be improved too, since each piece of the table has indexes smaller than an index on the entire data set would be. When an index no longer fits easily in memory, both read and write operations on the index take progressively more disk accesses.
- ☐ Bulk deletes may be accomplished by simply removing one of the partitions, if that requirement is planned into the partitioning design. `DROP TABLE` is far faster than a bulk `DELETE`, to say nothing of the ensuing `VACUUM` overhead.
- ☐ Seldom-used data can be migrated to cheaper and slower storage media.

Partitioning enhances the performance, manageability, and availability of a wide variety of applications and helps reduce the total cost of ownership for storing large amounts of data. Partitioning allows tables, indexes, and index-organized tables to be subdivided into smaller pieces, enabling these database objects to be managed and accessed at a finer level of granularity.

The benefits will normally be worthwhile only when a table would otherwise be very large. The exact point at which a table will benefit from partitioning depends on the application, although a rule of thumb is that the size of the table should exceed the physical memory of

The following forms of partitioning can be implemented in PostgreSQL:

Range Partitioning

The table is partitioned into "ranges" defined by a key column or set of columns, with no overlap between the ranges of values assigned to different partitions. For example one might partition by date ranges, or by ranges of identifiers for particular business objects.

List Partitioning

The table is partitioned by explicitly listing which key values appear in each partition.

After creating the partition, **database link (DBLINK)** is used to create a connection of the host database server with the client database.

Database Links:

The central concept in distributed database systems is a **database link**. A database link is a connection between two physical database servers that allows a client to access them as one logical database. Database link is a pointer that defines a one-way communication path from one Database server to another database server. The link pointer is actually defined as an entry in a data dictionary table. To access the link, you must be connected to the local database that contains the data dictionary entry.

A database link connection is one-way in the sense that a client connected to local database A can use a link stored in database A to access information in remote database B, but users connected to database B cannot use the same link to access data in database A. If local users on database B want to access data on database A, then they must define a link that is stored in the data dictionary of database B.

A database link connection allows local users to access data on a remote database. For this connection to occur, each database in the distributed system must have a unique global database name in the network domain. The global database name uniquely identifies a database server in a distributed system.

dblink executes a query (usually a SELECT, but it can be any SQL statement that returns rows) in a remote database.

When two text arguments are given, the first one is first looked up as a persistent connection's name; if found, the command is executed on that connection. If not found, the first argument is treated as a connection info string as for dblink_connect, and the indicated connection is made just for the duration of this command.

Arguments

connname

Name of the connection to use; omit this parameter to use the unnamed connection.

connstr

A connection info string, as previously described for dblink_connect.

sql

The SQL query that you wish to execute in the remote database, for example select * from foo.

fail_on_error

If true (the default when omitted) then an error thrown on the remote side of the connection causes an error to also be thrown locally. If false, the remote error is locally reported as a NOTICE, and the function returns no rows.

Return Value

The function returns the row(s) produced by the query. Since dblink can be used with any query, it is declared to return record, rather than specifying any particular set of columns. This means that you must specify the expected set of columns in the calling query — otherwise PostgreSQL would not know what to expect. Here is an example:

```
SELECT *
  FROM dblink('dbname=mydb', 'select proname, prosrc from pg_proc')
    AS t1(proname name, prosrc text)
  WHERE proname LIKE 'bytea%';
```

Procedure:

Implementing distributed database:

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1. **Create the parent table.**

Create the parent table.

```
CREATE TABLE sales(org int, name varchar(10));
```

2. **Create the child (partitioned) tables**

```
CREATE TABLE sales_part1
(CHECK (org < 6))
INHERITS (sales);

CREATE TABLE sales_part2
(CHECK (org >=6 and org <=10))
INHERITS (sales);
```

3. **Create the rules**

```
CREATE OR REPLACE RULE insert_sales_p1
AS ON INSERT TO sales
WHERE (org <6)
DO INSTEAD
INSERT INTO sales_part1 VALUES(NEW.org, NEW.name);

CREATE OR REPLACE RULE insert_sales_p2
AS ON INSERT TO sales
WHERE (org >=6 and org <=10 )
DO INSTEAD
INSERT INTO sales_part2 VALUES(New.org,New.name);
```

4. **Add sample data to the new table.**

```
INSERT INTO sales VALUES(1,'Craig');
INSERT INTO sales VALUES(2,'Mike');
INSERT INTO sales VALUES(3,'Michelle');
INSERT INTO sales VALUES(4,'Joe');
INSERT INTO sales VALUES(5,'Scott');
INSERT INTO sales VALUES(6,'Roger');
INSERT INTO sales VALUES(7,'Fred');
INSERT INTO sales VALUES(8,'Sam');
INSERT INTO sales VALUES(9,'Sonny');
INSERT INTO sales VALUES(10,'Chris');
```

5. **Confirm that the data was added to the parent table and the partition tables**

```
SELECT * FROM sales;

SELECT * FROM sales_part1;
SELECT * FROM sales_part2;
```

6. **Create a dblink_connect to create a connection string to use.**

   Access the file : pg_hba.conf file under C:\Program Files\PostgreSQL\9.3\data and make the following entry , stating that the host machine is accessible to other machines.

host all all all trust

7. **Use dblink command on the remote machine to access the partitions present in the host machine.**

Create Extension dblink;

SELECT dblink_connect('myconn' ,'hostaddr=172.17.17.103 dbname=postgres user=postgres password=postgres')

select * from dblink('myconn','select * from sales_part2')AS T1(Column1 int, column2 varchar(10)) order by column2 desc;

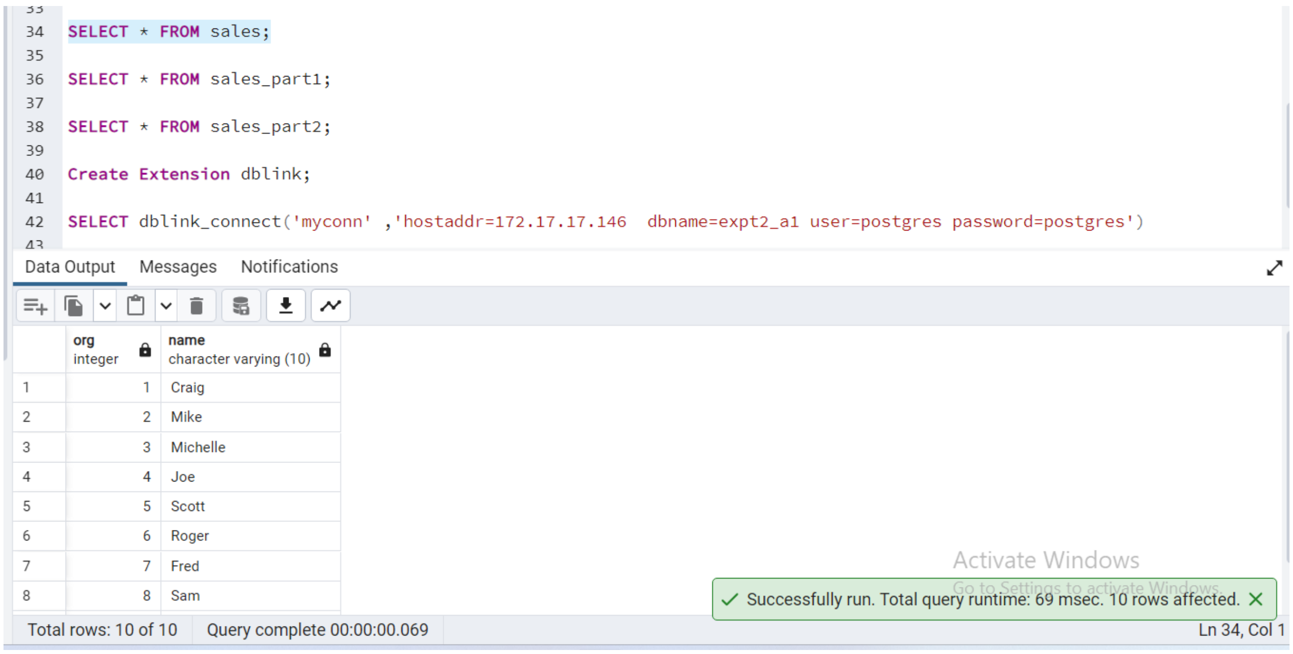
Inserting data into the table remotely

select dblink_exec('myconn','insert into sales values(12 select * from dblink('myconn','select * from sales')AS T1(Column1 int, column2 varchar(10)) order by column1 asc;
,''John'')')

Delete data from table remotely

select dblink_exec('myconn','delete from sales org=3')
select * from dblink('myconn','select * from sales')AS T1(Column1 int, column2 varchar(10)) order by column1 asc;

_ Results: (Program printout with output)

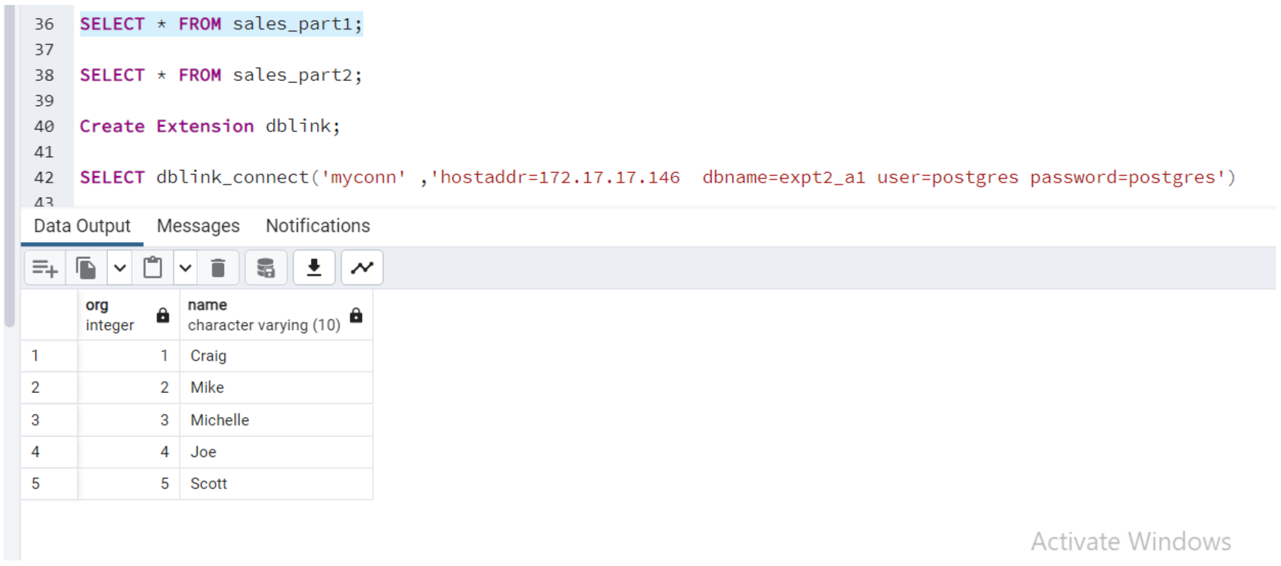


```
SELECT * FROM sales;

SELECT * FROM sales_part1;

SELECT * FROM sales_part2;

Create Extension dblink;

SELECT dblink_connect('myconn' ,'hostaddr=172.17.17.146  dbname=expt2_a1 user=postgres password=postgres')
```

	org integer	name character varying (10)
1	1	Craig
2	2	Mike
3	3	Michelle
4	4	Joe
5	5	Scott
6	6	Roger
7	7	Fred
8	8	Sam

Successfully run. Total query runtime: 69 msec. 10 rows affected.

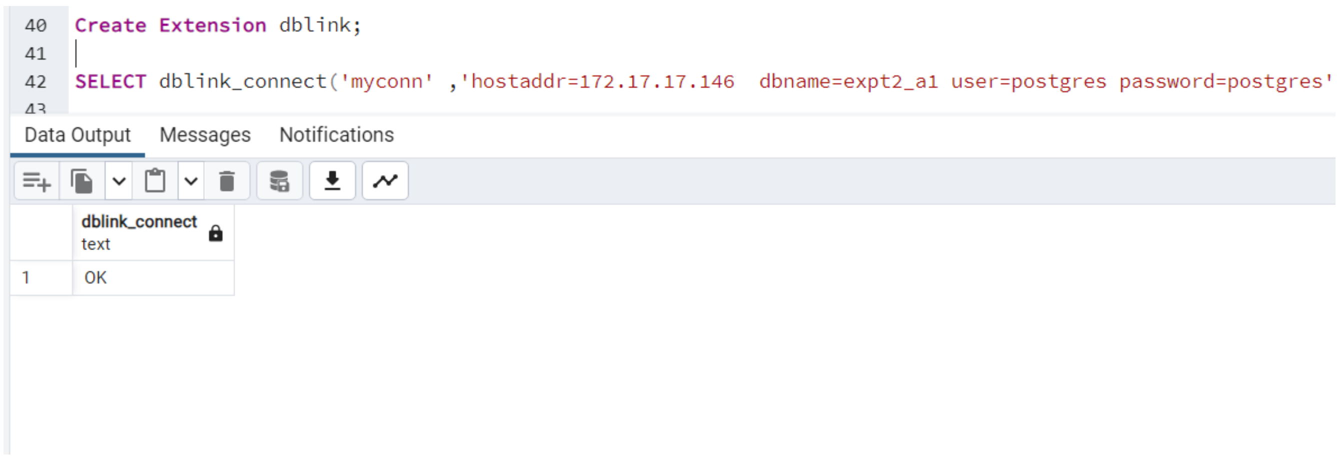
Total rows: 10 of 10 Query complete 00:00:00.069 Ln 34, Col 1



```sql
SELECT * FROM sales_part1;

SELECT * FROM sales_part2;

Create Extension dblink;

SELECT dblink_connect('myconn' ,'hostaddr=172.17.17.146  dbname=expt2_a1 user=postgres password=postgres')
```

Data Output   Messages   Notifications

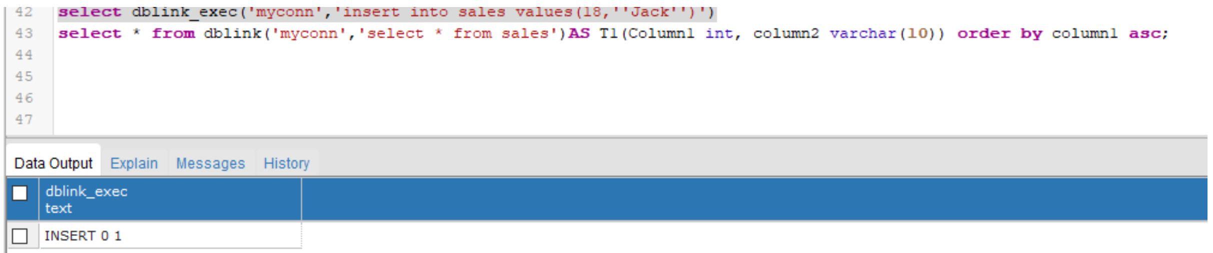
```
   org        name
   integer    character varying (10)
1        1    Craig
2        2    Mike
3        3    Michelle
4        4    Joe
5        5    Scott
```



```sql
Create Extension dblink;

SELECT dblink_connect('myconn' ,'hostaddr=172.17.17.146  dbname=expt2_a1 user=postgres password=postgres'
```

Data Output   Messages   Notifications

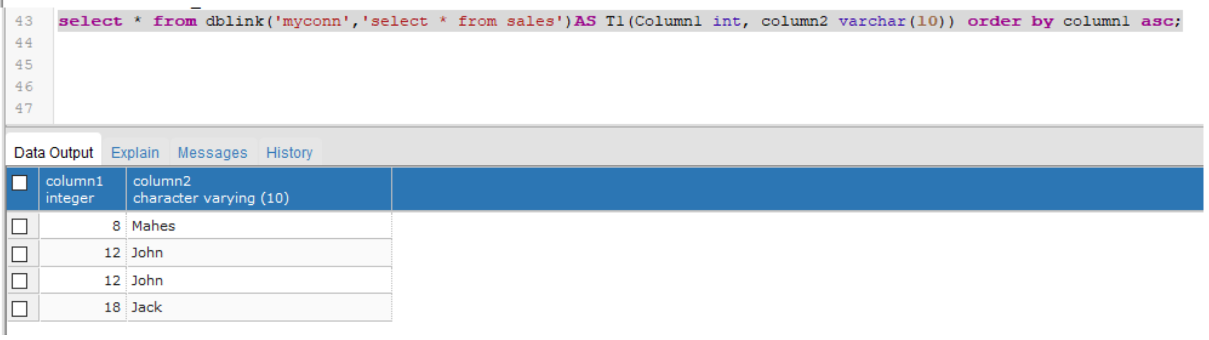
```
   dblink_connect
   text
1  OK
```



```sql
select dblink_exec('myconn','insert into sales values(18,''Jack'')')
select * from dblink('myconn','select * from sales')AS T1(Column1 int, column2 varchar(10)) order by column1 asc;
```

Data Output   Explain   Messages   History

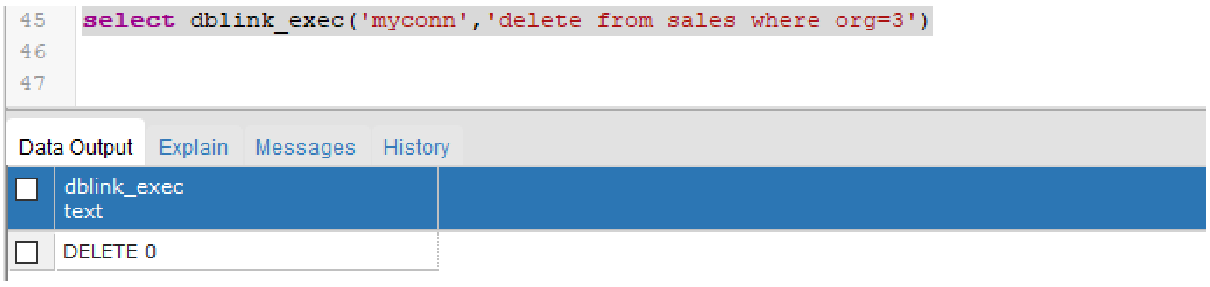
```
dblink_exec
text
INSERT 0 1
```



```sql
select * from dblink('myconn','select * from sales')AS T1(Column1 int, column2 varchar(10)) order by column1 asc;
```

Data Output   Explain   Messages   History

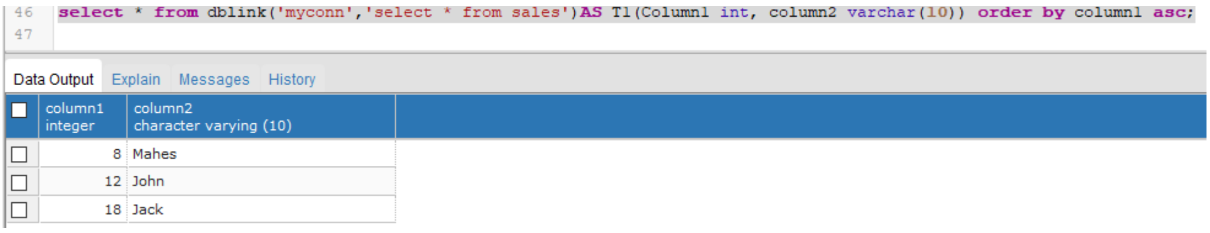
```
column1   column2
integer   character varying (10)
       8  Mahes
      12  John
      12  John
      18  Jack
```



```
select dblink_exec('myconn','delete from sales where org=3')
```

Data Output | Explain | Messages | History

```
dblink_exec
text
DELETE 0
```



```
select * from dblink('myconn','select * from sales')AS T1(Column1 int, column2 varchar(10)) order by column1 asc;
```

Data Output | Explain | Messages | History

```
column1   column2
integer   character varying (10)
       8  Mahes
      12  John
      18  Jack
```

Questions:

1. **What are the different types of distributed database systems.**

Ans. There are several types of distributed database systems, each with its own characteristics and advantages. Here are some common types:

Homogeneous Distributed Database:

In this type, all database nodes use the same database management system (DBMS). The underlying hardware and software are uniform across all nodes.
Heterogeneous Distributed Database:

Unlike homogeneous systems, heterogeneous systems allow different types of DBMS to be used on different nodes.
This type often involves more complex integration and communication mechanisms.

2. **Give steps to insert and delete records in remote table.**
Ans. Inserting Records in a Remote Table:
Connect to the Database:

Establish a connection to the distributed database system. This typically involves providing connection details such as host, port, username, and password.
Choose the Target Node:

Identify the specific node or location where you want to insert the records. In distributed systems, data might be spread across multiple nodes.
Formulate the Insert Query:

Write an SQL insert query specifying the data to be inserted and the target table. For example:
sql
Copy code
```
INSERT INTO remote_table (column1, column2, ...) VALUES (value1, value2, ...);
```
Execute the Query:

Send the insert query to the remote node using the established database connection. This could involve using a library or driver specific to your programming language.
Handle Errors and Confirm:

Check for any errors during the insert operation and handle them appropriately. Confirm the successful insertion of records.
Deleting Records from a Remote Table:
Connect to the Database:

Establish a connection to the distributed database system, similar to the insertion process.
Identify the Target Node:

Determine the node or location from which you want to delete records. Again, distributed databases may have data distributed across multiple nodes.
Create the Delete Query:

Write an SQL delete query specifying the conditions for deleting records from the target table. For example:
sql
Copy code
```
DELETE FROM remote_table WHERE condition;
```
Execute the Query:

Send the delete query to the remote node using the established database connection.
Handle Errors and Confirm:

Check for any errors during the delete operation and handle them appropriately.
Confirm the successful deletion of records.

Outcomes:

Design advanced database systems using Parallel, Distributed and In-memory databases and its implementation.

Conclusion: (Conclusion to be based on the outcomes achieved):
The implementation of a distributed database offers both positive outcomes and challenges. On the positive side, it can lead to improved performance through localized data access, scalability to handle growing data and user loads, high availability, and fault tolerance. Additionally, geographical distribution supports global user bases and compliance with data residency requirements.

Grade: AA / AB / BB / BC / CC / CD /DD

Signature of faculty in-charge with date

References:

Books/ Journals/ Websites:

1. Elmasri and Navathe, “Fundamentals of Database Systems”, Pearson Education

2. https://www.postgresql.org/docs/