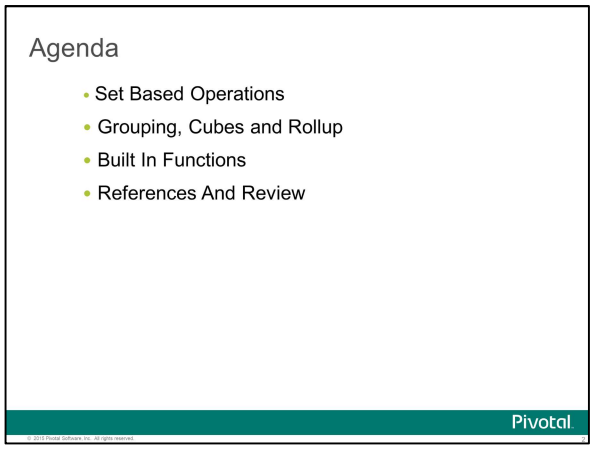
Set Operations and Built In Functions

Pivotal® Greenplum Database

Pivotal



Hello, this is Marshall Presser. In this section, we'll be talking about how you can use some important functions that are part of the Pivotal Greenplum Database to help solve analytic business problems. Some come with the database itself and others are easily installed.

First, we'll consider set based operations and grouping operators.
Then we'll look at some built in functions and do a brief demo

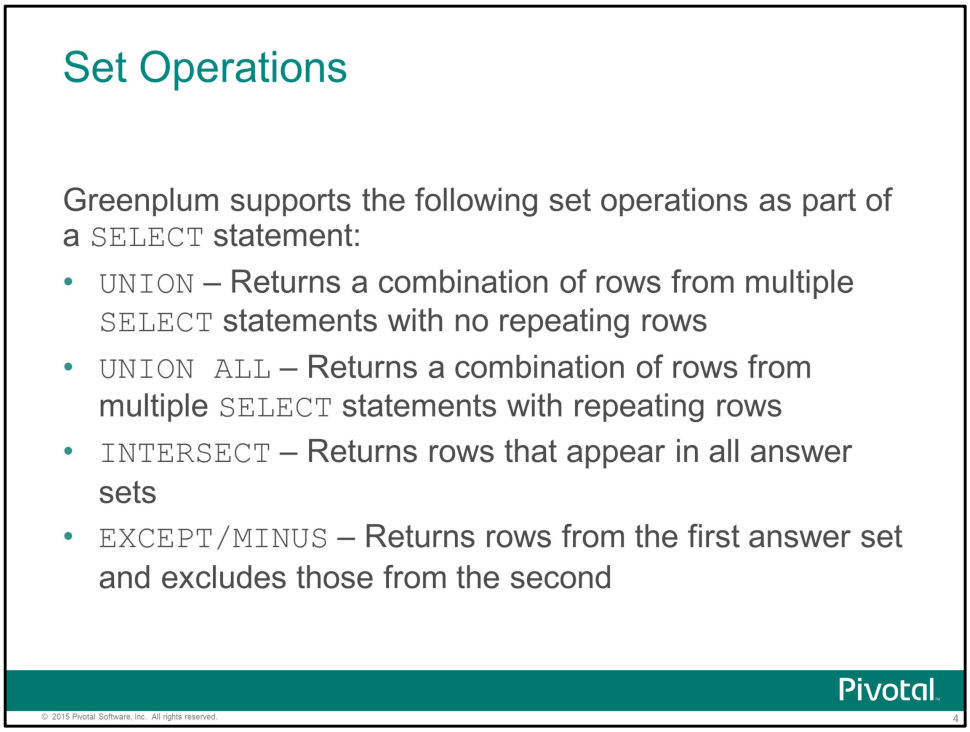
Next we'll look at the machine learning functions that come with Madlib, a package of very useful functions that make doing Data Science in GPDB a lot easier

We'll also look at PostGIS, the PostgreSQL geospatial database functions and have another brief demo.
.

If you're used to OLTP operations in a SQL database, you probably think more in terms of inserts, deletes, updates, foreign key contstrains, triggers and other such operations.

While GPDB has triggers, update statements and the like, its main use is for analytics in which much or all of the data needs to be examined, not just a single row or a few rows.

Pivotal



Set operators:

- Manipulate the results sets of two or more queries by combining the results of individual queries into a single results set.
- Do not perform row level filtering.

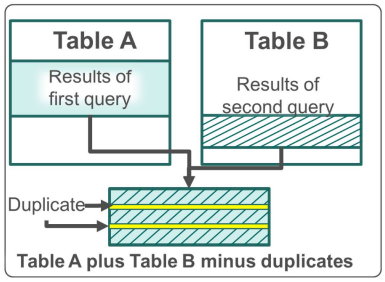
Set operations supported by Greenplum are:

- **`INTERSECT`** which returns rows that appear in all answer sets generated by individual `SELECT` statements.
- **`EXCEPT`** returns all rows from the first `SELECT` except for those which also selected by the second `SELECT`. This operation is the same as the `MINUS` operation.
- **`UNION`** combines the results of two or more `SELECT` statements. There will be no repeating rows.
- **`UNION ALL`** combines all the results of two or more `SELECT` statements. There may be repeating rows.

Set Operations – UNION

UNION:

- Combines rows from the first query with rows from the second query
- Removes duplicates or repeating rows




```
SELECT t.transid
       c.custname
FROM   facts.transaction t
  JOIN dimensions.customer c
    ON c.customerid = t.customerid
WHERE  t.transdate BETWEEN
       '2008-01-01' AND '2008-05-17'

  UNION

SELECT t.transid
       c.custname
FROM   facts.transaction t
  JOIN dimensions.customer c
    ON c.customerid = t.customerid
WHERE  t.transdate BETWEEN
       '2008-01-01' AND '2008-01-21'
```

Pivotal

5

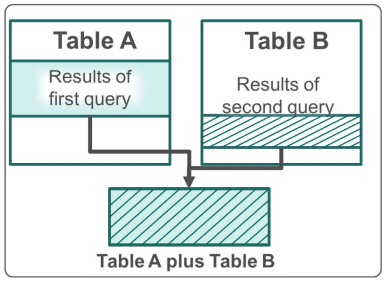
A union operation combines the results of the SELECT statement from the first table with the results from the query on the second table. The result set does not contain any repeating rows.

Since you may have very large data sets, doing a union or union all without some sort of aggregation can generate a result set with billions of rows. It's unlikely that you mean to do this. That's why our examples show the unions with aggreation operators.

Set Operations – UNION ALL

UNION ALL:

- Combines rows from the first query with rows from the second query
- Does not remove duplicate rows




```
SELECT t.transid
       c.custname
FROM   facts.transaction t
  JOIN dimensions.customer c
    ON c.customerid = t.customerid
WHERE  t.transdate BETWEEN
       '2008-01-01' AND '2008-05-17'

  UNION ALL

SELECT t.transid
       c.custname
FROM   facts.transaction t
  JOIN dimensions.customer c
    ON c.customerid = t.customerid
WHERE  t.transdate BETWEEN
       '2008-01-01' AND '2008-01-21'
```

Pivotal

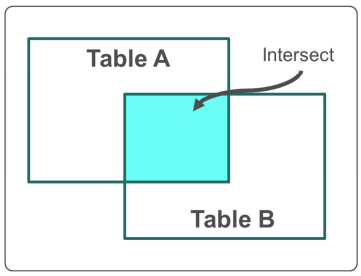
6

The UNION ALL set operation is like the UNION operation but it does not remove duplicate or repeating rows.

Set Operations – INTERSECT

INTERSECT:

- Returns only the rows that appear in both SQL queries
- Removes duplicate rows




```
SELECT   t.transid
         c.custname
FROM     facts.transaction t
    JOIN dimensions.customer c
      ON c.customerid = t.customerid

INTERSECT

SELECT t.transid
       c.custname
FROM   facts.transaction t
  JOIN dimensions.customer c
    ON c.customerid = t.customerid
WHERE  t.transdate BETWEEN
       '2008-01-01' AND '2008-01-21'
```

Pivotal

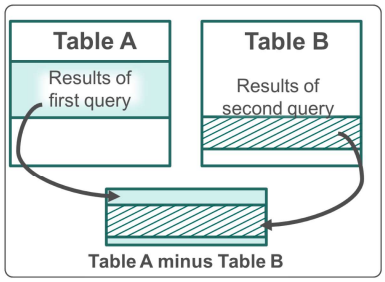
7

A set operation takes the results of two queries and returns only the results that appear in both result sets. Duplicate rows are removed from the final set returned.

Set Operations – EXCEPT

EXCEPT:

- Returns all rows from the first SELECT statement
- Omits all rows that appear in the second SELECT statement

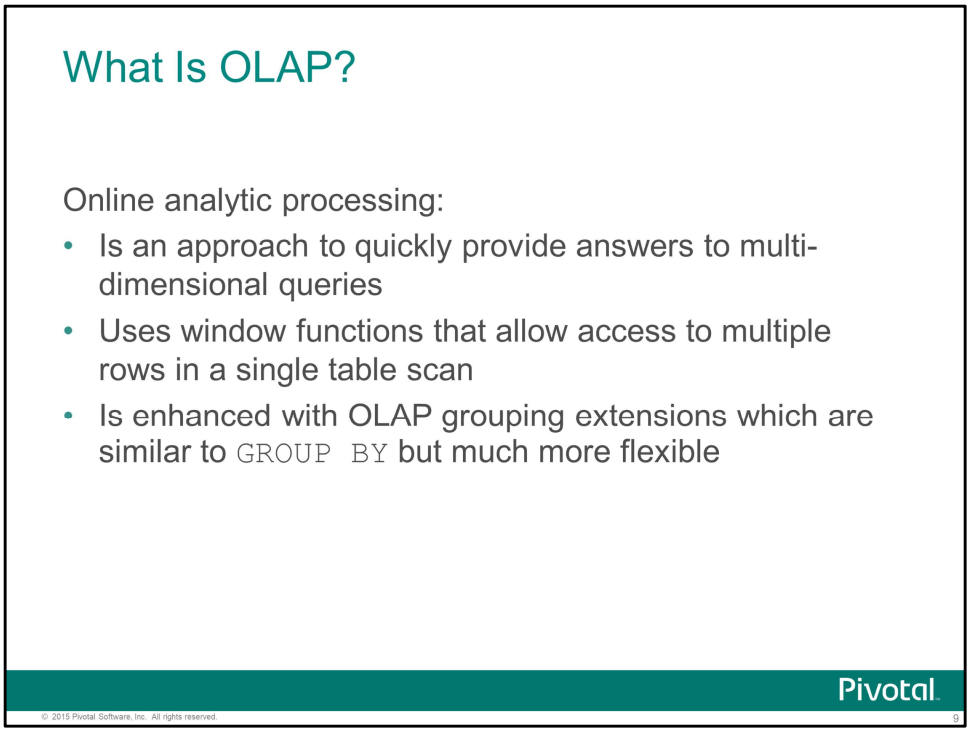



```
SELECT   t.transid
         c.custname
FROM     facts.transaction t
    JOIN dimensions.customer c
      ON c.customerid = t.customerid

  EXCEPT

SELECT t.transid
       c.custname
FROM   facts.transaction t
  JOIN dimensions.customer c
    ON c.customerid = t.customerid
WHERE  t.transdate BETWEEN
       '2008-01-01' AND '2008-01-21'
```


Pivotal

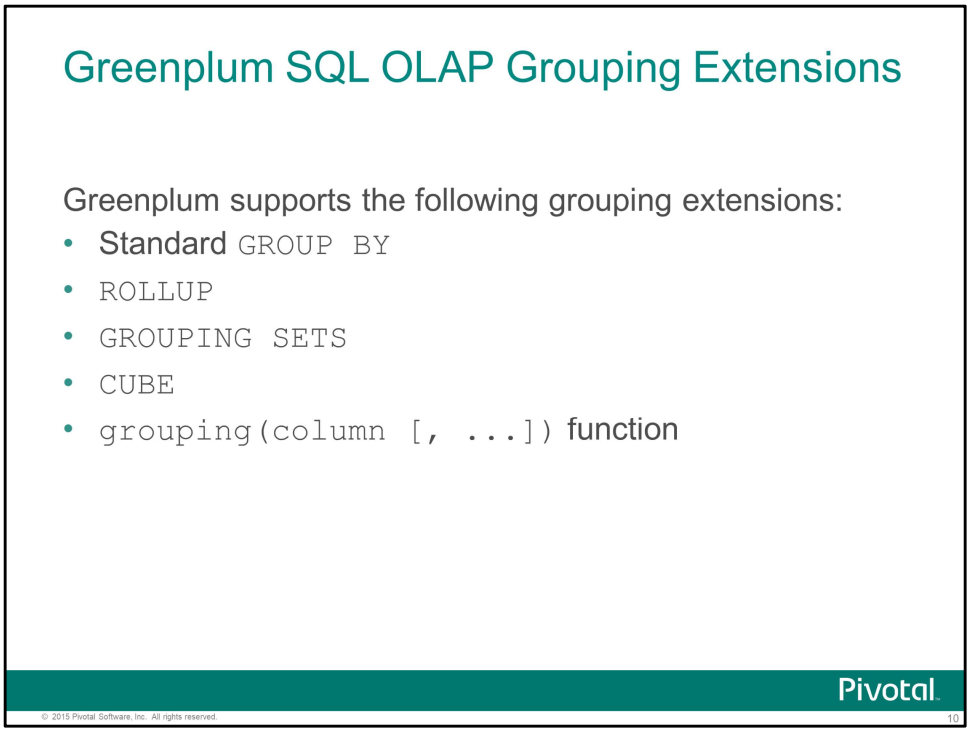
8

The EXCEPT set operation takes the distinct rows of the first query and returns all of the rows that do not appear in the result set of the second query.



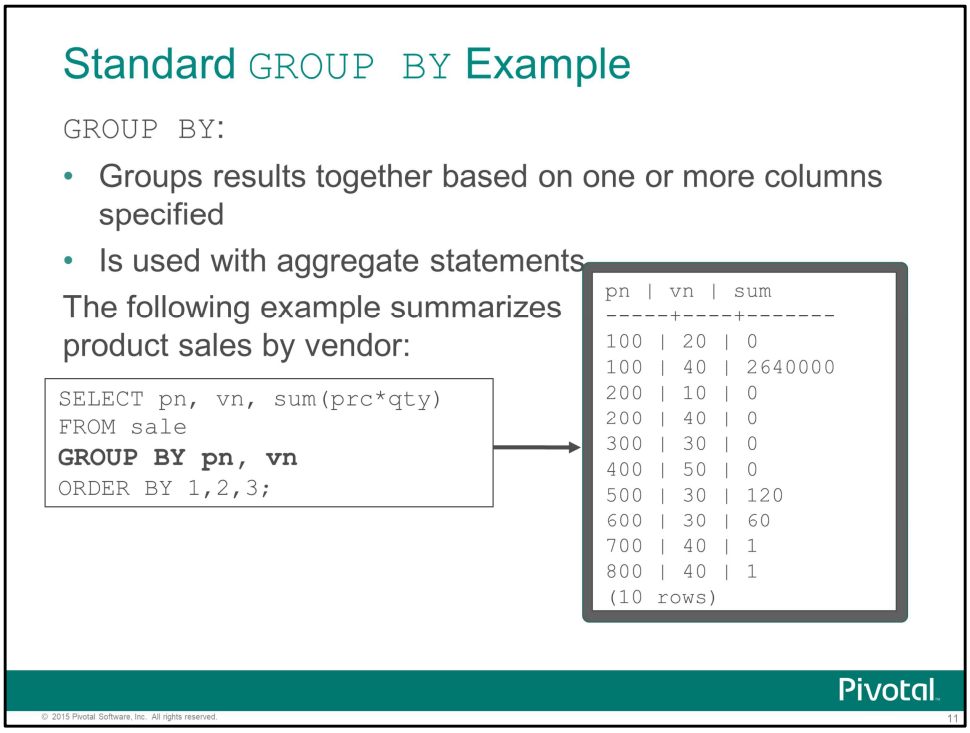
Part of broader category of BI, online analytic process is an approach to answer multi-dimensional queries. Databases configured for OLAP use a multidimensional data model that allows for complex analytical and ad-hoc queries.

Greenplum supports OLAP with window functions that provide access to multiple rows in a single table scan and grouping extensions, which provide flexibility when grouping result sets using the `GROUP BY` clause.



Greenplum introduced support for extensions to the standard `GROUP BY` clause, which is fully supported. These clauses can simplify the expression of complex groupings:

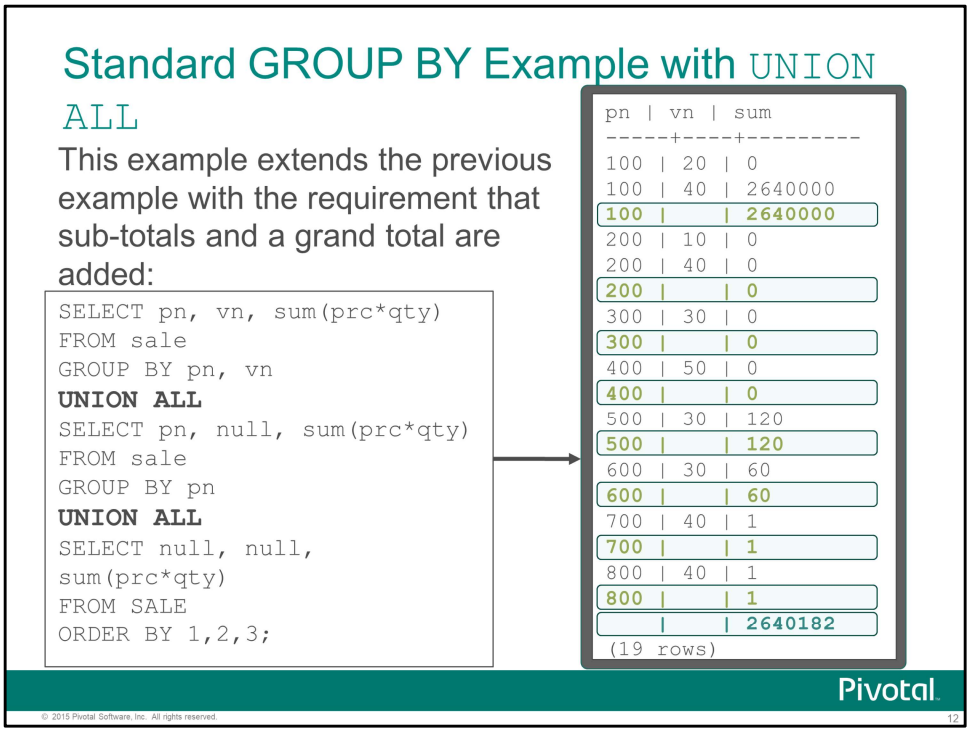
- **`ROLLUP`** – This extension provides hierarchical grouping.
- **`CUBE`** – Complete cross-tabular grouping, or all possible grouping combinations, is provided with this extension.
- **`GROUPING SETS`** – Generalized grouping is provided with the `GROUPING SETS` clause.
- **`grouping` function** – This clause helps identify super-aggregated rows from regular grouped rows.
- **`group_id` function** – This clause is used to identify duplicate rows in grouped output.



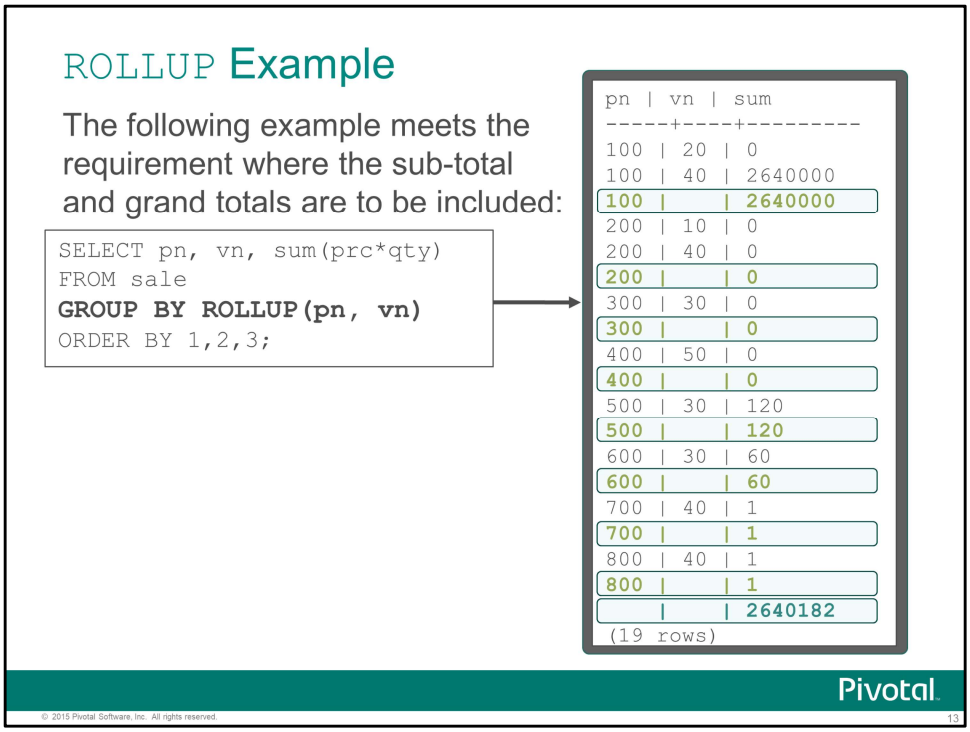
In the examples we'll show, the base table contiains a row for each sale in which where the columns are: pn, the product number, vn = the vendor number, prc= the price of the prouct for that transaction and qty, the quantity of the product sold.

The standard `GROUP BY` clause groups results together based on one or more columns specified. It is used in conjunction with aggregate statements, such as `SUM`, `MIN`, or `MAX`. This helps to make the resulting data set much more readable to a user.

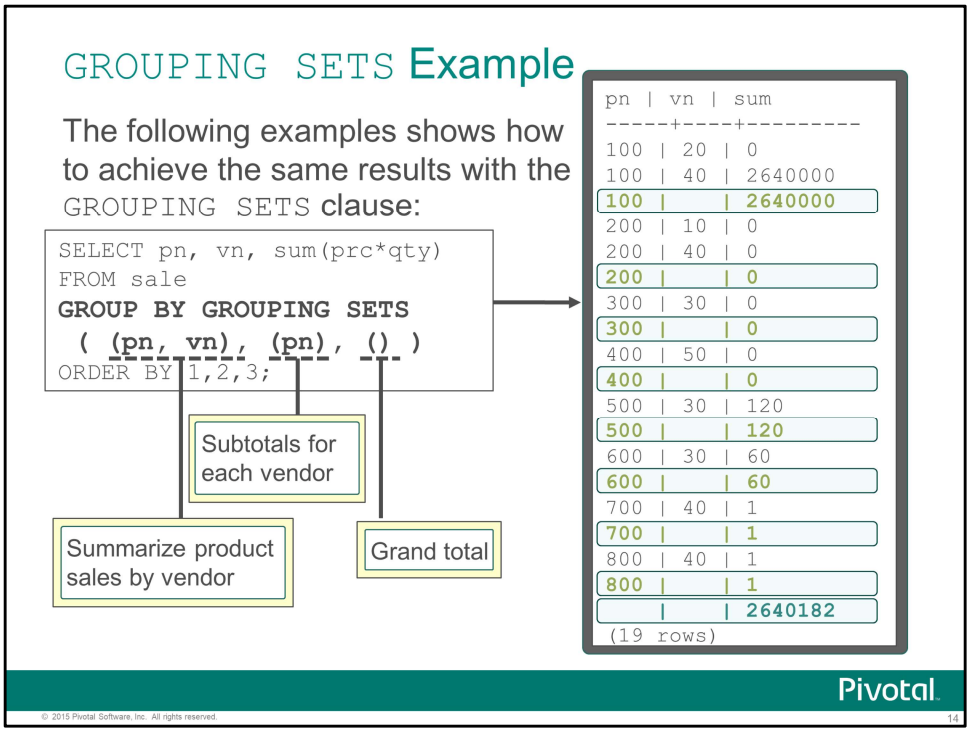
The slide shows an example of a standard `GROUP BY` clause used to summarize product sales by vendor.



In this follow-on example, the requirements for the query have been extended to include sub-totals and a grand total. You would need to use a `UNION ALL` to continue the grouping and provide for the additional requirements.

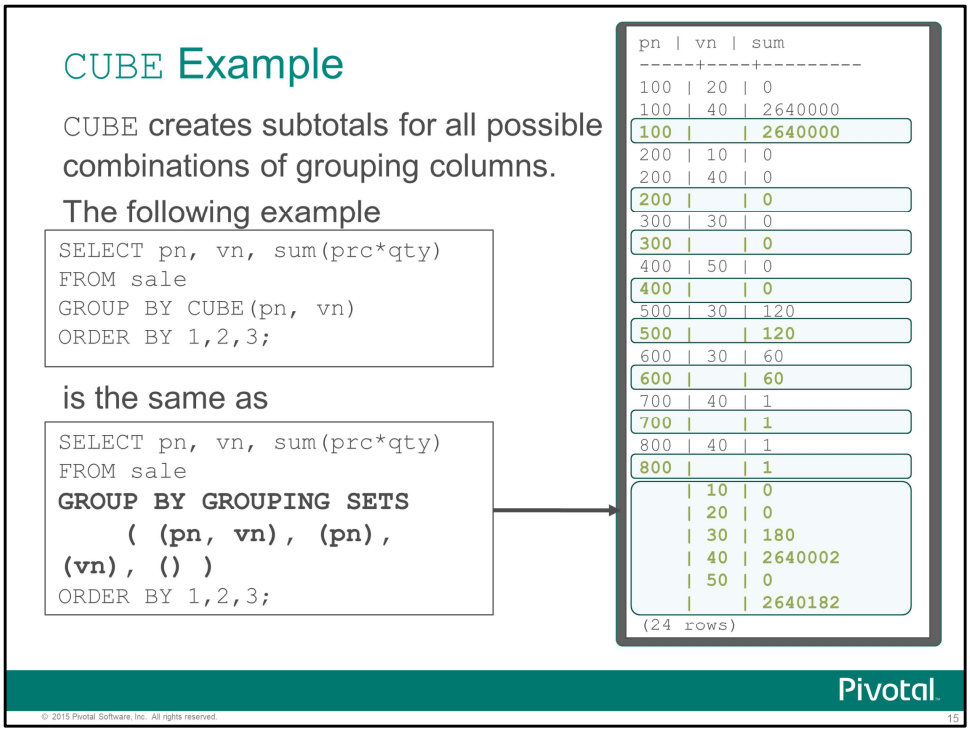


This slide meets the requirements provided in the previous slide, but uses the ROLLUP grouping extension. ROLLUP allows you to perform hierarchical grouping and helps to reduce the code.



The `GROUPING SETS` extension allows you to specify grouping sets. If you use the GROUPING SETS clause to meet the earlier requirements so that it produced the same output as `ROLLUP`, it would use the following groups:

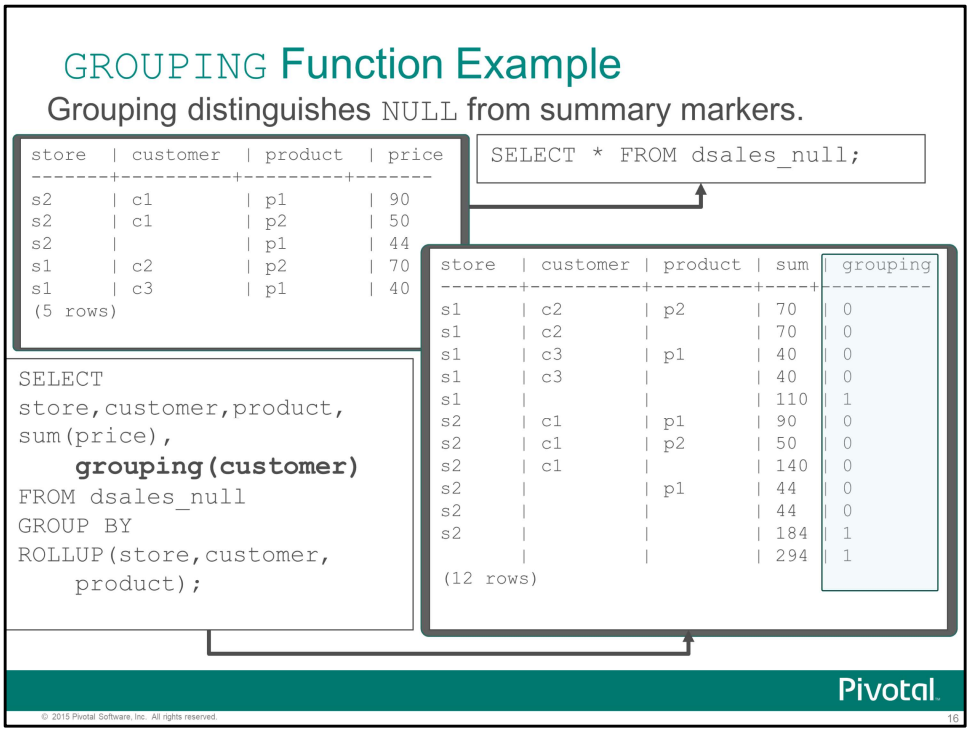
- `(pn,vn)` – This grouping summarizes product sales by vendor.
- `(pn)` – This grouping provides subtotal sales for each vendor.
- `()` – This grouping provides the grand total for all sales for all vendors.



A `CUBE` grouping creates subtotals for all of the possible combinations of the given list of grouping columns, or expressions. In terms of multidimensional analysis, CUBE generates all the subtotals that could be calculated for a data cube with the specified dimensions.

In the example shown on the slide, the additional grouping set of `(vn)` - subtotaling the sales by vendor, is included as part of the cube.

Note that *n* elements of a CUBE translate to 2*n* grouping sets. Consider using `CUBE` in any situation requiring cross-tabular reports. `CUBE` is typically most suitable in queries that use columns from multiple dimensions rather than columns representing different levels of a single dimension. For instance, a commonly requested cross-tabulation might need subtotals for all the combinations of month, state, and product.

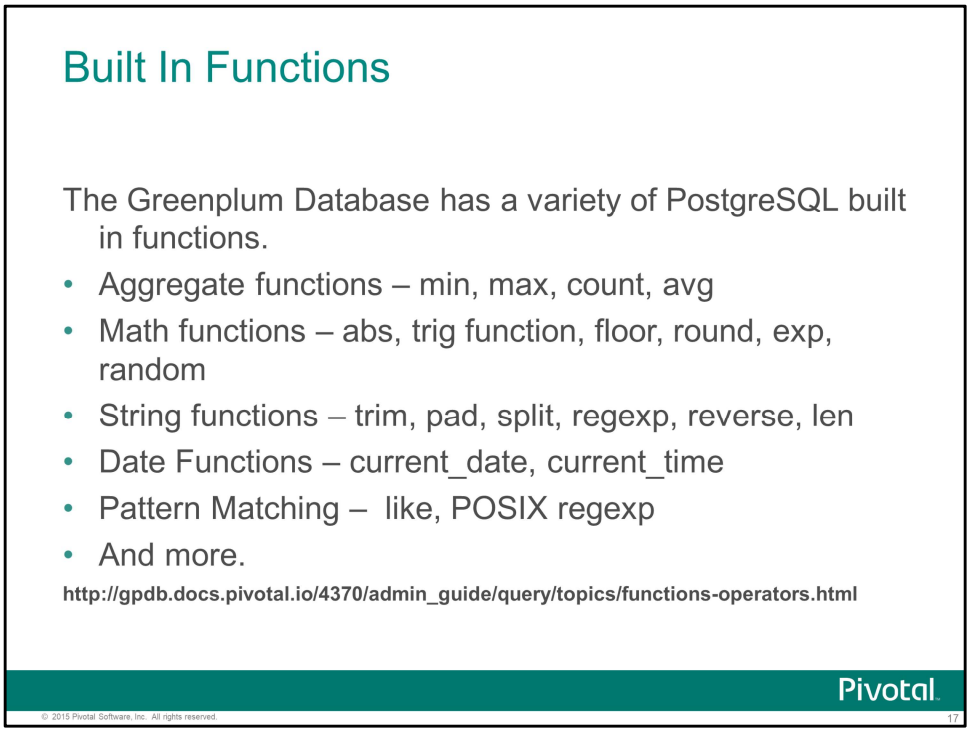


When you use grouping extensions to calculate summary rows, such as sub-totals and grand totals, the output can become confusing if the data in a grouping column contains `NULL` values. It is hard to tell if a row is supposed to be a subtotal row or a regular row containing a NULL.

In the example shown on the slide, one of the rows shown where the `customer` field is NULL. Without the grouping id, you could misinterpret the sum of 44 as a subtotal row for store 2.

The `GROUPING` function returns a result for each output row, where:

- 1 represents a summary row.
- 0 represents grouped rows.



There are also many functions that do operations on individual rows and columns in addition to the aggreate functions like min, max, avg, and count.

It's important to remember that the GPDB does these in parallel across all the segments simultaneouly, making these operations, like pretty much everything else much faster in GPDB than in a single process database.

References

- All the Pivotal Greenplum Database documentation is available online
  - Reference Guide
  - Admin Guide
  - Client Tools
  - Load Tools
  - Connectivity Tools
  - Many more
- Pivotal Greenplum Database documentation:
  - http://gpdb.docs.pivotal.io/gpdb-438.html

Pivotal

Thank You

Pivotal


Pivotal
A NEW PLATFORM FOR A NEW ERA