Query Performance Lab

Joseph Ketcham

Contents

[Analysis 3](#_Toc350628211)

[(1) Default Query: 6](#_Toc350628212)

[(2) Forcing Order: 8](#_Toc350628213)

[(3) Largest Record Count First 10](#_Toc350628214)

[(4) Smallest Record Count First 12](#_Toc350628215)

[(5) Smallest Attribute Count First 14](#_Toc350628216)

[Appendix A – General Schema Stats 16](#_Toc350628217)

[Appendix B – Query Results 17](#_Toc350628218)

# Analysis

Query #1:

I handed over the best results to the auto ordered SQL statement with tables mixed in the WHERE statement. The tables are not in any particular order, the SQL optimizer figures out the best way to go about joining the tables utilizing indexes and applying constraints at various levels. Filters in the selects are being applied as early as the 7th step through the 13th of 21. Indexes are accessed for four of the eight tables (Suppliers, Employees, Categories, Shippers). All of the indexed tables have keys that are number type so they are likely using a dense index with a binary search. These tables though only account for less than 2% of the overall records in this database. An index applied to CustomerID in tables: Orders and Customers would have a significant impact as this primary key is a character code and those two tables contain nearly a third of the data! I’d expect a significant speed up from introducing an index on those tables, possibly a sparse index due to the text based key with a large dataset in the Orders table.

Query #2:

This query had the worst overall performance, it took a significant amount of time, pulled the most tuples, and came in second place for total byte count processed. The ordering forced the most restrictive constraint to last place, operation 21 of 21! This resulted in a lot of data being carried up the tree only reducing the tuple count significantly on the final step. Some of the filters could be applied earlier in the tree but this did not have much effect with a large number of Cartesian joins increasing byte count at a binomial rate! This query accessed by far the largest number of rows, took the longest to calculate, and only made second to last place in byte count due to some of the filters being applied early on which had a minimal reduction and apparently no improvement in CPU time. None of the indexes were utilized. If an index existed on the Orders and Customers table the CPU performance would have been reduced but the byte count would still be very high due to all of the Cartesian joins.

Query #3:

For this query the largest tables were accessed early on and smaller tables later. Step 9 applied the restrictive filter of specific city names in the Customer table and hash joins were used for all of the top four tables containing 98.5% of the data! Again as mentioned earlier an index on these tables, especially the character based CustomerID, would have a significant improvement in performance. In this case oracle was smart enough to implement hash tables which are BigO(1) for lookups on data to boost performance. On second thought since Oracle is utilizing hash table lookups I do wonder if an index would help, maybe not? This one is a tossup for me. All of the filters were applied by step 13 of 21 resulting in the lowest number of rows pulled second only to the default optimization that Oracle performed on Query #1. The bytes processed were also low in this query but not as low as Query 1, but the overall elapsed time was just under the auto optimizer. This is puzzling but it may have been that I’ve been accessing the data so the database pushed some of the information to RAM making it a hot lookup versus cold where some of the DBMS optimizers have not had a chance to fill its cache. This is only a guess though and the difference is so small its insignificant.

Query #4

This time I flipped query 3 taking the smallest tables first and largest last. This resulted in a row count 3x larger than query 3, and 10x more bytes processed! The elapsed time was still small as filters were applied about midway through the query tree reducing the row and byte count quickly so the second half of the operations had a very small set to work with reducing the work load despite the Cartesian joins and lack of index usage. If some indexes existed on the OrderDetails and Orders table it may have improved the performance here but I’m not sure if the oracle system would have used them given the number of Cartesian joins in the tree. This ordering is obviously wrong in that it carries the largest number of tuples down increasing the work load significantly.

Query #5

Here again I played with taking the smallest to largest number. I took the product of tuples to attributes and reordered my tables in this manner. This resulted in the worst stats so far in terms of byte code, but the overall row count was still less than the worst query, #2. The elapsed time to execute increased giving the worst performance second to only query #2. Some hash joins were performed to get some speed up beyond what happened in Query #2, but the volume of data being processed meant the lapsed time to complete the query would be large. Again as before, indexes on the CustomerID would be nice along with the primary keys on the top four tables: OrderDetails, Orders, Customers, Products. With those indexes it would likely have some performance increase especially when the record size increases. This query again demonstrates that in general it appears the tables should be accessed largest to smallest.

# (1) Default Query:

SELECT su.CompanyName, CategoryName, ProductName, c.CompanyName, c.country, FirstName, LastName, Quantity, d.UnitPrice, sh.CompanyName

FROM OrderDetails d, Suppliers su, Shippers sh, Categories t, Products p, Employees e, Customers c, orders o

WHERE t.CategoryID=p.CategoryID AND c.CustomerID=o.CustomerID AND e.EmployeeID=o.EmployeeID AND o.OrderID=d.OrderID AND p.ProductID=d.ProductID AND sh.ShipperID=o.ShipVia AND su.SupplierID=p.SupplierID AND LOWER(ProductName) Like '%lager%' AND LOWER(c.city) IN ('vancouver', 'london','charleroi','cunewalde') AND d.Quantity

BETWEEN 5 AND 100 AND RequiredDate - ShippedDate > 10

ORDER BY c.CompanyName;

Autotrace Enabled

Shows the execution plan as well as statistics of the statement.

COMPANYNAME CATEGORYNAME PRODUCTNAME COMPANYNAME COUNTRY FIRSTNAME LASTNAME QUANTITY UNITPRICE COMPANYNAME

---------------------------------------- --------------- ---------------------------------------- ---------------------------------------- --------------- ---------- -------------------- ---------- ---------- ----------------------------------------

Bigfoot Breweries Beverages Laughing Lumberjack Lager Around the Horn UK Margaret Peacock 15 14 United Package

Pavlova, Ltd. Beverages Outback Lager Around the Horn UK Nancy Davolio 25 12 United Package

Pavlova, Ltd. Beverages Outback Lager B's Beverages UK Anne Dodsworth 7 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Laughing Bacchus Wine Cellars Canada Andrew Fuller 5 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager North/South UK Janet Leverling 6 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager QUICK-Stop Germany Nancy Davolio 20 15 Speedy Express

Pavlova, Ltd. Beverages Outback Lager QUICK-Stop Germany Laura Callahan 50 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Suprêmes délices Belgium Andrew Fuller 30 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Suprêmes délices Belgium Michael Suyama 30 15 Federal Shipping

9 rows selected

Elapsed: 00:00:00.073

Plan hash value: 4251859426

--------------------------------------------------------------------------------------------------

| Id | Operation | Name | Rows | Bytes | Cost (%CPU)| Time |

--------------------------------------------------------------------------------------------------

| 0 | SELECT STATEMENT | | 2 | 640 | 31 (10)| 00:00:01 |

| 1 | SORT ORDER BY | | 2 | 640 | 31 (10)| 00:00:01 |

| 2 | NESTED LOOPS | | | | | |

| 3 | NESTED LOOPS | | 2 | 640 | 30 (7)| 00:00:01 |

| 4 | NESTED LOOPS | | 2 | 552 | 28 (8)| 00:00:01 |

| 5 | NESTED LOOPS | | 2 | 514 | 26 (8)| 00:00:01 |

| 6 | NESTED LOOPS | | 2 | 426 | 24 (9)| 00:00:01 |

|\* 7 | HASH JOIN | | 2 | 356 | 22 (10)| 00:00:01 |

|\* 8 | HASH JOIN | | 50 | 4950 | 18 (6)| 00:00:01 |

|\* 9 | HASH JOIN | | 99 | 6534 | 9 (12)| 00:00:01 |

|\* 10 | TABLE ACCESS FULL | PRODUCTS | 4 | 200 | 3 (0)| 00:00:01 |

|\* 11 | TABLE ACCESS FULL | ORDERDETAILS | 1972 | 31552 | 5 (0)| 00:00:01 |

|\* 12 | TABLE ACCESS FULL | ORDERS | 422 | 13926 | 9 (0)| 00:00:01 |

|\* 13 | TABLE ACCESS FULL | CUSTOMERS | 4 | 316 | 3 (0)| 00:00:01 |

| 14 | TABLE ACCESS BY INDEX ROWID| EMPLOYEES | 1 | 35 | 1 (0)| 00:00:01 |

|\* 15 | INDEX UNIQUE SCAN | SYS\_C0012487 | 1 | | 0 (0)| 00:00:01 |

| 16 | TABLE ACCESS BY INDEX ROWID | SHIPPERS | 1 | 44 | 1 (0)| 00:00:01 |

|\* 17 | INDEX UNIQUE SCAN | SYS\_C0012488 | 1 | | 0 (0)| 00:00:01 |

| 18 | TABLE ACCESS BY INDEX ROWID | CATEGORIES | 1 | 19 | 1 (0)| 00:00:01 |

|\* 19 | INDEX UNIQUE SCAN | SYS\_C0012485 | 1 | | 0 (0)| 00:00:01 |

|\* 20 | INDEX UNIQUE SCAN | SYS\_C0012489 | 1 | | 0 (0)| 00:00:01 |

| 21 | TABLE ACCESS BY INDEX ROWID | SUPPLIERS | 1 | 44 | 1 (0)| 00:00:01 |

--------------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

7 - access("C"."CUSTOMERID"="O"."CUSTOMERID")

8 - access("O"."ORDERID"="D"."ORDERID")

9 - access("P"."PRODUCTID"="D"."PRODUCTID")

10 - filter(LOWER("PRODUCTNAME") LIKE '%lager%')

11 - filter("D"."QUANTITY">=5 AND "D"."QUANTITY"<=100)

12 - filter("REQUIREDDATE"-"SHIPPEDDATE">10)

13 - filter(LOWER("C"."CITY")='vancouver' OR LOWER("C"."CITY")='london' OR

LOWER("C"."CITY")='charleroi' OR LOWER("C"."CITY")='cunewalde')

15 - access("E"."EMPLOYEEID"="O"."EMPLOYEEID")

17 - access("SH"."SHIPPERID"="O"."SHIPVIA")

19 - access("T"."CATEGORYID"="P"."CATEGORYID")

20 - access("SU"."SUPPLIERID"="P"."SUPPLIERID")

Statistics

-----------------------------------------------------------

3 user calls

0 physical read total bytes

0 physical write total bytes

0 spare statistic 3

0 commit cleanout failures: cannot pin

0 TBS Extension: bytes extended

0 total number of times SMON posted

0 SMON posted for undo segment recovery

0 SMON posted for dropping temp segment

1. segment prealloc tasks

# (2) Forcing Order:

SELECT /\*+ ORDERED \*/

su.CompanyName, CategoryName, ProductName, c.CompanyName, c.country, FirstName, LastName, Quantity, d.UnitPrice, sh.CompanyName

FROM OrderDetails d, Suppliers su, Shippers sh, Categories t, Products p, Employees e, Customers c, orders o

WHERE t.CategoryID=p.CategoryID AND c.CustomerID=o.CustomerID AND e.EmployeeID=o.EmployeeID AND o.OrderID=d.OrderID AND p.ProductID=d.ProductID AND sh.ShipperID=o.ShipVia AND su.SupplierID=p.SupplierID AND LOWER(ProductName) Like '%lager%' AND LOWER(c.city) IN ('vancouver', 'london','charleroi','cunewalde') AND d.Quantity

BETWEEN 5 AND 100 AND (RequiredDate - ShippedDate > 10)

ORDER BY c.CompanyName;

COMPANYNAME CATEGORYNAME PRODUCTNAME COMPANYNAME COUNTRY FIRSTNAME LASTNAME QUANTITY UNITPRICE COMPANYNAME

---------------------------------------- --------------- ---------------------------------------- ---------------------------------------- --------------- ---------- -------------------- ---------- ---------- ----------------------------------------

Bigfoot Breweries Beverages Laughing Lumberjack Lager Around the Horn UK Margaret Peacock 15 14 United Package

Pavlova, Ltd. Beverages Outback Lager Around the Horn UK Nancy Davolio 25 12 United Package

Pavlova, Ltd. Beverages Outback Lager B's Beverages UK Anne Dodsworth 7 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Laughing Bacchus Wine Cellars Canada Andrew Fuller 5 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager North/South UK Janet Leverling 6 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager QUICK-Stop Germany Laura Callahan 50 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager QUICK-Stop Germany Nancy Davolio 20 15 Speedy Express

Pavlova, Ltd. Beverages Outback Lager Suprêmes délices Belgium Andrew Fuller 30 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Suprêmes délices Belgium Michael Suyama 30 15 Federal Shipping

9 rows selected

Elapsed: 00:00:00.414

Plan hash value: 4138617299

--------------------------------------------------------------------------------------------

| Id | Operation | Name | Rows | Bytes | Cost (%CPU)| Time |

--------------------------------------------------------------------------------------------

| 0 | SELECT STATEMENT | | 2 | 640 | 316K (1)| 01:03:22 |

| 1 | SORT ORDER BY | | 2 | 640 | 316K (1)| 01:03:22 |

|\* 2 | HASH JOIN | | 2 | 640 | 316K (1)| 01:03:22 |

|\* 3 | TABLE ACCESS FULL | ORDERS | 422 | 13926 | 9 (0)| 00:00:01 |

| 4 | MERGE JOIN CARTESIAN | | 9546 | 2675K| 316K (1)| 01:03:21 |

| 5 | MERGE JOIN CARTESIAN | | 2662 | 540K| 313K (1)| 01:02:38 |

|\* 6 | HASH JOIN | | 296 | 51208 | 312K (1)| 01:02:33 |

|\* 7 | TABLE ACCESS FULL | PRODUCTS | 4 | 200 | 3 (0)| 00:00:01 |

| 8 | MERGE JOIN CARTESIAN | | 1372K| 160M| 312K (1)| 01:02:33 |

| 9 | MERGE JOIN CARTESIAN | | 171K| 17M| 80187 (1)| 00:16:03 |

| 10 | MERGE JOIN CARTESIAN| | 57188 | 3350K| 2679 (1)| 00:00:33 |

|\* 11 | TABLE ACCESS FULL | ORDERDETAILS | 1972 | 31552 | 5 (0)| 00:00:01 |

| 12 | BUFFER SORT | | 29 | 1276 | 2674 (1)| 00:00:33 |

| 13 | TABLE ACCESS FULL | SUPPLIERS | 29 | 1276 | 1 (0)| 00:00:01 |

| 14 | BUFFER SORT | | 3 | 132 | 80186 (1)| 00:16:03 |

| 15 | TABLE ACCESS FULL | SHIPPERS | 3 | 132 | 1 (0)| 00:00:01 |

| 16 | BUFFER SORT | | 8 | 152 | 312K (1)| 01:02:33 |

| 17 | TABLE ACCESS FULL | CATEGORIES | 8 | 152 | 1 (0)| 00:00:01 |

| 18 | BUFFER SORT | | 9 | 315 | 313K (1)| 01:02:38 |

| 19 | TABLE ACCESS FULL | EMPLOYEES | 9 | 315 | 1 (0)| 00:00:01 |

| 20 | BUFFER SORT | | 4 | 316 | 316K (1)| 01:03:21 |

|\* 21 | TABLE ACCESS FULL | CUSTOMERS | 4 | 316 | 1 (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

2 - access("C"."CUSTOMERID"="O"."CUSTOMERID" AND

"E"."EMPLOYEEID"="O"."EMPLOYEEID" AND "O"."ORDERID"="D"."ORDERID" AND

"SH"."SHIPPERID"="O"."SHIPVIA")

3 - filter("REQUIREDDATE"-"SHIPPEDDATE">10)

6 - access("T"."CATEGORYID"="P"."CATEGORYID" AND "P"."PRODUCTID"="D"."PRODUCTID"

AND "SU"."SUPPLIERID"="P"."SUPPLIERID")

7 - filter(LOWER("PRODUCTNAME") LIKE '%lager%')

11 - filter("D"."QUANTITY">=5 AND "D"."QUANTITY"<=100)

21 - filter(LOWER("C"."CITY")='vancouver' OR LOWER("C"."CITY")='london' OR

LOWER("C"."CITY")='charleroi' OR LOWER("C"."CITY")='cunewalde')

Statistics

-----------------------------------------------------------

3 user calls

0 physical read total bytes

0 physical write total bytes

0 spare statistic 3

0 commit cleanout failures: cannot pin

0 TBS Extension: bytes extended

0 total number of times SMON posted

0 SMON posted for undo segment recovery

0 SMON posted for dropping temp segment

0 segment prealloc tasks

# (3) Largest Record Count First

SELECT /\*+ ORDERED \*/

su.CompanyName, CategoryName, ProductName, c.CompanyName, c.country, FirstName, LastName, Quantity, d.UnitPrice, sh.CompanyName

FROM OrderDetails d, Orders o, Customers c, Products p, Suppliers su, Employees e, Categories t, Shippers sh

WHERE t.CategoryID=p.CategoryID AND c.CustomerID=o.CustomerID AND e.EmployeeID=o.EmployeeID AND o.OrderID=d.OrderID AND p.ProductID=d.ProductID AND sh.ShipperID=o.ShipVia AND su.SupplierID=p.SupplierID AND LOWER(ProductName) Like '%lager%' AND LOWER(c.city) IN ('vancouver', 'london','charleroi','cunewalde') AND d.Quantity

BETWEEN 5 AND 100 AND (RequiredDate - ShippedDate > 10)

ORDER BY c.CompanyName;

COMPANYNAME CATEGORYNAME PRODUCTNAME COMPANYNAME COUNTRY FIRSTNAME LASTNAME QUANTITY UNITPRICE COMPANYNAME

---------------------------------------- --------------- ---------------------------------------- ---------------------------------------- --------------- ---------- -------------------- ---------- ---------- ----------------------------------------

Pavlova, Ltd. Beverages Outback Lager Around the Horn UK Nancy Davolio 25 12 United Package

Bigfoot Breweries Beverages Laughing Lumberjack Lager Around the Horn UK Margaret Peacock 15 14 United Package

Pavlova, Ltd. Beverages Outback Lager B's Beverages UK Anne Dodsworth 7 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Laughing Bacchus Wine Cellars Canada Andrew Fuller 5 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager North/South UK Janet Leverling 6 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager QUICK-Stop Germany Laura Callahan 50 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager QUICK-Stop Germany Nancy Davolio 20 15 Speedy Express

Pavlova, Ltd. Beverages Outback Lager Suprêmes délices Belgium Michael Suyama 30 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Suprêmes délices Belgium Andrew Fuller 30 15 Federal Shipping

9 rows selected

Elapsed: 00:00:00.070

Plan hash value: 3086687371

--------------------------------------------------------------------------------------------------

| Id | Operation | Name | Rows | Bytes | Cost (%CPU)| Time |

--------------------------------------------------------------------------------------------------

| 0 | SELECT STATEMENT | | 2 | 640 | 31 (10)| 00:00:01 |

| 1 | SORT ORDER BY | | 2 | 640 | 31 (10)| 00:00:01 |

| 2 | NESTED LOOPS | | | | | |

| 3 | NESTED LOOPS | | 2 | 640 | 30 (7)| 00:00:01 |

| 4 | NESTED LOOPS | | 2 | 552 | 28 (8)| 00:00:01 |

| 5 | NESTED LOOPS | | 2 | 514 | 26 (8)| 00:00:01 |

| 6 | NESTED LOOPS | | 2 | 444 | 24 (9)| 00:00:01 |

|\* 7 | HASH JOIN | | 2 | 356 | 22 (10)| 00:00:01 |

|\* 8 | HASH JOIN | | 40 | 5120 | 18 (6)| 00:00:01 |

|\* 9 | TABLE ACCESS FULL | CUSTOMERS | 4 | 316 | 3 (0)| 00:00:01 |

|\* 10 | HASH JOIN | | 1004 | 49196 | 15 (7)| 00:00:01 |

|\* 11 | TABLE ACCESS FULL | ORDERDETAILS | 1972 | 31552 | 5 (0)| 00:00:01 |

|\* 12 | TABLE ACCESS FULL | ORDERS | 422 | 13926 | 9 (0)| 00:00:01 |

|\* 13 | TABLE ACCESS FULL | PRODUCTS | 4 | 200 | 3 (0)| 00:00:01 |

| 14 | TABLE ACCESS BY INDEX ROWID| SUPPLIERS | 1 | 44 | 1 (0)| 00:00:01 |

|\* 15 | INDEX UNIQUE SCAN | SYS\_C0012489 | 1 | | 0 (0)| 00:00:01 |

| 16 | TABLE ACCESS BY INDEX ROWID | EMPLOYEES | 1 | 35 | 1 (0)| 00:00:01 |

|\* 17 | INDEX UNIQUE SCAN | SYS\_C0012487 | 1 | | 0 (0)| 00:00:01 |

| 18 | TABLE ACCESS BY INDEX ROWID | CATEGORIES | 1 | 19 | 1 (0)| 00:00:01 |

|\* 19 | INDEX UNIQUE SCAN | SYS\_C0012485 | 1 | | 0 (0)| 00:00:01 |

|\* 20 | INDEX UNIQUE SCAN | SYS\_C0012488 | 1 | | 0 (0)| 00:00:01 |

| 21 | TABLE ACCESS BY INDEX ROWID | SHIPPERS | 1 | 44 | 1 (0)| 00:00:01 |

--------------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

7 - access("P"."PRODUCTID"="D"."PRODUCTID")

8 - access("C"."CUSTOMERID"="O"."CUSTOMERID")

9 - filter(LOWER("C"."CITY")='vancouver' OR LOWER("C"."CITY")='london' OR

LOWER("C"."CITY")='charleroi' OR LOWER("C"."CITY")='cunewalde')

10 - access("O"."ORDERID"="D"."ORDERID")

11 - filter("D"."QUANTITY">=5 AND "D"."QUANTITY"<=100)

12 - filter("REQUIREDDATE"-"SHIPPEDDATE">10)

13 - filter(LOWER("PRODUCTNAME") LIKE '%lager%')

15 - access("SU"."SUPPLIERID"="P"."SUPPLIERID")

17 - access("E"."EMPLOYEEID"="O"."EMPLOYEEID")

19 - access("T"."CATEGORYID"="P"."CATEGORYID")

20 - access("SH"."SHIPPERID"="O"."SHIPVIA")

Statistics

-----------------------------------------------------------

3 user calls

0 physical read total bytes

0 physical write total bytes

0 spare statistic 3

0 commit cleanout failures: cannot pin

0 TBS Extension: bytes extended

0 total number of times SMON posted

0 SMON posted for undo segment recovery

0 SMON posted for dropping temp segment

0 segment prealloc tasks

# (4) Smallest Record Count First

SELECT /\*+ ORDERED \*/

su.CompanyName, CategoryName, ProductName, c.CompanyName, c.country, FirstName, LastName, Quantity, d.UnitPrice, sh.CompanyName

FROM Shippers sh, Categories t, Employees e, Suppliers su, Products p, Customers c, Orders o, OrderDetails d

WHERE t.CategoryID=p.CategoryID AND c.CustomerID=o.CustomerID AND e.EmployeeID=o.EmployeeID AND o.OrderID=d.OrderID AND p.ProductID=d.ProductID AND sh.ShipperID=o.ShipVia AND su.SupplierID=p.SupplierID AND LOWER(ProductName) Like '%lager%' AND LOWER(c.city) IN ('vancouver', 'london','charleroi','cunewalde') AND d.Quantity

BETWEEN 5 AND 100 AND (RequiredDate - ShippedDate > 10)

ORDER BY c.CompanyName;

COMPANYNAME CATEGORYNAME PRODUCTNAME COMPANYNAME COUNTRY FIRSTNAME LASTNAME QUANTITY UNITPRICE COMPANYNAME

---------------------------------------- --------------- ---------------------------------------- ---------------------------------------- --------------- ---------- -------------------- ---------- ---------- ----------------------------------------

Bigfoot Breweries Beverages Laughing Lumberjack Lager Around the Horn UK Margaret Peacock 15 14 United Package

Pavlova, Ltd. Beverages Outback Lager Around the Horn UK Nancy Davolio 25 12 United Package

Pavlova, Ltd. Beverages Outback Lager B's Beverages UK Anne Dodsworth 7 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Laughing Bacchus Wine Cellars Canada Andrew Fuller 5 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager North/South UK Janet Leverling 6 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager QUICK-Stop Germany Laura Callahan 50 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager QUICK-Stop Germany Nancy Davolio 20 15 Speedy Express

Pavlova, Ltd. Beverages Outback Lager Suprêmes délices Belgium Andrew Fuller 30 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Suprêmes délices Belgium Michael Suyama 30 15 Federal Shipping

9 rows selected

Elapsed: 00:00:00.074

Plan hash value: 1087348458

--------------------------------------------------------------------------------------------

| Id | Operation | Name | Rows | Bytes | Cost (%CPU)| Time |

--------------------------------------------------------------------------------------------

| 0 | SELECT STATEMENT | | 2 | 640 | 499 (1)| 00:00:06 |

| 1 | SORT ORDER BY | | 2 | 640 | 499 (1)| 00:00:06 |

|\* 2 | HASH JOIN | | 2 | 640 | 498 (1)| 00:00:06 |

|\* 3 | HASH JOIN | | 65 | 19760 | 493 (1)| 00:00:06 |

|\* 4 | TABLE ACCESS FULL | ORDERS | 422 | 13926 | 9 (0)| 00:00:01 |

| 5 | MERGE JOIN CARTESIAN | | 373 | 98K| 483 (1)| 00:00:06 |

|\* 6 | HASH JOIN | | 104 | 19968 | 341 (1)| 00:00:05 |

|\* 7 | TABLE ACCESS FULL | PRODUCTS | 4 | 200 | 3 (0)| 00:00:01 |

| 8 | MERGE JOIN CARTESIAN | | 6264 | 868K| 337 (0)| 00:00:05 |

| 9 | MERGE JOIN CARTESIAN | | 216 | 21168 | 43 (0)| 00:00:01 |

| 10 | MERGE JOIN CARTESIAN| | 24 | 1512 | 9 (0)| 00:00:01 |

| 11 | TABLE ACCESS FULL | SHIPPERS | 3 | 132 | 3 (0)| 00:00:01 |

| 12 | BUFFER SORT | | 8 | 152 | 6 (0)| 00:00:01 |

| 13 | TABLE ACCESS FULL | CATEGORIES | 8 | 152 | 2 (0)| 00:00:01 |

| 14 | BUFFER SORT | | 9 | 315 | 41 (0)| 00:00:01 |

| 15 | TABLE ACCESS FULL | EMPLOYEES | 9 | 315 | 1 (0)| 00:00:01 |

| 16 | BUFFER SORT | | 29 | 1276 | 336 (0)| 00:00:05 |

| 17 | TABLE ACCESS FULL | SUPPLIERS | 29 | 1276 | 1 (0)| 00:00:01 |

| 18 | BUFFER SORT | | 4 | 316 | 480 (1)| 00:00:06 |

|\* 19 | TABLE ACCESS FULL | CUSTOMERS | 4 | 316 | 1 (0)| 00:00:01 |

|\* 20 | TABLE ACCESS FULL | ORDERDETAILS | 1972 | 31552 | 5 (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

2 - access("O"."ORDERID"="D"."ORDERID" AND "P"."PRODUCTID"="D"."PRODUCTID")

3 - access("C"."CUSTOMERID"="O"."CUSTOMERID" AND

"E"."EMPLOYEEID"="O"."EMPLOYEEID" AND "SH"."SHIPPERID"="O"."SHIPVIA")

4 - filter("REQUIREDDATE"-"SHIPPEDDATE">10)

6 - access("T"."CATEGORYID"="P"."CATEGORYID" AND

"SU"."SUPPLIERID"="P"."SUPPLIERID")

7 - filter(LOWER("PRODUCTNAME") LIKE '%lager%')

19 - filter(LOWER("C"."CITY")='vancouver' OR LOWER("C"."CITY")='london' OR

LOWER("C"."CITY")='charleroi' OR LOWER("C"."CITY")='cunewalde')

20 - filter("D"."QUANTITY">=5 AND "D"."QUANTITY"<=100)

Statistics

-----------------------------------------------------------

3 user calls

0 physical read total bytes

0 physical write total bytes

0 spare statistic 3

0 commit cleanout failures: cannot pin

0 TBS Extension: bytes extended

0 total number of times SMON posted

0 SMON posted for undo segment recovery

0 SMON posted for dropping temp segment

0 segment prealloc tasks

# (5) Smallest Attribute Count First

SELECT /\*+ ORDERED \*/

su.CompanyName, CategoryName, ProductName, c.CompanyName, c.country, FirstName, LastName, Quantity, d.UnitPrice, sh.CompanyName

FROM Shippers sh, Categories t, Employees e, Suppliers su, Products p, Customers c, OrderDetails d, Orders o

WHERE t.CategoryID=p.CategoryID AND c.CustomerID=o.CustomerID AND e.EmployeeID=o.EmployeeID AND o.OrderID=d.OrderID AND p.ProductID=d.ProductID AND sh.ShipperID=o.ShipVia AND su.SupplierID=p.SupplierID AND LOWER(ProductName) Like '%lager%' AND LOWER(c.city) IN ('vancouver', 'london','charleroi','cunewalde') AND d.Quantity

BETWEEN 5 AND 100 AND (RequiredDate - ShippedDate > 10)

ORDER BY c.CompanyName;

COMPANYNAME CATEGORYNAME PRODUCTNAME COMPANYNAME COUNTRY FIRSTNAME LASTNAME QUANTITY UNITPRICE COMPANYNAME

---------------------------------------- --------------- ---------------------------------------- ---------------------------------------- --------------- ---------- -------------------- ---------- ---------- ----------------------------------------

Pavlova, Ltd. Beverages Outback Lager Around the Horn UK Nancy Davolio 25 12 United Package

Bigfoot Breweries Beverages Laughing Lumberjack Lager Around the Horn UK Margaret Peacock 15 14 United Package

Pavlova, Ltd. Beverages Outback Lager B's Beverages UK Anne Dodsworth 7 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Laughing Bacchus Wine Cellars Canada Andrew Fuller 5 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager North/South UK Janet Leverling 6 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager QUICK-Stop Germany Laura Callahan 50 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager QUICK-Stop Germany Nancy Davolio 20 15 Speedy Express

Pavlova, Ltd. Beverages Outback Lager Suprêmes délices Belgium Michael Suyama 30 15 Federal Shipping

Pavlova, Ltd. Beverages Outback Lager Suprêmes délices Belgium Andrew Fuller 30 15 Federal Shipping

9 rows selected

Elapsed: 00:00:00.092

Plan hash value: 2363857668

--------------------------------------------------------------------------------------------

| Id | Operation | Name | Rows | Bytes | Cost (%CPU)| Time |

--------------------------------------------------------------------------------------------

| 0 | SELECT STATEMENT | | 2 | 640 | 500 (1)| 00:00:06 |

| 1 | SORT ORDER BY | | 2 | 640 | 500 (1)| 00:00:06 |

|\* 2 | HASH JOIN | | 2 | 640 | 499 (1)| 00:00:06 |

|\* 3 | TABLE ACCESS FULL | ORDERS | 422 | 13926 | 9 (0)| 00:00:01 |

|\* 4 | HASH JOIN | | 9546 | 2675K| 489 (1)| 00:00:06 |

|\* 5 | TABLE ACCESS FULL | ORDERDETAILS | 1972 | 31552 | 5 (0)| 00:00:01 |

| 6 | MERGE JOIN CARTESIAN | | 373 | 98K| 483 (1)| 00:00:06 |

|\* 7 | HASH JOIN | | 104 | 19968 | 341 (1)| 00:00:05 |

|\* 8 | TABLE ACCESS FULL | PRODUCTS | 4 | 200 | 3 (0)| 00:00:01 |

| 9 | MERGE JOIN CARTESIAN | | 6264 | 868K| 337 (0)| 00:00:05 |

| 10 | MERGE JOIN CARTESIAN | | 216 | 21168 | 43 (0)| 00:00:01 |

| 11 | MERGE JOIN CARTESIAN| | 24 | 1512 | 9 (0)| 00:00:01 |

| 12 | TABLE ACCESS FULL | SHIPPERS | 3 | 132 | 3 (0)| 00:00:01 |

| 13 | BUFFER SORT | | 8 | 152 | 6 (0)| 00:00:01 |

| 14 | TABLE ACCESS FULL | CATEGORIES | 8 | 152 | 2 (0)| 00:00:01 |

| 15 | BUFFER SORT | | 9 | 315 | 41 (0)| 00:00:01 |

| 16 | TABLE ACCESS FULL | EMPLOYEES | 9 | 315 | 1 (0)| 00:00:01 |

| 17 | BUFFER SORT | | 29 | 1276 | 336 (0)| 00:00:05 |

| 18 | TABLE ACCESS FULL | SUPPLIERS | 29 | 1276 | 1 (0)| 00:00:01 |

| 19 | BUFFER SORT | | 4 | 316 | 480 (1)| 00:00:06 |

|\* 20 | TABLE ACCESS FULL | CUSTOMERS | 4 | 316 | 1 (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

2 - access("C"."CUSTOMERID"="O"."CUSTOMERID" AND

"E"."EMPLOYEEID"="O"."EMPLOYEEID" AND "O"."ORDERID"="D"."ORDERID" AND

"SH"."SHIPPERID"="O"."SHIPVIA")

3 - filter("REQUIREDDATE"-"SHIPPEDDATE">10)

4 - access("P"."PRODUCTID"="D"."PRODUCTID")

5 - filter("D"."QUANTITY">=5 AND "D"."QUANTITY"<=100)

7 - access("T"."CATEGORYID"="P"."CATEGORYID" AND

"SU"."SUPPLIERID"="P"."SUPPLIERID")

8 - filter(LOWER("PRODUCTNAME") LIKE '%lager%')

20 - filter(LOWER("C"."CITY")='vancouver' OR LOWER("C"."CITY")='london' OR

LOWER("C"."CITY")='charleroi' OR LOWER("C"."CITY")='cunewalde')

Statistics

-----------------------------------------------------------

3 user calls

0 physical read total bytes

0 physical write total bytes

0 spare statistic 3

0 commit cleanout failures: cannot pin

0 TBS Extension: bytes extended

0 total number of times SMON posted

0 SMON posted for undo segment recovery

0 SMON posted for dropping temp segment

1. segment prealloc tasks

# Appendix A – General Schema Stats

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **TABLE** | **# OF RECORDS** |  | **# of Attributes** | **Product Records and Attributes** | **Notes** |
| OrderDetails d | 2155 | 67.3% | 5 | 10775 | all numbers |
| Orders o | 830 | 25.9% | 14 | 11620 | Char fields up to 60 |
| Customers c | 91 | 2.8% | 11 | 1001 | All char up to 60 |
| Products p | 77 | 2.4% | 10 | 770 | 3 char, mostly number 38 |
| Suppliers su | 29 | 0.9% | 11 | 319 | mostly char up to 60 |
| Employees e | 9 | 0.3% | 16 | 144 | Notes field but varchar, mix of char and dates |
| Categories t | 8 | 0.2% | 3 | 24 | mix |
| Shippers sh | 3 | 0.1% | 3 | 9 | Mix |
|  | 3202 |  |  |  |  |

# Appendix B – Query Results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Query** | **Order** | **Elapsed Time** | **Rows** | **Bytes** |  |
| 1 | Mixed Order Without Forced Order | 0.073 | 2,573 | 61,388 | **BEST** |
| 2 | Mixed Order With Forced Order | 0.414 | 73,745 | 3,307,748 | **WORST** |
| 3 | Largest to Smallest Record Count | 0.07 | 3,468 | 104,238 |  |
| 4 | Smallest to Largest Record Count | 0.074 | 9,553 | 1,080,256 |  |
| 5 | Smallest to Largest Product of Tuples and Attributes | 0.092 | 19,034 | 3,735,496 |  |