

How to Read and Interpret an Explain Plan



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Syllabus

- Explain Plan Explained?
- Creating Explain Plans
- Reading and Interpreting Explain Plans
- Some Final Thoughts (if time permits)

Discussion

Explain Plan Explained

What is an Explain Plan

- When a SQL statement being explained the statement is not run
- The optimizer chooses an execution plan
- The plan information is made visible in a global temporary table named **PLAN\$** usually access via the synonym **PLAN_TABLE**

Optimizer

- Rule Based Optimizer (RBO)
 - 14 rules that only apply to version 7 object types
- Cost Based Optimizer (CBO)
 - Introduced in Oracle 7
 - Initially terrible, that began changing significantly in 8i
 - The CBO has been the best choice since 9.2.0.4
 - The better the information provided the optimizer the better its choices (most of the time)
- What is true in one version of the optimizer likely is not be true in another. Good 9i code may be bad 10g code. Good 10g code may not perform as expected in 11g.

The RBO

Access paths and their ranking	
Path 1	Single Row by Rowid
Path 2	Single Row by Cluster Join
Path 3	Single Row by Hash Cluster key with Unique or Primary Key
Path 4	Single Row by Unique or Primary Key
Path 5	Clustered Join
Path 6	Hash Cluster Key
Path 7	Indexed Cluster Key
Path 8	Composite Index
Path 9	Single-Column Index
Path 10	Bounded Range Search on Indexed Columns
Path 11	Unbounded Range Search on Indexed Columns
Path 12	Sort-Merge Join
Path 13	MAX or MIN of Indexed Column
Path 14	ORDER BY on Indexed Column
Path 15	Full Table Scan

The CBO

- Artificial intelligence uses information about your data to calculate the best access path
- Statistics must be collected using DBMS_STATS
- How do you determine if statistics are current?

```
CREATE TABLE demo AS SELECT * FROM dba_tables;

SELECT COUNT(*) FROM demo;

SELECT table_name, num_rows, last_analyzed
FROM user_tables
ORDER BY 1;

exec dbms_stats.gather_table_stats(USER, 'DEMO');

SELECT table_name, num_rows, last_analyzed
FROM user_tables
ORDER BY 1;
```

Demo

Optimizer Compatibility

```
SQL> set serveroutput on

SQL> DECLARE
  2   ver      VARCHAR2(30);
  3   compat  VARCHAR2(30);
  4 BEGIN
  5   dbms_utility.db_version(ver, compat);
  6   dbms_output.put_line('Version: ' || ver || ' compatible: ' || compat);
  7 END;
  8 /
Version: 11.1.0.7.0 Compatible: 10.2.0.4.0

PL/SQL procedure successfully completed.
```

This server is not taking advantage of 11.1.0.7 optimizer enhancements

I have seen this with many customers. It is usually the result of an in-place upgrade or patch. The result is that the production server may behave differently from the development and test servers.

Tuning Methodology

BAAG Party - Battle Against Any Guess

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About BAAG

Battle Against Any Guess

BAAG - what is it all about? The main idea is to eliminate guesswork from our decision making process — once and for all. It's not Oracle specific even though the roots lie in the area of Oracle database administration. So keep reading even if you don't know anything about Oracle or computers. Before we go any further I should say that the title was inspired by another fine BAA... site — [BAARE](#). Just to avoid any guesses. 😊

After some mental fermentation the [birth](#) of BAAG had been finally triggered by an Oracle-L [thread](#) started as [10gR2 performance sux](#). Title of the post was a direct consequence of pure guess and, worse yet, uneducated guess. It's also interesting to see how the thread [developed](#) - guesswork. [Another problem](#) in the same thread was followed up by the same troubleshooting style. Perhaps, the author, inspired by previous responses, also hoped to find the magic solution from of Oracle-L powered (and often educated) guesses.

Database performance tuning is one of the most noticeable areas where guesswork is still flourishing. There were quite a few methodological techniques born recently, such as [YAPP](#) and [Method R](#), and older guess-based methods such as [Tuning by BCHR](#) are going away. Nevertheless, people's mentality is very difficult to change and we keep relying on guesswork hoping to solve the issue faster. Hope-powered guess is the evil.

Performance tuning is just one example. Imagine that your Oracle database crashes with ORA-600 and guesswork starts powered by your experience. Depending how good your memory and experience are you might want to ask in an Oracle forum something like "My database x.x.x.x crashed with ORA-600. Anyone seen it?" It's fishing for a

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Discussion

Creating Explain Plans

Explain Plan Creation

```
SELECT srvr_id  
FROM servers  
INTERSECT  
SELECT srvr_id  
FROM serv_inst;
```

```
EXPLAIN PLAN FOR  
SELECT srvr_id  
FROM servers  
INTERSECT  
SELECT srvr_id  
FROM serv_inst;
```

Demo

Legacy Explain Plan Report Creation

- Uses a recursive query that selects fixed columns from the plan table

```
EXPLAIN PLAN
SET STATEMENT_ID = 'abc' FOR
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```



```
SELECT LPAD(' ',2*(level-1)) || operation || ' ' || options || ' ' || object_name
|| ' ' || DECODE(id,0,'Cost = ' || position) QUERY_OUTPUT
FROM plan_table
START WITH id = 0
AND statement_id = 'abc'
CONNECT BY PRIOR id = parent_id
AND statement_id = 'abc';
```

Demo

Contemporary Explain Plan Report Creation

- Uses a pipelined table function built into the DBMS_XPLAN built-in package to dynamically display plan information

```
EXPLAIN PLAN
SET STATEMENT_ID = 'abc' FOR
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;

SELECT * FROM TABLE(dbms_xplan.display);
```

Demo

Output an Explain Plan

The old method (pre-9i):

```
SELECT LPAD(' ', 2*(level-1)) || operation || ' ' ||  
       options || ' ' || object_name || ' ' ||  
       DECODE(id,0,'Cost = ' || position) QUERY_OUTPUT  
FROM plan_table  
START WITH id = 0  
AND statement_id = 'abc'  
CONNECT BY PRIOR id = parent_id  
AND statement_id = 'abc';
```

The current method (9i or above):

```
SELECT * FROM TABLE(dbms_xplan.display);  
  
CREATE OR REPLACE VIEW xplan AS  
SELECT * FROM TABLE(dbms_xplan.display);
```

Discussion

Reading and Interpreting Explain Plans

The SQL Challenge

The SQL challenge ... find the best way to return values present in two different tables

```
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```

```
SELECT srvr_id
FROM servers
WHERE srvr_id IN (
  SELECT srvr_id
  FROM serv_inst);
```

```
SELECT srvr_id
FROM servers s
WHERE EXISTS (
  SELECT srvr_id
  FROM serv_inst i
  WHERE s.srvr_id = i.srvr_id);
```

```
SELECT DISTINCT s.srvr_id
FROM servers s, serv_inst i
WHERE s.srvr_id = i.srvr_id;
```

The SQL Challenge

The SQL challenge ... find the best way to return values present in two different tables

```
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```

```
SELECT srvr_id
FROM servers
WHERE srvr_id IN (
  SELECT srvr_id
  FROM serv_inst);
```

```
SELECT srvr_id
FROM servers s
WHERE EXISTS (
  SELECT srvr_id
  FROM serv_inst i
  WHERE s.srvr_id = i.srvr_id);
```

```
SELECT DISTINCT s.srvr_id
FROM servers s, serv_inst i
WHERE s.srvr_id = i.srvr_id;
```

The SQL Challenge

The SQL challenge ... find the best way to return values present in two different tables

```
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```

```
SELECT srvr_id
FROM servers
WHERE srvr_id IN (
  SELECT srvr_id
  FROM serv_inst);
```

```
SELECT srvr_id
FROM servers s
WHERE EXISTS (
  SELECT srvr_id
  FROM serv_inst i
  WHERE s.srvr_id = i.srvr_id);
```

```
SELECT DISTINCT s.srvr_id
FROM servers s, serv_inst i
WHERE s.srvr_id = i.srvr_id;
```

Demo

And there are more ways that range from the sublime

```
SELECT srvr_id
FROM servers
WHERE srvr_id IN (
  SELECT i.srvr_id
  FROM serv_inst i, servers s
  WHERE i.srvr_id = s.srvr_id);
```

```
SELECT DISTINCT s.srvr_id
FROM servers s, serv_inst i
WHERE s.srvr_id(+) = i.srvr_id;
```

```
WITH q AS (
  SELECT DISTINCT s.srvr_id
  FROM servers s, serv_inst i
  WHERE s.srvr_id = i.srvr_id)
SELECT * FROM q;
```

to the ridiculous

```
SELECT DISTINCT srvr_id
FROM servers
WHERE srvr_id NOT IN (
  SELECT srvr_id
  FROM servers
  MINUS
  SELECT srvr_id
  FROM serv_inst);
```

```
SELECT srvr_id
FROM (
  SELECT srvr_id, SUM(cnt) SUMCNT
  FROM (
    SELECT DISTINCT srvr_id, 1 AS CNT
    FROM servers
    UNION ALL
    SELECT DISTINCT srvr_id, 1
    FROM serv_inst)
  GROUP BY srvr_id)
WHERE sumcnt = 2;
```

Create Explain Plan

```
EXPLAIN PLAN FOR
SELECT srvr_id
FROM servers s
WHERE EXISTS (
  SELECT srvr_id
  FROM serv_inst i
  WHERE s.srvr_id = i.srvr_id);

SELECT * FROM TABLE(dbms_xplan.display);
```

Demo

TOAD Plans

The screenshot displays the TOAD for Oracle interface. The title bar reads "Toad for Oracle - [UWCLASS@ATDBASE - Editor (ALTER TABLE emp2 PARALLEL 2)]". The menu bar includes File, Edit, Search, Grid, Editor, Session, Database, Debug, View, Utilities, Window, and Help. The toolbar contains various icons for file operations and database actions. The main window shows the SQL editor with the text "<No name>". Below the editor, the "Plan" tab is active, displaying an Explain Plan for a "SELECT STATEMENT ALL_ROWS". The plan details are as follows:

- SELECT STATEMENT ALL_ROWS**
Cost: 3 Bytes: 10,634 Cardinality: 409
- 8 PX COORDINATOR**
- 7 PX SEND QC (RANDOM) PARALLEL_TO_SERIAL SYS.:TQ10001 :Q1001**
Cost: 3 Bytes: 10,634 Cardinality: 409
- 6 HASH GROUP BY PARALLEL_COMBINED_WITH_PARENT :Q1001**
Cost: 3 Bytes: 10,634 Cardinality: 409
- 5 PX RECEIVE PARALLEL_COMBINED_WITH_PARENT :Q1001**
Cost: 3 Bytes: 10,634 Cardinality: 409
- 4 PX SEND HASH PARALLEL_TO_PARALLEL SYS.:TQ10000 :Q1000**
Cost: 3 Bytes: 10,634 Cardinality: 409
- 3 HASH GROUP BY PARALLEL_COMBINED_WITH_PARENT :Q1000**
Cost: 3 Bytes: 10,634 Cardinality: 409
- 2 PX BLOCK ITERATOR PARALLEL_COMBINED_WITH_CHILD :Q1000**
Cost: 2 Bytes: 10,634 Cardinality: 409
- 1 TABLE ACCESS FULL TABLE PARALLEL_COMBINED_WITH_PARENT HR.EMP2 :**
Cost: 2 Bytes: 10,634 Cardinality: 409

At the bottom of the plan window, it states "9. Rows were returned by the SELECT statement." The status bar at the very bottom shows "AutoCommit is OFF" and "CAPS NUM INS".

TOAD Plans

1 2 3 4

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time	TQ	IN-OUT	PQ Distrib
0	SELECT STATEMENT		107	2782	3 (34)	00:00:01			
1	PX COORDINATOR								
2	PX SEND QC (RANDOM)	:TQ10001	107	2782	3 (34)	00:00:01	Q1,01	P->S	QC (
3	HASH GROUP BY		107	2782	3 (34)	00:00:01	Q1,01	PCWP	
4	PX RECEIVE		107	2782	3 (34)	00:00:01	Q1,01	PCWP	
5	PX SEND HASH	:TQ10000	107	2782	3 (34)	00:00:01	Q1,00	P->P	HASH
6	HASH GROUP BY		107	2782	3 (34)	00:00:01	Q1,00	PCWP	
7	PX BLOCK ITERATOR		107	2782	2 (0)	00:00:01	Q1,00	PCWC	
8	TABLE ACCESS FULL	EMP2	107	2782	2 (0)	00:00:01	Q1,00	PCWP	

Note

- dynamic sampling used for this statement

5

Correct

1. ID
2. Operation
3. Name
4. Cost
5. IN - OUT

Error / Missing

1. Rows (Cardinality) are wrong
2. Bytes values are wrong
3. CPU% of cost not reported
4. Time not reported
5. Dynamic sampling not reported

TOAD Plans

The screenshot shows the TOAD for Oracle interface. The title bar reads "Toad for Oracle - [UWCLASS@ATDBASE - Editor (ALTER TABLE emp2 PARALLEL 2)]". The menu bar includes File, Edit, Search, Grid, Editor, Session, Database, Debug, View, Utilities, Window, and Help. The toolbar contains various icons for file operations and database actions. The status bar at the top indicates the user is "UWCLASS@ATDBASE" and the current schema is "UWCLASS".

The main window displays an Explain Plan for the statement "ALTER TABLE emp2 PARALLEL 2". The plan is as follows:

- Plan
- 1 SELECT STATEMENT ALL_ROWS
Cost: 3,435 Bytes: 12,756,640 Cardinality: 98,128
- 2 SORT ORDER BY
Cost: 3,435 Bytes: 12,756,640 Cardinality: 98,128
- 1 TABLE ACCESS FULL TABLE SYS.SOURCE\$
Cost: 577 Bytes: 12,756,640 Cardinality: 98,128

At the bottom of the plan, it states: "3. Rows were returned by the SELECT statement." The status bar at the bottom of the window shows "3: 16" and "UWCLASS@ATDBASE Modified".

TOAD Plans

Id	Operation	Name	Rows	Bytes	TempSpc	Cost (%CPU)	Time
0	SELECT STATEMENT		98128	12M		3435 (1)	00:00:42
1	SORT ORDER BY		98128	12M	25M	3435 (1)	00:00:42
2	TABLE ACCESS FULL	SOURCE\$	98128	12M		577 (2)	00:00:07

Correct

1. Operation
2. Name
3. Rows
4. Bytes
5. Cost

Error / Missing

1. Missing swap to TEMP tablespace
2. CPU% of cost not reported
3. Time not reported

Use DBMS_XPLAN Because

- Always current for the database version
 - Patched when the Oracle database is patched
 - Upgraded when the Oracle database is upgraded
- Always understands all Oracle data types
- Always accurately reflect what the optimizer is thinking
- Nothing to install or maintain on the client
- Free (in all Oracle databases)

An Explain Plan Report

```
SQL> EXPLAIN PLAN FOR
2  SELECT srvr_id
3  FROM servers s
4  WHERE EXISTS (
5    SELECT srvr_id
6    FROM serv_inst i
7    WHERE s.srvr_id = i.srvr_id);
```

Explained.

```
SQL> SELECT * FROM TABLE(dbms_xplan.display);
PLAN_TABLE_OUTPUT
```

Plan hash value: 2840037858

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		11	286	4 (25)	00:00:01
1	NESTED LOOPS		11	286	4 (25)	00:00:01
2	SORT UNIQUE		999	12987	3 (0)	00:00:01
3	INDEX FAST FULL SCAN	PK_SERV_INST	999	12987	3 (0)	00:00:01
* 4	INDEX UNIQUE SCAN	PK_SERVERS	1	13	0 (0)	00:00:01

Predicate Information (identified by operation id):

4 - access("S"."SRVR_ID"="I"."SRVR_ID")

Note

- dynamic sampling used for this statement

How to read an Explain Plan Report

- Begin reading with the line most indented to the right
- If two lines are indented equally the top line is normally executed first
- Sum costs with similar indents in the indent group
- Use the CPU percentage to determine the portion of the cost that is CPU
- $(\text{Cost} - \text{CPU}\% \text{ of Cost}) = \text{Disk I/O}$

Reading an Explain Plan Report

```
SQL> EXPLAIN PLAN FOR
 2 SELECT srvr_id
 3 FROM servers s
 4 WHERE EXISTS (
 5     SELECT srvr_id
 6     FROM serv_inst i
 7     WHERE s.srvr_id = i.srvr_id);
```

Explained.

```
SQL> SELECT * FROM TABLE(dbms_xplan.display);
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Plan hash value: 2840037858

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		11	286	4 (25)	00:00:01
1	NESTED LOOPS		11	286	4 (25)	00:00:01
2	SORT UNIQUE		999	12987	3 (0)	00:00:01
3	INDEX FAST FULL SCAN	PK_SERV_INST	999	12987	3 (0)	00:00:01
* 4	INDEX UNIQUE SCAN	PK_SERVERS	1	13	0 (0)	00:00:01

Predicate Information (identified by operation id):

4 - access("S"."SRVR_ID"="I"."SRVR_ID")

Note

- dynamic sampling used for this statement

1. Start with the most indented: Read 999 rows, ~13KB from the SERV_INST table's primary key index
2. Since there is no CPU percentage the cost indicates it will read 3 blocks

Reading an Explain Plan Report

```
SQL> EXPLAIN PLAN FOR
 2 SELECT srvr_id
 3 FROM servers s
 4 WHERE EXISTS (
 5   SELECT srvr_id
 6   FROM serv_inst i
 7   WHERE s.srvr_id = i.srvr_id);
```

Explained.

```
SQL> SELECT * FROM TABLE(dbms_xplan.display);
PLAN_TABLE_OUTPUT
```

Plan hash value: 2840037858

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		11	286	4 (25)	00:00:01
1	NESTED LOOPS		11	286	4 (25)	00:00:01
2	SORT UNIQUE		999	12987	3 (0)	00:00:01
3	INDEX FAST FULL SCAN	PK_SERV_INST	999	12987	3 (0)	00:00:01
* 4	INDEX UNIQUE SCAN	PK_SERVERS	1	13	0 (0)	00:00:01

Predicate Information (identified by operation id):

4 - access("S"."SRVR_ID"="I"."SRVR_ID")

Note

- dynamic sampling used for this statement

3. Sort for the query of the PK_SERV_INST index for unique values

Reading an Explain Plan Report

```
SQL> EXPLAIN PLAN FOR
 2 SELECT srvr_id
 3 FROM servers s
 4 WHERE EXISTS (
 5     SELECT srvr_id
 6     FROM serv_inst i
 7     WHERE s.srvr_id = i.srvr_id);
Explained.

SQL> SELECT * FROM TABLE(dbms_xplan.display);
PLAN_TABLE_OUTPUT
-----
Plan hash value: 2840037858
-----
| Id | Operation                | Name          | Rows  | Bytes | Cost (%CPU)| Time     |
-----|-----|-----|-----|-----|-----|-----|
|  0 | SELECT STATEMENT         |               |    11 |   286 |    4 (25) | 00:00:01 |
|  1 |   NESTED LOOPS           |               |    11 |   286 |    4 (25) | 00:00:01 |
|  2 |     SORT UNIQUE          |               |   999 | 12987 |    3 (0)  | 00:00:01 |
|  3 |       INDEX FAST FULL SCAN| PK_SERV_INST |   999 | 12987 |    3 (0)  | 00:00:01 |
|*  4 |        INDEX UNIQUE SCAN  | PK_SERVERS   |     1 |    13 |    0 (0)  | 00:00:01 |
-----
Predicate Information (identified by operation id):
-----
   4 - access("S"."SRVR_ID"="I"."SRVR_ID")

Note
-----
   - dynamic sampling used for this statement
```

4. Read one row, 13 bytes from the SERVER table's primary key index: The cost is negligible

Reading an Explain Plan Report

```
SQL> EXPLAIN PLAN FOR
 2 SELECT srvr_id
 3 FROM servers s
 4 WHERE EXISTS (
 5     SELECT srvr_id
 6     FROM serv_inst i
 7     WHERE s.srvr_id = i.srvr_id);
```

Explained.

```
SQL> SELECT * FROM TABLE(dbms_xplan.display);
PLAN_TABLE_OUTPUT
```

Plan hash value: 2840037858

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		11	286	4 (25)	00:00:01
1	NESTED LOOPS		11	286	4 (25)	00:00:01
2	SORT UNIQUE		999	12987	3 (0)	00:00:01
3	INDEX FAST FULL SCAN	PK_SERV_INST	999	12987	3 (0)	00:00:01
* 4	INDEX UNIQUE SCAN	PK_SERVERS	1	13	0 (0)	00:00:01

Predicate Information (identified by operation id):

4 - access("S"."SRVR_ID"="I"."SRVR_ID")

Note

- dynamic sampling used for this statement

5. Use a NESTED LOOP to join the results of the two index queries
6. The cost after this operation will be 4 of which 25% is CPU (3+1=4)

Reading an Explain Plan Report

```
SQL> EXPLAIN PLAN FOR
 2 SELECT srvr_id
 3 FROM servers s
 4 WHERE EXISTS (
 5     SELECT srvr_id
 6     FROM serv_inst i
 7     WHERE s.srvr_id = i.srvr_id);
Explained.

SQL> SELECT * FROM TABLE(dbms_xplan.display);
PLAN_TABLE_OUTPUT
-----
Plan hash value: 2840037858
-----
| Id | Operation                | Name           | Rows  | Bytes | Cost (%CPU)| Time     |
-----|-----|-----|-----|-----|-----|-----|
|  0 | SELECT STATEMENT         |                |    11 |   286 |    4 (25) | 00:00:01 |
|  1 |   NESTED LOOPS           |                |    11 |   286 |    4 (25) | 00:00:01 |
|  2 |     SORT UNIQUE          |                |   999 | 12987 |    3 (0)  | 00:00:01 |
|  3 |       INDEX FAST FULL SCAN| PK_SERV_INST  |   999 | 12987 |    3 (0)  | 00:00:01 |
|*  4 |        INDEX UNIQUE SCAN | PK_SERVERS    |     1 |    13 |    0 (0)  | 00:00:01 |
-----
Predicate Information (identified by operation id):
-----
   4 - access("S"."SRVR_ID"="I"."SRVR_ID")

Note
-----
   - dynamic sampling used for this statement
```

7. The result returned to the end-user will be 11 rows (286 bytes)

A Slightly More Complex Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		1	17	9 (45)
1	HASH UNIQUE		1	17	9 (45)
* 2	HASH JOIN ANTI		140	2380	8 (38)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	VIEW	VW_NSO_1	141	1833	6 (34)
5	MINUS				
6	SORT UNIQUE		141	564	
7	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
8	SORT UNIQUE		999	3996	
9	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

1. Read 141 rows, about 0.5K of disk, which is 1 block
2. Sort the query result for unique values

A Slightly More Complex Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		1	17	9 (45)
1	HASH UNIQUE		1	17	9 (45)
* 2	HASH JOIN ANTI		140	2380	8 (38)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	VIEW	VW_NSO_1	141	1833	6 (34)
5	MINUS				
6	SORT UNIQUE		141	564	
7	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
8	SORT UNIQUE		999	3996	
9	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

3. Read 999 rows, about 4K of disk, which is 3 blocks
4. Sort the query result for unique values

A Slightly More Complex Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		1	17	9 (45)
1	HASH UNIQUE		1	17	9 (45)
* 2	HASH JOIN ANTI		140	2380	8 (38)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	VIEW	VW_NSO_1	141	1833	6 (34)
5	MINUS				
6	SORT UNIQUE		141	564	
7	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
8	SORT UNIQUE		999	3996	
9	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

5. Subtract the result of the IX_SERV_INST query from the result of the PK_SERVERS query

A Slightly More Complex Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		1	17	9 (45)
1	HASH UNIQUE		1	17	9 (45)
* 2	HASH JOIN ANTI		140	2380	8 (38)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	VIEW	VW_NSO_1	141	1833	6 (34)
5	MINUS				
6	SORT UNIQUE		141	564	
7	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
8	SORT UNIQUE		999	3996	
9	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

6. And materialize the result of the subtraction as a view
7. The cost up to now has been 4 (3+1). Now the cost is 6 of which 34% (2) is CPU

A Slightly More Complex Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		1	17	9 (45)
1	HASH UNIQUE		1	17	9 (45)
* 2	HASH JOIN ANTI		140	2380	8 (38)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	VIEW	VW_NSO_1	141	1833	6 (34)
5	MINUS				
6	SORT UNIQUE		141	564	
7	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
8	SORT UNIQUE		999	3996	
9	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

8. Perform a second full scan of the PK_SERVERS index
9. The cost had been 6 we just added one (0% is CPU so it is disk i/o) making the total 7

A Slightly More Complex Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		1	17	9 (45)
1	HASH UNIQUE		1	17	9 (45)
* 2	HASH JOIN ANTI		140	2380	8 (38)
3	↑ INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	VIEW	VW_NSO_1	141	1833	6 (34)
5	MINUS				
6	SORT UNIQUE		141	564	
7	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
8	SORT UNIQUE		999	3996	
9	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

10. Join the results in the view with the results of the index read
11. The cost has gone from 7 (6+1) to 8 of which 38%, or 3, is CPU

A Slightly More Complex Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		1	17	9 (45)
1	HASH UNIQUE		1	17	9 (45)
* 2	HASH JOIN ANTI		140	2380	8 (38)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	VIEW	VW_NSO_1	141	1833	6 (34)
5	MINUS				
6	SORT UNIQUE		141	564	
7	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
8	SORT UNIQUE		999	3996	
9	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

12. Use a hashing algorithm to collect a set of unique values for the result set
13. The cost has gone from 8 to 9 of which 45%, or 4, is CPU

A Slightly More Complex Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		1	17	9 (45)
1	HASH UNIQUE		1	17	9 (45)
* 2	HASH JOIN ANTI		140	2380	8 (38)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	VIEW	VW_NSO_1	141	1833	6 (34)
5	MINUS				
6	SORT UNIQUE		141	564	
7	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
8	SORT UNIQUE		999	3996	
9	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

14. The result returned to the end-user will be 1 row (17 bytes)
15. The total cost is 9 of which 45% (4) is CPU. The balance (5) is disk i/o.

Plans With Errors

```
EXPLAIN PLAN FOR
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		141	4560	6 (84)
1	INTERSECTION				
2	SORT UNIQUE NOSORT		141	564	2 (50)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	SORT UNIQUE		999	3996	4 (25)
5	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

Can you find the error?

Reading an Explain Plan

```
EXPLAIN PLAN FOR
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		141	4560	6 (84)
1	INTERSECTION				
2	SORT UNIQUE NOSORT		141	564	2 (50)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	SORT UNIQUE		999	3996	4 (25)
5	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

1. Read 999 rows, ~4K from the SERV_INST table's index IX_SERV_INST: The cost is 3

Reading an Explain Plan

```
EXPLAIN PLAN FOR
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		141	4560	6 (84)
1	INTERSECTION				
2	SORT UNIQUE NOSORT		141	564	2 (50)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	SORT UNIQUE		999	3996	4 (25)
5	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

2. Sort the IX_SERV_INST index entries
3. The additional cost is 1 (3+1=4) and 25% of the cost of 4 is CPU (4 x 0.25 = 1): The math works

Reading an Explain Plan

```
EXPLAIN PLAN FOR
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		141	4560	6 (84)
1	INTERSECTION				
2	SORT UNIQUE NOSORT		141	564	2 (50)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	SORT UNIQUE		999	3996	4 (25)
5	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

4. Read 141 rows, 0.5K, from the primary key of the SERVERS table: The cost is 1
5. This line is indented so it is not added, directly, to the cost of operations 4 and 5

Reading an Explain Plan

```
EXPLAIN PLAN FOR
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		141	4560	6 (84)
1	INTERSECTION				
2	SORT UNIQUE NOSORT		141	564	2 (50)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	SORT UNIQUE		999	3996	4 (25)
5	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

6. A SORT UNIQUE NOSORT is used to remove potential duplicate rows
7. The additional cost is 1 (1+1=2) and 50% of the cost of 2 is CPU (2 x 0.50 = 1): The math works again

Reading an Explain Plan

```
EXPLAIN PLAN FOR
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		141	4560	6 (84)
1	INTERSECTION				
2	SORT UNIQUE NOSORT		141	564	2 (50)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1 (0)
4	SORT UNIQUE		999	3996	4 (25)
5	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3 (0)

8. Perform an intersection of the two result sets

Reading an Explain Plan

```
EXPLAIN PLAN FOR
SELECT srvr_id
FROM servers
INTERSECT
SELECT srvr_id
FROM serv_inst;
```

Id	Operation	Name	Rows	Bytes	Cost	(%CPU)
0	SELECT STATEMENT		141	4560	6	(5)
1	INTERSECTION					
2	SORT UNIQUE NOSORT		141	564	2	(50)
3	INDEX FULL SCAN	PK_SERVERS	141	564	1	(0)
4	SORT UNIQUE		999	3996	4	(25)
5	INDEX FAST FULL SCAN	IX_SERV_INST	999	3996	3	(0)

9. Add the two costs (2+4=6): The math works
10. 25% of the 4 is CPU (1) and 50% of the 2 is CPU (1) and (1+1=2). Is 84% of 6 equal to 2?

Explain Plan Demos (if time permits)

- Bitmap Indexes
- Parallel Query
- Partition Pruning
- Temp Space Usage

Demo

Bitmap Indexes

```
EXPLAIN PLAN FOR
SELECT *
FROM serv_inst
WHERE location_code = 30386
OR ws_id BETWEEN 326 AND 333;
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		2	148	3 (0)	00:00:01
1	CONCATENATION					
2	TABLE ACCESS BY INDEX ROWID	SERV_INST	1	74	1 (0)	00:00:01
3	BITMAP CONVERSION TO ROWIDS					
* 4	BITMAP INDEX RANGE SCAN	BIX_SERV_INST_WS_ID				
* 5	TABLE ACCESS BY INDEX ROWID	SERV_INST	1	74	1 (0)	00:00:01
6	BITMAP CONVERSION TO ROWIDS					
* 7	BITMAP INDEX SINGLE VALUE	BIX_SERV_INST_LOCATION_CODE				

Predicate Information (identified by operation id):

- 4 - access("WS_ID">=326 AND "WS_ID"<=333)
- 5 - filter(LNNVL("WS_ID">=326) OR LNNVL("WS_ID"<=333))
- 7 - access("LOCATION_CODE"=30386)

Query Rewrite Example

Predicate Information (identified by operation id):

- 4 - access("WS_ID">=326 AND "WS_ID"<=333)
- 5 - filter(LNNVL("WS_ID">=326) OR LNNVL("WS_ID"<=333))
- 7 - access("LOCATION_CODE"=30386)

Parallel Query (PQ)

```
SQL> EXPLAIN PLAN FOR
 2 SELECT SUM(salary)
 3 FROM emp2
 4 GROUP BY department_id;
```

Explained.

```
SQL> SELECT plan_table_output FROM table(dbms_xplan.display);
PLAN_TABLE_OUTPUT
```

Plan hash value: 3939201228

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time	TQ	IN-OUT	PQ Distrib
0	SELECT STATEMENT		107	2782	3 (34)	00:00:01			
1	PX COORDINATOR								
2	PX SEND QC (RANDOM)	:TQ10001	107	2782	3 (34)	00:00:01	Q1,01	P->S	QC (
3	HASH GROUP BY		107	2782	3 (34)	00:00:01	Q1,01	PCWP	
4	PX RECEIVE		107	2782	3 (34)	00:00:01	Q1,01	PCWP	
5	PX SEND HASH	:TQ10000	107	2782	3 (34)	00:00:01	Q1,00	P->P	HASH
6	HASH GROUP BY		107	2782	3 (34)	00:00:01	Q1,00	PCWP	
7	PX BLOCK ITERATOR		107	2782	2 (0)	00:00:01	Q1,00	PCWC	
8	TABLE ACCESS FULL	EMP2	107	2782	2 (0)	00:00:01	Q1,00	PCWP	

Note

- dynamic sampling used for this statement

Partition Pruning

```
explain plan for
select * from part_zip where state = 'CA';
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time	Pstart	Pstop
0	SELECT STATEMENT		3	72	2 (0)	00:00:01		
1	PARTITION HASH SINGLE		3	72	2 (0)	00:00:01	1	1
* 2	TABLE ACCESS FULL	PART_ZIP	3	72	2 (0)	00:00:01	1	1

```
explain plan for
select * from part_zip where state = 'HI';
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time	Pstart	Pstop
0	SELECT STATEMENT		3	72	2 (0)	00:00:01		
1	PARTITION HASH SINGLE		3	72	2 (0)	00:00:01	2	2
* 2	TABLE ACCESS FULL	PART_ZIP	3	72	2 (0)	00:00:01	2	2

```
explain plan for
select * from part_zip where zipcode LIKE '%5%';
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time	Pstart	Pstop
0	SELECT STATEMENT		2	48	2 (0)	00:00:01		
1	PARTITION HASH ALL		2	48	2 (0)	00:00:01	1	3
* 2	TABLE ACCESS FULL	PART_ZIP	2	48	2 (0)	00:00:01	1	3

Temp Space Usage

```
SQL> SELECT * FROM TABLE(dbms_xplan.display);
```

```
PLAN_TABLE_OUTPUT
```

```
-----  
Plan hash value: 995087943  
-----
```

Id	Operation	Name	Rows	Bytes	TempSpc	Cost (%CPU)	Time
0	SELECT STATEMENT		98128	12M		3435 (1)	00:00:42
1	SORT ORDER BY		98128	12M	25M	3435 (1)	00:00:42
2	TABLE ACCESS FULL	SOURCE\$	98128	12M		577 (2)	00:00:07

Discussion

Final Thoughts

Common Issues

- Explain Plans are not everything and not what will necessarily happen
- You can Explain Plan any DML statement
- Join Syntax Consistency (traditional vs ANSI)
- Missing Joins (Cartesian Products)
- Myth Busting

This Is One Way To Look At It

```
SQL> EXPLAIN PLAN FOR
  2 SELECT COUNT(*)
  3 FROM parent p, child c
  4 WHERE p.parent_id = c.parent_id;

SQL> select * From table(dbms_xplan.display);
PLAN_TABLE_OUTPUT
-----
Plan hash value: 3584092213
-----
| Id | Operation          | Name   | Rows  | Bytes |TempSpc| Cost (%CPU) | Time      |
-----|-----|-----|-----|-----|-----|-----|-----|
|  0 | SELECT STATEMENT   |        |     1 |    10 |        |    3163  (5) | 00:00:38 |
|  1 | SORT AGGREGATE     |        |     1 |    10 |        |           |          |
|*  2 | HASH JOIN          |        | 1500K |   14M | 8312K |    3163  (5) | 00:00:38 |
|  3 | TABLE ACCESS FULL| PARENT |   500K| 2442K |        |     380  (4) | 00:00:05 |
|  4 | TABLE ACCESS FULL| CHILD  | 1500K | 7324K |        |    1106  (5) | 00:00:14 |
-----

SQL> EXPLAIN PLAN FOR
  2 SELECT COUNT(*)
  3 FROM parent p, child c
  4 WHERE p.parent_id = c.parent_id
  5 AND c.birth_date is NOT NULL;

SQL> select * From table(dbms_xplan.display);
PLAN_TABLE_OUTPUT
-----
Plan hash value: 3584092213
-----
| Id | Operation          | Name   | Rows  | Bytes |TempSpc| Cost (%CPU) | Time      |
-----|-----|-----|-----|-----|-----|-----|-----|
|  0 | SELECT STATEMENT   |        |     1 |    16 |        |    3037  (5) | 00:00:37 |
|  1 | SORT AGGREGATE     |        |     1 |    16 |        |           |          |
|*  2 | HASH JOIN          |        |   999K |   15M | 8312K |    3037  (5) | 00:00:37 |
|  3 | TABLE ACCESS FULL| PARENT |   500K| 2442K |        |     380  (4) | 00:00:05 |
|*  4 | TABLE ACCESS FULL| CHILD  |   999K |   10M |        |    1116  (6) | 00:00:14 |
-----
```

This Is Another

```
SQL> set timing on

SQL> SELECT COUNT(*)
 2 FROM parent p, child c
 3 WHERE p.parent_id = c.parent_id;

COUNT(*)
-----
1500000

Elapsed: 00:00:00.59

SQL> SELECT COUNT(*)
 2 FROM parent p, child c
 3 WHERE p.parent_id = c.parent_id
 4 AND birth_date is NOT NULL;

COUNT(*)
-----
1000000

Elapsed: 00:00:00.53
```

They are both important

Seeing What's Real

- DBMS_XPLAN.DISPLAY_CURSOR

```
SELECT /* XPLAN_CURSOR */ DISTINCT s.srvr_id
FROM servers s, serv_inst I
WHERE s.srvr_id = i.srvr_id;

SELECT sql_id
FROM gv$sql
WHERE sql_text LIKE '%XPLAN_CURSOR%';

SELECT * FROM
TABLE(dbms_xplan.display_cursor('cpm9ss48qd32f'));
```

DBMS_XPLAN.DISPLAY_CURSOR

```
dbms_xplan.display_cursor(  
sql_id          IN VARCHAR2 DEFAULT NULL,  
cursor_child_no IN INTEGER DEFAULT 0,  
format         IN VARCHAR2 DEFAULT 'TYPICAL')  
RETURN dbms_xplan_type_table PIPELINED;
```

Format Constants	
ALIAS	If relevant, shows the "Query Block Name / Object Alias" section
ALLSTATS	A shortcut for 'IOSTATS MEMSTATS'
BYTES	If relevant, shows the number of bytes estimated by the optimizer
COST	If relevant, shows optimizer cost information
IOSTATS	Assuming that basic plan statistics are collected when SQL statements are executed (either by using the gather_plan_statistics hint or by setting the parameter statistics_level to ALL), this format will show IO statistics for ALL (or only for the LAST as shown below) executions of the cursor
LAST	By default, plan statistics are shown for all executions of the cursor. The keyword LAST can be specified to see only the statistics for the last execution
MEMSTATS	Assuming that PGA memory management is enabled (that is, pga_aggregate_target parameter is set to a non 0 value), this format allows to display memory management statistics (for example, execution mode of the operator, how much memory was used, number of bytes spilled to disk, and so on). These statistics only apply to memory intensive operations like hash-joins, sort or some bitmap operators
NOTE	If relevant, shows the note section of the explain plan
PARALLEL	If relevant, shows PX information (distribution method and table queue information)
PARTITION	If relevant, shows partition pruning information
PREDICATE	If relevant, shows the predicate section
PROJECTION	If relevant, shows the projection section
REMOTE	If relevant, shows the information for distributed query (for example, remote from serial distribution and remote SQL)
ROWS	If relevant, shows the number of rows estimated by the optimizer
RUNSTATS_LAST	Same as IOSTATS LAST: displays the runtime stat for the last execution of the cursor
RUNSTATS_TOT	Same as IOSTATS: displays IO statistics for all executions of the specified cursor

V\$SQL

```
SQL> desc v$sql
Name                                                    Null?   Type
-----
SQL_TEXT                                                VARCHAR2 (1000)
SQL_FULLTEXT                                             CLOB
SQL_ID                                                   VARCHAR2 (13)
SHARABLE_MEM                                             NUMBER
PERSISTENT_MEM                                           NUMBER
RUNTIME_MEM                                              NUMBER
SORTS                                                    NUMBER
FETCHES                                                  NUMBER
PX_SERVERS_EXECUTIONS                                   NUMBER
PARSE_CALLS                                              NUMBER
DISK_READS                                               NUMBER
DIRECT_WRITES                                            NUMBER
BUFFER_GETS                                              NUMBER
APPLICATION_WAIT_TIME                                   NUMBER
CONCURRENCY_WAIT_TIME                                  NUMBER
CLUSTER_WAIT_TIME                                       NUMBER
USER_IO_WAIT_TIME                                       NUMBER
PLSQL_EXEC_TIME                                          NUMBER
JAVA_EXEC_TIME                                          NUMBER
ROWS_PROCESSED                                           NUMBER
COMMAND_TYPE                                             NUMBER
OPTIMIZER_MODE                                           VARCHAR2 (10)
OPTIMIZER_COST                                           NUMBER
OPTIMIZER_ENV                                           RAW (2000)
PLAN_HASH_VALUE                                          NUMBER
CHILD_NUMBER                                             NUMBER
CPU_TIME                                                 NUMBER
ELAPSED_TIME                                             NUMBER
IS_BIND_SENSITIVE                                       VARCHAR2 (1)
SQL_PROFILE                                              VARCHAR2 (64)
LAST_ACTIVE_TIME                                         DATE
BIND_DATA                                               RAW (2000)
IO_INTERCONNECT_BYTES                                   NUMBER
IO_DISK_BYTES                                           NUMBER
```

Abbreviated column list

V\$SQL_PLAN

```
SQL> desc v$sql_plan
Name                                                    Null?    Type
-----
ADDRESS                                                  RAW (4)
HASH_VALUE                                               NUMBER
SQL_ID                                                  VARCHAR2 (13)
PLAN_HASH_VALUE                                         NUMBER
TIMESTAMP                                               DATE
OPERATION                                               VARCHAR2 (30)
OPTIMIZER                                               VARCHAR2 (20)
ID                                                       NUMBER
PARENT_ID                                               NUMBER
DEPTH                                                    NUMBER
POSITION                                                 NUMBER
SEARCH_COLUMNS                                          NUMBER
COST                                                     NUMBER
CARDINALITY                                             NUMBER
BYTES                                                    NUMBER
PARTITION_START                                         VARCHAR2 (64)
PARTITION_STOP                                         VARCHAR2 (64)
CPU_COST                                                NUMBER
IO_COST                                                 NUMBER
TEMP_SPACE                                              NUMBER
ACCESS_PREDICATES                                       VARCHAR2 (4000)
FILTER_PREDICATES                                       VARCHAR2 (4000)
PROJECTION                                              VARCHAR2 (4000)
TIME                                                    NUMBER
QBLOCK_NAME                                             VARCHAR2 (30)
```

Abbreviated column list

Any DML Statement Can Be Explained

```
SQL> explain plan for
 2  MERGE INTO bonuses b
 3  USING (
 4    SELECT employee_id, salary, dept_no
 5    FROM employee
 6    WHERE dept_no =20) e
 7  ON (b.employee_id = e.employee_id)
 8  WHEN MATCHED THEN
 9    UPDATE SET b.bonus = e.salary * 0.1
10    DELETE WHERE (e.salary < 40000)
11  WHEN NOT MATCHED THEN
12    INSERT (b.employee_id, b.bonus)
13    VALUES (e.employee_id, e.salary * 0.05)
14    WHERE (e.salary > 40000);
```

```
SQL> select * from table(dbms_xplan.display);
```

```
PLAN_TABLE_OUTPUT
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	MERGE STATEMENT		6	546	17 (6)	00:00:01
1	MERGE	BONUSES				
2	VIEW					
* 3	HASH JOIN OUTER		6	462	17 (6)	00:00:01
* 4	TABLE ACCESS FULL	EMPLOYEE	6	234	8 (0)	00:00:01
5	TABLE ACCESS FULL	BONUSES	6	228	8 (0)	00:00:01

INSERT, UPDATE, DELETE, and MERGE

Any Join Syntax Can Be Used (Traditional or ANSI joins)

```
explain plan for
select distinct i.srvr_id
from servers s, serv_inst i
where s.srvr_id = i.srvr_id;
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		999	25974	9 (12)	00:00:01
1	HASH UNIQUE		999	25974	9 (12)	00:00:01
2	NESTED LOOPS		999	25974	8 (0)	00:00:01
3	TABLE ACCESS FULL	SERV_INST	999	12987	8 (0)	00:00:01
* 4	INDEX UNIQUE SCAN	PK_SERVERS	1	13	0 (0)	00:00:01

```
explain plan for
select distinct i.srvr_id
from servers s inner join serv_inst i
on s.srvr_id = i.srvr_id;
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		999	25974	9 (12)	00:00:01
1	HASH UNIQUE		999	25974	9 (12)	00:00:01
2	NESTED LOOPS		999	25974	8 (0)	00:00:01
3	TABLE ACCESS FULL	SERV_INST	999	12987	8 (0)	00:00:01
* 4	INDEX UNIQUE SCAN	PK_SERVERS	1	13	0 (0)	00:00:01

Produce identical plans
... in all currently supported versions ...

Beware of Missing Joins

```
SQL> explain plan for
 2 select s.srvr_id
 3 from servers s, serv_inst i
 4 where s.srvr_id = i.srvr_id;
```

```
SQL> select * from table(dbms_xplan.display);
```

```
PLAN_TABLE_OUTPUT
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		999	25974	8 (0)	00:00:01
1	NESTED LOOPS		999	25974	8 (0)	00:00:01
2	TABLE ACCESS FULL	SERV_INST	999	12987	8 (0)	00:00:01
* 3	INDEX UNIQUE SCAN	PK_SERVERS	1	13	0 (0)	00:00:01

```
SQL> explain plan for
 2 select s.srvr_id
 3 from servers s, serv_inst i;
```

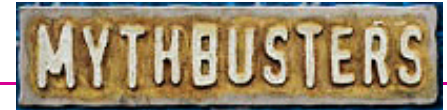
```
SQL> select * from table(dbms_xplan.display);
```

```
PLAN_TABLE_OUTPUT
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		140K	1788K	130 (1)	00:00:02
1	MERGE JOIN CARTESIAN		140K	1788K	130 (1)	00:00:02
2	INDEX FAST FULL SCAN	PK_SERVERS	141	1833	2 (0)	00:00:01
3	BUFFER SORT		999		128 (1)	00:00:02
4	BITMAP CONVERSION TO ROWIDS		999		1 (0)	00:00:01
5	BITMAP INDEX FAST FULL SCAN	BIX_SERV_INST_WS_ID				

Note the impact of the missing join

Myth Busting



```
SQL> explain plan for
 2  SELECT doc_name
 3  FROM t
 4  WHERE person_id = 221;
```

```
SQL> select * from table(dbms_xplan.display);
PLAN_TABLE_OUTPUT
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		216	6264	64 (4)	00:00:01
* 1	TABLE ACCESS FULL	T	216	6264	64 (4)	00:00:01

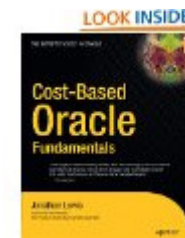
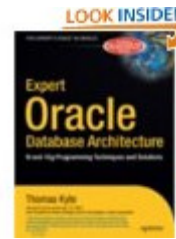
```
SQL> explain plan for
 2  SELECT /*+ INDEX(t ix_t_person_id) */ doc_name
 3  FROM t
 4  WHERE person_id = 221;
```

```
SQL> select * from table(dbms_xplan.display);
PLAN_TABLE_OUTPUT
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		216	6264	216 (0)	00:00:03
1	TABLE ACCESS BY INDEX ROWID	T	216	6264	216 (0)	00:00:03
* 2	INDEX RANGE SCAN	IX_T_PERSON_ID	216		1 (0)	00:00:01

Resources

- Oracle Technology Network
 - <http://tahiti.oracle.com>
- Morgan of Morgan's Library on the web
 - www.morganslibrary.org
- Tom Kyte
 - <http://asktom.oracle.com>
 - Tom's Books
- Jonathan Lewis
 - <http://www.jlcomp.demon.co.uk/faq>
 - Jonathan's Books
- Cary Millsap
 - <http://carymillsap.blogspot.com>



Questions



Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

25 + 2 = 27

Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

16 + 109 = 125

Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

And with a few more operations ends up at 153

Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

106+4 = 110

Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

A few more operations but still at 110

Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

$$19+7 = 26 \text{ and } 26+2 = 28$$

Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

110 28+1 more CPU = 139

Complex Query Plan

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		1	66	264 (2)	00:00:04
1	MERGE JOIN OUTER		1	66	264 (2)	00:00:04
2	MERGE JOIN OUTER		1	44	139 (3)	00:00:02
3	NESTED LOOPS OUTER		1	22	28 (4)	00:00:01
4	FAST DUAL		1		2 (0)	00:00:01
5	VIEW		1	22	26 (4)	00:00:01
6	VIEW		1	18	26 (4)	00:00:01
* 7	FILTER					
8	SORT AGGREGATE		1	80		
* 9	HASH JOIN		717	57360	26 (4)	00:00:01
* 10	HASH JOIN		67	4623	7 (15)	00:00:01
11	TABLE ACCESS FULL	MKTDRIDAILYRESAVAIL	17	629	3 (0)	00:00:01
* 12	TABLE ACCESS FULL	MKTDRIHRLYRESAVAIL	67	2144	3 (0)	00:00:01
13	TABLE ACCESS FULL	MKTHOUR	1752	19272	19 (0)	00:00:01
14	VIEW		1	22	110 (1)	00:00:02
15	VIEW		1	9	110 (1)	00:00:02
* 16	FILTER					
17	SORT AGGREGATE		1	19		
18	MERGE JOIN		365	6935	110 (1)	00:00:02
* 19	TABLE ACCESS BY INDEX ROWID	MKTSTUDYMODE	2	18	4 (0)	00:00:01
20	INDEX FULL SCAN	XPKMKTSTUDYMODE	16		1 (0)	00:00:01
* 21	SORT JOIN		1318	13180	106 (1)	00:00:02
* 22	TABLE ACCESS FULL	MKTPLAN	1318	13180	105 (0)	00:00:02
23	BUFFER SORT		1	22	153 (1)	00:00:02
24	VIEW		1	22	125 (0)	00:00:02
25	VIEW		1	9	125 (0)	00:00:02
* 26	FILTER					
27	SORT AGGREGATE		1	54		
* 28	HASH JOIN		99	5346	125 (0)	00:00:02
29	NESTED LOOPS					
30	NESTED LOOPS		81	3483	109 (0)	00:00:02
31	NESTED LOOPS		94	2632	27 (0)	00:00:01
32	VIEW		1	9	2 (0)	00:00:01
* 33	COUNT STOPKEY					
34	FAST DUAL		1		2 (0)	00:00:01
35	TABLE ACCESS BY INDEX ROWID	MKTCASE	94	1786	25 (0)	00:00:01
* 36	INDEX RANGE SCAN	XFMKTCASE_MKTDAYAPPV2200_U	94		1 (0)	00:00:01
* 37	INDEX UNIQUE SCAN	XPKMKTPLAN	1		0 (0)	00:00:01
38	TABLE ACCESS BY INDEX ROWID	MKTPLAN	1	15	1 (0)	00:00:01
39	INDEX FAST FULL SCAN	XPKMKTCASEDRFORECAST	4560	50160	16 (0)	00:00:01

$$125v+139 = 264$$