How to Read and Interpret an Explain Plan

Presentation for PEOUG PERU ORACLE USERS GROUP October 12, 2010

Daniel A. Morgan

- Oracle ACE Director
- University of Washington Oracle Instructor for 10 years
- Morgan of Morgan's Library on the web
- Board Member: Western Washington OUG
- Member UKOUG
- Conference Speaker
  - OpenWorld, Collaborate, Kaleidoscope, Canada, Chile, Denmark, Estonia, Finland, Germany, Japan, New Zealand, Norway, Sweden, UK & US
- 11g Beta Tester

UNIVERSITY OF WASHINGTON

ORACLE RACSIG

Official Beta Site ORACLE DATABASE 11g

UK OUG

International zSeries Oracle SIG

cd $MORGAN_HOME

cd $MORGAN_HOME

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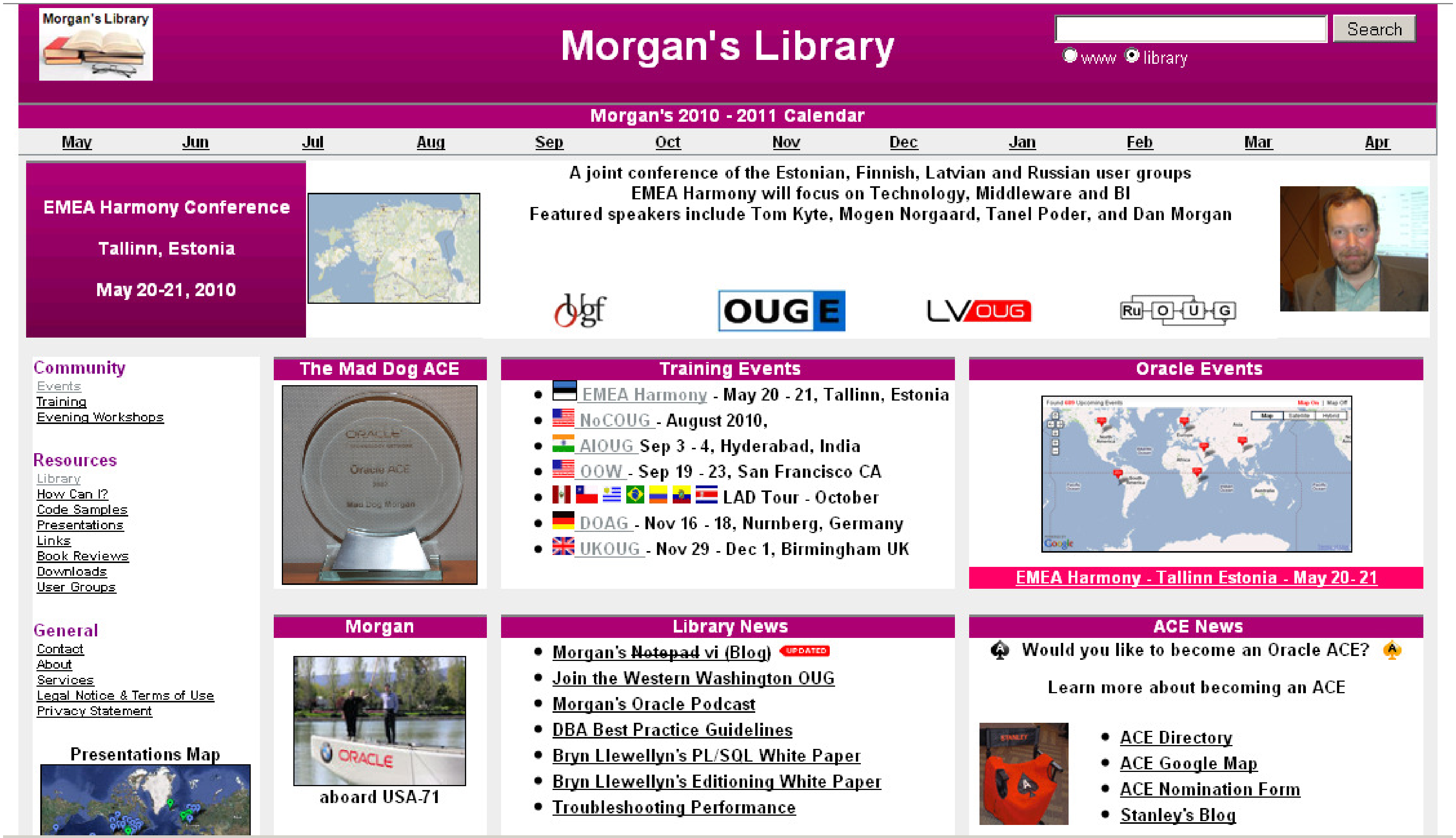


Syllabus

- 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 8*i*
  - 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 probably bad 10g code.
  - Good 10g code may not be good 11g code.

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?

```
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

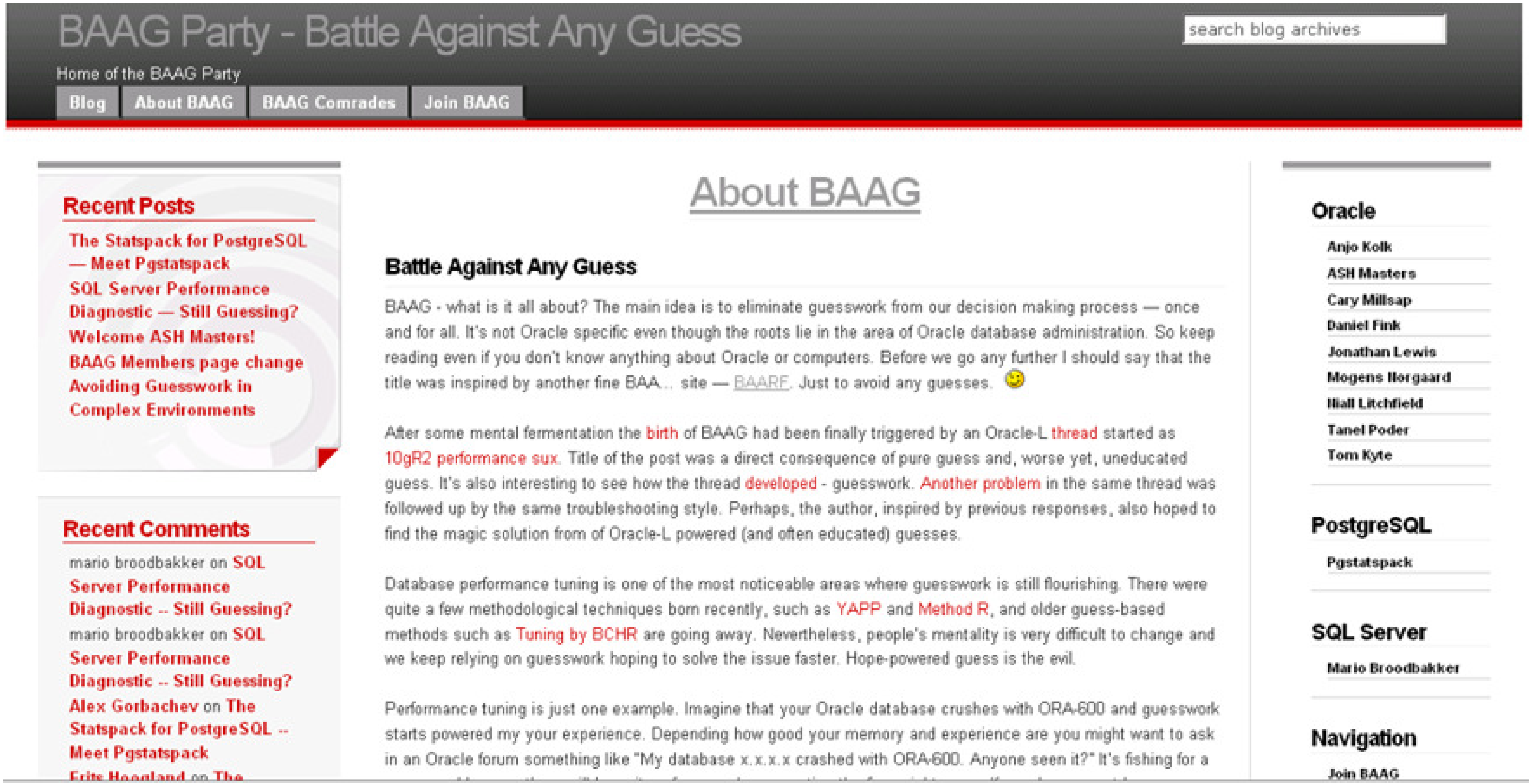
Optimizer Compatibility

```
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



Optimizer Plans (the way it was)

```
SELECT DISTINCT E1_2.OBJECT_ID
   FROM PMCM.ELEMENT_DETAIL E1_1, PMCM.ELEMENT_DETAIL E1_2, PMCM.MARK_NETW_HIERARCHY H1,
        PMCM.ELEMENT_DETAIL E2_1, PMCM.ELEMENT_DETAIL E2_2, PMCM.MARK_NETW_HIERARCHY H2
   WHERE E1_1.OBJECT_ID = H1.PARENT_ID
     AND E1_2.OBJECT_ID = H1.OBJECT_ID
     AND E2_1.OBJECT_ID = H2.PARENT_ID
     AND E2_2.OBJECT_ID = H2.OBJECT_ID
     AND E1_1.CURRENT_IND = 'Y' AND E2_1.CURRENT_IND = 'Y'
     AND E2_1.CURRENT_IND = 'Y' AND E2_2.CURRENT_IND = 'Y'
     AND H1.CURRENT_IND = 'Y' AND H2.CURRENT_IND = 'Y'
     AND H1.HIERARCHY_TYPE = 'NETWORK' AND H2.HIERARCHY_TYPE = 'NETWORK'
     AND H1.PARENT_TYPE IN ('BSC','RNC')  AND H2.PARENT_TYPE IN ('BSC','RNC')
     AND E2_2.ELEMENT_TYPE = 'CELL' AND E1_2.ELEMENT_TYPE = 'CELL'
     AND H1.PARENT_TYPE IN ('BSC','RNC')
     AND E1_1.ELEMENT_NAME = E2_1.ELEMENT_NAME
     AND E1_1.ELEMENT_ID = E2_1.ELEMENT_ID
     AND E1_2.ELEMENT_NAME = E2_2.ELEMENT_NAME
     AND E1_2.ELEMENT_ID = E2_2.ELEMENT_ID
     AND E1_2.USEID LIKE '*%' AND E2_2.USEID NOT LIKE '*%';
```

Run time 51 hours

```
| Id  | Operation                    | Name                          | Rows  | Bytes |TempSpc| Cost  (%CPU)| Time      | Pstart| Pstop |
|   0 | SELECT STATEMENT             |                               |     1 |    78 |       |   74M  (40)| 50:54:42  |       |       |
|   1 |  TEMP TABLE TRANSFORMATION   |                               |       |       |       |            |           |       |       |
|   2 |   LOAD AS SELECT             |                               |       |       |       |            |           |       |       |
|   3 |    PARTITION RANGE ALL       |                               |   22M|  1111M|       | 38153  (11)| 00:01:34  |     1 |    29 |
|*  4 |     TABLE ACCESS FULL        | ELEMENT_DETAIL                |   22M|  1111M|       | 38153  (11)| 00:01:34  |       |       |
|   5 |   LOAD AS SELECT             |                               |       |       |       |            |           |       |       |
|   6 |    PARTITION HASH ALL        |                               |  337K|  9231K|       |  3514  (15)| 00:00:09  |     1 |    16 |
|*  7 |     TABLE ACCESS FULL        | MARK_NETW_HIERARCHY           |  337K|  9231K|       |  3514  (15)| 00:00:09  |       |       |
|   8 |   SORT AGGREGATE             |                               |     1 |    78 |       |            |           |       |       |
|*  9 |    HASH JOIN                 |                               |  927G|    65T|  534M|    74M (40)| 50:53:00  |       |       |
|  10 |     VIEW                     |                               |   22M|   277M|       | 16808  (12)| 00:00:42  |       |       |
|  11 |      TABLE ACCESS FULL       | SYS_TEMP_0FDA7485F_6A66C42E |   22M|  1111M|       | 16808  (12)| 00        |       |       |
|* 12 |     HASH JOIN                |                               |   21G|  1272G|  534M|  1616K (43)| 01:06:04  |       |       |
|  13 |      VIEW                    |                               |   22M|   277M|       | 16808  (12)| 00:00:42  |       |       |
|  14 |       TABLE ACCESS FULL      | SYS_TEMP_0FDA7485F_6A66C42E |   22M|  1111M|       | 16808  (12)| 0         |       |       |
|* 15 |      HASH JOIN               |                               |  476M|    23G|  524M| 97327  (22)| 00:03:59  |       |       |
|* 16 |       HASH JOIN              |                               |   10M|   401M| 8704K| 34520  (10)| 00:01:25  |       |       |
|* 17 |        HASH JOIN             |                               |  234K|  5948K| 8256K|   783  (10)| 00:00:02  |       |       |
|  18 |         VIEW                 |                               |  337K|  4286K|       |   142  (14)| 00:00:01  |       |       |
|  19 |          TABLE ACCESS FULL   | SYS_TEMP_0FDA74860_6A66C42E |  337K|  3956K|       |   142  (14)| 00:00:01  |       |       |
|  20 |         VIEW                 |                               |  337K|  4286K|       |   142  (14)| 00:00:01  |       |       |
|  21 |          TABLE ACCESS FULL   | SYS_TEMP_0FDA74860_6A66C42E |  337K|  3956K|       |   142  (14)| 00:00:01  |       |       |
|  22 |        VIEW                  |                               |   22M|   277M|       | 16808  (12)| 00:00:42  |       |       |
|  23 |         TABLE ACCESS FULL    | SYS_TEMP_0FDA7485F_6A66C42E |   22M|  1111M|       | 16808  (12)| 00:00:42  |       |       |
|  24 |       VIEW                   |                               |   22M|   277M|       | 16808  (12)| 00:00:42  |       |       |
|  25 |        TABLE ACCESS FULL     | SYS_TEMP_0FDA7485F_6A66C42E |   22M|  1111M|       | 16808  (12)| 0         |       |       |
```

Optimizer Plans (making it a whole lot worse)

```
---------------------------------------------------------------------------------------------------------------------------------
| Id  | Operation                    | Name                           | Rows  | Bytes |TempSpc| Cost (%CPU)| Time      | Pstart| Pstop |
---------------------------------------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |                                |     1 |    78 |       |   14T(100)|999:59:59 |       |       |
|   1 |  TEMP TABLE TRANSFORMATION   |                                |       |       |       |            |           |       |       |
|   2 |   LOAD AS SELECT             |                                |       |       |       |            |           |       |       |
|   3 |    PARTITION RANGE ALL       |                                |   22M|  1111M|       | 38153  (11)| 00:01:34 |     1 |    29 |
|*  4 |     TABLE ACCESS FULL        | ELEMENT_DETAIL                 |   22M|  1111M|       | 38153  (11)| 00:01:34 |       |       |
|   5 |   LOAD AS SELECT             |                                |       |       |       |            |           |       |       |
|   6 |    PARTITION HASH ALL        |                                |  337K|  9231K|       |  3514  (15)| 00:00:09 |     1 |    16 |
|*  7 |     TABLE ACCESS FULL        | MARK_NETW_HIERARCHY            |  337K|  9231K|       |  3514  (15)| 00:00:09 |       |       |
|   8 |   SORT AGGREGATE             |                                |     1 |    78 |       |            |           |       |       |
|   9 |    MERGE JOIN                |                                |  471P|   15E|       |   14T(100)|999:59:59 |       |       |
|  10 |     MERGE JOIN               |                                |   10P|  616P|       |  694G  (81)|999:59:59 |       |       |
|  11 |      MERGE JOIN              |                                |  231T|   10P|       |  377G  (64)|999:59:59 |       |       |
|  12 |       SORT JOIN              |                                |  334T|   11P|   28P|  377G  (64)|999:59:59 |       |       |
|  13 |        MERGE JOIN CARTESIAN|                                |  334T|   11P|       |  140G  (14)|999:59:59 |       |       |
|* 14 |         HASH JOIN            |                                |  989M|   23G|  534M| 96010  (38)| 00:03:56 |       |       |
|  15 |          VIEW                |                                |   22M|   277M|       | 16808  (12)| 00:00:42 |       |       |
|  16 |           TABLE ACCESS FULL| SYS_TEMP_0FDA7485B_6A66C42E |   22M|  1111M|       | 16808  (12)| 00:00:42 |       |       |
|  17 |          VIEW                |                                |   22M|   277M|       | 16808  (12)| 00:00:42 |       |       |
|  18 |           TABLE ACCESS FULL| SYS_TEMP_0FDA7485B_6A66C42E |   22M|  1111M|       | 16808  (12)| 00:00:42 |       |       |
|  19 |         BUFFER SORT          |                                |  337K|  4286K|       |  140G  (14)|999:59:59 |       |       |
|  20 |          VIEW                |                                |  337K|  4286K|       |   142  (14)| 00:00:01 |       |       |
|  21 |           TABLE ACCESS FULL| SYS_TEMP_0FDA7485C_6A66C42E |  337K|  3956K|       |   142  (14)| 00:00:01 |       |       |
|* 22 |       SORT JOIN              |                                |  337K|  4286K|   12M|   844  (14)| 00:00:03 |       |       |
|  23 |        VIEW                  |                                |  337K|  4286K|       |   142  (14)| 00:00:01 |       |       |
|  24 |         TABLE ACCESS FULL    | SYS_TEMP_0FDA7485C_6A66C42E |  337K|  3956K|       |   142  (14)| 00:00:01 |       |       |
|* 25 |      SORT JOIN               |                                |   22M|   277M|  855M| 65084  (16)| 00:02:40 |       |       |
|  26 |       VIEW                   |                                |   22M|   277M|       | 16808  (12)| 00:00:42 |       |       |
|  27 |        TABLE ACCESS FULL     | SYS_TEMP_0FDA7485B_6A66C42E |   22M|  1111M|       | 16808  (12)| 0         |       |       |
|* 28 |     SORT JOIN                |                                |   22M|   277M|  855M| 65084  (16)| 00:02:40 |       |       |
|  29 |      VIEW                    |                                |   22M|   277M|       | 16808  (12)| 00:00:42 |       |       |
|  30 |       TABLE ACCESS FULL      | SYS_TEMP_0FDA7485B_6A66C42E |   22M|  1111M|       | 16808  (12)| 0         |       |       |
---------------------------------------------------------------------------------------------------------------------------------
```

Optimizer Plans (making it better)

```sql
WITH ed AS (SELECT object_id, element_id, element_name, element_type, useid
            FROM pmcm.element_detail
            WHERE element_type = 'CELL'
            AND current_ind = 'Y'),
     mnh AS (SELECT parent_id, object_id
             FROM pmcm.mark_netw_hierarchy
             WHERE current_ind = 'Y'
             AND hierarchy_type = 'NETWORK'
             AND parent_type IN ('BSC', 'RNC'))
SELECT COUNT(*)
FROM ed e1_1, ed e1_2, ed e2_1, ed e2_2, mnh h1, mnh h2
WHERE e1_1.object_id = h1.parent_id AND   e1_2.object_id = h1.object_id
AND   e2_1.object_id = h2.parent_id AND   e2_2.object_id = h2.object_id
AND   e1_1.element_name = e2_1.element_name
AND   e1_1.element_id = e2_1.element_id
AND   e1_2.element_name = e2_2.element_name
AND   e1_2.element_id = e2_2.element_id
AND   e1_2.useid LIKE '*%'
AND   e2_2.useid NOT LIKE '*%';
```

Run time 4 minutes

```
------------------------------------------------------------------------------------------------------------------------
| Id  | Operation                          | Name                 | Rows  | Bytes |TempSpc| Cost (%CPU)| Time     |
------------------------------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT                   |                      |     1 |   214 |       |   100K  (6)| 00:04:08 |
|   1 |  HASH UNIQUE                       |                      |     1 |   214 |       |   100K  (6)| 00:04:08 |
|*  2 |   HASH JOIN                        |                      |     1 |   214 |   12M|   100K  (6)| 00:04:08 |
|   3 |    PARTITION HASH ALL              |                      |  337K|  9231K|       |  3514  (15)| 00:00:09 |
|*  4 |     TABLE ACCESS FULL              | MARK_NETW_HIERARCHY  |  337K|  9231K|       |  3514  (15)| 00:00:00 |
|*  5 |    HASH JOIN                       |                      |  207K|    36M|   22M| 95860   (6)| 00:03:56 |
|   6 |     PARTITION RANGE ALL            |                      |  586K|    15M|       | 16233   (2)| 00:00:40 |
|   7 |      TABLE ACCESS BY LOCAL INDEX ROWID | ELEMENT_DETAIL   |  586K|    15M|       | 16233      | ??:??:?? |
|*  8 |       INDEX SKIP SCAN              | ED_ET_TECH_CI        |  586K|       |       | 12791   (1)| 00:00:3? |
|*  9 |     HASH JOIN                      |                      |  207K|    31M|   22M| 77982   (7)| 00:03:12 |
|  10 |      PARTITION RANGE ALL           |                      |  586K|    15M|       | 16233   (2)| 00:00:40 |
|  11 |       TABLE ACCESS BY LOCAL INDEX ROWID | ELEMENT_DETAIL  |  586K|    15M|       | 16233      | ??:??:?? |
|* 12 |        INDEX SKIP SCAN             | ED_ET_TECH_CI        |  586K|       |       | 12791   (1)| 00:00:?? |
|* 13 |      HASH JOIN                     |                      |  179K|    22M|   12M| 60372   (8)| 00:02:29 |
|  14 |       PARTITION HASH ALL           |                      |  337K|  9231K|       |  3514  (15)| 00:00:09 |
|* 15 |        TABLE ACCESS FULL           | MARK_NETW_HIERARCHY  |  337K|  9231K|       |  3514  (15)| 00:00:?? |
|* 16 |       HASH JOIN                    |                      |  184K|    17M|   10M| 55886   (8)| 00:02:18 |
|  17 |        PARTITION RANGE ALL         |                      |  184K|  9008K|       | 37137   (8)| 00:01:32 |
|* 18 |         TABLE ACCESS FULL          | ELEMENT_DETAIL       |  184K|  9008K|       | 37137   (8)| 00:01:32 |
|  19 |        PARTITION RANGE ALL         |                      |  576K|    28M|       | 17383   (8)| 00:00:43 |
|* 20 |         TABLE ACCESS BY LOCAL INDEX ROWID| ELEMENT_DETAIL |  576K|    28M|       | 17383   (8)| ??:??:?? |
|* 21 |          INDEX SKIP SCAN           | ED_ET_TECH_CI        |  583K|       |       | 13939   (9)| 00:00:35 |
------------------------------------------------------------------------------------------------------------------------
```

Discussion

Creating Explain Plans

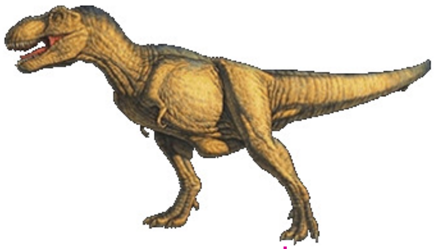
Do Not Do This

- 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';
```

Do This

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



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

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

Demo

Create An Explain Plan View

```
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;
```

Many More Solutions

```
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;
```

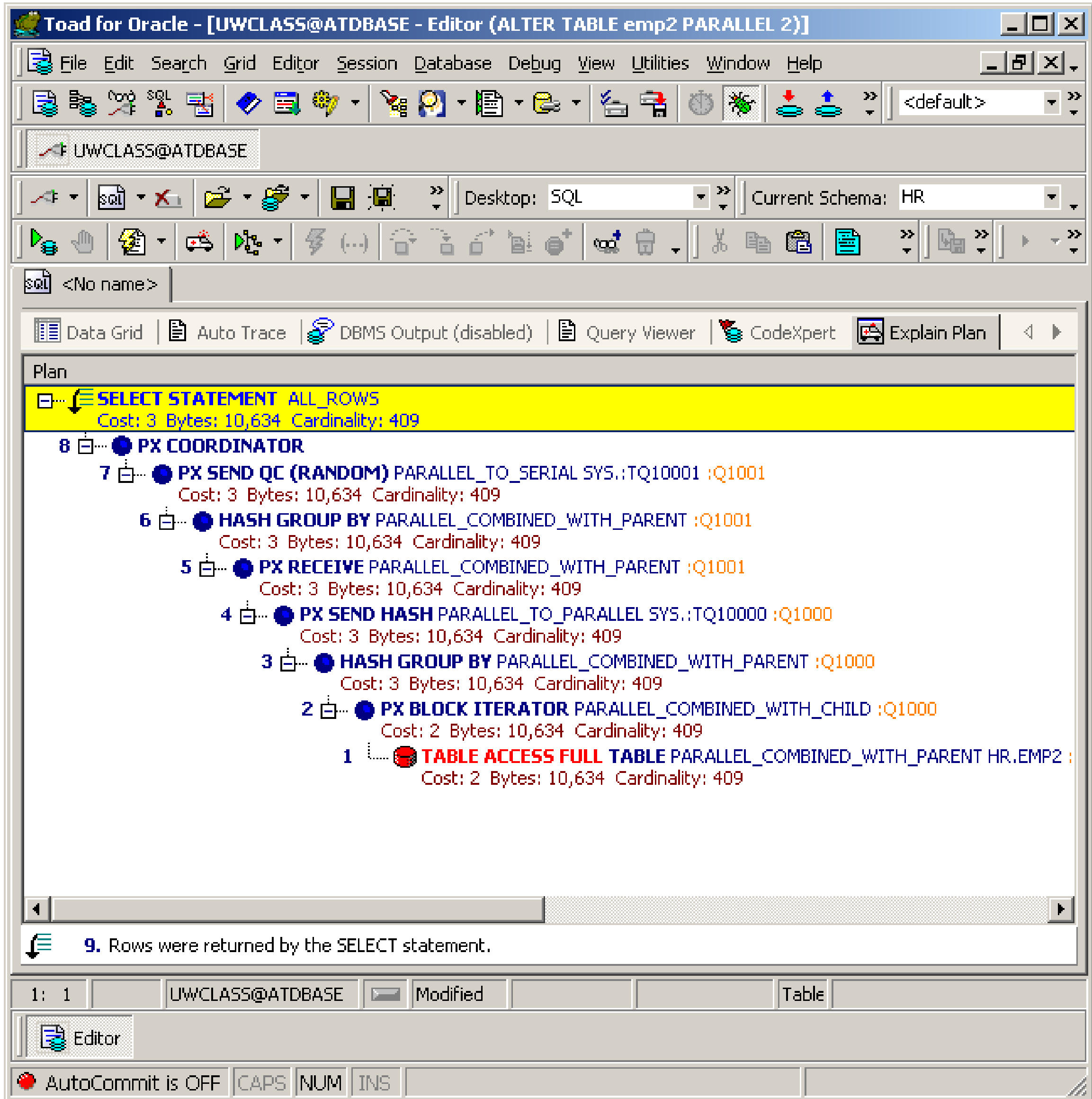
```
WITH q AS (
  SELECT DISTINCT s.srvr_id
  FROM servers s, serv_inst i
  WHERE s.srvr_id = i.srvr_id)
SELECT * FROM q;
```

Some Very Bad Solutions

```
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;
```

TOAD Plans


Toad for Oracle - [UWCLASS@ATDBASE - Editor (ALTER TABLE emp2 PARALLEL 2)]
File Edit Search Grid Editor Session Database Debug View Utilities Window Help
<default>
UWCLASS@ATDBASE
Desktop: SQL
Current Schema: HR
<No name>
Data Grid
Auto Trace
DBMS Output (disabled)
Query Viewer
CodeXpert
Explain Plan
Plan
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
9. Rows were returned by the SELECT statement.
1: 1
UWCLASS@ATDBASE
Modified
Table
Editor
AutoCommit is OFF
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

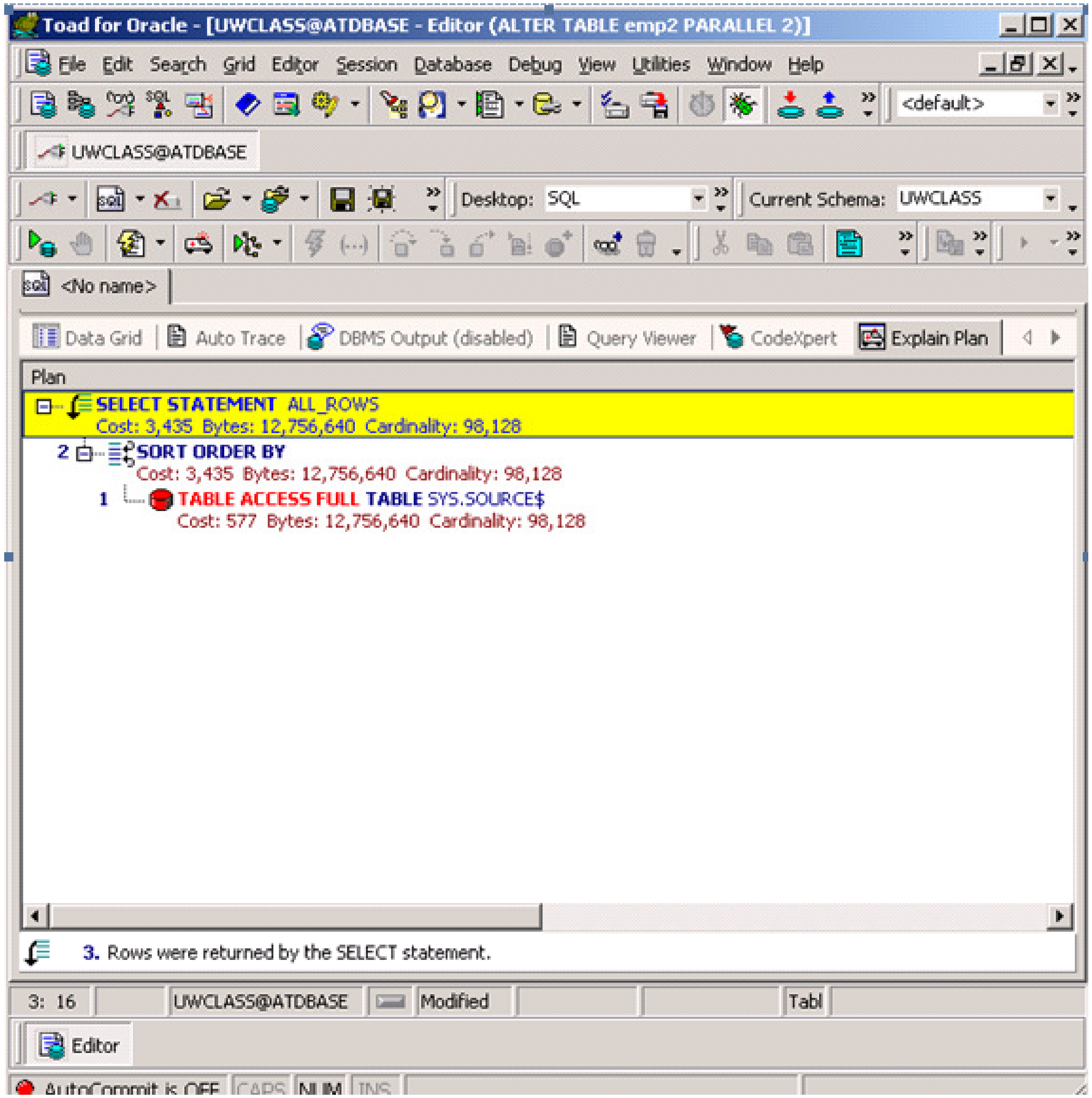
Correct

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



Toad for Oracle - [UWCLASS@ATDBASE - Editor (ALTER TABLE emp2 PARALLEL 2)]
File Edit Search Grid Editor Session Database Debug View Utilities Window Help
<default>
UWCLASS@ATDBASE
Desktop: SQL
Current Schema: UWCLASS
<No name>
Data Grid
Auto Trace
DBMS Output (disabled)
Query Viewer
CodeXpert
Explain Plan
Plan
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
3. Rows were returned by the SELECT statement.
3: 16
UWCLASS@ATDBASE
Modified
Tabl
Editor
AutoCommit is OFF
CAPS
NUM
INS

TOAD Plans

1 2 3

```
-------------------------------------------------------------------------------------
| 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
- (Cost - CPU% of Cost) = Disk I/O

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

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- 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
- (Cost - CPU% of Cost) = Disk I/O

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
- (Cost - CPU% of Cost) = 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);
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
```

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   (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)|
 ---------------------------------------------------------------------------
```

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)
```

LNNVL: Evaluates a condition when one or both operands of the condition may be null

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

Low Cost Per Query but ...

SQL ordered by Executions

- Total Executions: 29,717,627
- Captured SQL account for 77.4% of Total

Executions	Rows Processed	Rows per Exec	CPU per Exec (s)	Elap per Exec (s)	SQL Id	SQL Module	SQL Text
10,128,178	2,506,529	0.25	0.00	0.00	932srzg1krc33	ASN_07B_DIP(004110016)	SELECT NE_TIMEZONE FROM CMPM.E...
7,576,759	7,579,197	1.00	0.00	0.00	1h698sb62un99	asci_56_RANAPProtocolStats(01611000E)	SELECT DISTINCT NE_TIMEZONE FR...
3,914,621	3,848,268	0.98	0.00	0.00	5tbzddgguu8cc	asci_56_RANAPProtocolStats(01611000E)	SELECT SYS_VERSION FROM CMPM.T...
311,645	311,604	1.00	0.00	0.00	7gtztzv329wg0		select c.name, u.name from co...
301,428	301,325	1.00	0.00	0.00	36s446f9cnwhw		SELECT C.NAME FROM COL$ C WHER...
200,692	200,669	1.00	0.00	0.00	4vs91dcv7u1p6	OMS	insert into sys.aud$(sessioni...
65,044	65,035	1.00	0.00	0.00	fz9xwpt2cvt0k		SELECT par_type, param_clob, ...
64,949	3,945,482	60.75	0.00	0.00	f5ra7dru5fk5n	XML_P7R_RNC_RCS(003110008)	SELECT NAME, PATH, READ, WR...
64,801	64,807	1.00	0.00	0.00	fhzj09a7fnrnb	XML_V7I_IN_LP_DC(00811000V)	SELECT DBTIMEZONE, LENGTH(DBT...
64,632	64,542	1.00	0.00	0.00	15jnrrb6016nd	XML_V7I_IN_LP_DC(00811000V)	SELECT SESSIONTIMEZONE, LENGT...

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)

Oracle Join

```
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 |
---------------------------------------------------------------------------------
```

ANSI Join

```
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 |      |       |             |          |
----------------------------------------------------------------------------------------------
```

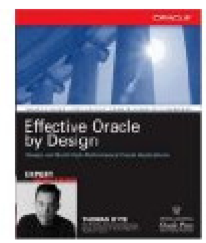
Note the impact of the missing join

Myth Busting

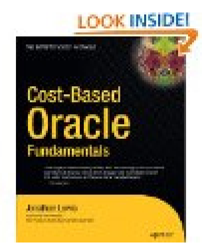
```
SQL> explain plan for
  2  SELECT doc_name
  3  FROM t
  4  WHERE person_id = 221;

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’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

Thank you

ERROR at line 1:
ORA-00028: your session has been killed

All demos at morganslibrary.org

- **Library**

damorgan11g@gmail.com

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 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 |
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```

125v+139 = 264