Banner Performance on Oracle 10g

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Session Rules of Etiquette

- **Please turn off your cell phone/pager**

- **If you must leave the session early, please do so as discreetly as possible**

- **Please avoid side conversation during the session**

Thank you for your cooperation!

Introduction

- **Purpose**
  To show how you can get great performance from Banner on 10g by understanding the CBO, statistics and histograms.

- **Benefits:**
  - **Understand histograms, bind variables, bind variable peeking and why you should care.**
  - **Understand how to manipulate the CBO for Banner**
  - **Understand what to do when performance issues arise**
  - **Learn why the 10g default stats may be bad for you**
  - **Learn how to have stats ready from day 1 on Oracle 10g**

Agenda

- **A Geographic Example**
  - Can we get there from here?

- **Put the CBO on a Need-to-Know Basis**
  - What it doesn't know may help you.

- **A Tribute to Wolfgang Breitling**
  - The real genius behind our success.

- **Don't Fear the CBO**
  - Embrace it!

- **Start with Stats**
  - Gather your stats appropriately and have them there from the start.

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A Geographic Example

Can we get there from here?

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A Geographic Example

- **What's the quickest route between the two blue points?**

A Geographic Example

- **Google Maps says it's the outer loop - 19.1 miles.**
  - **Kind of like a full (Grand Rapids) table scan!**

A Geographic Example

- **What if we told it to go through green point B - 12.5 miles**
  - **Kind of like an INDEX or RULE hint!**

A Geographic Example

- **So why did Google Maps suggest the "long" way?**
  - **Most likely because it had information we do not.**

- **Google Maps probably knew that there are tons of long stop lights on the straight line path and that the speed limit is only 35, therefore it believes the straight line path would take 25 minutes.**
  - **Think histogram data!**

- **The long route had a higher speed limit and very few stop lights and it believes it would only takes 21 minutes.**
  - **Stop lights are like the number of index blocks to be read and speed limit is like the I/O rate.**

- **It did a Cost-based Optimization!**

A Geographic Example

- **Great, so every car should take the long route, right?**
  - **Maybe not if it's 3 AM and all the stop lights are green!**
  - **So it depends on the value of other variables.**

A Geographic Example

- **Oracle 10g works similarly with one exception: it looks at the value of the variables, but ONLY THE FIRST TIME it is parsed.**
  - **It's called bind variable peeking.**

- **So what happens if the first parse happens at 3 AM? Everyone for the rest of the day gets sent down the stop light filled straight path even at rush hour!**
  - **The plan is stored in the shared pool and reused each time to avoid the expensive hard parse, until it ages out.**

- **Performance can vary from day to day causing frustration for your drivers…er, end users.**

PM 08
PERFORMANCE MATTERS

Performance Matters!
Ron O'Donnell, theater professor
Founder, All the World's a Stage,
a showcase for original student work.

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Put the CBO on a Need-to-Know Basis

What it doesn't know may help you.

Put the CBO on a Need-to-Know Basis

- **In Banner and most OLTP applications you want the indexed route (the straight path) because it was designed to be accessed that way and is more efficient. We'll talk about exceptions later.**

- **Remove the histograms data (stoplights and speed limits data) and Oracle will choose the same path each time the query is parsed, no matter the variable data.**

- **This is the way Banner performed under the RBO. It did not consider as many costs or variables and it returned a consistent plan.**

- **"Histograms and bind variables have a somewhat strained relationship. They do not really go well together." – Wolfgang Breightling – "*Histograms – Myths and Facts*"**

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Tribute to Wolfgang Breitling

The real genius behind our success.

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Tribute to Wolfgang Breitling

- **Wolgang Breitling is an independent consultant for Peoplesoft Applications and an expert on the Oracle CBO, statistics and histograms.**

- **He is a member of the famed "OakTable Network".**

- **Papers and presentations available at http://www.centrexcc.com/**

- **Of particular interest is "Histograms – Myths and Facts" presented at the IOUG Collaborate 06 conference in Nashville, TN in April 2006.**

Tribute to Wolfgang Breitling

"Whenever the optimizer is called upon to parse a SQL statement and compile an access plan (hard parse), it uses the value for the bind variable for that execute request as if it had been coded as a literal in the SQL. Thus it can make full use of any available histograms. However, all future executes of this SQL will use this same plan, regardless of any difference in bind variable values, as long as the SQL remains valid in the shared pool. If that first hard parse uses an uncharacteristic bind value from the rest of the 'mainstream' SQL, then this bind variable peeking can backfire badly."

"Only use histograms where you can prove performance, otherwise it is potentially dangerous."
– From notes taken at IOUG 2006

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Tribute to Wolfgang Breitling

- **Three ways to fix from *Histograms – Myths and Facts***
  - **Execute the SQL in a startup trigger with bind values corresponding to the typical use – and then lock the SQL in the shared pool with the DBMS_SHARED_POOL.KEEP procedure.**
  - **Create a stored outline – or profile in Oracle10g – for the SQL when used with bind values corresponding to the typical use and set "USE_STORED_OUTLINES" for those sessions interested.**
  - **Disable bind variable peeking by setting "_OPTIM_PEEK_USER_BINDS=false". With this the optimizer returns to the pre-Oracle9i calculation of selectivities of columns with histograms. Since this is an undocumented (and unsupported) initialization parameter, it would be safer to just delete the histograms.**

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Tribute to Wolfgang Breitling

- **Tom Kyte agrees. From AskTom: *Histograms on high cardinality (most of the time)* January 1, 2007 -**
  - **"If you are using binds, you are expecting one plan and only one plan. Histograms in general would not be advised in that case."**
- **For even more info on bind variables and Oracle go to asktom.oracle.com, select the Files tab and download binding.pdf**

- **Other great sources:**
  - **"Inside the Oracle Optimizer – Removing the Black Magic" blog sponsored by the Oracle Optimizer Development Group http://www.optimizermagic.blogspot.com/**

  - **"Cost-Based Oracle Fundamentals" by Jonathan Lewis**

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Don't Fear the CBO

Embrace it!

Don't Fear the CBO

- **Banner uses bind variables**
    - **This is a really good thing!**

- **In order to have consistent plans you must eliminate the histogram data or bind variable peeking.**
    - **Eliminating histograms is much easier and speeds stats collection.**

- **There may be times when you really do want the long route for performance due to heavy skew in the data and data volume retrieved (Online versus Batch).**
    - **Put specific histograms in place when this skew comes into play and let the CBO help you.**

Don't Fear the CBO

- **Example: SCBCRSE Query**
    - **We have 3 campuses; one with ~40,000 students, one with ~24,000 students and one with ~6,000 students.**
    - **The largest campus has over 50% of the rows in SCBCRSE.**
    - **We use VPD to separate campuses so all queries get the VPD predicate added to them.**
    - **VPD code is the leading column in the PK.**
    - **A select * from SCBCRSE issued from a user at the large campus would end up being something like:**
    - **Select * from SCBCRSE where VPD_CODE = 1;**
    - **Without histogram data Oracle decides on an index range scan for this query when a full table scan would be more efficient.**
    - **Adding a histogram may backfire if this is a frequently used online form because only one plan would be stored.**
- **Histograms may be good for batch processes or infrequent online queries with skew.**
    - **Remember, only the first occurrence is peeked at.**

Don't Fear the CBO

- **We have histograms on only the following tables*:**
  - **SSBSECT**
  - **SORWDSP**
  - **GLBEXTR**
  - **SCBCRSE**
  - **STVSUBJ**
  - **FTVORGN**
  - **TBRAPPL**
  - **FGBTRNH (partitioned)**
  - **FGBTRND (partitioned)**

  - *** Your mileage may very so don't assume these will work for you as well.**

Don't Fear the CBO

- **How did we determine which tables to put histograms on?**
  - **Looked at processes that were reported as slow.**
  - **Traced the process (10046, level 12) or looked at it through Enterprise Manager to find the offending SQL.**
  - **Examined the plan and the bind variable data captured by the trace or captured in dba_hist_sqlbind table.**
  - **Looked for skew in the data, especially indexed columns, using queries like:**
    Select VPD_CODE, count(*) from SCBCRSE
    group by VPD_CODE;
  - **Recalced stats with SIZE=254 to generate histograms to help deal with skew.**
  - **Tested batch and online processes that touch the table.**

Don't Fear the CBO

- **To determine what histogram data are present for a table:**
  select table_name, column_name, num_distinct, num_nulls,
      density, histogram, num_buckets, last_analyzed
  from dba_tab_col_statistics
  where owner='SATURN'
  and table_name = 'SCBCRSE';

TABLE_NAME	COLUMN_NAME	NUM_DISTINCT	NUM_NULLS	DENSITY	HISTOGRAM	NUM_BUCKETS	LAST_ANALYZED
SCBCRSE	SCBCRSE_REPS_CODE	6	17155	0.000178185937272726	FREQUENCY	6	1/28/2008 1:38:53 AM
SCBCRSE	SCBCRSE_MAX_RPT_UNIT	32	18198	0.000283607497237663	FREQUENCY	32	1/28/2008 1:38:53 AM
SCBCRSE	SCBCRSE_CAPP_PREREC	2	0	0.000025048845248234	FREQUENCY	2	1/28/2008 1:38:53 AM
SCBCRSE	SCBCRSE_VPD_CODE	3	0	0.000025048845248234	FREQUENCY	3	1/28/2008 1:38:53 AM
SCBCRSE	SCBCRSE_SUBJ_CODE	345	0	0.0029757426818796	HEIGHT BALAN	254	1/28/2008 1:38:53 AM
SCBCRSE	SCBCRSE_CRSE_NUMB	630	0	0.0026541444239431	HEIGHT BALAN	254	1/28/2008 1:38:53 AM
SCBCRSE	SCBCRSE_EFF_TERM	43	0	0.000025048845248234	FREQUENCY	43	1/28/2008 1:38:53 AM
SCBCRSE	SCBCRSE_COLL_CODE	44	0	0.000025048845248234	FREQUENCY	44	1/28/2008 1:38:53 AM
SCBCRSE	SCBCRSE_DIVS_CODE	1	19945	0.03125	FREQUENCY	1	1/28/2008 1:38:53 AM
SCBCRSE	SCBCRSE_DEPT_CODE	302	200	0.0036069082305922	HEIGHT BALAN	254	1/28/2008 1:38:53 AM
SCBCRSE	SCBCRSE_CSTA_CODE	3	0	0.000025048845248234	FREQUENCY	3	1/28/2008 1:38:53 AM

Performance Matters!
Ron O'Connell, Theater professor
Founder, All the World's a Stage,
a showcase for original student work.

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Start with Stats

Gather your stats appropriately and
have them there from the start.

Start with Stats

- **Oracle 10g has a default stats job that runs nightly from the scheduler called GATHER_STATS_JOB. It only gathers new stats when 10% of the table have changed. It determines if a column needs histograms and the number of buckets using SIZE=AUTO.**
- **Turn this off using:**
  EXECUTE DBMS_SCHEDULER.DISABLE('GATHER_STATS_JOB');
- **Gather stats using DBMS_STATS.GATHER_TABLE_STATS with SIZE=1 to eliminate histograms.**
- **Consider running stats less frequently, like weekly or monthly.**
- **Consider changing threshold for new stats.**
  We use a threshold of 5% change or 250,000 changes to determine when to gather new stats.
- **Feel free to use our stats script, runStats.ksh, which can be downloaded from the Summit site under this session number.**

Don't Fear the CBO

- **Stats commands you should become familiar with:**

  - **exec DBMS_STATS.GATHER_TABLE_STATS**

  - **exec DBMS_STATS.RESTORE_TABLE_STATS**

  - **exec DBMS_STATS.LOCK_TABLE_STATS**

  - **exec DBMS_STATS.UNLOCK_TABLE_STATS**

  - **exec DBMS_STATS.DELETE_TABLE_STATS**

Start with Stats

- **You'll need stats immediately after your upgrade to 10g and running new stats on a large database can take a long time making your upgrade window much longer.**

- **To shorten the down time collect stats in a recent full sized 10g test database copied from production and then export the stats to be imported during the upgrade window. This method saves considerable time!**

Start with Stats

- **To export stats first create a stats table, populate it and then export.**
  - **exec dbms_stats.create_stat_table('ORACLE','T_STATS_TEMP');**
    set head off feed off pagesize 0
    spool exp_STATS_$ORACLE_SID.sql
    select distinct 'exec dbms_stats.export_schema_stats('''||owner||''',statown=>'''||'ORACLE'||''',stattab=>'''||'T_STATS_TEMP'||''');' from dba_tables;
    spool off
    set head on feed on pagesize 25
  - **Execute exp_STATS_$ORACLE_SID.sql. This will export all database stats into ORACLE.T_STATS_TEMP table.**
  - **Export this table –**
    exp / file=exp_T_STATS_TEMP.dmp log=exp_T_STATS_TEMP.log tables=oracle.t_stats_temp direct=y

Start with Stats

- **During the production upgrade import the stats. You'll be ready for testing with good stats in less than 20 minutes!**
  - **imp / file=exp_T_STATS_TEMP.dmp log=imp_T_STATS_TEMP.log full=y ignore=y**
  - **Import the stats into the dictionary:**
    set head off feed off pagesize 0
    spool imp_STATS_$ORACLE_SID.sql
    select distinct 'exec dbms_stats.import_schema_stats('''||owner||''','||'statown=>'''||'ORACLE'||''',stattab=>'''||'T_STATS_TEMP'||''');' from dba_tables;
    spool off;
    set head on feed on pagesize 25
  - **Execute imp_STATS_$ORACLE_SID.sql. This will import all database stats from ORACLE.T_STATS_TEMP table into the dictionary.**

Summary

- **Histograms and bind variables don't mix well.**

- **Default 10g stats are not good for Banner.**

- **If performance is poor without histograms then look for skew and test with histograms.**

- **Gather stats in test database and import to prod during 10g upgrade.**

Questions & Answers

Thank You!

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Course ID S-0133