

# Optimizing Oracle 18c Performance

## The Memoptimize Pool and Private Temporary Tables

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- Director of Applications @ TidalScale

 Oracle ACE Director Alum

- Oracle Educator



Curriculum author and primary instructor, Oracle Program, University of Washington 1998-2009




Consultant: Harvard University

- Guest lecturer at universities in Canada, Chile, Costa Rica, New Zealand, Norway, Panama
- Frequent lecturer at Oracle conferences ... 43 countries since 2008
- IT Professional
  - 2019 will be my 50<sup>th</sup> year in IT
  - First computer: IBM 360/40 in 1969: Fortran IV
  - Oracle Database since 1988-9 and Oracle Beta tester
  - The Morgan behind [www.morganslibrary.org](http://www.morganslibrary.org)
  - Member Oracle Data Integration Solutions Partner Advisory Council
  - Founding member International TidalScale User Community (ITUC)

# My Personal Website

www.morganslibrary.org



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● www ○ library

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### The Library

The library is a spam-free on-line resource with code demos for DBAs and Developers. If you would like to see new Oracle database functionality added to the library ... just email us. Oracle Database 12cR2 is now available in the Cloud. If you are not already working in a 12cR1 CDB database ... you are late to the party and you are losing your competitive edge.

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**Mad Dog Morgan**




**Training Events and Travels**

- OTN APAC, Sydney, Australia - Oct 31
- OTN APAC, Gold Coast, Australia - Nov 02
- OTN APAC, Beijing China - Nov 04-05
- OTN APAC, Shanghai China - Nov 06
- Sangam16, Bangalore, India - Nov 11-12
- NYOUG, New York City - Dec 07


**Next Event: Indiana Oracle Users Group**

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**Morgan**





aboard USA-71



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**ACE News**

Would you like to become an Oracle ACE? 📢










Learn more about becoming an ACE



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## Performance Problems Have Serious Consequences . . .

- Internal and External customers have expectations
- There is a long history of disappoint
- Thus, we have Service Level Agreements

## When We Fail To Deliver . . .

- Internal customers develop their own solutions
- External customers go elsewhere
- SLA violations result in financial penalties
- Management wonders whether we are providing value

# Only 2 Things Matter In Business Computing . . .

## QoS

- Stability
- Security
- Scalability
- Usability
- Performance

## TCO

- Affordability

# The History of Oracle Performance Tuning . . .



# How Many Books Read?

## How Many Oracle Tools Deployed?

- DBMS\_SUPPORT (version 7.2)
- DBMS\_TRACE (version 8.1.5)
- DBMS\_MONITOR (version 10gR1)
- Oracle Enterprise Manager (OEM)
- StatsPack, ADDM, ASH, AWR, TKPROF, ....

```
ALTER SESSION SET tracefile_identifier = 'test_plan1';

ALTER SESSION SET EVENTS '10053 trace name context forever, level 1';

ALTER SESSION SET EVENTS '10046 trace name context forever, level 12';

-- execute SQL

ALTER SESSION SET EVENTS '10053 trace name context OFF';
ALTER SESSION SET EVENTS '10046 trace name context OFF';
or
ALTER SESSION SET SQL_TRACE=FALSE;

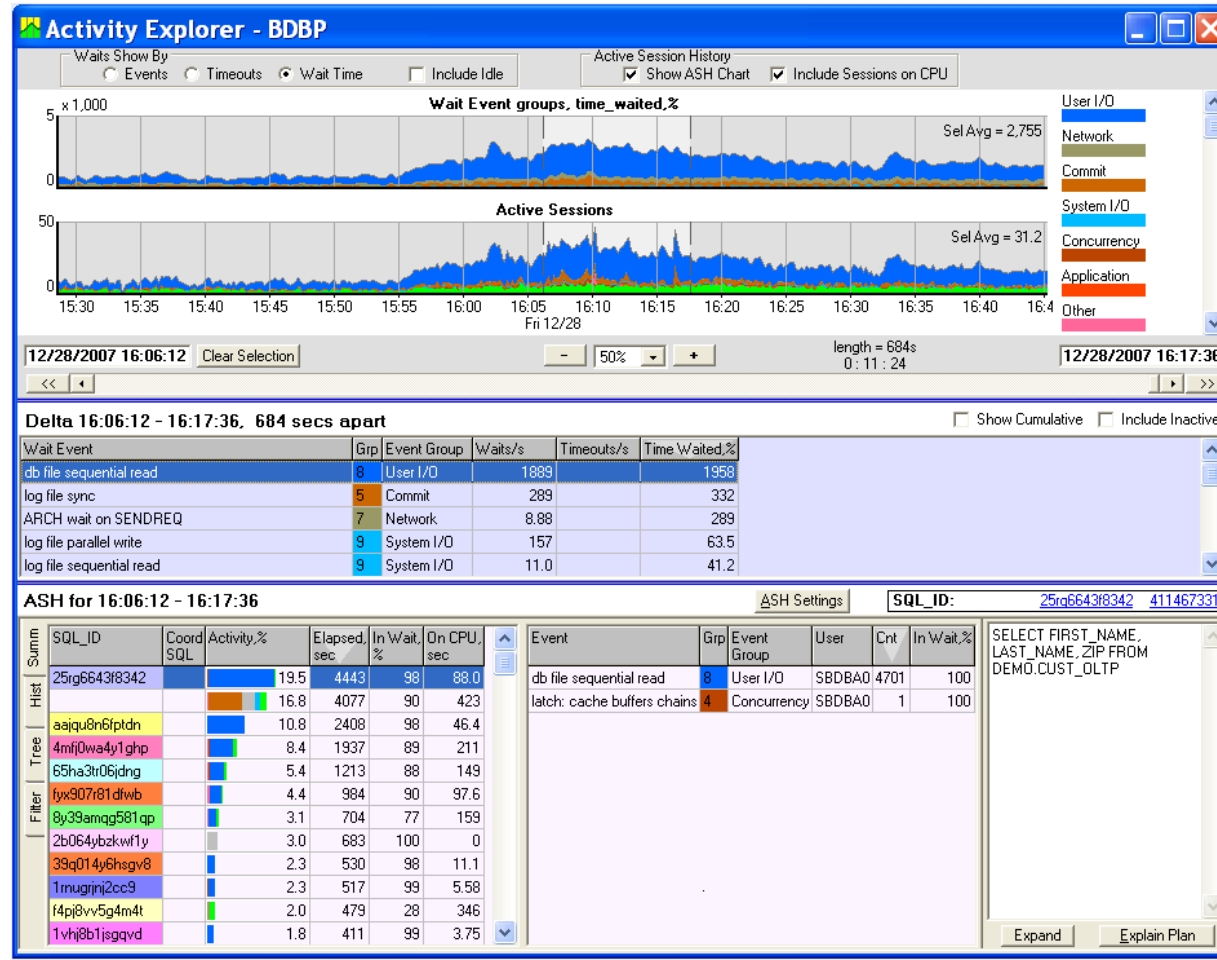
review the trace file in $ORACLE_BASE/diag/orabase/orabase/trace
```



# How Many Tools Have You Purchased?



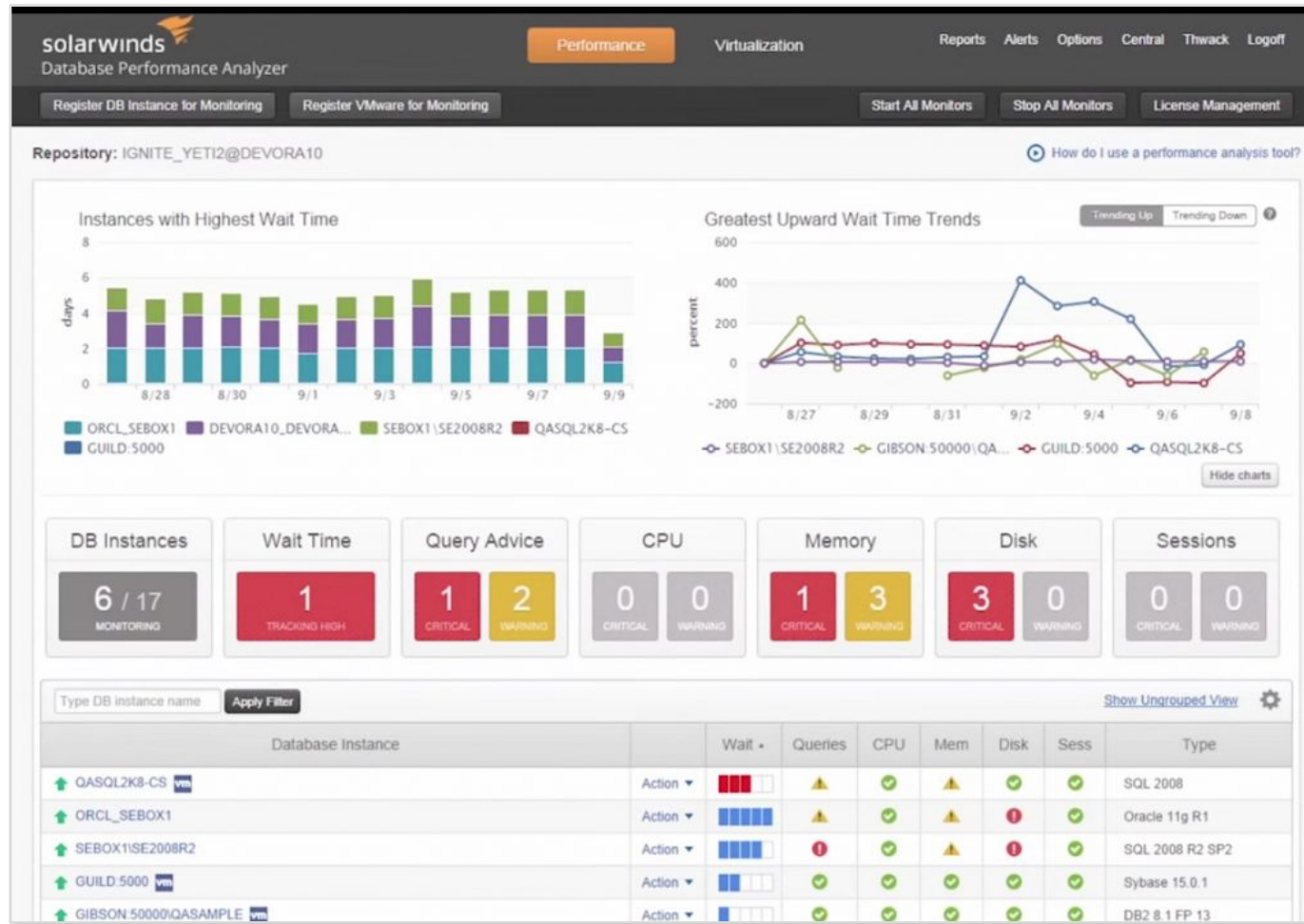
# How Many Tools Have You Purchased?



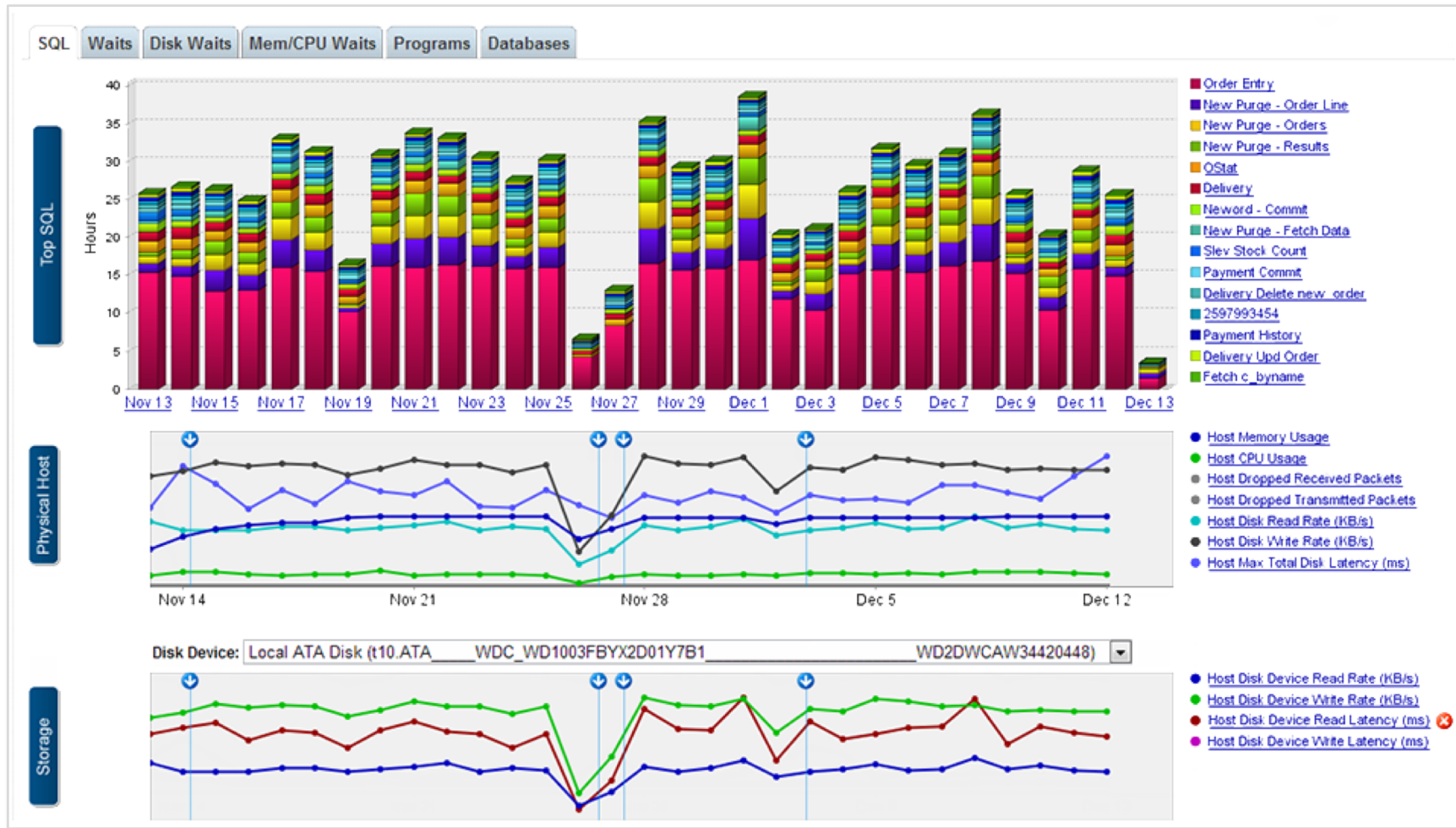
# How Many Tools Have You Purchased?



# How Many Tools Have You Purchased?



# How Many Tools Have You Purchased?



# How Many Startup Parameters Configured?

| Initialization Parameter          | Description  |
|-----------------------------------|--|
| BITMAP_MERGE_AREA_SIZE            | Specifies the amount of memory used to merge bitmaps retrieved from an index range scan                      |
| DB_BIG_TABLE_CACHE_PERCENT_TARGET | Specifies the cache section target size for automatic big table caching, as a percentage of the buffer cache |
| DB_nK_CACHE_SIZE                  | Holds 8K table and index blocks  |
| CREATE_BITMAP_AREA_SIZE           | Memory allocated for bitmap creation a larger value may speed up index creation                              |
| DB_BLOCK_BUFFERS                  | Specifies the number of database buffers in the buffer cache   |
| DB_CACHE_SIZE                     | Specifies the size of the DEFAULT buffer pool for buffers with the primary block size                        |
| DB_FLASH_CACHE_SIZE               | Specifies the size of the Database Smart Flash Cache   |
| DB_KEEP_CACHE_SIZE                | Specifies the size of the KEEP buffer pool   |
| DB_RECYCLE_CACHE_SIZE             | Specifies the size of the RECYCLE buffer pool  |
| HASH_AREA_SIZE                    | Specifies the maximum amount of memory, in bytes, to be used for hash joins                                  |
| JAVA_MAX_SESSIONSPACE_SIZE        | Memory that holds Java state from one database call to another   |
| JAVA_POOL_SIZE                    | Pool, from which the Java memory manager allocates most Java state during runtime execution                  |
| LARGE_POOL_SIZE                   | Specifies (in bytes) the size of the large pool allocation heap  |
| LOG_BUFFER                        | Memory used when buffering redo entries to a redo log file   |
| MEMOPTIMIZE_POOL_SIZE             | Specifies the size of the memoptimize pool, a memory area in the SGA used by the Memoptimized Rowstore       |

| Initialization Parameter      | Description   |
|-------------------------------|---|
| MEMORY_MAX_TARGET             | Specifies the maximum value to which a DBA can set the MEMORY_TARGET initialization parameter                                 |
| MEMORY_TARGET                 | Specifies the Oracle system-wide usable memory  |
| OBJECT_CACHE_MAX_SIZE_PERCENT | specifies the percentage of the optimal cache size that the session object cache can grow past the optimal size               |
| OBJECT_CACHE_OPTIMAL_SIZE     | Specifies the size by which the session object cache is reduced when the cache size exceeds the maximum size                  |
| OLAP_PAGE_POOL_SIZE           | Specifies the size of the OLAP page pool  |
| PGA_AGGREGATE_LIMIT           | Specifies a limit on the aggregate PGA memory consumed by the instance  |
| PGA_AGGREGATE_TARGET          | Specifies the target aggregate PGA memory available to all server processes attached to the instance                          |
| PRE_PAGE_SGA                  | Specifies whether Oracle reads the entire SGA into memory at startup so that O/S page table entries are pre-built for the SGA |
| SGA_MAX_SIZE                  | Specifies the maximum size of the SGA for the lifetime of the instance  |
| SGA_MIN_SIZE                  | Specifies the minimum size of the SGA for the lifetime of the instance  |
| SGA_TARGET                    | Specifies the total size of all SGA components  |
| SHARED_POOL_RESERVED_SIZE     | Specifies the shared pool space reserved for large contiguous requests for shared pool memory                                 |
| SHARED_POOL_SIZE              | Specifies the size of the shared pool which contains shared cursors, stored procedures, control and other structures          |
| SORT_AREA_RETAINED_SIZE       | Specifies the maximum amount of the user global area (UGA) memory retained after a sort run completes                         |
| SORT_AREA_SIZE                | Specifies the maximum amount of memory Oracle will use for a sort   |
| STREAMS_POOL_SIZE             | Specifies the memory allocated for Streams, GoldenGate Integrated Capture and other related processes                         |
| USE_LARGE_PAGES               | Specify the management of the database's use of large pages for SGA memory  |

# WORKLOAD REPOSITORY report for

| DB Name | DB Id      | Unique Name | Role    | Edition | Release    | RAC | CDB |
|---------|------------|-------------|---------|---------|------------|-----|-----|
| ORCL    | 1499046141 | orcl        | PRIMARY | EE      | 12.2.0.1.0 | NO  | NO  |

| Instance | Inst Num | Startup Time    |
|----------|----------|-----------------|
| oracle   | 1        | 25-Aug-18 16:08 |

| Host Name  | Platform         | CPUs | Cores | Sockets | Memory (GB) |
|------------|------------------|------|-------|---------|-------------|
| oracle7002 | Linux x86 64-bit | 36   | 36    | 36      | 1153.16     |

|             | Snap Id | Snap Time          | Sessions | Cursors/Session |
|-------------|---------|--------------------|----------|-----------------|
| Begin Snap: | 2713    | 27-Aug-18 00:46:47 | 47       | .8              |
| End Snap:   | 2714    | 27-Aug-18 00:58:57 | 103      | .8              |
| Elapsed:    |         | 12.18 (mins)       |          |                 |
| DB Time:    |         | 138.66 (mins)      |          |                 |

## Report Summary

### Top ADDM Findings by Average Active Sessions

| Finding Name               | Avg active sessions of the task | Percent active sessions of finding | Task Name              | Begin Snap Time | End Snap Time   |
|----------------------------|---------------------------------|------------------------------------|------------------------|-----------------|-----------------|
| Top SQL Statements         | 11.40                           | 70.40                              | ADDM:1499046141_1_2714 | 27-Aug-18 00:46 | 27-Aug-18 00:58 |
| Undersized PGA             | 11.40                           | 3.47                               | ADDM:1499046141_1_2714 | 27-Aug-18 00:46 | 27-Aug-18 00:58 |
| Undersized SGA             | 11.40                           | 2.82                               | ADDM:1499046141_1_2714 | 27-Aug-18 00:46 | 27-Aug-18 00:58 |
| Unusual "Other" Wait Event | 11.40                           | 2.27                               | ADDM:1499046141_1_2714 | 27-Aug-18 00:46 | 27-Aug-18 00:58 |

## Memory Statistics

|                              | Begin       | End         |
|------------------------------|-------------|-------------|
| Host Mem (MB):               | 1,180,832.7 | 1,180,832.7 |
| SGA use (MB):                | 972,800.0   | 972,800.0   |
| PGA use (MB):                | 361.9       | 7,848.7     |
| % Host Mem used for SGA+PGA: | 82.41       | 83.05       |

## Cache Sizes

|                   | Begin    | End      |                 |          |
|-------------------|----------|----------|-----------------|----------|
| Buffer Cache:     | 96,768M  | 96,768M  | Std Block Size: | 8K       |
| Shared Pool Size: | 202,163M | 202,149M | Log Buffer:     | 495,048K |
| In-Memory Area:   | 665,600M | 665,600M |                 |          |

## Shared Pool Statistics

|                            | Begin | End   |
|----------------------------|-------|-------|
| Memory Usage %:            | 3.57  | 3.66  |
| % SQL with executions>1:   | 91.10 | 90.41 |
| % Memory for SQL w/exec>1: | 89.90 | 87.87 |

## Foreground Wait Events

- s - second, ms - millisecond, us - microsecond, ns - nanosecond
- Only events with Total Wait Time (s) >= .001 are shown
- ordered by wait time desc, waits desc (idle events last)
- %Timeouts: value of 0 indicates value was < .5%. Value of null is truly 0

| Event                  | Waits   | %Time-outs | Total Wait Time (s) | Avg wait | Waits /txn | % DB time |
|------------------------|---------|------------|---------------------|----------|------------|-----------|
| direct path write temp | 25,156  |            | 286                 | 11.37ms  | 613.56     | 3.44      |
| PGA memory operation   | 191,325 |            | 189                 | .99ms    | 4,666.46   | 2.27      |
| library cache: mutex X | 2,415   |            | 27                  | 11.24ms  | 58.90      | 0.33      |

## Memoptimize Pool

- Caches data to optimize read operations for key based SELECT statements from uncompressed heap tables created or altered with the MEMOPTIMIZE FOR READ clause
- When populated provides significant performance improvements with statements of the form

```
SELECT <column_name_list>  
FROM <table_name>  
WHERE <primary_key_column_name> = <value>;
```

which is pretty much every query ever written

- Manage the pool with the DBMS\_MEMOPTIMIZE built-in PL/SQL package

```
SSQL> exec dbms_memoptimize.populate('C##UWCLASS', 'SERVERS');  
  
SQL> exec dbms_memoptimize.drop_object('C##UWCLASS', 'SERVERS');
```

# Memoptimize Pool

```
SQL> conn / as sysdba
```

```
SQL> show parameter memopt
```

| NAME                  | TYPE        | VALUE |
|-----------------------|-------------|-------|
| memoptimize_pool_size | big integer | 0     |

```
SQL> col value format 9999999999
```

```
SQL> SELECT * FROM v$sga;
```

| NAME             | VALUE      | CON_ID |
|------------------|------------|--------|
| Fixed Size       | 8907792    | 0      |
| Variable Size    | 1040187392 | 0      |
| Database Buffers | 4429185024 | 0      |
| Redo Buffers     | 74977280   | 0      |

```
SQL> ALTER SYSTEM SET memoptimize_pool_size = 1G sid='*' scope=SPFILE;
```

```
System altered.
```

# Memoptimize Pool

```
SQL> SHUTDOWN IMMEDIATE;  
Database closed.  
Database dismounted.  
ORACLE instance shut down.
```

```
SQL> STARTUP;  
ORACLE instance started.
```

```
Total System Global Area 5553257488 bytes  
Fixed Size 8907792 bytes  
Variable Size 2030043136 bytes  
Database Buffers 3439329280 bytes  
Redo Buffers 74977280 bytes  
Database mounted.  
Database opened.
```

# Memoptimize Pool

```
SQL> show parameter memopt
```

| NAME                  | TYPE        | VALUE |
|-----------------------|-------------|-------|
| -----                 |             |       |
| memoptimize_pool_size | big integer | 1G    |

```
SQL> col value format 9999999999
```

```
SQL> SELECT * FROM v$sga;
```

| NAME             | VALUE      | CON_ID |
|------------------|------------|--------|
| -----            |            |        |
| Fixed Size       | 8907792    | 0      |
| Variable Size    | 1912602624 | 0      |
| Database Buffers | 3556769792 | 0      |
| Redo Buffers     | 74977280   | 0      |

-- compare the yellow and green highlighted rows before and after enabling the memoptimize pool.

```
SQL> col component format a30
```

| NAME             | VALUE      | CON_ID |
|------------------|------------|--------|
| -----            |            |        |
| Fixed Size       | 8907792    | 0      |
| Variable Size    | 1040187392 | 0      |
| Database Buffers | 4429185024 | 0      |
| Redo Buffers     | 74977280   | 0      |

## Private Temporary Tables

- First available in Oracle 18c
- A memory-based temporary table that is dropped at the end of the session or transaction
  - Global Temporary Tables (Temp Tablespace)
  - Private Temporary Tables (In-Memory)
  - SYS cannot create PTTs
- With Private Temporary Tables Oracle has a temporary table that behaves like those in products based on the UC Berkeley Ingres model

```
SQL> sho parameter private
```

| NAME                      | TYPE   | VALUE     |
|---------------------------|--------|-----------|
| private_temp_table_prefix | string | ORA\$PTT_ |

```
SQL> CREATE PRIVATE TEMPORARY TABLE ora$ptt_ocdr(  
2  rid    NUMBER(10),  
3  rname  VARCHAR2(20))  
4  ON COMMIT PRESERVE DEFINITION;
```

```
SQL> SELECT table_name, tablespace_name  
2  FROM dba_private_temp_tables
```

| TABLE_NAME    | TABLESPACE_NAME |
|---------------|-----------------|
| ORA\$PTT_OCDR | TEMP            |

## Wrap Up . . .

- Memory is 300X faster than flash
- The more of your data you can cache in memory the more your performance will improve due to reducing PIO and increasing LIO
- If you are running OLTP loads that will not benefit from Database In-Memory examine the advantage of
  - Using TidalScale Software Defined Servers to provide you with sufficient memory
  - Enable the Memoptimize Pool
  - Building your biggest tables at Private Temporary Tables reducing PIO
- TidalScale Software Defined Servers let you create an ideal environment with the cpu and memory customized to
  - Improve performance
  - Control your licensing cost

# Next Steps



## Contact me directly to

- Answer questions about TidalScale Software Defined Servers
- Present TidalScale Software Defined Servers to your team
- Identify opportunities in your organization for Software Defined Servers

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