Safe Harbor Statement

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Program Agenda

1. Introducing Applied Machine Learning for Operations
2. Applied Machine Learning for Real-time Prevention
3. Applied Machine Learning for Rapid Recovery
4. ODA Management Appliance Profile
5. For Further Information / Q & A
Program Agenda with Highlight

1. Introducing Applied Machine Learning for Diagnostics
2. Applied Machine Learning for Real-time Prevention
3. Applied Machine Learning for Rapid Recovery
4. ODA Management Appliance Profile
5. For Further Information / Q & A
Why Applied Machine Learning?

• Brings an application’s perspective versus a platform toolkit viewpoint
• Brings data science, algorithms, and domain expertise together
• Packages machine learning into usable, real-world operational algorithms and models that are applied at runtime
• Produces results and recommendations easily understood and trusted by non-data scientist/analyst end-users
Applied Machine Learning for Diagnostics

• Generic ML-extracted Data Clusters are insufficient for diagnostics
• Operational data correlation does not determine root cause
• Trusted root cause determination critical to swift corrective actions
• Algorithms selected and models built require domain expertise
• Models refined via field feedback
Oracle 12c Autonomous Health Framework

Powered by Applied Machine Learning

Managed Centrally by ODA DSC
Applied ML in Oracle Autonomous Health Framework

Real-time Prevention

- Bugs/SRs
- Best Practices
- Metrics
- Logs
- Diagnostics

Preventative Actions

- Manual
- Auto

Cluster Health Advisor
Hang Manager

Trace File Analyser

- Prognostics
- Alerts
- Metrics
- Logs
- Bugs/SRs

Corrective Actions

- Manual
- Auto

Oracle Enterprise Manager

Oracle Support Services

QoS/M Policies

SRs

Bugs/SRs

Best Practices

Metrics

Logs

Diagnostics

Prognostics

Alerts

Metrics

Logs

Bugs/SRs

Real-time Prevention

Rapid Recovery

Inputs

Inputs

ORACLE SUPPORT SERVICES
Program Agenda

1. Introducing Applied Machine Learning for Diagnostics
2. Applied Machine Learning for Real-time Prevention
3. Applied Machine Learning for Rapid Recovery
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Applied Machine Learning – Cluster Health Advisor (CHA)

• Monitors in real-time Oracle database* systems and their hosts
  • Detects early impending as well as ongoing system faults
  • Diagnoses and identifies the most likely root causes
  • Provides targeted actions for prevention or escalation of DB/server problems
  • Generates relevant alerts and notifications for rapid response

• Released in 12.2 and currently under test by major RAC customers for production

* Currently RAC/R1N Databases only
Cluster Health Advisor - Scope of Problem Detection

Best Effort Immediate Guided Diagnosis

- Over 30 node and database problems have been modeled
- Over 150 OS and DB metric predictors identified
- Problem network model created based upon its signature
- Problem Detection in 12.2.0.1 includes
  - Interconnect, Global Cache and Cluster Problems
  - Host CPU and Memory, PGA Memory stress
  - IO and Storage Performance issues
  - Reconfiguration and Recovery issues
  - Workload and Session abnormal variations
Cluster Health Advisor (CHA) Architecture Overview

- **cha** – Cluster node resource
- Single Java oracle.cha.server.CHADDriver daemon per node
- Reads Cluster Health Monitor data directly from memory
- Reads DB ASH data from SMR w/o DB connection
- Uses OS and DB models and data to perform prognostics
- Stores analysis and evidence in the GI Management Repository
- Sends alerts to EMCC Incident Manager per target
Applied Machine Learning – Cluster Health Advisor

**Discovers Potential Cluster & DB Problems**

- Actual Internal and External customer data drives model development
- Applied purpose-built Applied ML for knowledge extraction
- Expert Dev team scrubs data
- Generates Bayesian Network-based diagnostic root-cause models
- Uses BN-based run-time models to perform real-time prognostics
Cluster Health Advisor

Data Sources and Data Points

A CHA Data Point contains > 150 signals (statistics and events) from multiple sources

OS, ASM, Network ——> DB (ASH, AWR session, system and PDB statistics)

<table>
<thead>
<tr>
<th>Time</th>
<th>CPU</th>
<th>ASM</th>
<th>IOPS</th>
<th>Network % util</th>
<th>Network Packets Dropped</th>
<th>Log file sync</th>
<th>Log file parallel write</th>
<th>GC CR request</th>
<th>GC current request</th>
<th>GC current block 2-way</th>
<th>GC current block busy</th>
<th>Enq: CF - contention</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:16:00</td>
<td>0.90</td>
<td>4100</td>
<td>13%</td>
<td>0</td>
<td>2 ms</td>
<td>600 us</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>300 us</td>
<td>1.5 ms</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Statistics are collected at a 1 second internal sampling rate, synchronized, smoothed and aggregated to a Data Point every 5 seconds.
Models Capture all Normal Operating Modes

Models Capture the Dynamic Behavior of all Normal Operation

A model captures *the normal load phases* and their statistics over time, and thus the characteristics for all load intensities and profiles. During monitoring, *any data point similar* to one of the vectors is NORMAL. One could say *that the model REMEMBERS the normal operational dynamics over time*.
Cluster Health Advisor

**CHA Model: Find Similarity with Normal Values**

**In-Memory Reference Matrix**

*Part of “Normality” Model*

<table>
<thead>
<tr>
<th></th>
<th>IOPS</th>
<th>User Commits</th>
<th>Log File Parallel Write</th>
<th>Log File Sync</th>
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<tr>
<td></td>
<td>####</td>
<td>#####</td>
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<td></td>
<td>2500</td>
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<td></td>
<td>4900</td>
<td>21000</td>
<td>4100</td>
<td>9025</td>
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<tr>
<td></td>
<td>800</td>
<td>4400</td>
<td>22050</td>
<td>4024</td>
</tr>
<tr>
<td></td>
<td>####</td>
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<tr>
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<td></td>
</tr>
</tbody>
</table>

**Observed values**

*Part of a Data Point*

<table>
<thead>
<tr>
<th></th>
<th>10500</th>
<th>20000</th>
<th>4050</th>
<th>10250</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-1000</td>
<td>-50</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Residual Values**

*Part of a Data Point*

<table>
<thead>
<tr>
<th></th>
<th>5600</th>
<th>-1000</th>
<th>-50</th>
<th>325</th>
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<td></td>
</tr>
</tbody>
</table>

**CHA estimator/predictor (ESEE):** “based on my normality model, the value of IOPS should be in the vicinity of ~ 4900, but it is reported as 10500, this is causing a residual of ~ 5600 in magnitude”,

**CHA fault detector:** “such high magnitude of residuals should be tracked carefully! I’ll keep an eye on the incoming sequence of this signal IOPS and if it remains deviant I’ll generate a fault on it”.

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ORACLE


# Cluster Health Advisor

## Inline and Immediate Fault Detection and Diagnostic Inference

**Input : Data Point at Time t**

<table>
<thead>
<tr>
<th>Time</th>
<th>CPU</th>
<th>ASM IOPS</th>
<th>Network % util</th>
<th>Network Packets Dropped</th>
<th>Log file sync</th>
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<tbody>
<tr>
<td>15:16:00</td>
<td>0.90</td>
<td>4100</td>
<td>88%</td>
<td>105</td>
<td>2 ms</td>
<td>600 us</td>
<td>504 ms</td>
<td>513 ms</td>
<td>2 ms</td>
<td>5.9 ms</td>
<td>0</td>
</tr>
</tbody>
</table>

### Fault Detection and Classification

<table>
<thead>
<tr>
<th>Time</th>
<th>Status 1</th>
<th>Status 2</th>
<th>Status 3</th>
<th>Status 4</th>
<th>Status 5</th>
<th>Status 6</th>
<th>Status 7</th>
<th>Status 8</th>
<th>Status 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:16:00</td>
<td>OK</td>
<td>OK</td>
<td>HIGH 1</td>
<td>HIGH 2</td>
<td>OK</td>
<td>OK</td>
<td>HIGH 3</td>
<td>HIGH 3</td>
<td>HIGH 4</td>
</tr>
</tbody>
</table>

### Diagnostic Inference

**Symptoms**

1. Network Bandwidth Utilization
2. Network Packet Loss
3. Global Cache Requests Incomplete
4. Global Cache Message Latency

**Root Cause**

(Target of Corrective Action)

Network Bandwidth Utilization
ASM Cluster-wide Disk Utilization on Host rwsbi06 Database/Cluster rwsbi0508-mb2 Instance. The Cluster Health Advisor (CHA) detected slower ti...

Unassigned, Not acknowledged

**Incident Details**

- ID: 766
- Metric: Alert Level
- Metric Group: CHA Alerts
  - Key: CHA_INCIDENT_STATE_CHANGE_CLUSTERWARE_rwsbi0508-mb2__CHA_
  - Target: rwsbi0508-mb2 (Cluster)
- Incident Created: Sep 29, 2017 7:06:45 PM GMT
- Last Updated: Sep 29, 2017 7:06:45 PM GMT
- Summary: ASM Cluster-wide Disk Utilization on Host rwsbi06 Database/Cluster rwsbi0508-mb2 Instance. The Cluster Health Advisor (CHA) detected slower than expected disk performance because the high disk I/O demand from the other servers increased the utilization of the shared disks. Review the CHA findings and corrective actions from the other servers and database instances in the cluster for I/O issues. Add disks to the database disk groups.
- Internal Event Name: cha_alerts:cha_alert_level
- Event Type: Metric Alert
- Category: Unclassified

**Tracking**

- Escalated: No
- Priority: None
- Status: New
- Last: Incident created by rule (Name = Incident management rule set for all targets, Create incident for critical metric
- Comment: (System generated rule): on Sep 29, 2017 7:06:45 PM GMT

- Acknowledge
- Add Comment ...
- Manage ...

This incident will be automatically cleared when the underlying issue is resolved.

**Guided Resolution**

- Diagnostics: Problem Analysis
- Actions: Edit Thresholds
- Corrective Actions: No corrective action defined.
  - Add corrective action

**Metric Data**

- Critical Threshold: Not Applicable
- Warning Threshold: Not Applicable
- Number of Occurrences: 0
- Last Known Value: Critical
Cluster Health Advisor

The degradation is caused by a higher than expected utilization of shared storage devices for this database. No evidence of significant increase in I/O demand on the local node.

**Problem**

95.17%

**Action**

Validate whether there is increase in I/O demand on other nodes than the local and find I/O intensive SQL. Add more disks to disk group or move database to faster disks.

**Metric Data**

- Critical Threshold: Not Applicable
- Warning Threshold: Not Applicable
- Number of Occurrences: 0
- Last Known Value: Critical

---

**Cluster Health Advisor**

The degradation is caused by a higher than expected utilization of shared storage devices for this database. No evidence of significant increase in I/O demand on the local node.

**Problem**

95.17%

**Action**

Validate whether there is increase in I/O demand on other nodes than the local and find I/O intensive SQL. Add more disks to disk group or move database to faster disks.
Oracle Cluster Health Advisor (CHA)
Standalone Data Exploration Tool

- Standalone Java GUI Client
- Must be run on local cluster node
- Can be run against live GIMR or MDB (dump) file
  `chactl export repository -format mdb -start '2017-05-01 00:00:00' -end '2017-05-10 00:00:00'`
- Used internally for development
- Will be available and maintained on Oracle Technology Network
Cluster 'mycluster'

Hosts

Databases
Database prod, Instances: 2

DB prod in mycluster Sep-16 22:16:35

Instance 'prod_1'

Instance 'prod_2'
CHA detected that the redo log writes are slower than expected.
1: CHA detected that the redo log writes are slower than expected.

**Cause:**
The Cluster Health Advisory (CHA) detected that the writes to the redo logs slowed down because the data disk group IO rate has increased.

**Corrective Action:**
Separate the redo logs from the other database files. Move the redo logs to faster disks or Solid State Devices. Check logs and ASM statistics for signs of device errors and differences in performance between the redo logs, and replace the malfunctioning disks.
1: CHA detected that the Database Writer processes (DBW) are waiting longer than expected for checkpoints to complete. This can result in performance degradation during log switches and can also affect instance recovery times.

2: CHA detected that the redo log writes are slower than expected.
1: CHA detected that the Database Writer processes (DBW) are waiting longer than expected for checkpoints to complete. This can result in performance degradation during log switches and can also affect instance recovery times.

**Cause:**
The Cluster Health Advisor (CHA) detected that Database Writer (DBW) checkpoints were slow because the database writes took longer than expected to complete.

**Corrective Action:**
Increase the number of DBWR processes. Add additional disks to the disk group for the database. Relocate the database files to faster disks or to Solid State Devices. If the storage subsystem supports a storage write back cache, check that the storage cache is functioning properly.

2: CHA detected that the redo log writes are slower than expected.

- **Db file parallel write**: 71.215 ms, expected: 11.00 ms
- **Log file parallel write**: 17.295 ms, expected: 16.647 ms
1: CHA detected that the Database Writer processes (DBW) are waiting longer than expected for checkpoints to complete. This can result in performance degradation during log switches and can also affect instance recovery times.

Cause:
The Cluster Health Advisor (CHA) detected that Database Writer (DBW) checkpoints were slow because the database writes took longer than expected to complete.

Corrective Action:
Increase the number of DBWR processes. Add additional disks to the disk group for the database. Relocate the database files to faster disks or to Solid State Devices. If the storage subsystem supports a storage write back cache, check that the storage cache is functioning properly.

2: CHA detected that the redo log writes are slower than expected.

3: CHA detected that the ASM disk service time is higher than expected.
1: CHA detected that the Database Writer processes (DBW) are waiting longer than expected for checkpoints to complete. This can result in performance degradation during log switches and can also affect instance recovery times.

2: CHA detected that the redo log writes are slower than expected.

3: CHA detected that the ASM disk service time is higher than expected.

Cause:
The Cluster Health Advisor (CHA) detected slower than expected disk performance because the high disk I/O demand from the other servers increased the utilization of the shared disks.

Corrective Action:
Review the CHA findings and corrective actions from the other servers and database instances in the cluster for IO issues. Add disks to the database disk groups.

Disk service time (ASM): 11.00 ms/I/O, expected: 8.04 ms/I/O

Sep-16 22:02:05
1: CHA detected that the ASM disk service time is higher than expected.

Cause:
The Cluster Health Advisor (CHA) detected slower than expected disk performance because the high disk I/O demand from the other servers increased the utilization of the shared disks.

Corrective Action:
Review the CHA findings and corrective actions from the other servers and database instances in the cluster for IO issues. Add disks to the database disk groups.
Oracle Cluster Health Advisor Coming Features

- Cross Cluster Problem Support
  - Inter-Instance Problem Detection
  - Inter-Database Problem Detection
- Portable HTML Report
  - Consolidated diagnosis output
  - Easy to send and review

2017-02-06 09:40:55.0  Database oltpacdb  DB Multi Block
Read I/O Performance (oltpacdb_1) [detected]

Top Instances/PDBs by : IOs per sec
Database oltpacdb  Host slcac455  Instance total 2228.80
Database oltpacdb  Host slcac455  PDB OLTPA  308.40
Database oltpacdb  Host slcac455  PDB OLTPA1  12.80
Database oltpacdb  Host slcac455  PDB OLTPA5  11.60
Database oltpacdb  Host slcac455  PDB OLTPA4  7.60
Database oltpacdb  Host slcac455  PDB OLTPA2  4.00
Database oltpacdb  Host slcac454  Instance total 1136.20
Database oltpacdb  Host slcac454  PDB OLTPA  784.20
Database oltpacdb  Host slcac454  PDB OLTPA4  428.00
Database oltpacdb  Host slcac454  PDB OLTPA2  21.80
Database oltpbcdb  Host slcac455  Instance total 0.20
Database oltpccdb  Host slcac455  Instance total 0.00
Database oltpbcdb  Host slcac454  Instance total 0.00
Autonomously Preserves Database Availability and Performance

Oracle 12c Database Hang Manager
Oracle 12c Hang Manager

Autonomously Preserves Database Availability and Performance

- Always on - Enabled by default
- Reliably detects database hangs and deadlocks
- Autonomously resolves them
- Supports QoS Performance Classes, Ranks and Policies to maintain SLAs
- Logs all detections and resolutions
- New SQL interface to configure sensitivity (Normal/High) and trace file sizes
Oracle Database Hang Manager – Applied Machine Learning

Discovers and Resolves Runtime Database Hangs

- Actual Internal and External customer data drives model development
- Purpose-built diagnostic technology used for knowledge extraction
- Expert Dev team scrubs data
- Hang Heuristic Engine created and deployed @Customer
- HM uses run-time engine to perform real-time DB hang detection and resolution
Oracle 12c Hang Manager

Full Resolution Dump Trace File and DB Alert Log Audit Reports

Dump file .../diag/rdbms/hm6/hm62/incident/incdir_5753/hm62_dia0_12656_i5753.trc
Oracle Database 12c Enterprise Edition Release 12.2.0.0.0 - 64bit Beta
With the Partitioning, Real Application Clusters, OLAP, Advanced Analytics and Real Application Testing options
Build label:  RDBMS_MAIN_LINUX.X64_151013
ORACLE_HOME:  .../3775268204/oracle
System name:  Linux
Node name:  slc05kyr
Release:  2.6.39-400.211.1.el6uek.x86_64
Machine:  x86_64
VM name:  Xen Version: 3.4 (PVM)
Instance name:  hm62
Redo thread mounted by this instance:  2
Oracle process number:  19
Unix process pid:  12656, image: oracle@slc05kyr (DIA0)

*** 2015-10-13T16:47:59.541509+17:00
*** SESSION ID:(96.41299) 2015-10-13T16:47:59.541519+17:00
*** CLIENT ID:() 2015-10-13T16:47:59.541529+17:00
*** SERVICE NAME:(SYS$BACKGROUND) 2015-10-13T16:47:59.541538+17:00
*** MODULE NAME:() 2015-10-13T16:47:59.541547+17:00
*** ACTION NAME:() 2015-10-13T16:47:59.541556+17:00
*** CLIENT DRIVER:() 2015-10-13T16:47:59.541565+17:00

2015-10-13T16:47:59.435039+17:00
Errors in file /oracle/log/diag/rdbms/hm6/hm6/trace/hm6_dia0_12433.trc (incident=7353):
ORA-32701: Possible hangs up to hang ID=1 detected
Incident details in: .../diag/rdbms/hm6/hm6/incident/incdir_7353/hm6_dia0_12433_i7353.trc
2015-10-13T16:47:59.506775+17:00
DIA0 requesting termination of session sid:40 with serial # 43179 (ospid:13031) on instance 2
due to a GLOBAL, HIGH confidence hang with ID=1.
Hang Resolution Reason: Automatic hang resolution was performed to free a
significant number of affected sessions.
DIA0: Examine the alert log on instance 2 for session termination status of hang with ID=1.

In the alert log on the instance local to the session (instance 2 in this case),
we see the following:

2015-10-13T16:47:59.538673+17:00
Errors in file .../diag/rdbms/hm6/hm62/trace/hm62_dia0_12656.trc (incident=5753):
ORA-32701: Possible hangs up to hang ID=1 detected
Incident details in: .../diag/rdbms/hm6/hm62/incident/incdir_5753/hm62_dia0_12656_i5753.trc
2015-10-13T16:48:04.222661+17:00
DIA0 terminating blocker (ospid: 13031 sid: 40 ser#: 43179) of hang with ID = 1
requested by master DIA0 process on instance 1
Hang Resolution Reason: Automatic hang resolution was performed to free a
significant number of affected sessions.
by terminating session sid:40 with serial # 43179 (ospid:13031)

2015-10-13T16:48:04.222661+17:00
DIA0 terminating blocker (ospid: 13031 sid: 40 ser#: 43179) of hang with ID = 1
requested by master DIA0 process on instance 1
Hang Resolution Reason: Automatic hang resolution was performed to free a
significant number of affected sessions.
by terminating session sid:40 with serial # 43179 (ospid:13031)
Program Agenda

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Speeds Issue Diagnosis, Triage and Resolution

Oracle 12c Trace File Analyzer
Challenges in Failure Recovery

- GBs of logs generated everyday
- Distributed across cluster nodes
- Diagnosing an issue can be “a needle in the haystack” problem
- Manual issue diagnosis can be tedious and time-consuming
- Any delay in issue diagnosis can adversely impact the business
Rapid Recovery with Trace File Analyzer (TFA)

• Autonomously collects data intelligently (Smart Collection)
  – Autonomously and intelligently collects only relevant logs
  – Reduces log files to small set of potential candidates

• Autonomously finds relevant information for issue at hand
  – Anomaly Timeline Generation
  – Identifies errors associated with the issue
  – Generates list of potential problems across the system ordered by time

• Speeds issue diagnosis with Oracle Support Services (OSS) for unknown issues
Rapid Recovery with TFA

Smart Collection with TFA Collector

• Always on
• Collects comprehensive first failure diagnostics on each node
• Filters and packages relevant diagnostic data using Applied ML model
• Automatically notifies DBAs and Sys Admins of errors
• Optionally allows quick issue resolution with Oracle Support
• Transfers data to centralized storage for detailed analysis with TFA Receiver
Trace File Analyzer – Applied Machine Learning

Speeds Issue Diagnosis, Triage and Resolution

- ML-based Knowledge Extraction of Logs, SRs and Bugs
- Expert training refines data training set
- Knowledge is embedded into the run-time model
- Model is shipped in TFA Collector to work with the live logs on the Cluster
- Log anomaly detection is performed with TFA Receiver
- No model training required by user
- Model is updated regularly
Oracle TFA in Cluster Domain Design Overview

1. Daemon initiates diagnostic collection
2. TFA signals collections on other nodes
3. Collections written to local TFA repositories
4. Collections consolidated on a single node
5. Collections copied to TFA service in DSC

Node 1
- File Metadata
- Collection Repository

Node N
- File Metadata
- Collection Repository

$ /tfacli diagcollect

User/Daemon initiated ➡️ TFA initiated ➡️ TFA metadata

Oracle Cluster Domain

Domain Services Cluster
Rapid Recovery with TFA
Detailed Issue Analysis using TFA Receiver

• Centralized aggregator in the Cluster Domain
• Mines logs and errors from all nodes registered with it
• Browser-Based UI
  – Supports browsing errors
  – Viewing associated logs
  – Easily construct timelines

DEMO
Cluster Summary Report

Cluster Health Heat Map

Events Frequency Drop Chart

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Cluster Summary Report

Cluster Health Heat Map

Events Frequency Drop Chart

Inspect Panel - Detailed analysis

Event Summary
### Cluster Summary Report

<table>
<thead>
<tr>
<th>Datacenters</th>
<th>Clusters</th>
<th>Databases</th>
<th>Hosts</th>
<th>Critical Events</th>
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<td>4</td>
<td>5</td>
<td>7</td>
<td>84</td>
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### Cluster Health Heat Map

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<thead>
<tr>
<th></th>
<th>Operating System</th>
<th>Clusterware</th>
<th>ASM</th>
<th>Database</th>
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</tr>
<tr>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

- **Warn** icon is visible next to the database row for "slc05knn".
Host: nsdb005
Time: 9/23/2017, 9:02:43 PM
ORA-06512: at "SYS.OBA05, STATS", line 47197

Component: CPU
Date: Sep 22 2017 7:20 PM
Value: 17.00
<table>
<thead>
<tr>
<th>Line</th>
<th>Timestamp</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>7653</td>
<td>2017-09-27T21:31:11.682129-07:00</td>
<td>Resize operation completed for file# 3, old size 2344068K, new size 2355208K</td>
</tr>
<tr>
<td>7654</td>
<td>2017-09-27T22:00:00.394854-07:00</td>
<td>Setting Resource Manager plan SCHEDULER[revact]:DEFAULT_MAINTENANCE_PLAN via scheduler window</td>
</tr>
<tr>
<td>7655</td>
<td>2017-09-27T22:00:00.394854-07:00</td>
<td>Setting Resource Manager plan DEFAULT_MAINTENANCE_PLAN via parameter</td>
</tr>
<tr>
<td>7656</td>
<td>2017-09-27T22:00:00.645988-07:00</td>
<td>Begin automatic SQL Tuning Advisor run for special tuning task &quot;SYS_AUTO_SQL_TUNING_TASK&quot;</td>
</tr>
<tr>
<td>7657</td>
<td>2017-09-27T22:00:00.080440-07:00</td>
<td>End automatic SQL Tuning Advisor run for special tuning task &quot;SYS_AUTO_SQL_TUNING_TASK&quot;</td>
</tr>
<tr>
<td>7658</td>
<td>2017-09-27T22:03:10.835621-07:00</td>
<td>Thread 2 advanced to log sequence 41 (LGWR switch)</td>
</tr>
<tr>
<td>7659</td>
<td>2017-09-27T22:04:43.000484-07:00</td>
<td>Errors in file /scratch/app/ora10g/diag/rdbms/hcmdb/hcmdb2/j082_6743.trc:</td>
</tr>
<tr>
<td>7660</td>
<td></td>
<td>ORA-12012: error on auto execute of job &quot;SYS&quot;. &quot;ORADATA_OS_OPT_SQL899&quot;</td>
</tr>
<tr>
<td>7661</td>
<td></td>
<td>ORA-20001: Statistics Advisor: Invalid task name for the current user</td>
</tr>
<tr>
<td>7662</td>
<td></td>
<td>ORA-06512: at &quot;SYS.DMBMS_STATS&quot;, line 47287</td>
</tr>
<tr>
<td>7663</td>
<td></td>
<td>ORA-06512: at &quot;SYS.DMBMS_STATS_ADVISE&quot;, line 882</td>
</tr>
<tr>
<td>7664</td>
<td></td>
<td>ORA-06512: at &quot;SYS.DMBMS_STATS_INTERNAL&quot;, line 20059</td>
</tr>
<tr>
<td>7665</td>
<td></td>
<td>ORA-06512: at &quot;SYS.DMBMS_STATS_INTERNAL&quot;, line 22201</td>
</tr>
<tr>
<td>7666</td>
<td></td>
<td>ORA-06512: at &quot;SYS.DMBMS_STATS&quot;, line 47197</td>
</tr>
</tbody>
</table>
Program Agenda

1. Introducing Applied Machine Learning for Diagnostics
2. Applied Machine Learning for Real-time Prevention
3. Applied Machine Learning for Rapid Recovery
4. ODA Management Appliance Profile
5. For Further Information / Q & A
Oracle 12c Domain Services Cluster
Deploy with Minimum Footprint and Maximum Manageability

- Hosts Framework as Services
- Reduces local resource footprint
- Centralizes management
- Speeds deployment and patching
- Optional Shared Storage
- Supports multiple versions and platforms going forward

NEW IN 12.2

ORACLE CLUSTER DOMAIN

Application Member Cluster

Database Member Cluster

Oracle Domain Services Cluster

Management Repository Service
Trace File Analyzer Service
Grid Names Service
Storage Services
QoS Management Service
Rapid Home Provisioning Service
• Ideal Management Solution for Oracle Engineered Systems
• Reduces diagnostic footprint
• Centralizes management function
• Does not interfere with provisioning and patching
• Pay only for ODA hardware (S/M/L)
• No additional software license fees
Program Agenda

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For Further Information

- Oracle 12c Autonomous Health Framework User’s Guide
- Oracle 12c Clusterware Administration and Deployment Guide
- Oracle Autonomous Health Framework on OTN
- Oracle QoS Management 12c User’s Guide
- Oracle QoS Management on OTN
- Oracle 12c ORAchk
- Oracle 12c Trace File Analyzer
Questions