AI/ML To The Rescue: How IT Operations Got Out Of A Monitoring Mess

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The Situation

Increase IT Operations Capacity

"Can you increase the quality of monitoring and alerting without increasing the associated operations cost?"

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Why did the Operations team believe this?

What is their plan?

Did it work?

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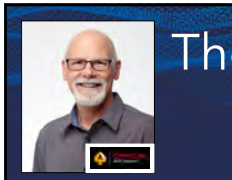

The Journey…

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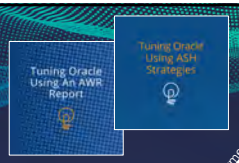

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My Machine Learning Journey

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It all started in 1987

It all started in 1987, when I was intrigued with developing a program that could not only retain data but could answer my questions about that data.

At that time, I was using Borland's *Turbo Pascal* and noticed they released a Prolog product. It was amazing…

I was hooked!

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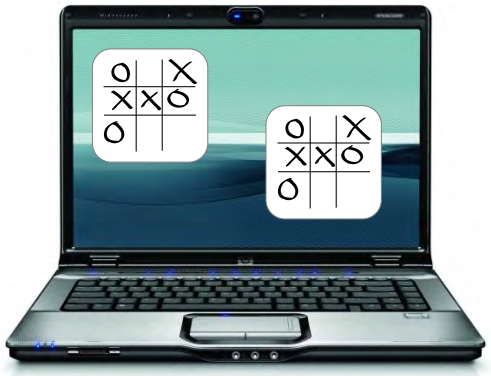
Then again in 1990



I created a program where I could play the game tic-tac-toe with a computer, but also enabled the computer to play itself… and learning through that process.

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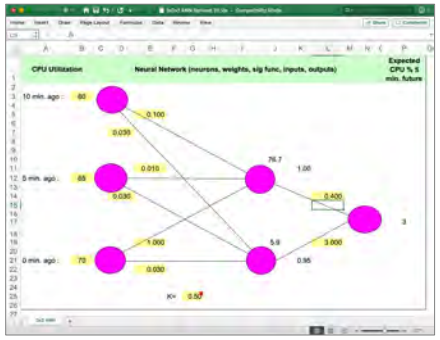
In 1997 Neural Networks…



I was obsessed is performance prediction… forecasting what was likely to happen or not happen in the future.

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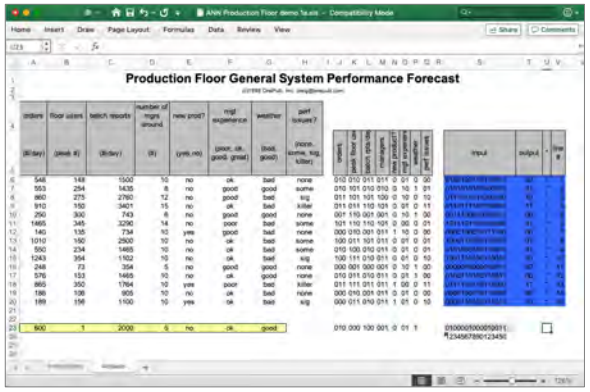
In 2001 at RMOUG



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In 2001, after two years of rejections, I presented on ANNs at the RMOUG conference. My goal was to predict poor performance in the near future. While ANN is sound, I was never able to realize my "near future" dream. But I believe that dream could now be realized.

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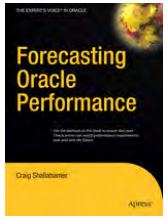
2007



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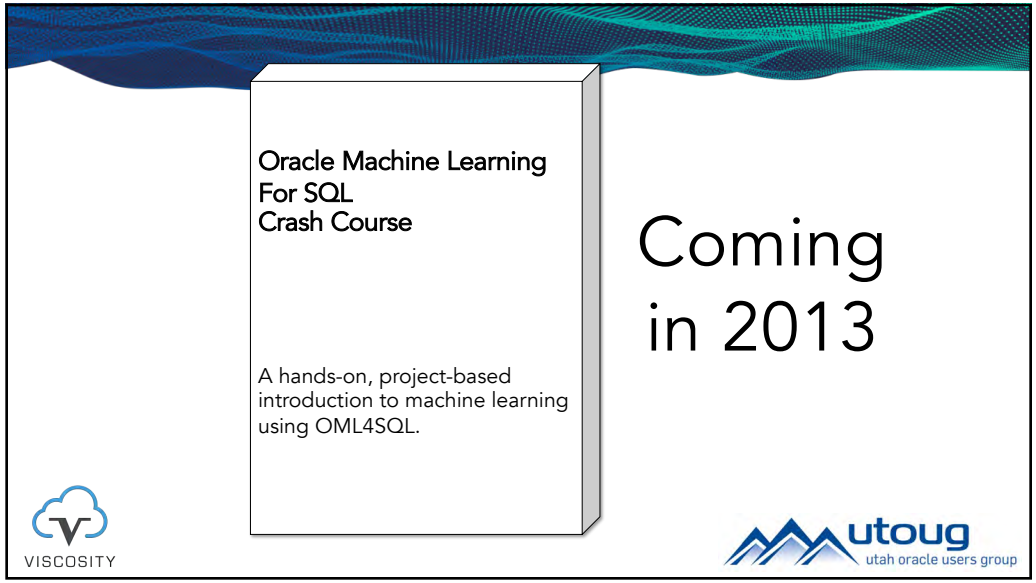

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Engineered Systems
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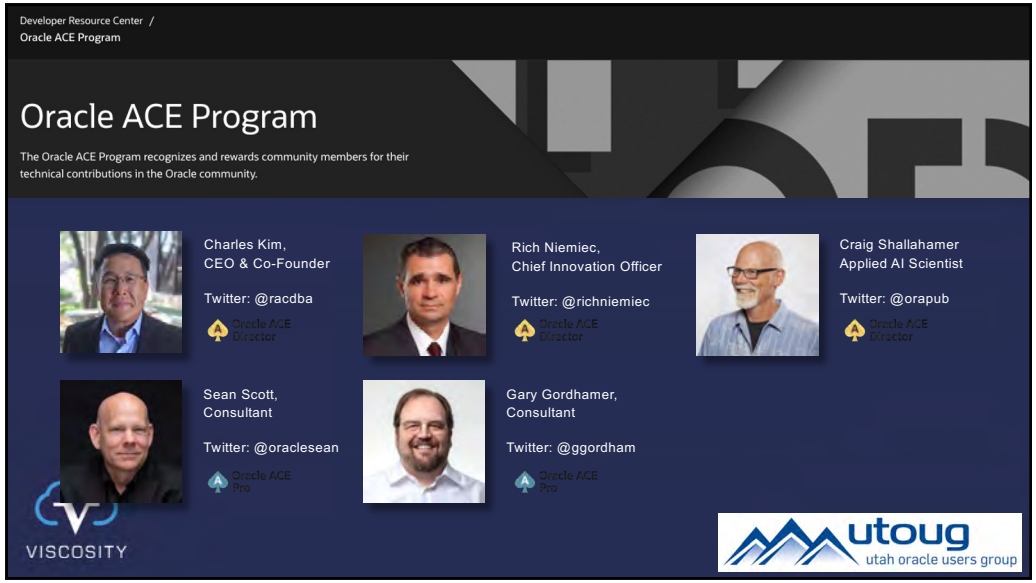
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Craig Shallahamer
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Twitter: @orapub
Oracle ACE Director
Sean Scott,
Consultant
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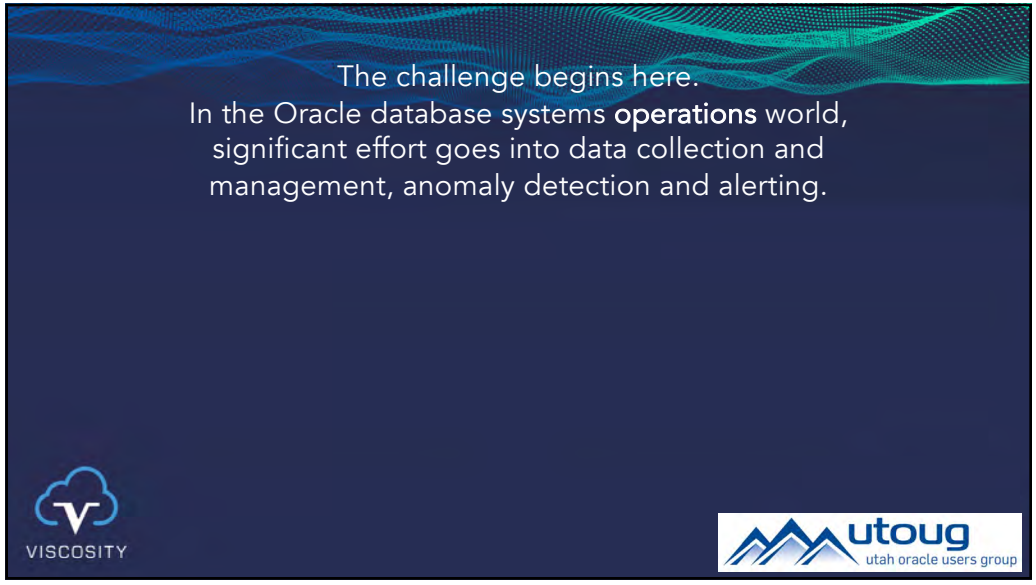

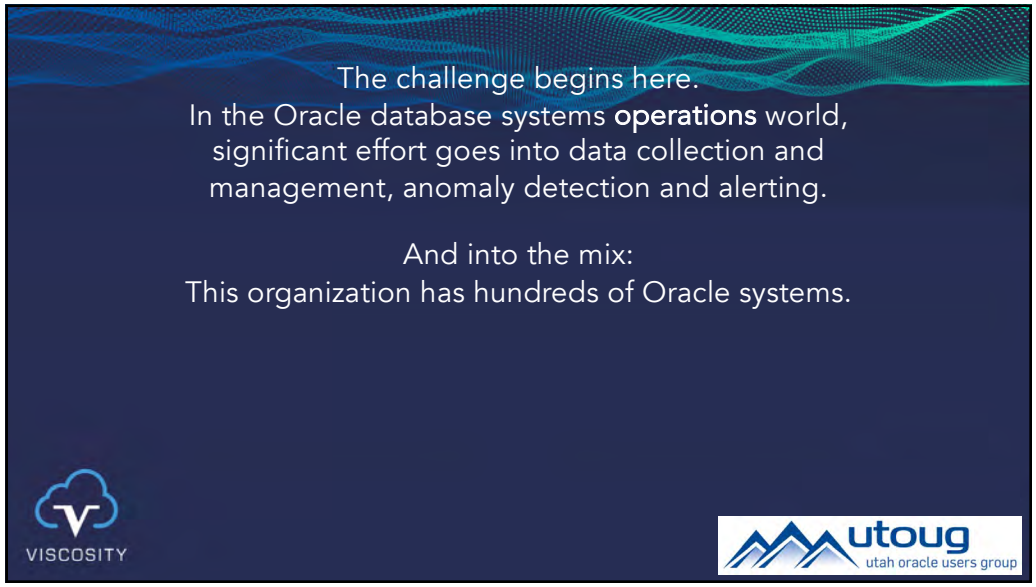

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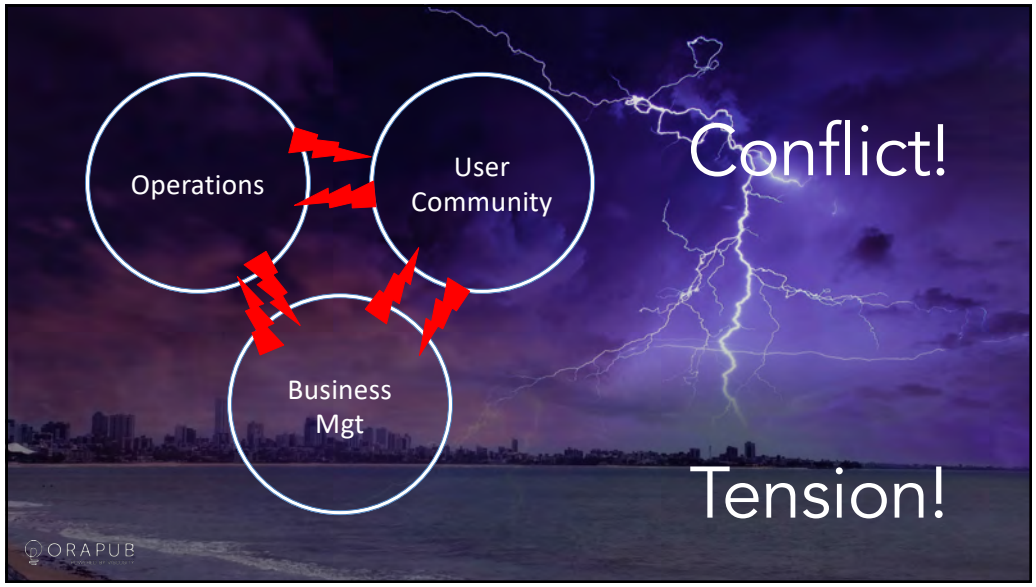

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"Can you increase the quality of monitoring and alerting without increasing the associated operations cost?"

Why does the Operations team believe this?

The Back Story…

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Currently, if-then rules (heuristics) and statistical methods are used to detect anomalous for each specific system.

Why is this not working good enough?

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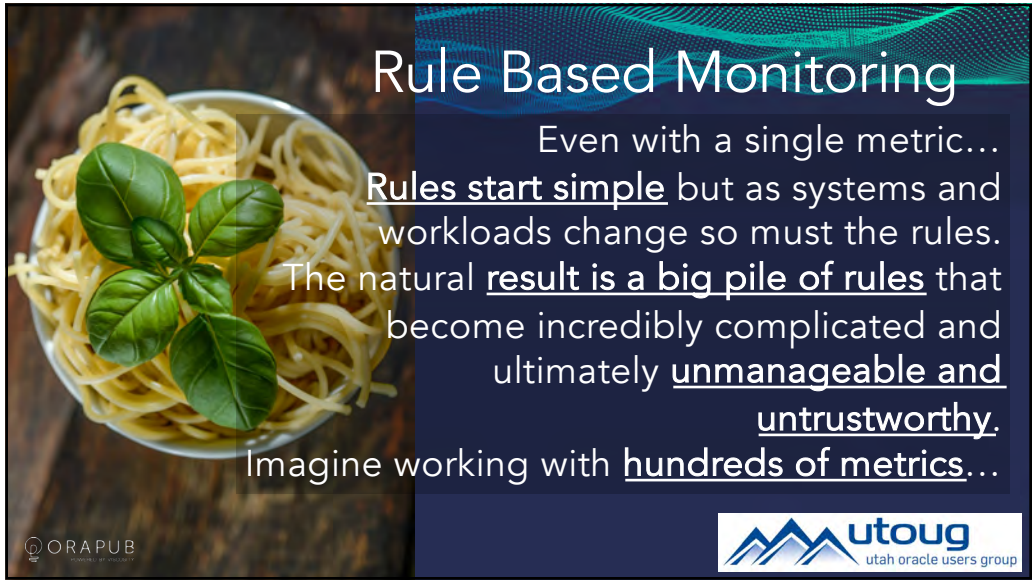

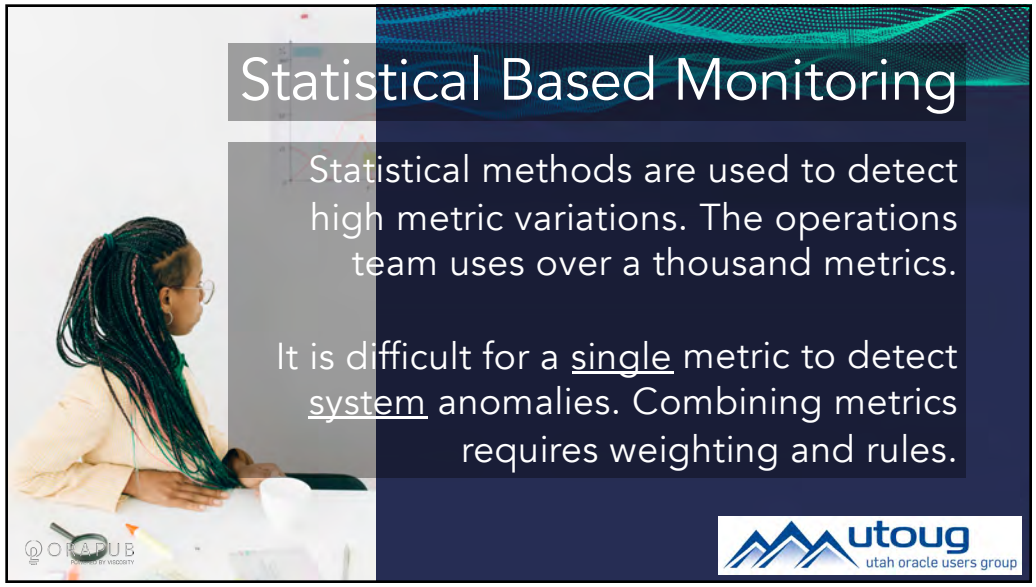

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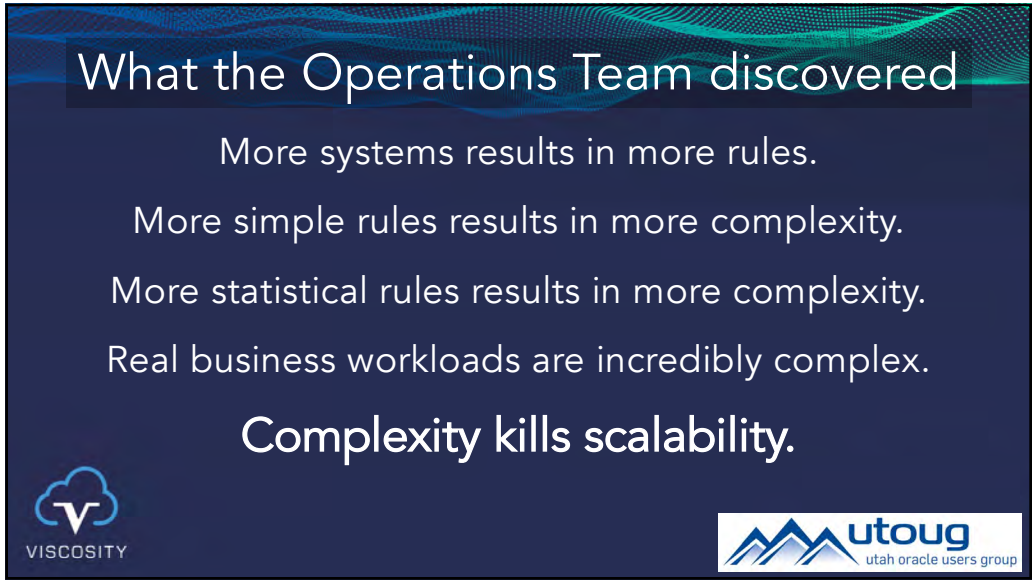

That's the
Business Challenge
and the
Back Story

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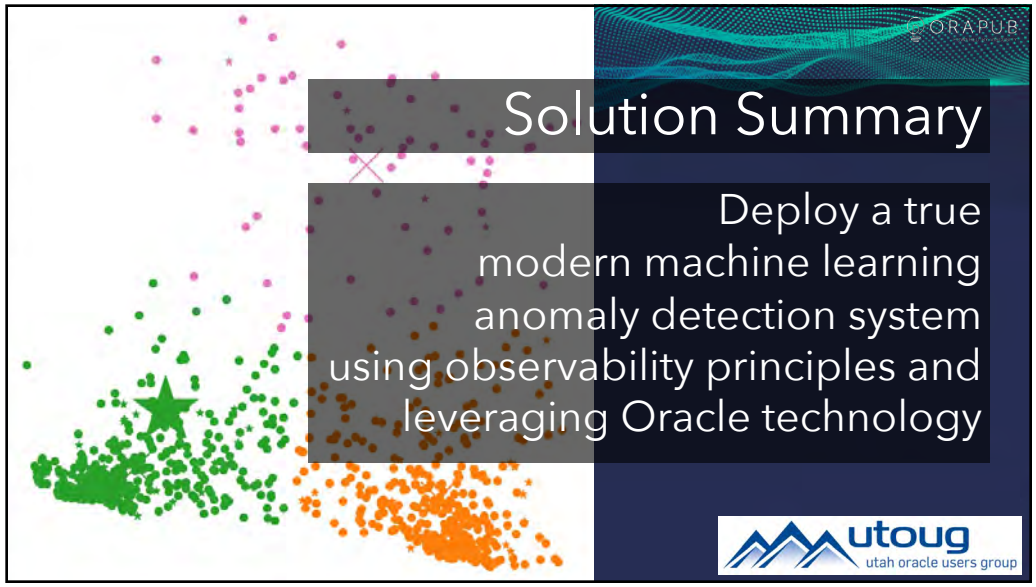

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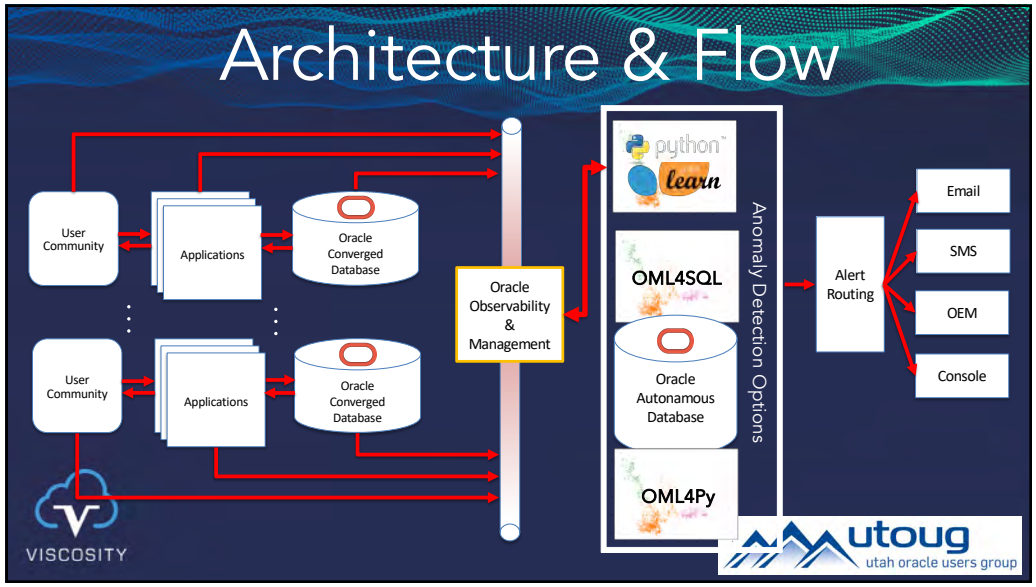

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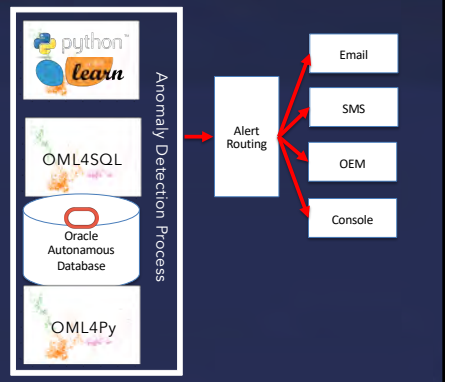
Business Requirements #1

- Fast! Less than 2 minutes
- Alerts logged, emailed, SMS, OEM and console
- **Alerts to contain diagnostic info… explainability**



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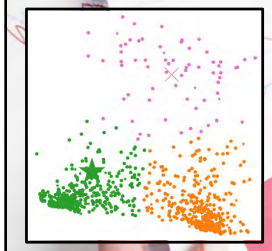
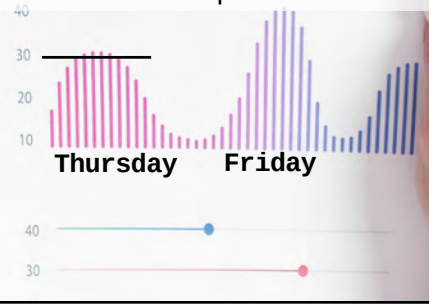
Business Requirements #2

- Understand real **business workloads**
- Use multiple **self adjusting** alert thresholds
- **View system** as multiple metrics





Business Requirements #3

- ML Tools:
  - Python, Scikit Learn, Jupyter
  - OML4PY, OML4SQL
- Deployment:
  - Linux, Conda, Oracle DB
  - Autonamous DB w/OML4PY and OML4SQL
- Maintenance: self adjusting threshold, live tuning and easy restart
- Data: Oracle AWR Sysmetric from Oracle's Observability & Management platform.

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ML Particulars

- General ML process
- General anomaly detection strategy
- Self-Adjusting threshold determination
- Providing diagnostic clues; explainability

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ML Particulars

General ML Process

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General Machine Learning Process

- **Load Data**
  - Pull new Sysmetric data and/or combine with existing
- **Preprocessing**
  - Denormalize Sysmetric data
  - Scale using standardization
  - Engineer new features
    - Date: hour of day, day of week, day of month
    - Moving average: 2 and 3
    - Power function: X^y where y is 0.5 and 2.0
    - Stepping/Lagging: 2 previous samples
    - Binning: percentile based (0.0, 0.25, 0.50, 0.75, 1.00)
  - Stationarity: remove trends
  - Feature selection using a High Correlation Filter, which resulted in around 7 to 15 features.
- **Build *n* clusters** using K-Means algorithm, usually 3 to 5 clusters
- **Thresholds** determination, usually above 98%-tile
- **Check for anomaly**, if true, send alerts

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ML Particulars

General Anomaly Detection Strategy

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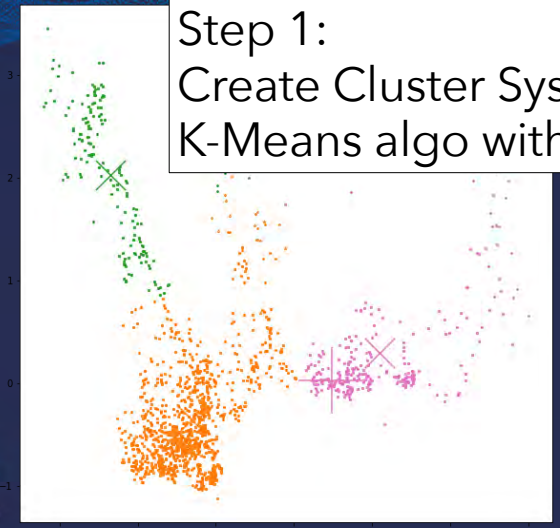
Step 1:
Create Cluster System
K-Means algo with 3 clusters



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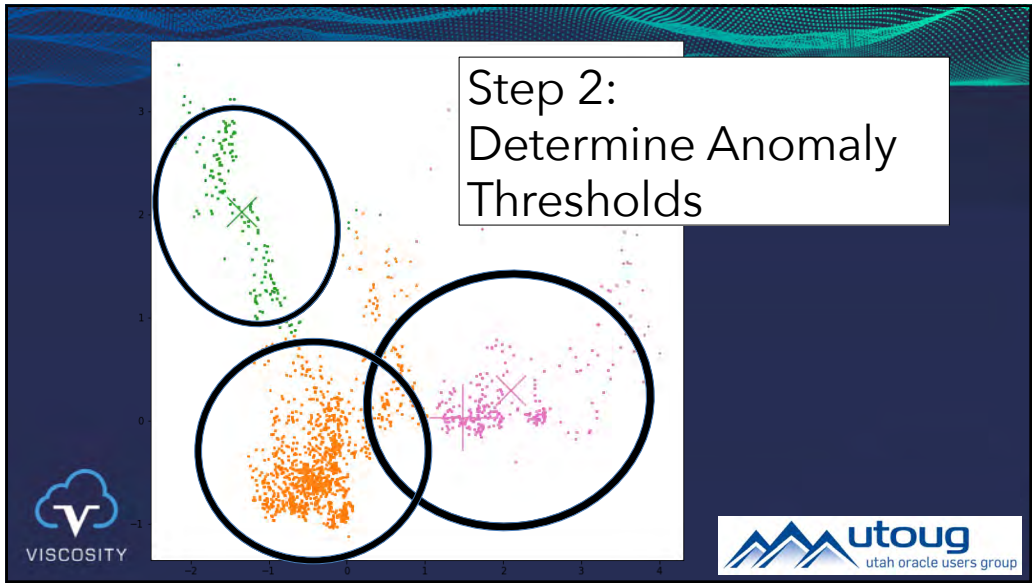

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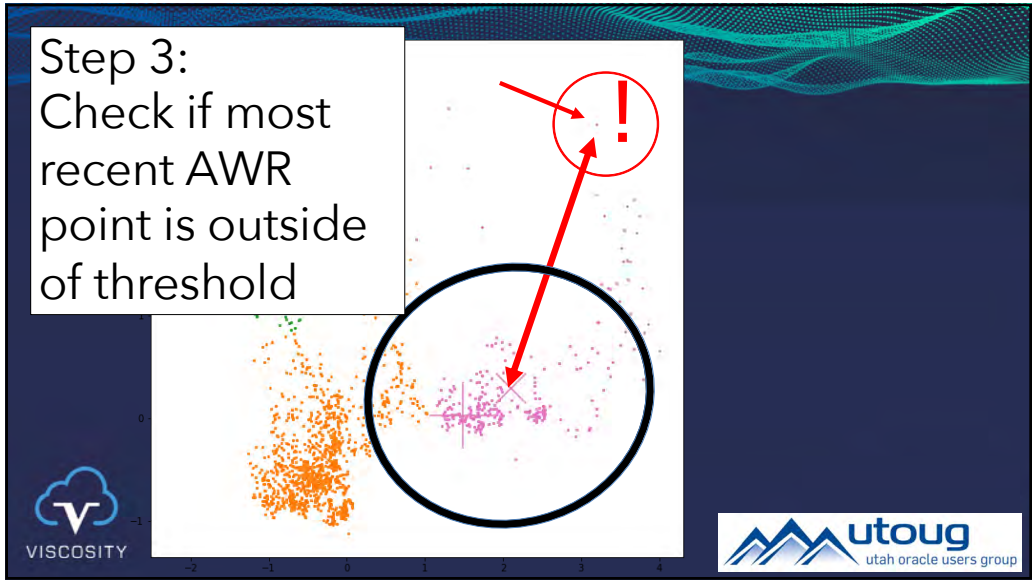

ML Particulars

Self-Adjusting Threshold Determination

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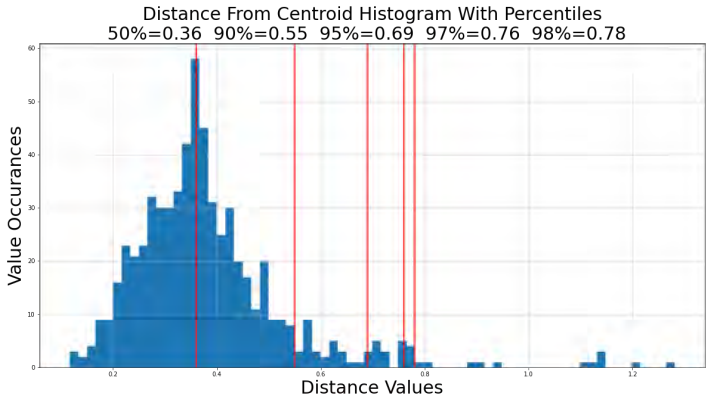
Alert Threshold Determination is based on cluster specific distances



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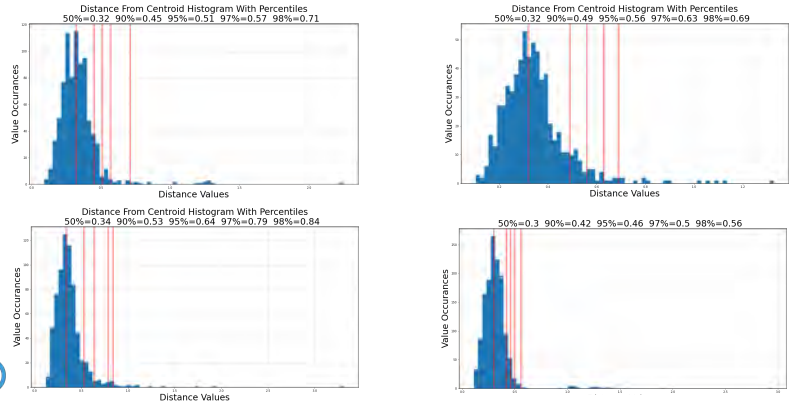
Percentile thresholds adapt to cluster specific distance values



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ML Particulars

Providing Diagnostic Clues
Explainability… big deal

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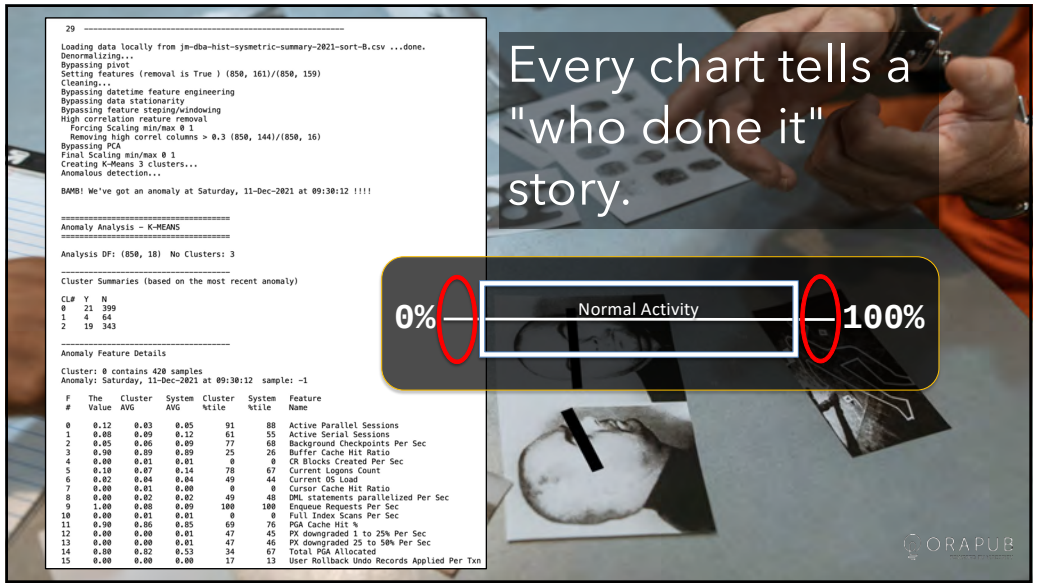

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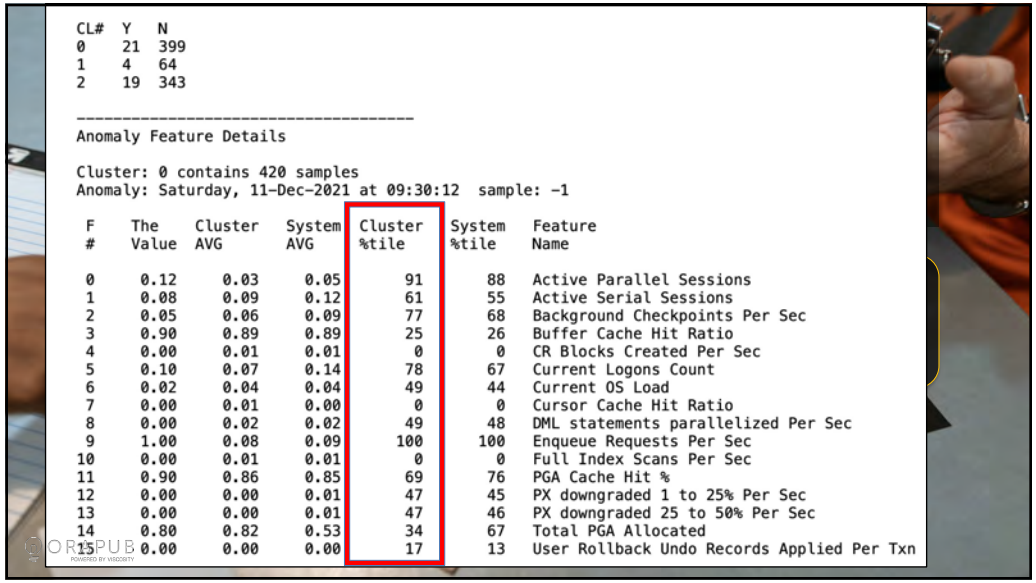

```
CL#  Y   N
0    21  399
1    4   64
2    19  343

----------------------------------------
Anomaly Feature Details

Cluster: 0 contains 420 samples
Anomaly: Saturday, 11-Dec-2021 at 09:30:12  sample: -1

 F    The    Cluster   System  Cluster   System   Feature
 #    Value  AVG       AVG     %tile     %tile    Name

 0     0.12     0.03     0.05       91       88   Active Parallel Sessions
 1     0.08     0.09     0.12       61       55   Active Serial Sessions
 2     0.05     0.06     0.09       77       68   Background Checkpoints Per Sec
 3     0.90     0.89     0.89       25       26   Buffer Cache Hit Ratio
 4     0.00     0.01     0.01        0        0   CR Blocks Created Per Sec
 5     0.10     0.07     0.14       78       67   Current Logons Count
 6     0.02     0.04     0.04       49       44   Current OS Load
 7     0.00     0.01     0.00        0        0   Cursor Cache Hit Ratio
 8     0.00     0.02     0.02       49       48   DML statements parallelized Per Sec
 9     1.00     0.08     0.09      100      100   Enqueue Requests Per Sec
10     0.00     0.01     0.01        0        0   Full Index Scans Per Sec
11     0.90     0.86     0.85       69       76   PGA Cache Hit %
12     0.00     0.00     0.01       47       45   PX downgraded 1 to 25% Per Sec
13     0.00     0.00     0.01       47       46   PX downgraded 25 to 50% Per Sec
14     0.80     0.82     0.53       34       67   Total PGA Allocated
15     0.00     0.00     0.00       17       13   User Rollback Undo Records Applied Per Txn
```

Important Points & Lessons Learned

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Demanded Very Well Defined Scope

- Once people get a glimpse of ML, they go crazy… "Let's predict when world peace will occur."
- Scope was documented and agreed upon.
- Scope was very tight.
  - Anomalous Oracle Database activity
  - Sysmetric data
  - Alerting: email, SMS, console
  - 15 minute AWR snap
  - 2 minutes to check for anomaly

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Domain Expertise Was Essential

- Our team had both Oracle performance and applied ML expertise.
- Real-world forecasting and modeling experience was very helpful.
- True Data Scientist was not needed because we used common and existing algorithms, for both core cluster algo and preprocessing.

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Big Team Not Required

- Our team had only three people part-time over a 2 month period.
- The second month was more focused on "tuning" the system and alert details.
- We leveraged the hardware, security and network teams.
- Our IT requirements were tiny compared to other systems.

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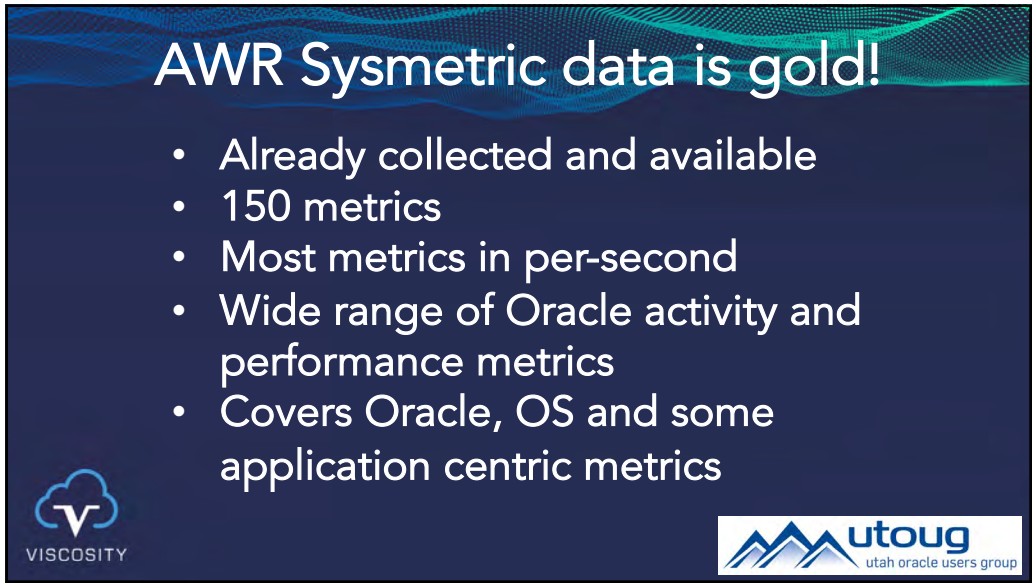

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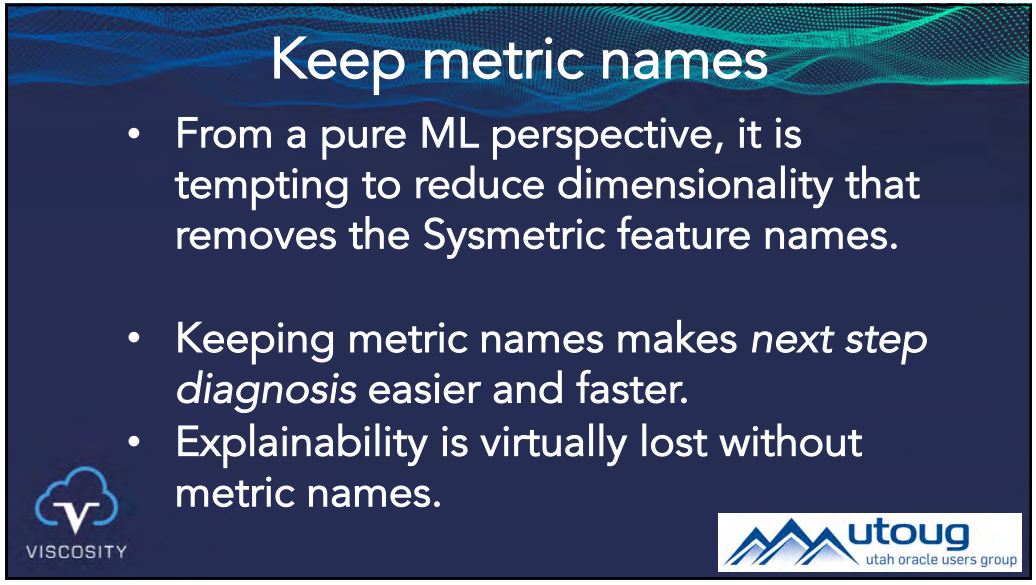

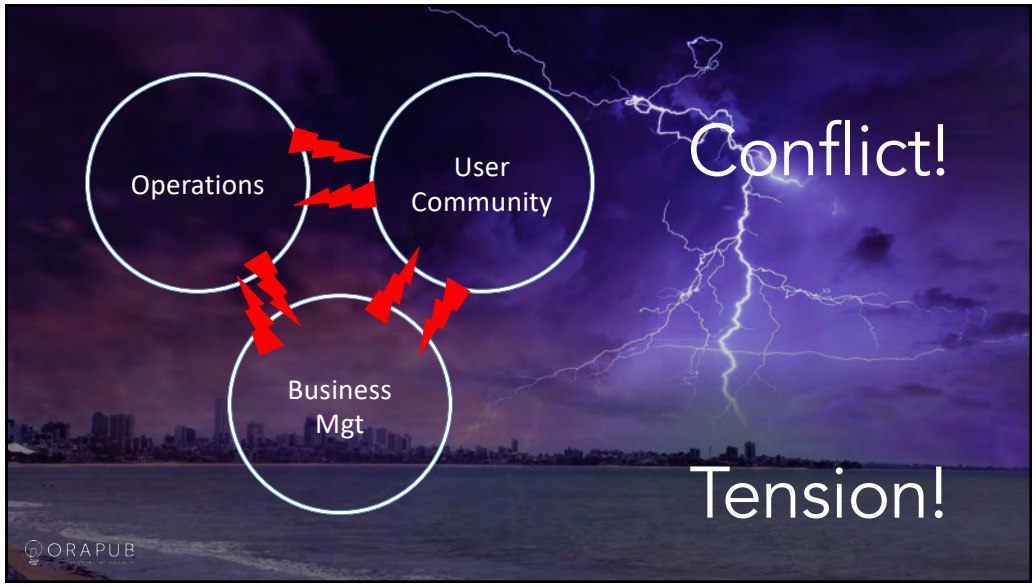
Operations
User Community
Business Mgt
Conflict!
Tension!
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Operations
User Community
Business Mgt
Peace. Complexity reduced. Needs being Met.
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How to get **all the materials** for this presentation and updated versions. Plus **all** Viscosity's webinars and conference presentations.

After the conference:
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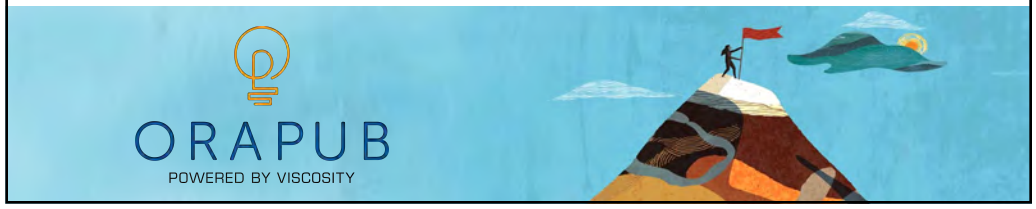

This presentation was given by Craig Shallahamer (craig@orapub.com / craig@viscosityna.com) on January 26, 2023 for the Utah OUG (UTOUG).
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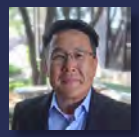
Developer Resource Center /
Oracle ACE Program

Oracle ACE Program

The Oracle ACE Program recognizes and rewards community members for their technical contributions in the Oracle community.



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AI/ML To The Rescue:
How IT Operations Got Out Of A Monitoring Mess
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