



Meetup Brazil
Dec/23

Agenda

- Morning Coffee and Welcome
 - Horário: 9-9:10
- Avaliando grandes cargas e análises de dados com MySQL HeatWave Lakehouse
 - Horário: 9:10-10:05
- Coffee Break: 15mins
 - Horário: 10:05 – 10:20
- MySQL Shell para Database Engineers: A melhor ferramenta de administração do MySQL
 - Horário: 10:20 – 11:15am
- ProxySQL no MySQL: Apenas um load balancer
 - Horário: 11:15 – 12:10
- Lunch Break & Discussion
 - Horário: 12:10-13:20
- Ferramentas e métodos para análise de performance em MySQL
 - Horário: 13:20-14:15
- Migração de Data Center para Oracle OCI Brasil: Otimização do MySQL8
 - Horário: 14:15-15:10
- Coffee break: 15mins
 - Horário: 15:10-15:25
- MySQL: 7 Dicas de Ouro e 7 Erros a Evitar
 - Horário: 15:25-16:20
- Closing session
 - Horário: 16:20-16:30
- LAB visit
 - Horário: 16:30-17:15



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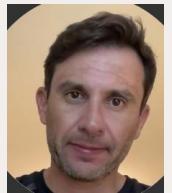


MySQL HeatWave Database Platform

One MySQL Database for OLTP, OLAP, Machine Learning and Lakehouse

MySQL LAD team

Sales - Cloud



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MySQL LAD team

Channels & Alliances

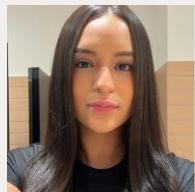


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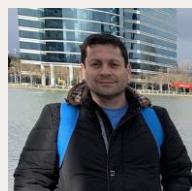


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Sales Engineering



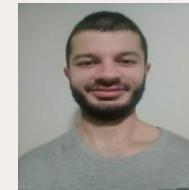
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Narciso Junior

- MySQL Cloud Evangelist at Oracle
- 20 Years of experience in IT & Telecom
- Experience with SW development, Solution Integration and Sales
- MBA in Business Management



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Agenda for today!

- Oracle's strategy for MySQL
- MySQL HeatWave - single data platform for multiple workloads
- Success cases
- News from Oracle Cloud World 23



Oracle's strategy for MySQL



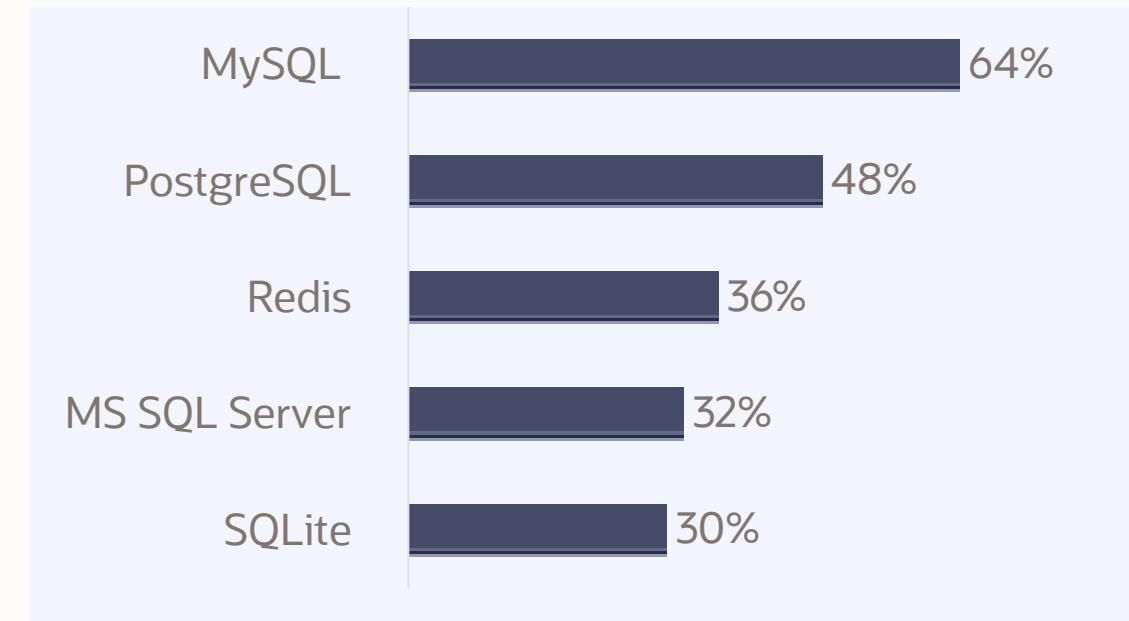
MySQL: the #1 Open Source Database

The most popular database for Developers

Rank			DBMS	Database Model	Oct 2023
Oct 2023	Sep 2023	Oct 2022			
1.	1.	1.	Oracle 	Relational, Multi-model 	1261.42
2.	2.	2.	MySQL 	Relational, Multi-model 	1133.32
3.	3.	3.	Microsoft SQL Server 	Relational, Multi-model 	896.88
4.	4.	4.	PostgreSQL 	Relational, Multi-model 	638.82

DB-ENGINES

Developers: Which databases have you used in the last 12 months?



[Jetbrains survey \(SQL is primary\)](#)

MySQL Today!

“Just works!”

Easy to maintain and operate



Most popular DB

#1 in the cloud

2nd largest in the industry

Top of Mind among developers

Open Source

Easy integration

Faster evolution

Huge DB community

For everyone!

Universities, SMB,

Public Sector, Startups



Uber

J.P. Morgan



Innovative organizations across many industries run MySQL – Do you?

Social

facebook



LinkedIn

WeChat

Pinterest

E-Commerce

Booking.com

NETFLIX

U B E R

airbnb

淘宝网
Taobao.com

阿里巴巴
Alibaba.com™

Tech

APPDYNAMICS
part of Cisco

GitHub

HubSpot

zendesk

intuit
mint

New Relic

Finance

Bank of America



J.P.Morgan

citi

Fidelity
INVESTMENTS

VISA

CA

Manufacturing

T E S L A



TOYOTA

CAT®

Innovative organizations in Latin America

Telco/Media



SaaS



Tech



Finance



Government



MySQL powers Open Source applications

Custom Apps Development



django



Content management and eCommerce



Learning platforms



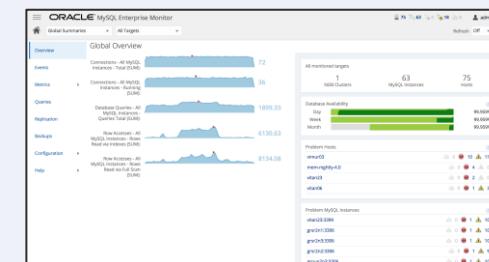
Community vs Enterprise



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Premier Support



Enterprise Monitor

Database Core

DB Engine, Replication, High Availability, Partitioning, Document Store (NoSQL)



Security



Backup



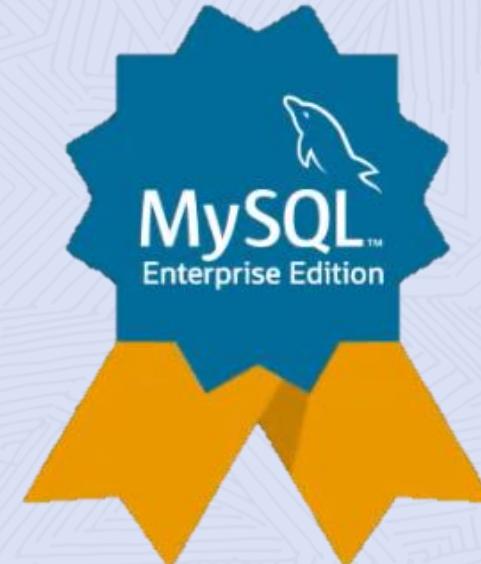
Thread Pool

Which MySQL edition are you running?

Forks

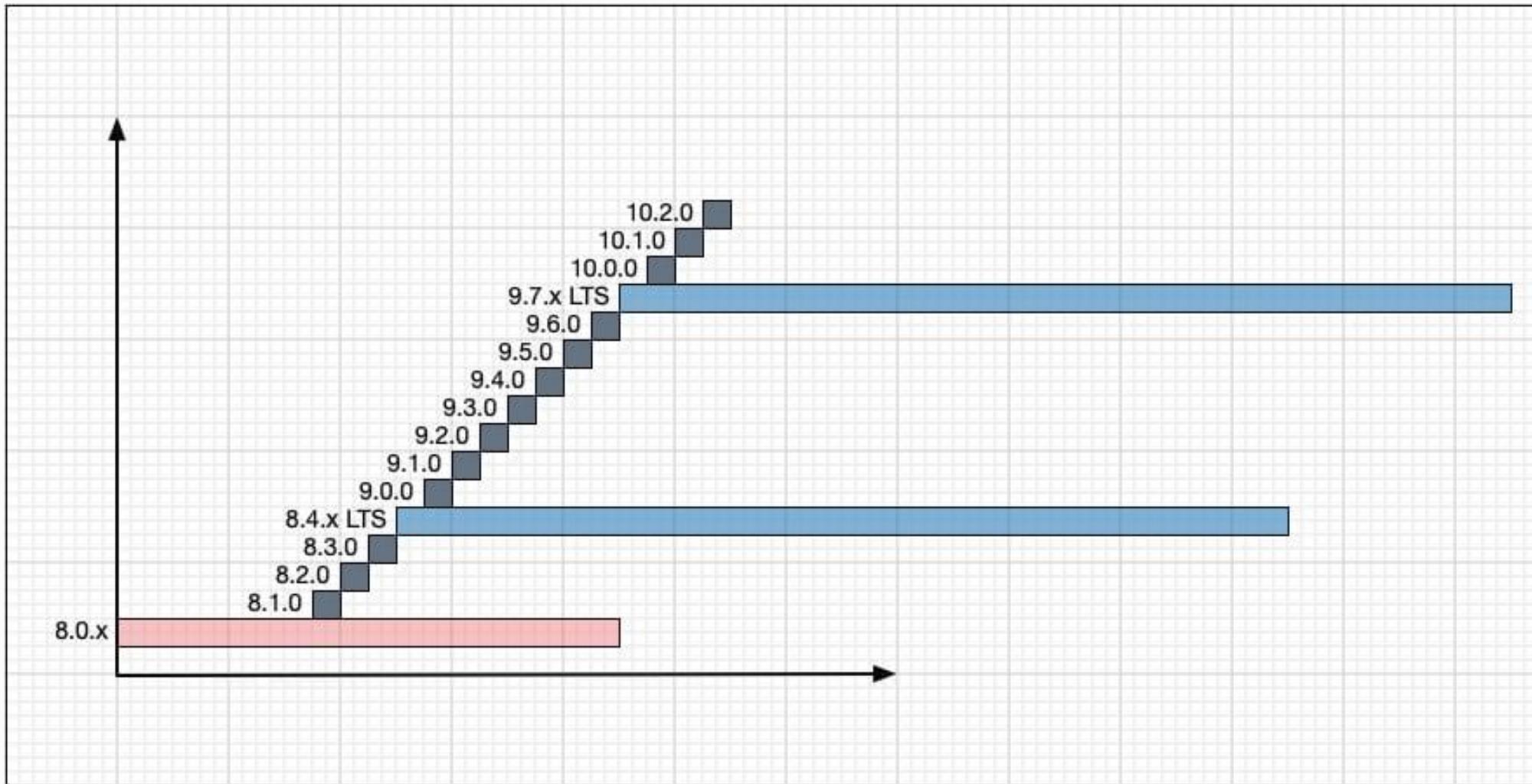


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*“MySQL Enterprise is provided by Oracle only!
Everybody else is community/free...”*

MySQL Innovation and Long-Term Support (LTS) versions



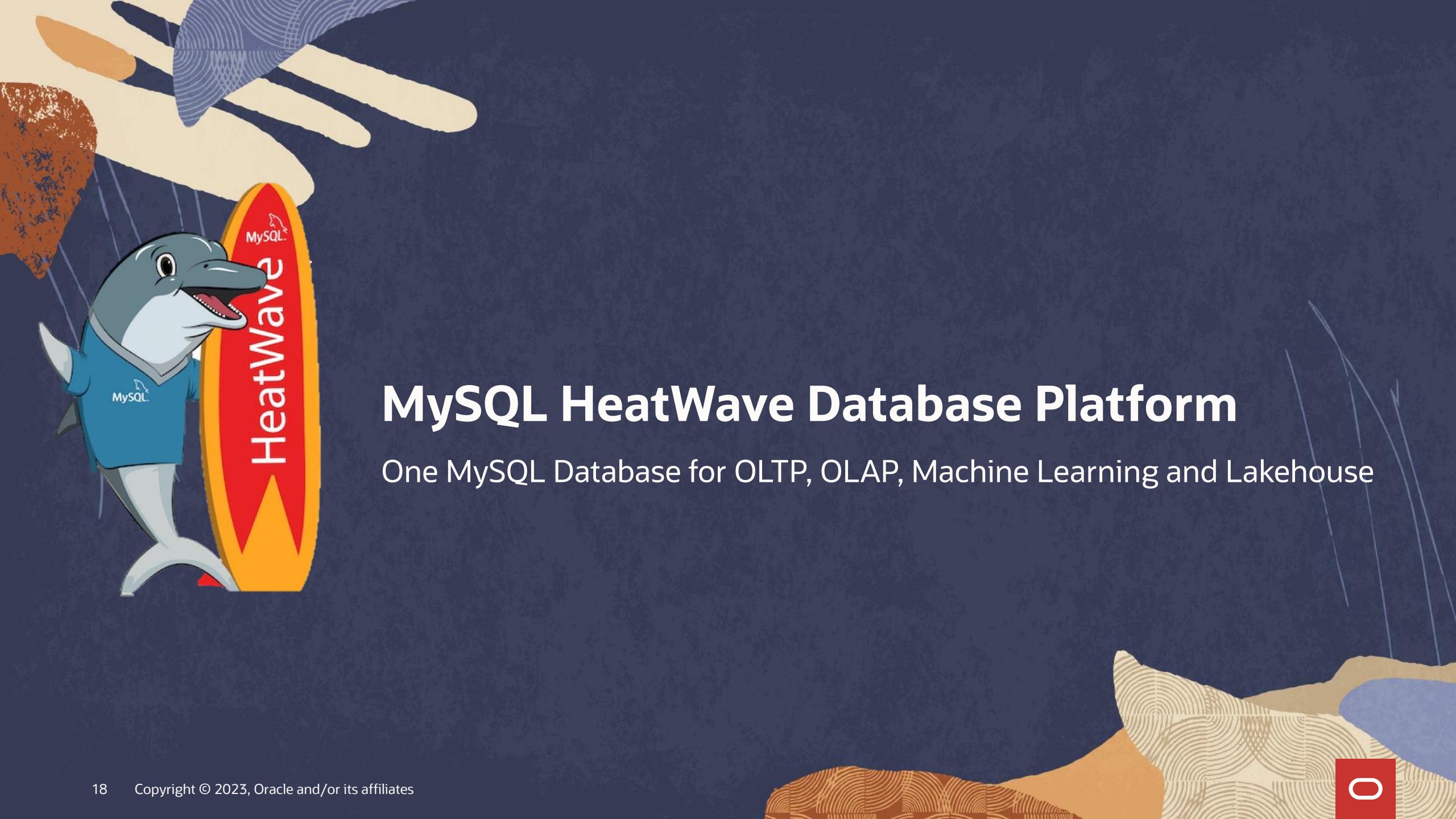
Oracle is the MySQL technology owner and is committed to provide the best value to the community and customers.

On-Prem



Cloud

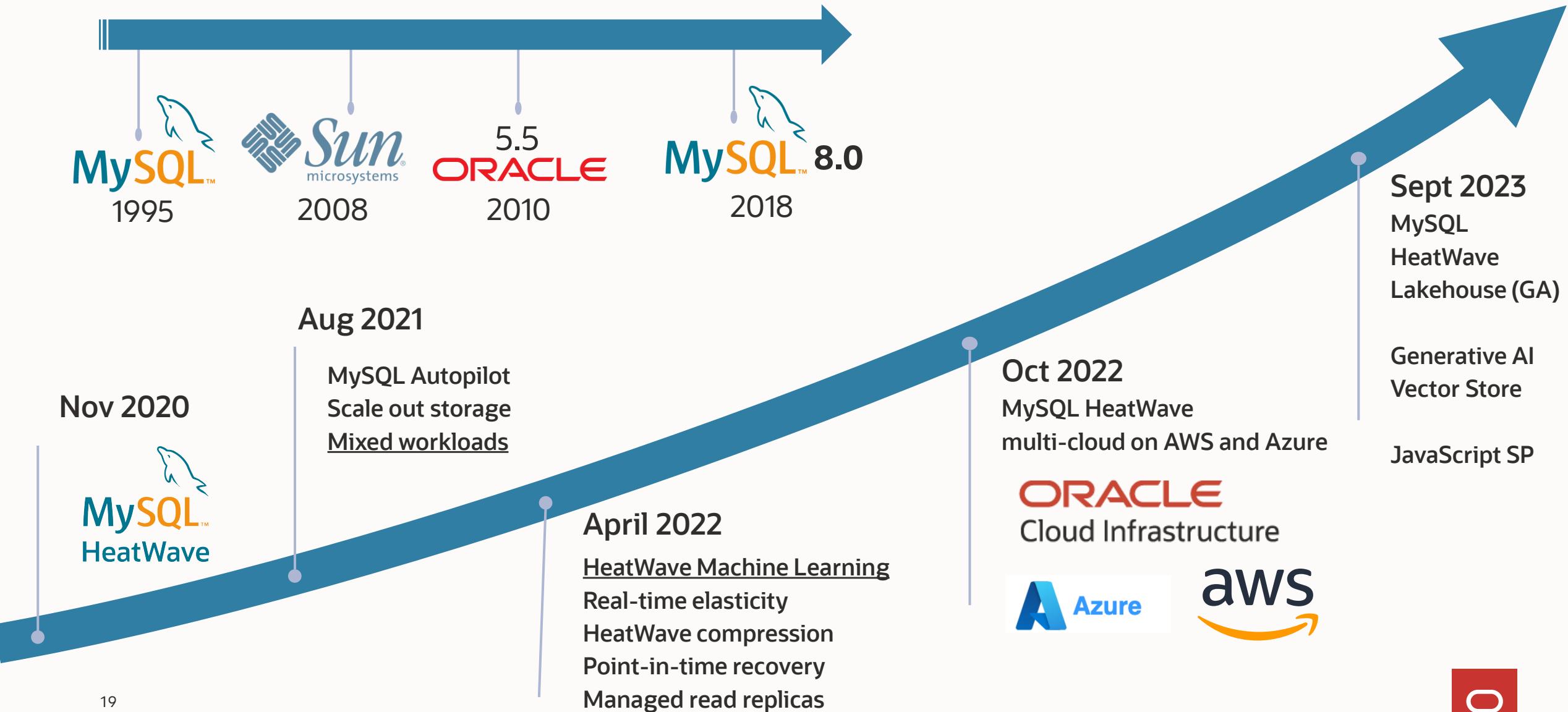




MySQL HeatWave Database Platform

One MySQL Database for OLTP, OLAP, Machine Learning and Lakehouse

Evolution – continuous innovation with MySQL HeatWave



Complete cloud capabilities using universal credits

Developer services



LOW CODE APEX, Digital Assistant



APPDEV Visual Builder Studio, GraalVM, Helidon, SQL Developer, Shell, APIs/CLI/SDKs/Docs



INFRASTRUCTURE as CODE Resource Manager, Terraform, Ansible



SERVERLESS Events, Functions, API Gateway

Applications



APP INTEGRATION Integration Cloud, Workflow, Notifications, Email Delivery



BUSINESS & INDUSTRY SaaS ERP, HCM, SCM, Sales, Marketing, Service, Vertical Industry

Analytics



BUSINESS ANALYTICS Analytics Cloud, Fusion Analytics



Governance & Administration



CLOUD OPS IAM, Compartments, Tagging, Console, Cost Advisor

SECURITY Cloud Guard, Security Zones, Vault, KMS, Data Safe, DDoS, WAF



OBSERVABILITY Monitoring, Logging, Logging Analytics, Notifications, Events, Operations Insights, APM, Management Cloud

Data & AI



BIG DATA Big Data, Data Flow, Data Integration, Data Catalog, Golden Gate



AI SERVICES Data Science, Text Analytics, Anomaly Detection



MESSAGING Streaming, Queueing, Service Connector



ORACLE DATABASES ATP, ADW, DBCS VM/BM, JSON, Dedicated, Exadata, Exadata C@C



DISTRIBUTED & OSS DBs NoSQL, MySQL, Postgres, Search Indexing, Distributed Cache

Core Infrastructure



COMPUTE Bare metal, VM, CPUs, GPUs, HPC



CONTAINERS Containers, Kubernetes, Service Mesh, Registry



OS, VMWARE Autonomous Linux, OS Mgmt Service, Marketplace



STORAGE NVMe, Block, File, Object, Archive, Data Transfer



NETWORKING VCN, LB, Service Gateway, FC, VPN, Cluster Networking

30 + COMMERCIAL REGIONS / GOV REGIONS / CLOUD@CUSTOMER

MySQL HeatWave: fully managed database service

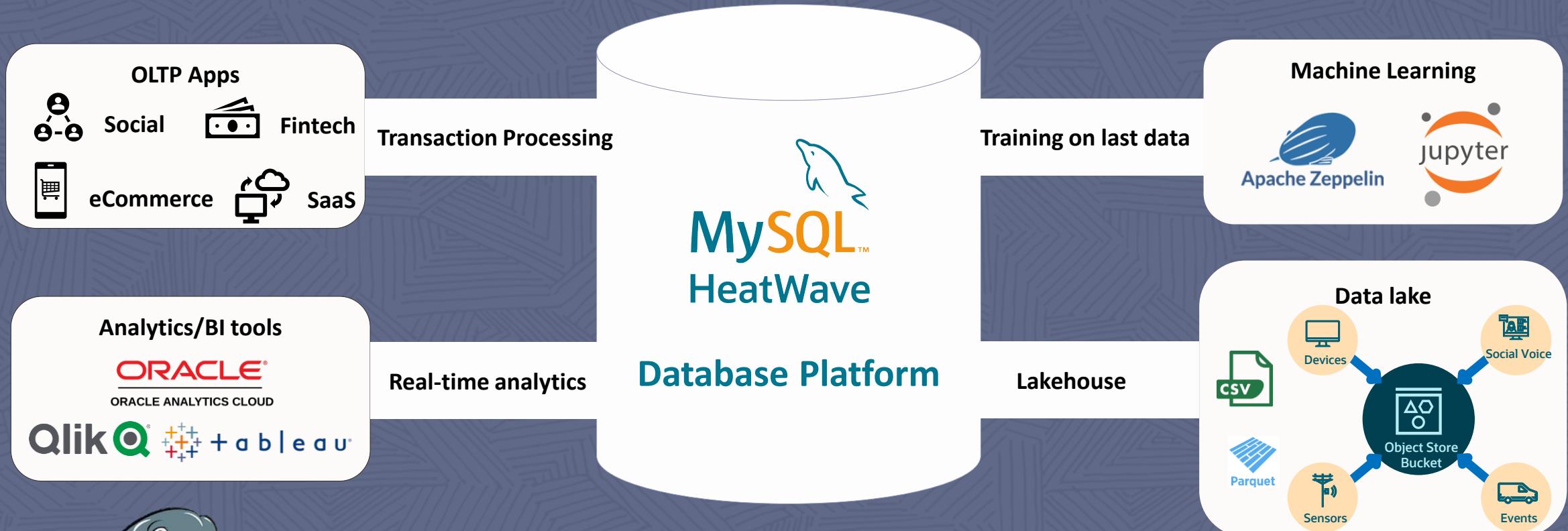
100% developed, managed, and supported by Oracle



	Automation	MySQL HeatWave
Database	High Availability	✓
	Backup	✓
	Query Acceleration	✓
	Machine Learning	✓
	Security Patch & Upgrade	✓
	Provision & Configure	✓
OS	OS Security Patch & Upgrade	✓
	OS Installation	✓
Server	Hardware Purchase & Maintenance	✓
Storage	Storage Purchase & Maintenance	✓
Data Center	Rack & Space	✓
	Power, HVAC, Networking	✓

MySQL HeatWave – one database service for OLTP, analytics, ML and data lake

Developed from the ground up for cloud – 10 years of research at Oracle



“MySQL HeatWave is innovation! ”

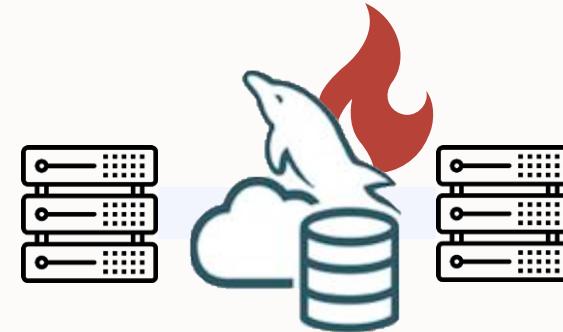
MySQL HeatWave flavours

100% managed and monitored by MySQL team



MySQL HeatWave
for OLTP

Transaction/OLTP



MySQL HeatWave
with Analytics cluster

Transaction/OLTP	Analytics / OLAP
Machine Learning	Lakehouse

Standalone & High Availability
RPO=0 RTO=mins

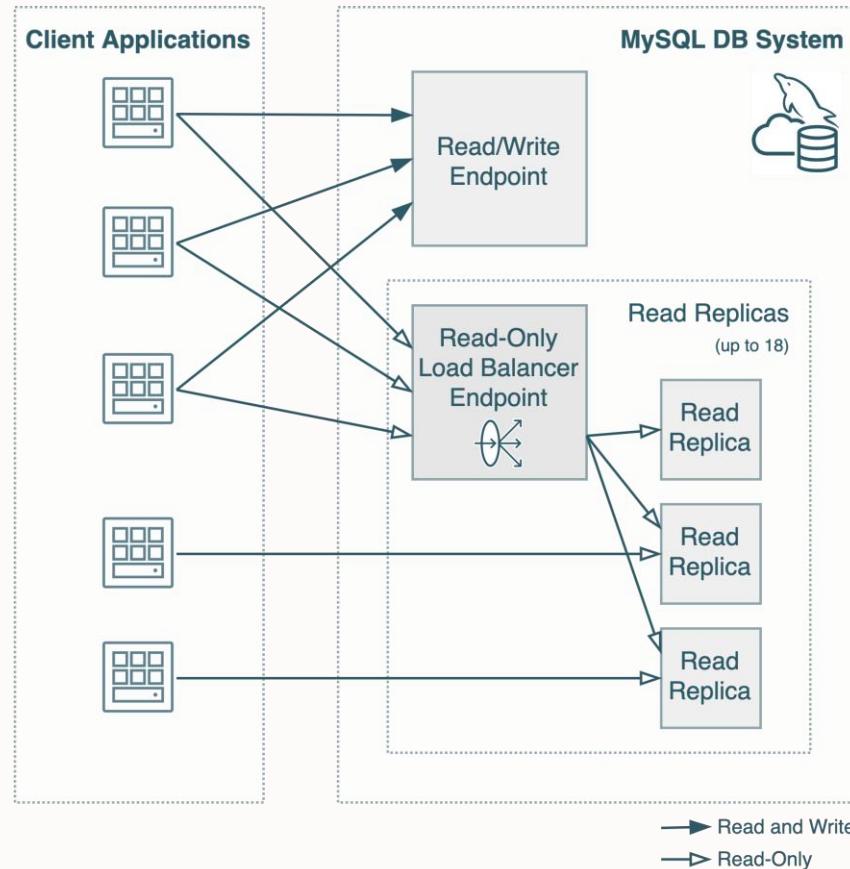
Scaling resources

MySQL HeatWave for OLTP - Shapes



OCPUs	RAM (GB)	AMD E4	Intel X9 Standard	Intel X9 Optimized
1	8	MySQL.VM.Standard.E4.1.8GB	MySQL.VM.Standard3.1.8GB	MySQL.VM.Optimized3.1.8GB
1	16	MySQL.VM.Standard.E4.1.16GB	MySQL.VM.Standard3.1.16GB	MySQL.VM.Optimized3.1.16GB
2	32	MySQL.VM.Standard.E4.2.32GB	MySQL.VM.Standard3.2.32GB	MySQL.VM.Optimized3.2.32GB
4	64	MySQL.VM.Standard.E4.4.64GB	MySQL.VM.Standard3.4.64GB	MySQL.VM.Optimized3.4.64GB
8	128	MySQL.VM.Standard.E4.8.128GB	MySQL.VM.Standard3.8.128GB	MySQL.VM.Optimized3.8.128GB
16	256	MySQL.VM.Standard.E4.16.256GB	MySQL.VM.Standard3.16.256GB	MySQL.VM.Optimized3.16.256GB
24	384	MySQL.VM.Standard.E4.24.384GB	MySQL.VM.Standard3.24.384GB	
32	512	MySQL.VM.Standard.E4.32.512GB	MySQL.VM.Standard3.32.512GB	
48	768	MySQL.VM.Standard.E4.48.768GB		
64	1024	MySQL.VM.Standard.E4.64.1024GB		

Read Replicas

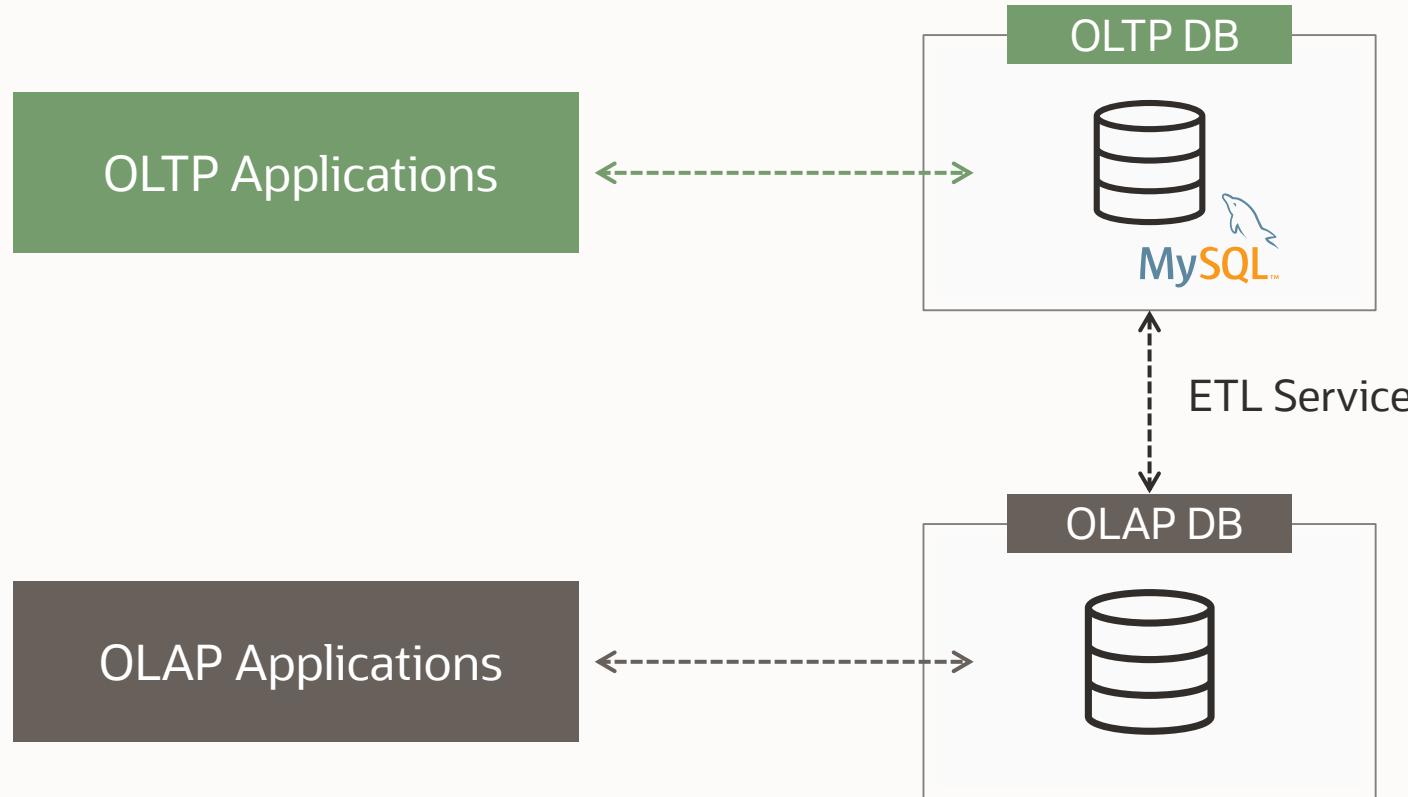


- Increase capacity for read-intensive workloads
- Add and remove Read Replicas for horizontal read elasticity
- Easy to deploy and maintain
- Built-in Load Balancer for the read-only endpoint
 - 5-Tuple Hash Load Balancing Policy: source IP and port, destination IP and port, protocol
- HA Cluster continues reliable and ready for switchover or failover

One database is better than two

OLTP + OLAP = MySQL HeatWave

MySQL is optimized for OLTP, not designed for analytic processing



Separate analytics database

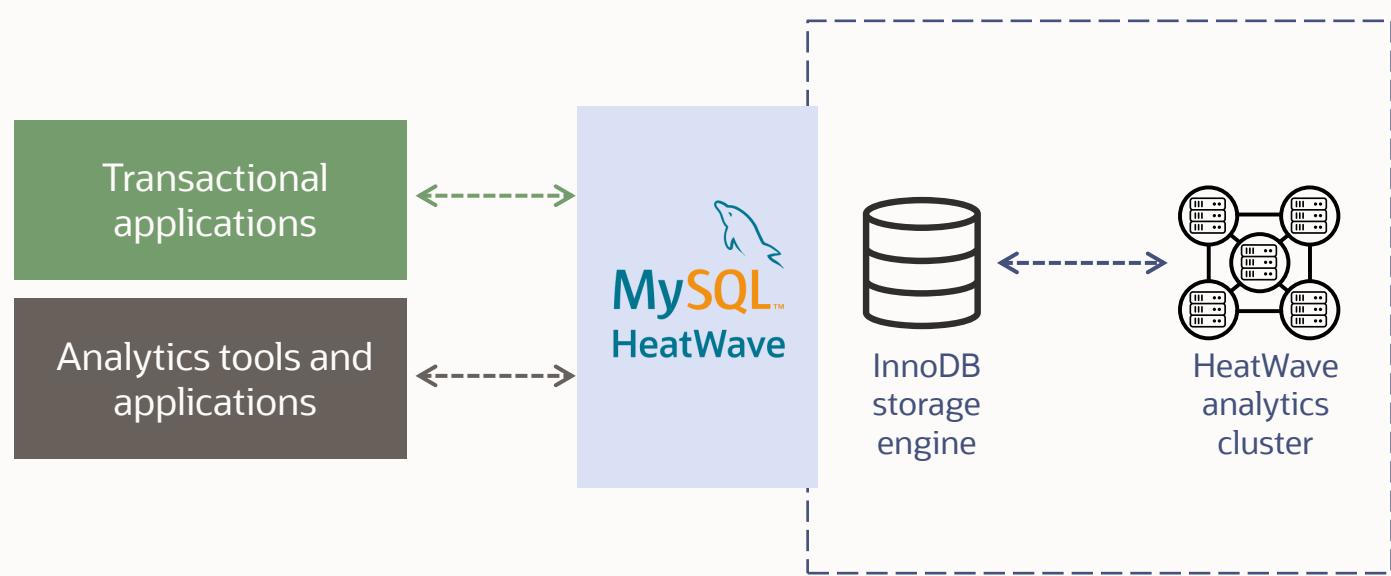
Complex ETL

No real-time analytics

Security & compliance risks

Increased costs

One database is better than two



One service for OLTP & OLAP

No ETL duplication

Unmatched performance, at a fraction of the cost

Real-time analytics

Improved security

Applications work without changes

1>2 with MySQL HeatWave

How long to execute this query in HeatWave?

And in InnoDB?

```
select
    `o`.`ORDER_ID` AS `order_id`,
    `o`.`ORDER_DATETIME` AS `ORDER_DATETIME`,
    `o`.`ORDER_STATUS` AS `order_status`,
    `c`.`CUSTOMER_ID` AS `customer_id`,
    `c`.`EMAIL_ADDRESS` AS `email_address`,
    `c`.`FULL_NAME` AS `full_name`,
    sum(`oi`.`QUANTITY` * `oi`.`UNIT_PRICE`) AS `order_total`,
    `p`.`PRODUCT_NAME` AS `product_name`,
    `oi`.`LINE_ITEM_ID` AS `LINE_ITEM_ID`,
    `oi`.`QUANTITY` AS `QUANTITY`,
    `oi`.`UNIT_PRICE` AS `UNIT_PRICE`
from (
    `orders` `o` join `order_items` `oi` on(`o`.`ORDER_ID` = `oi`.`ORDER_ID`)
    join `customers` `c` on(`o`.`CUSTOMER_ID` = `c`.`CUSTOMER_ID`)
    join `products` `p` on(`oi`.`PRODUCT_ID` = `p`.`PRODUCT_ID`)
)
group by
    `o`.`ORDER_ID`,
    `o`.`ORDER_DATETIME`,
    `o`.`ORDER_STATUS`,
    `c`.`CUSTOMER_ID`,
    `c`.`EMAIL_ADDRESS`,
    `c`.`FULL_NAME`,
    `p`.`PRODUCT_NAME`,
    `oi`.`LINE_ITEM_ID`,
    `oi`.`QUANTITY`,
    `oi`.`UNIT_PRICE`
limit 10;
```

iTerm2 Shell Edit View Session Scripts Profiles Toolbelt Window Help

Mon 7 Aug 14:19



opc@bastion-sp-113306:~

opc@bastion-sp-113306:~ (ssh)

[opc@bastion-sp-113306 ~]\$ █

...

█

opc@bastion-sp-113306:~ (ssh)

[opc@bastion-sp-113306 ~]\$ █

...





Tetris.co simplifies real-time analytics

“MySQL HeatWave dramatically reduced our AWS Aurora and Redshift cost by more than 50%. We are no longer moving data around so now we have blazing fast, real-time insights with no effort. More importantly, scalability has made our expansion plan possible, allowing us to onboard more data and new clients without impact to costs. It’s a dream come true.”

Pablo Lemos

Cofounder and CTO, Tetris.co

Business Challenge:

Tetris.co offers analytical software that unifies massive amounts of data from several sources to help Brazilian clients understand how digital marketing investments perform. It needed a data platform that is easy to use, low cost, and scalable.

Results:

- ✓ Migrated to MySQL HeatWave from AWS Aurora and Redshift and GCP BigQuery in one month
- ✓ Accelerated complex queries from minutes to milliseconds
- ✓ Reduced costs by more than 50% and eliminated ETL processes
- ✓ Onboard new clients of any size at no cost impact

Products Used:

MySQL HeatWave

Read [story](#)

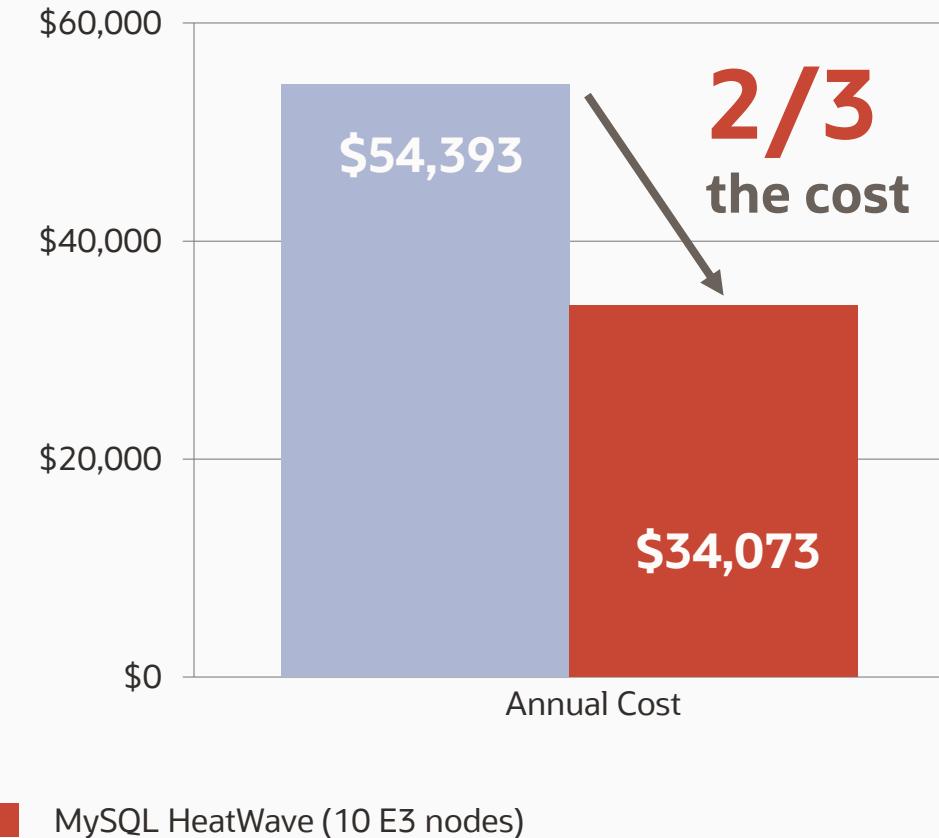
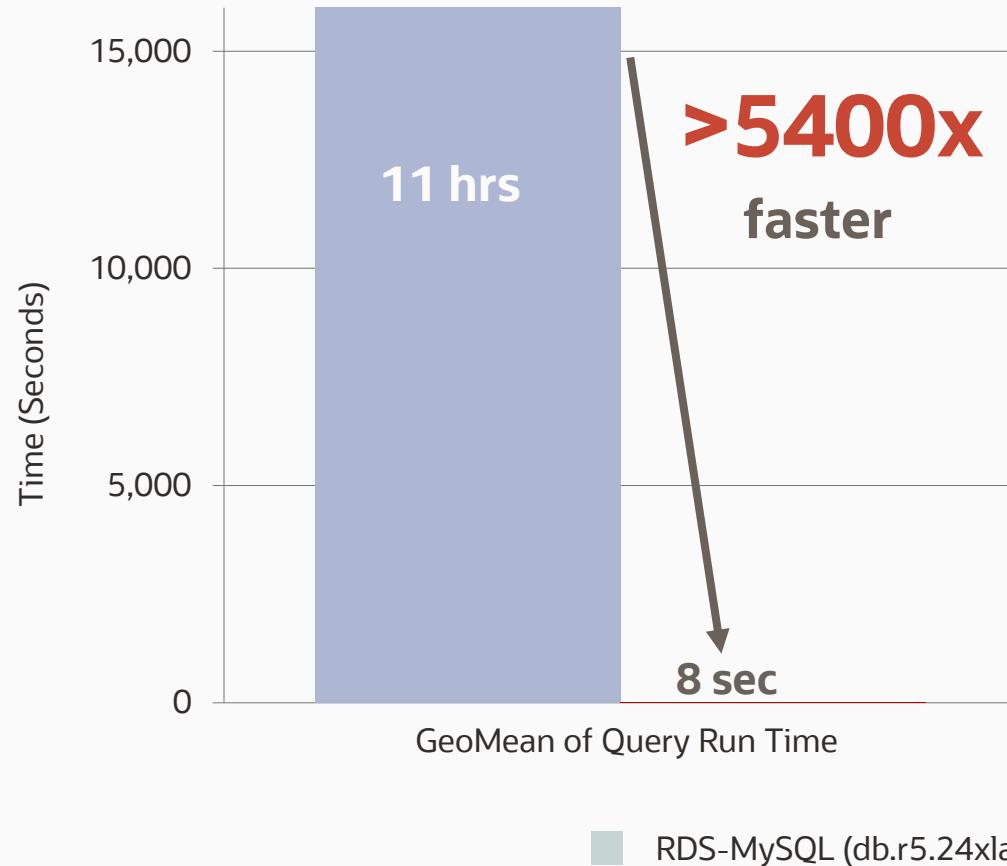


Success case – Tetris.co



MySQL HeatWave vs. Amazon RDS

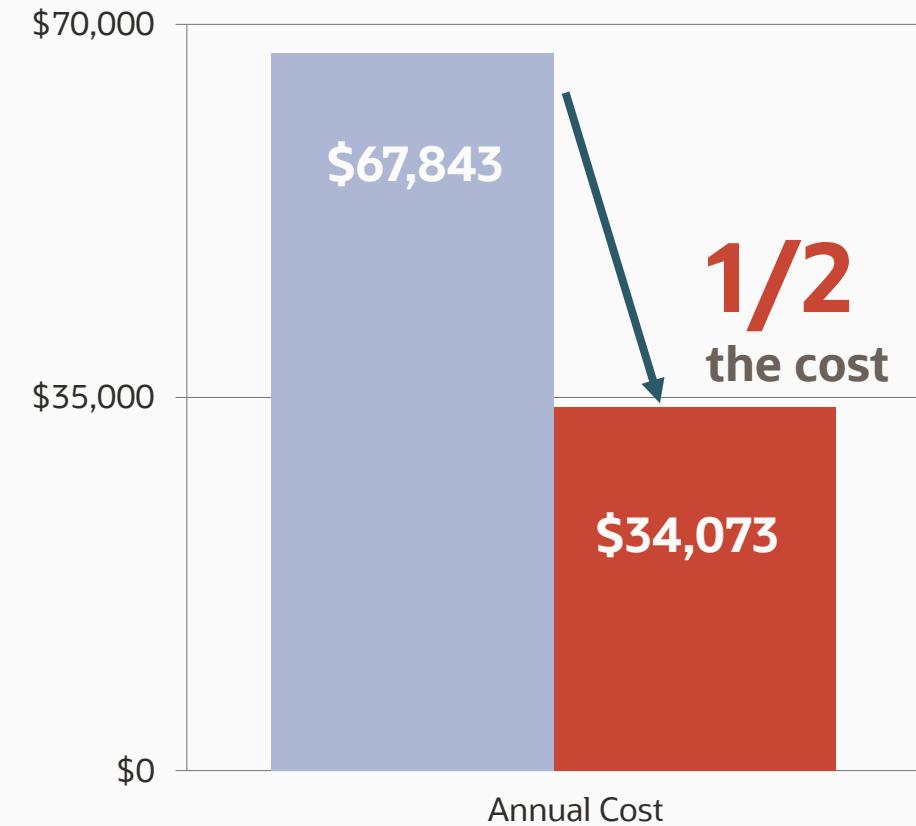
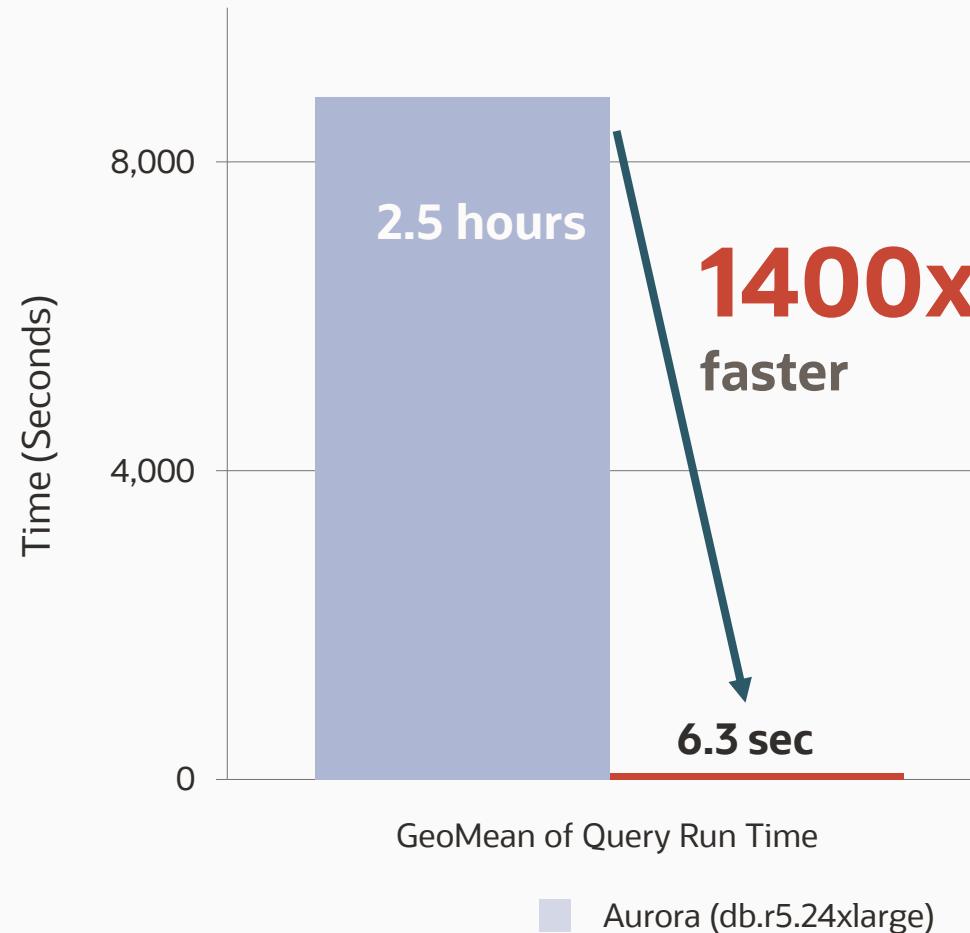
4 TB



*Benchmark queries are derived from TPC-H benchmark, but results are not comparable to published TPC-H benchmark results since they do not comply with TPC-H specification.

MySQL HeatWave vs. Amazon Aurora: 2800x better price performance

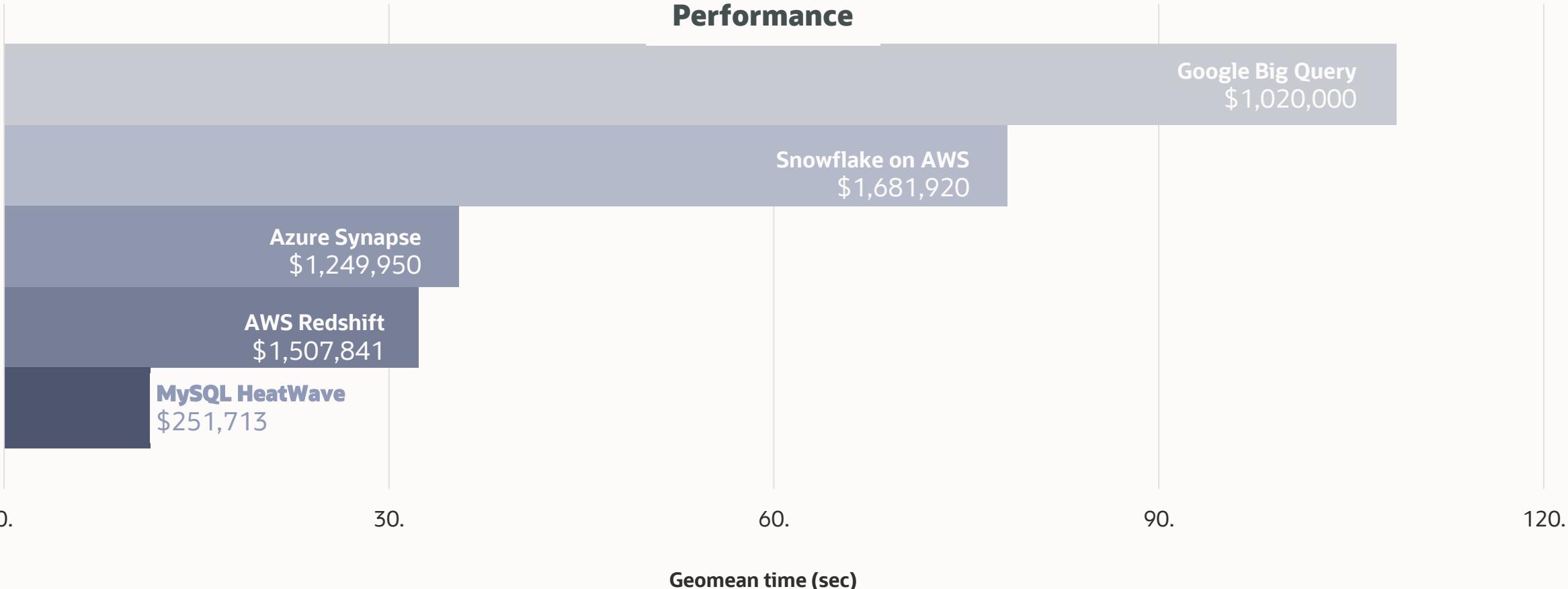
4 TB



*Benchmark queries are derived from TPC-H benchmark, but results are not comparable to published TPC-H benchmark results since they do not comply with TPC-H specification.

Performance and price comparison

30TB TPCH, HeatWave is faster and cheaper than all the competitive database services



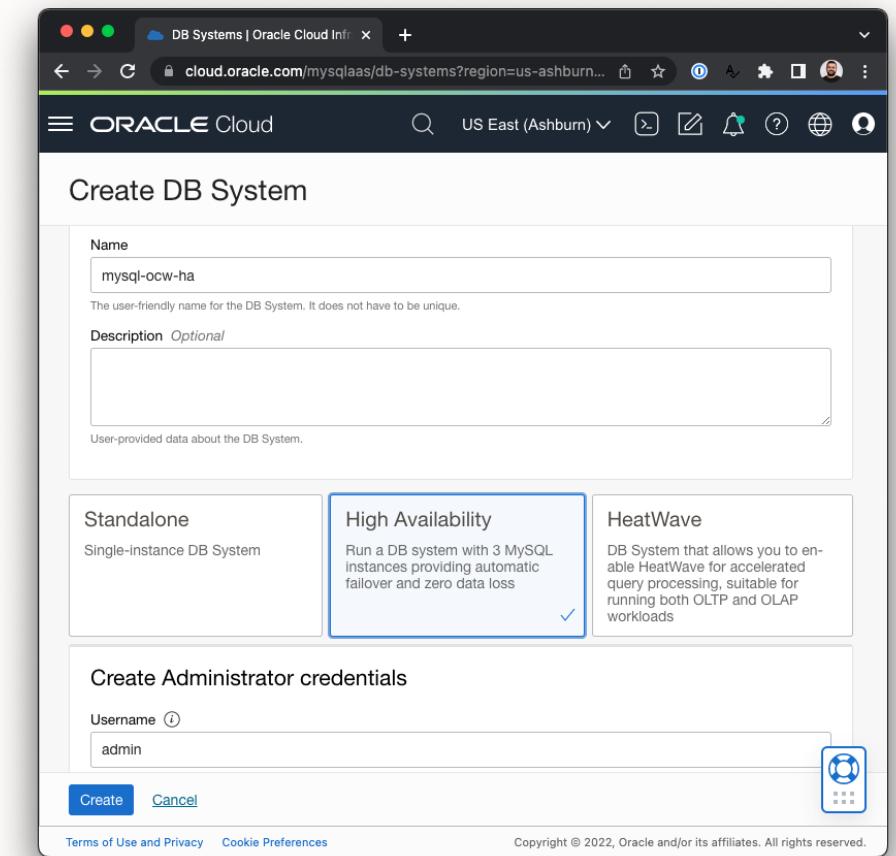
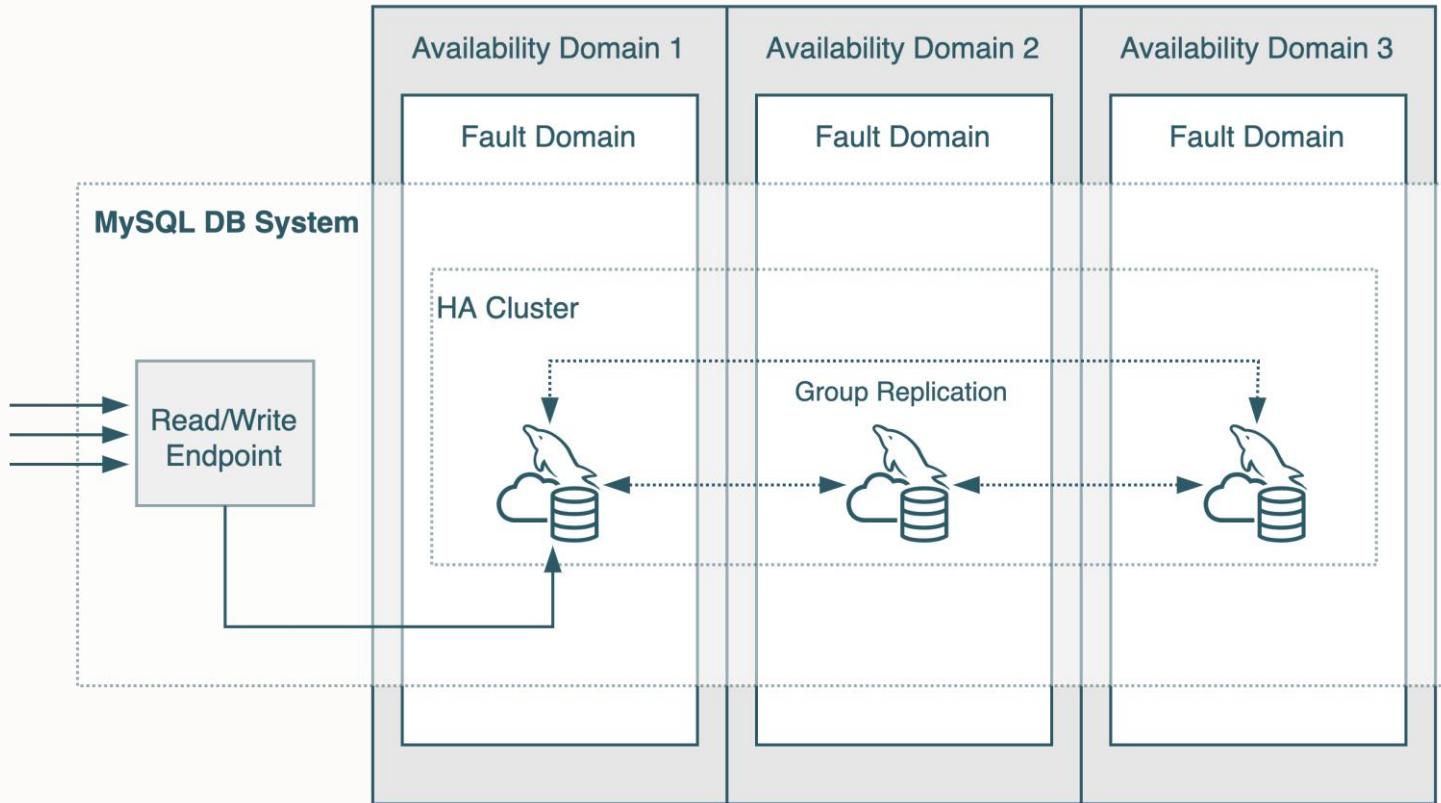
3rd party numbers derived from Gigaom report of Oct 2020

Using PAYG pricing for Snowflake. Other prices are based on 1 year pricing

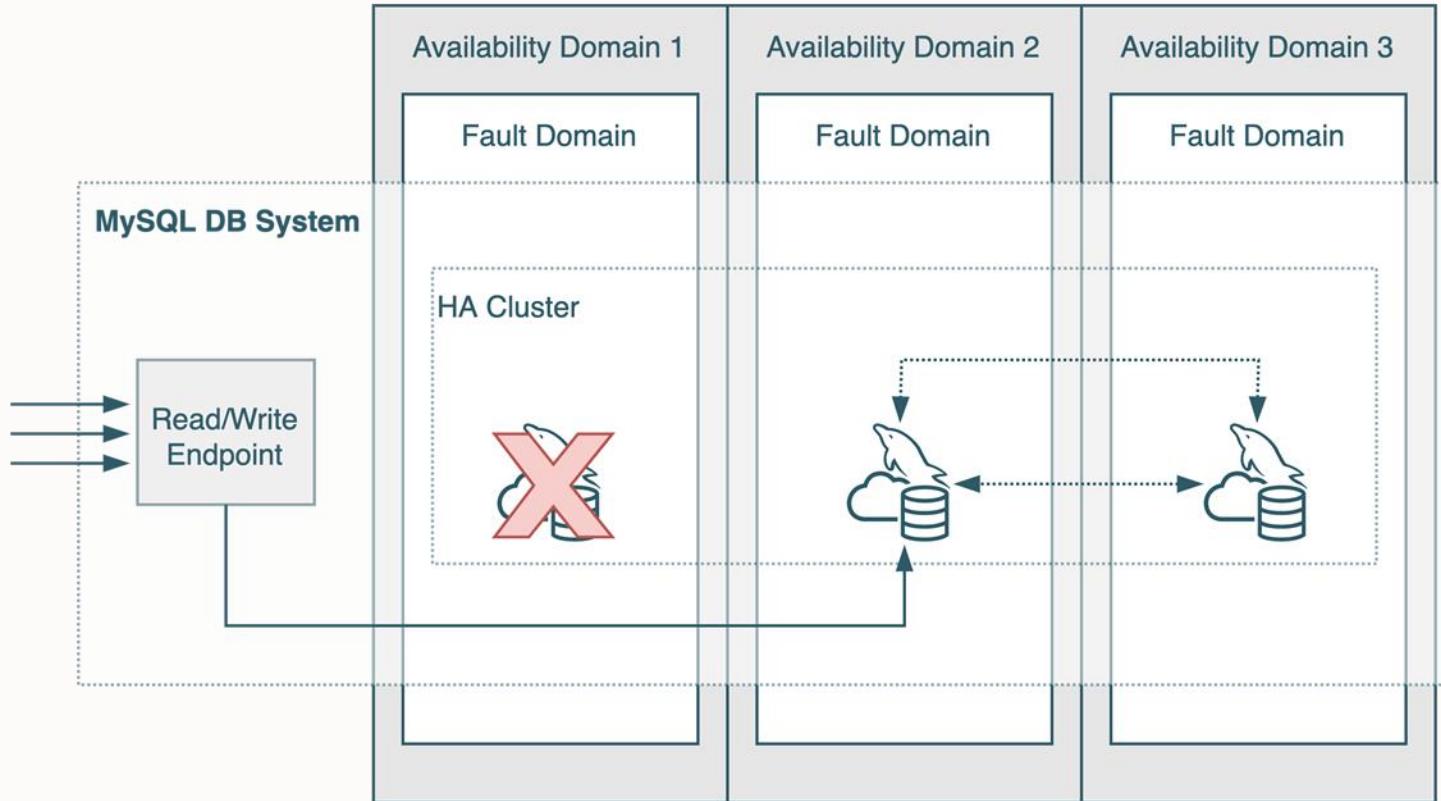
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Architectures

High Availability



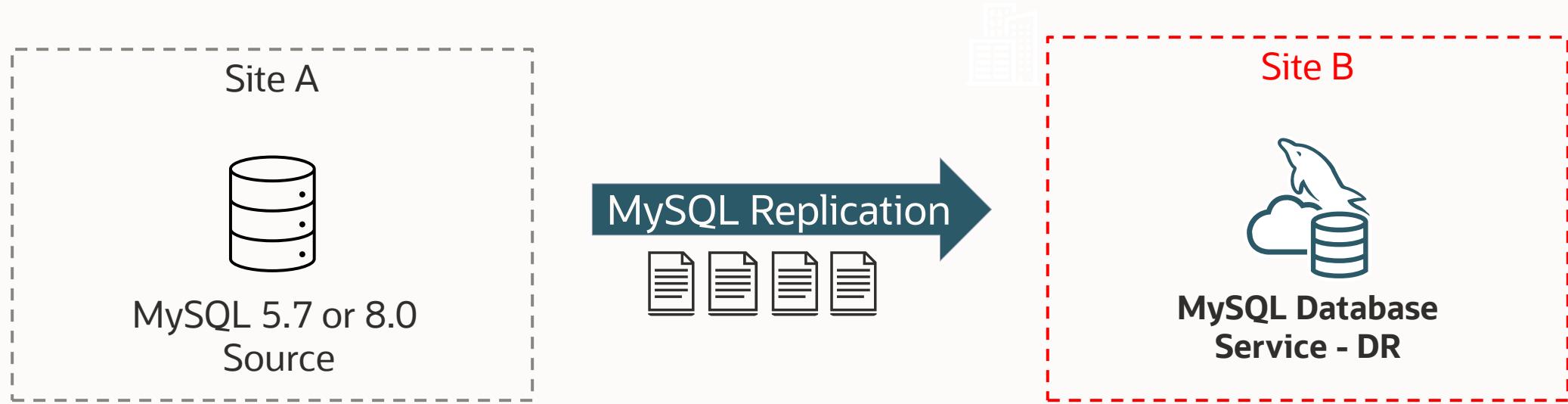
High Availability



- SLA 99.99%
- Automatic failover
- Manual switchover
- Rolling upgrades during maintenance
 - Less than 1 minute impact
 - MySQL version upgrades and OS security patches
- RPO: 0
- RTO: Less than a minute

Disaster Recovery - Think about it!

Disaster Recovery scenarios



On-Premises
Or IaaS



Google Cloud

Other vendors

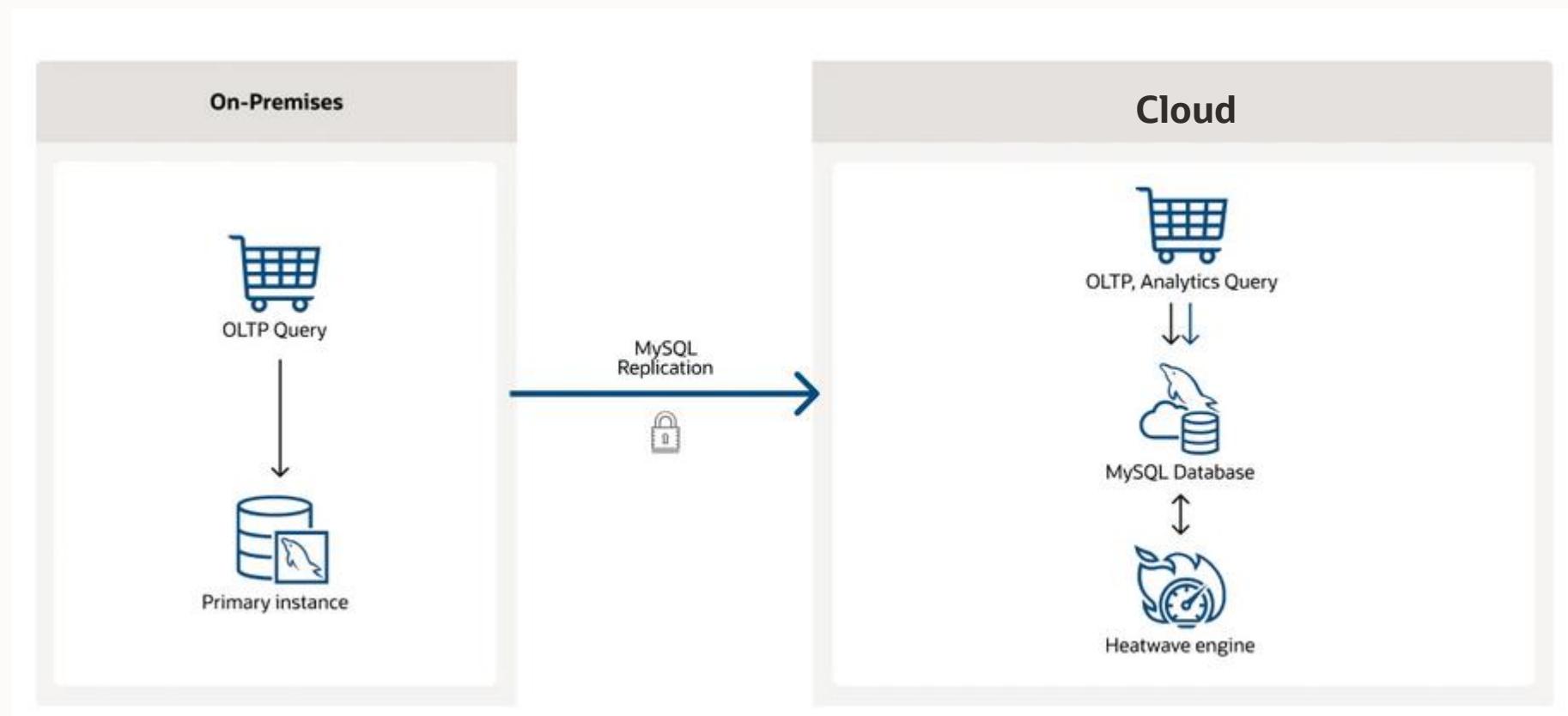
MariaDB PERCONA

ORACLE
Cloud Infrastructure

Between
OCI Regions

Enabling hybrid deployments

OLTP on-premises, OLAP in the cloud

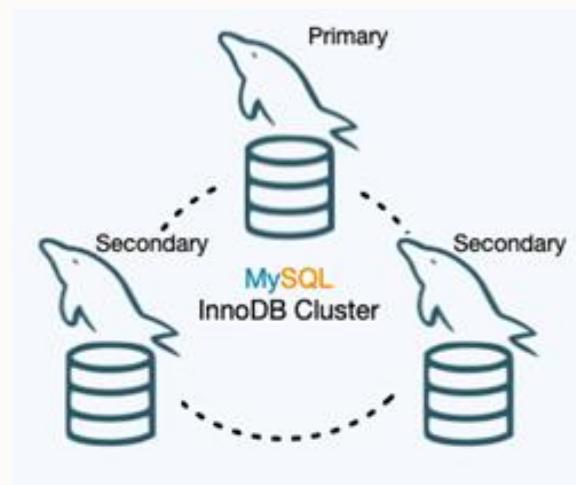


Success cases

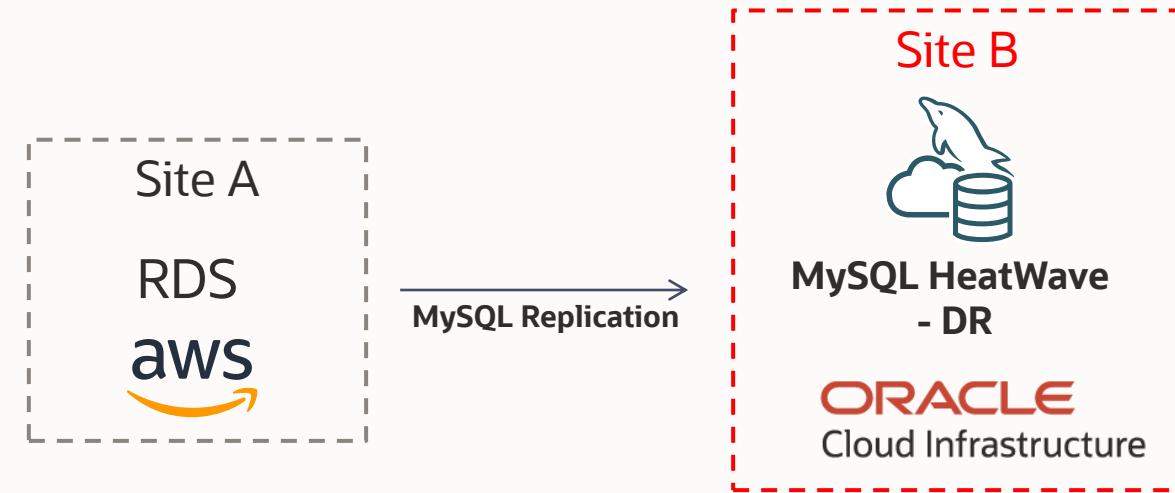
High Availability

Health care company in Brazil running in HA for its Zabbix monitoring platform

Several universities deployed their Learning Management Systems (LMS) based on Moodle using HA architecture



Disaster Recovery



A Consulting company in LAD was demanded to use AWS by its customer and decided to deploy a DR strategy replicating the data to OCI natively and easily.

MySQL AutoML - Machine Learning out of the box!

Why organizations want to adopt machine learning and advanced analytics

50%

faster response to customers, competitors, regulators, and partners by AI-powered enterprises

50%

of AI inquiries come with a discussion on graph, according to Gartner

66%

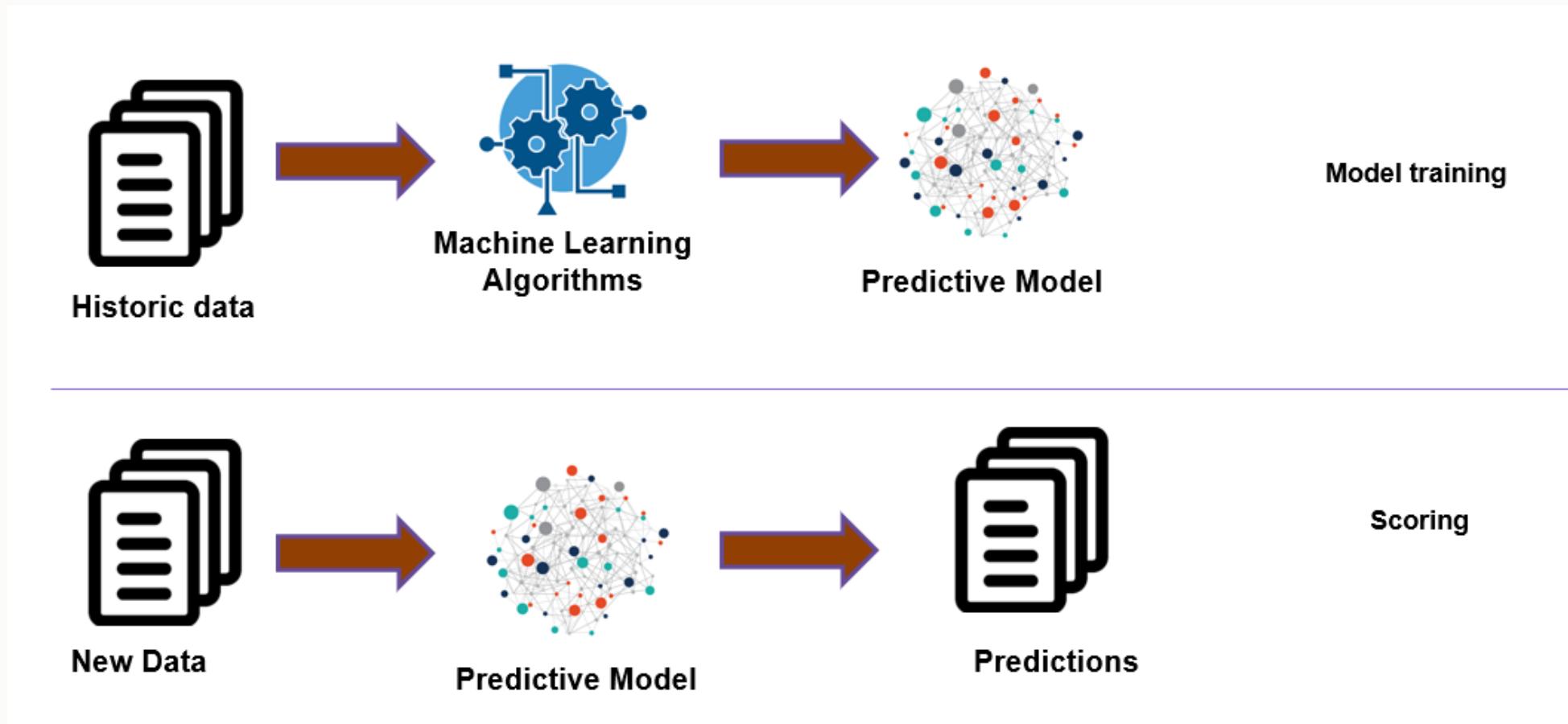
report reduced costs due to adoption of ML/AI technology

75%

of enterprises will adopt machine learning by 2024, according to Gartner

Machine Learning

Training and inference



Customer verticals with HeatWave AutoML POCs

Digital Marketing

Cost per acquisition

Targeted campaigns

Customer classification

E-Commerce

Videos for users

Lottery suggestions

Product upsell

Education

Predict student success

Monitor student behavior

HIPPA Compliance

Services

Erroneous ledger entries

Predict future losses

Predict price elasticity

FinTech

Loan default prediction

Identify loan extensions

Loan approval

Gaming

Player churn detection

Adjust game difficulty

Identify game hackers

Internet Of Things

Airport ticketing

Rain water level

Air pollution

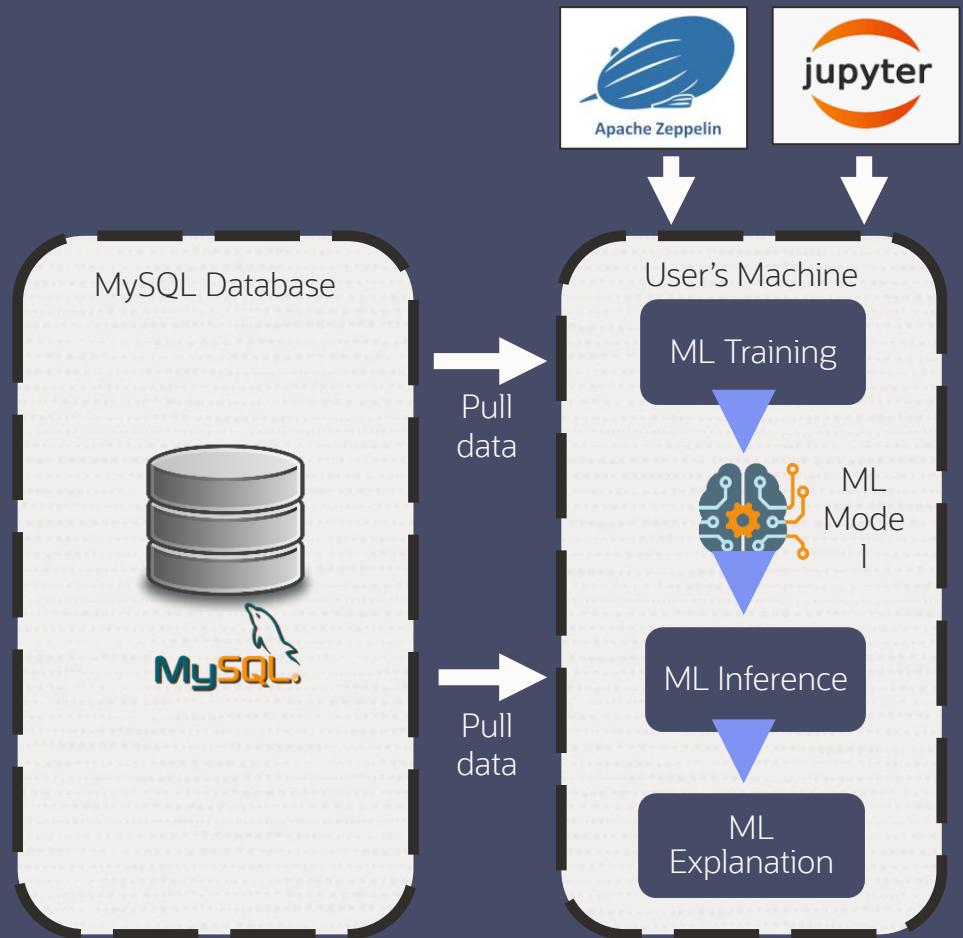
Manufacturing

Reduce warranty claims

Defective part identification

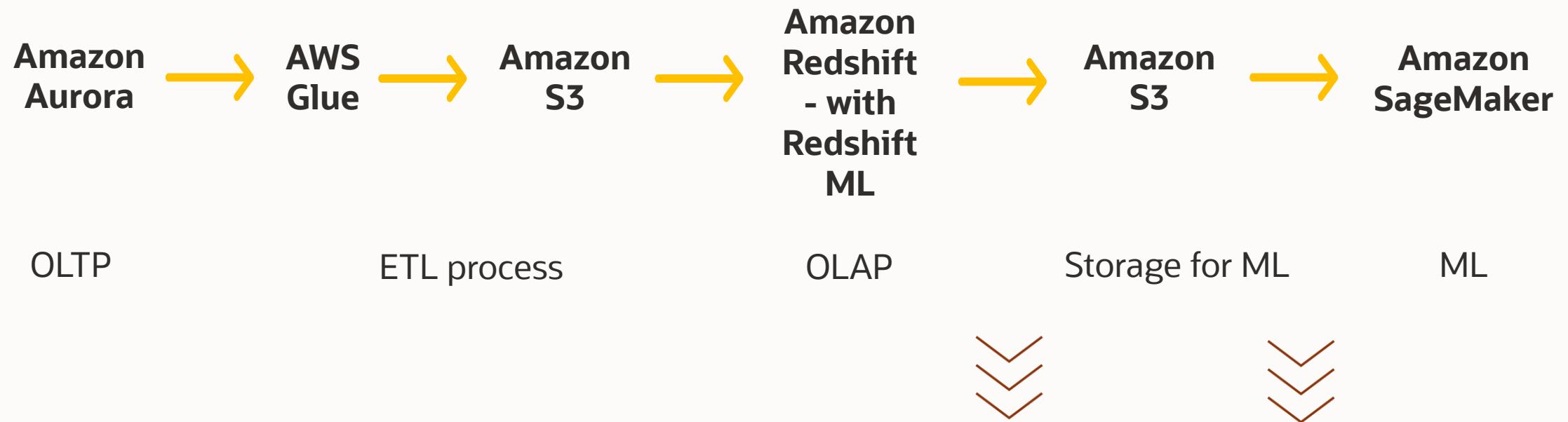
Detect anomalies in supplies



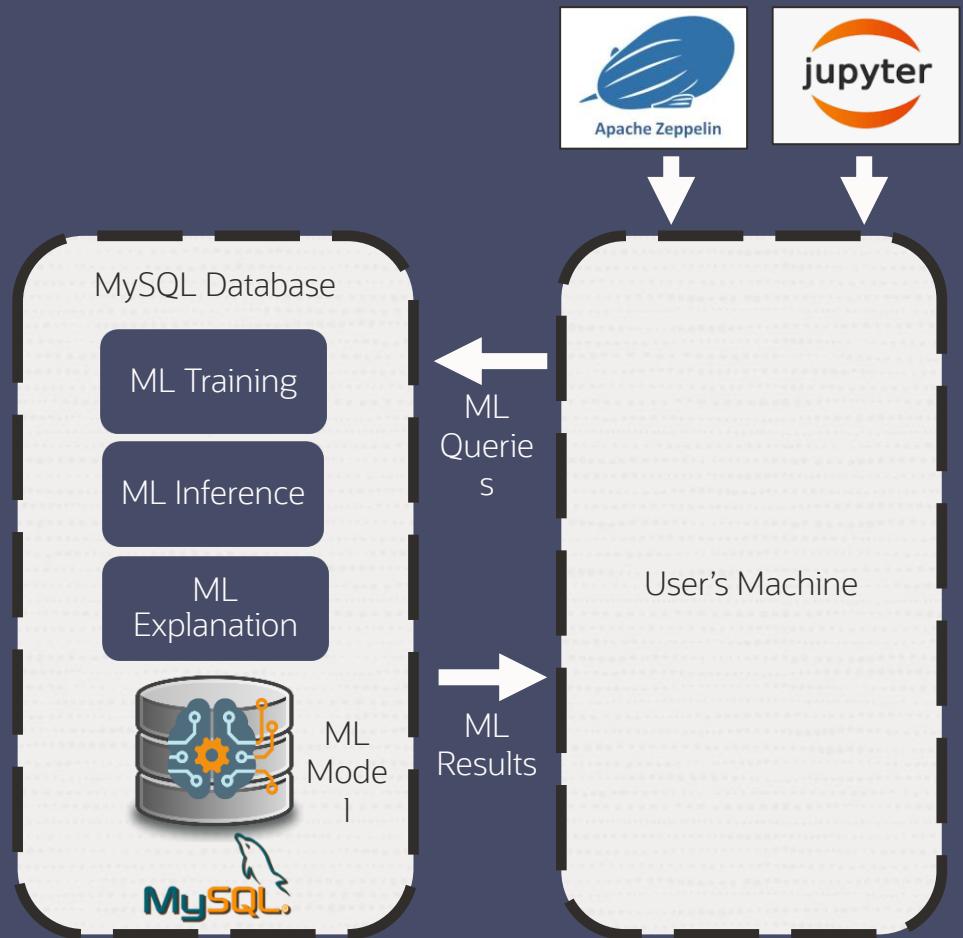


Prior approach with ML processing with MySQL requires ETL from the database

The pain of using AWS services



**Redshift ML does NOT provide in-database ML;
exports data to SageMaker via Amazon S3**



Machine learning with
HeatWave ML - No ETL,
secure, saves effort, no
additional cost, faster and
easier!

5 simple SQL calls: **ML_TRAIN**, **ML_MODEL_LOAD**,
ML_EXPLAIN_ROW, **ML_PREDICT_ROW**, **ML_SCORE**

Aicoll migrated from home grown ML solution

IMPROVED PREDICTIONS OF LOAN DEFAULT

A leader in loan default prediction with ambitions to become Latin America's largest financial technology hub

- Reduced time to build ML models from 3 months to 1 week
- Accelerated data preparation from 1 day to minutes
- Executes ML predictions for millions of users in real-time, without extracting data outside database
- Empowered operations team to create new ML models
- Improved liquidity by 20% across client portfolios

“Without a doubt, Oracle has helped us sell our loan default solutions to credit institutions throughout Colombia and beyond thanks to the automated machine learning engine within MySQL HeatWave, and to the high availability and scalability of Oracle Cloud Infrastructure.”

Yelitza Romero, CEO

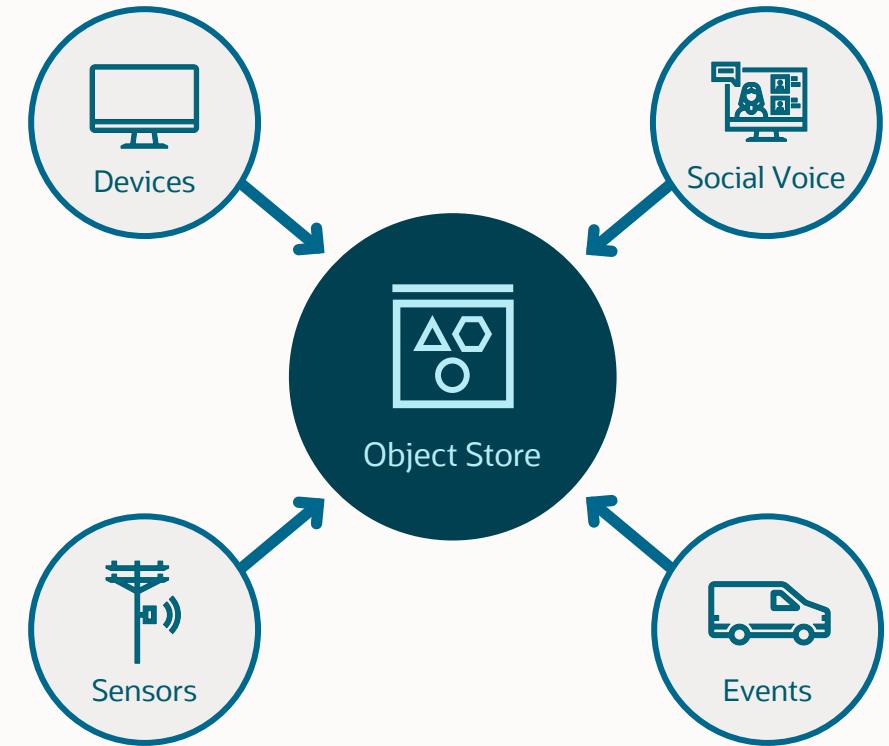


MySQL HeatWave Lakehouse

Growth of data outside of databases

Significant growth of data outside of databases

- Databases are systems of record
- Data lake is the repository for other types of data
- 79 Zetabytes of data generated in 2021, 180 ZB expected in 2025 (IDC)
- In 2019, IoTs alone generated 13.6 ZB of data
- 99.5% of collected data remains unused (Grow.com)
- More than 80% of data is unstructured (mitsloan.mit.edu)



99.5% of collected data remains unused. Why?

Lack of time, resources, and expertise to process different data formats across different data sources

Businesses confront unprecedented volumes of data

- **79** Zettabytes of data generated in 2021, **180** ZB expected 2025

The solution:



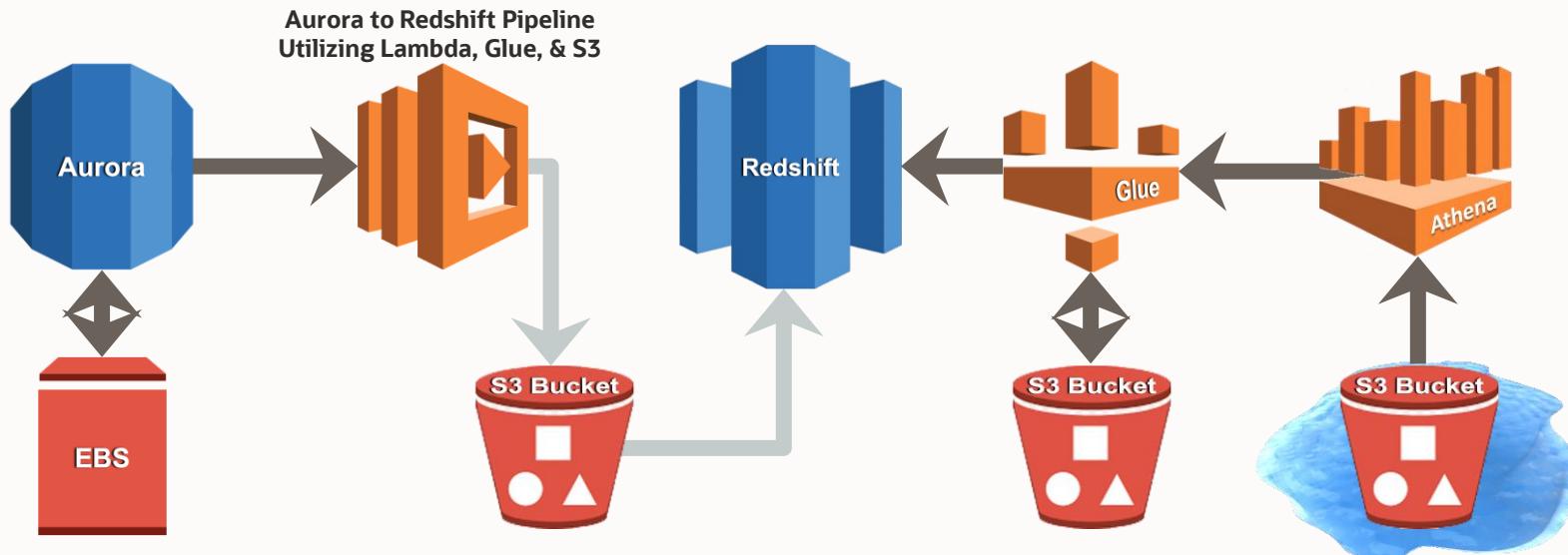
What is a Data Lakehouse?

Best of both worlds:

- Affordable data repository to collect data from both structured and unstructured sources
- Database tools and features to prepare and organize data for analysis, reporting and projections
- Accelerates analysis of data across different formats

...In contrast to the complexity of other Lakehouse offerings

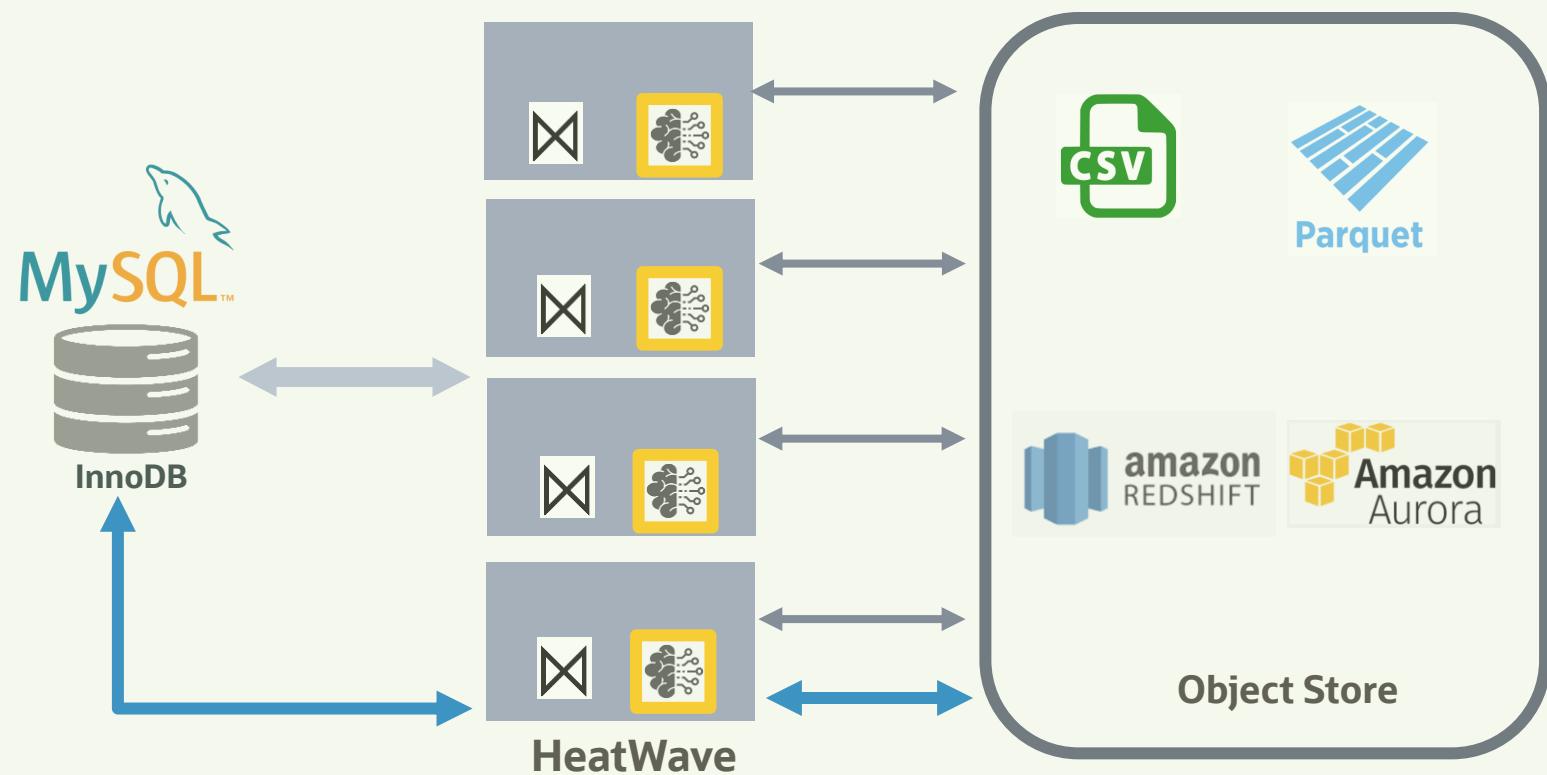
Using multiple services; paying for multiple copies of your data, stored on multiple object stores



Example: AWS Redshift Working with S3 Lakehouse

MySQL HeatWave Lakehouse

Support data on object store, multiple file formats, larger data size



MySQL HeatWave Lakehouse characteristics

1. *Unified query engine* for OLTP, OLAP, machine learning and data lake
2. Ability to *query across data* in MySQL database and external data source
3. MySQL *Autopilot* for Lakehouse
4. *Scale out architecture* for data management and query processing : 512 nodes
5. 100% compliant with MySQL syntax

```
mysql> CREATE TABLE Sensor (date DATE, degree INT) ENGINE=DATALAKE  
          ENGINE_ATTRIBUTE='{"dialect":{"format":"csv"},  
"file": [{"prefix":"temp_sensor_1.csv"}]}'  
          SECONDARY_ENGINE=RAPID;  
  
mysql> ALTER TABLE Sensor SECONDARY_LOAD;  
  
mysql> ALTER TABLE SALES SECONDARY_LOAD;  
  
mysql> SELECT count(*) FROM Sensor, SALES WHERE Sensor.degrees > 30 and Sensor.date = SALES.date;
```

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Get started Dashboard

Service links

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- Buckets Object Storage & Archive Storage
- Fleet Summary Database Management
- GoldenGate GoldenGate
- DB Systems MySQL HeatWave
- Instances Compute
- Virtual cloud networks Networking

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- Compartments Identity
- Bastion Identity & Security
- Email Delivery Application Integration
- Notifications Application Integration
- Service Metrics Monitoring
- Database Tools Developer Services

RECOMMENDED - For the profiles you selected ([Update](#))

- Authentication Settings Identity
- Overview Resource Manager
- Logging Logging
- Overview License Manager
- Autonomous Data Warehouse Autonomous Database
- Block Volumes Block Storage

All services operational

View health dashboard

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Join preview program

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Announcing availability of Oracle Cloud Agent version 1.34

View my deployments

FEATURED

Predict the result of the next race

25-30 mins

ORACLE RedBull RACING

CLOUD PARTNER

APPLICATION DEVELOPMENT

Deploy a WordPress website

6-8 mins

W

APPLICATION DEVELOPMENT

Deploy a low-code app on Autonomous Database using APEX

3-5 mins

X

APPLICATION DEVELOPMENT

Deploy RStudio in a container

10-12 mins

Cloud

APPLICATION DEVELOPMENT

Deploy a baseline landing zone

7-9 mins

Shield

DATABASE

Visualize and analyze Strava data on Autonomous Database

2-4 mins

Bike

https://cloud.oracle.com

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100% 100% Mon 7 Aug 14:21

opc@bastion-sp-113306:~

```
| Applying changes will take approximately 10.00 s
```

```
| Caution: Executing the generated load script will affect the secondary engine flags in the schema
```

```
+-----+  
11 rows in set (9.8056 sec)
```

```
Query OK, 0 rows affected (9.8056 sec)
```

```
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL> SELECT log->>"$.sql" AS "Load Script" FROM sys.heatwave_autopilot_report WHERE type = "sql" ORDER BY id;
```

```
+-----+  
| Load Script  
+-----+
```

```
+-----+  
| CREATE TABLE `mysql_customer_orders`.`delivery_orders`(`col_1` int unsigned NOT NULL, `col_2` bigint unsigned NOT NULL, `col_3` tinyint unsigned NOT NULL, `col_4` varchar(9) NOT NULL COMMENT 'RAPID_COLUMN=ENCODING=VARLEN', `col_5` tinyint unsigned NOT NULL, `col_6` tinyint unsigned NOT NULL, `col_7` tinyint unsigned NOT NULL) ENGINE=lakehouse SECONDARY_ENGINE=RAPID ENGINE_ATTRIBUTE='{"file": [{"par": "https://objectstorage.sa-saopaulo-1.oraclecloud.com/p/hDj4v0CZv5pQ4jKVn-7UuRCGZGiXPUhxLcu0ErZbAkpxtdKit-hKyx1kDI-R1gEH/n/idazzjlcjqzj/b/lakehousedemo/o/order/delivery-orders-1.csv"}], "dialect": {"format": "csv", "field_delimiter": "\\\t", "record_delimiter": "\\\n"}}';  
| ALTER TABLE `mysql_customer_orders`.`delivery_orders` SECONDARY_LOAD;  
+-----+
```

```
2 rows in set (0.0008 sec)
```

```
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL>  
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL>  
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL>  
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL> 
```



opc@bastion-sp-113306:~

2 rows in set (0.0008 sec)

```
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL >
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL >
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL >
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL > CREATE TABLE `mysql_customer_orders`.`delivery_orders`(`orders_delivery` int unsigned NOT NULL, `order_id` bigint unsigned NOT NULL, `customer_id` tinyint unsigned NOT NULL, `order_status` varchar(9) NOT NULL COMMENT 'RAPID_COLUMN=ENCODING=VARLEN', `store_id` tinyint unsigned NOT NULL, `delivery_vendor_id` tinyint unsigned NOT NULL, `estimated_time_hours` tinyint unsigned NOT NULL) ENGINE=lakehouse SECONDARY_ENGINE=RAPID ENGINE_ATTRIBUTE='{"file": [{"path": "https://objectstorage.sa-saopaulo-1.oraclecloud.com/p/hDj4v0CZv5pQ4jKVn-7UuRCGZGiXPUhxLcu0ErZbAkpxtdKit-hKyxlkDI-R1gEH/n/idazzjlcjzj/b/lakehousedemo/o/order/delivery-orders-1.csv"}], "dialect": {"format": "csv", "field_delimiter": "\t", "record_delimiter": "\n"}}';
Query OK, 0 rows affected (0.0063 sec)
```

```
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL >
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL > desc delivery_orders;
```

Field	Type	Null	Key	Default	Extra
orders_delivery	int unsigned	NO		NULL	
order_id	bigint unsigned	NO		NULL	
customer_id	tinyint unsigned	NO		NULL	
order_status	varchar(9)	NO		NULL	
store_id	tinyint unsigned	NO		NULL	
delivery_vendor_id	tinyint unsigned	NO		NULL	
estimated_time_hours	tinyint unsigned	NO		NULL	

7 rows in set (0.0021 sec)

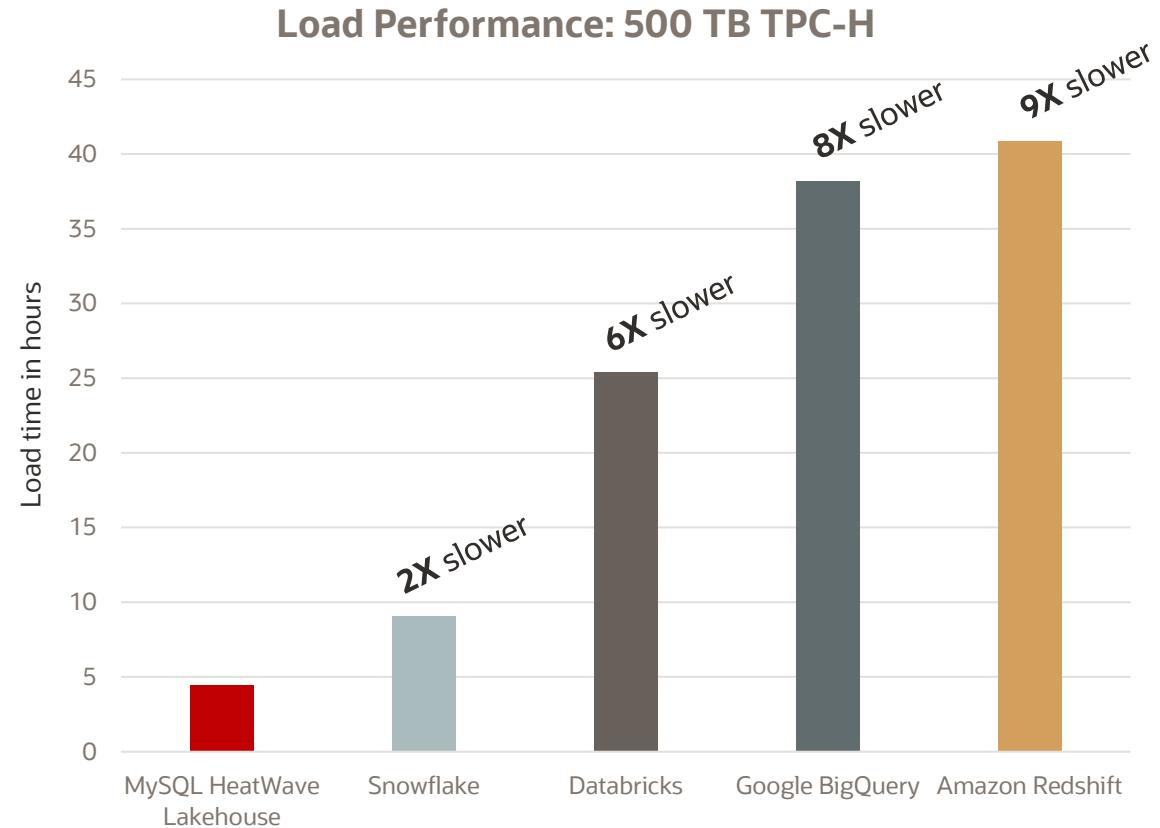
```
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL >
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL >
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL >
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL > ALTER TABLE `mysql_customer_orders`.`delivery_orders` SECONDARY_LOAD;
Query OK, 0 rows affected (19.6805 sec)
```

```
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL >
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL >
MySQL hwdemo:33060+ ssl mysql_customer_orders SQL >
```



Time Saved: Data Load performance of MySQL HeatWave Lakehouse

2X faster than Snowflake, 6X faster than Databricks, 9X faster than Redshift, 8X faster than BigQuery



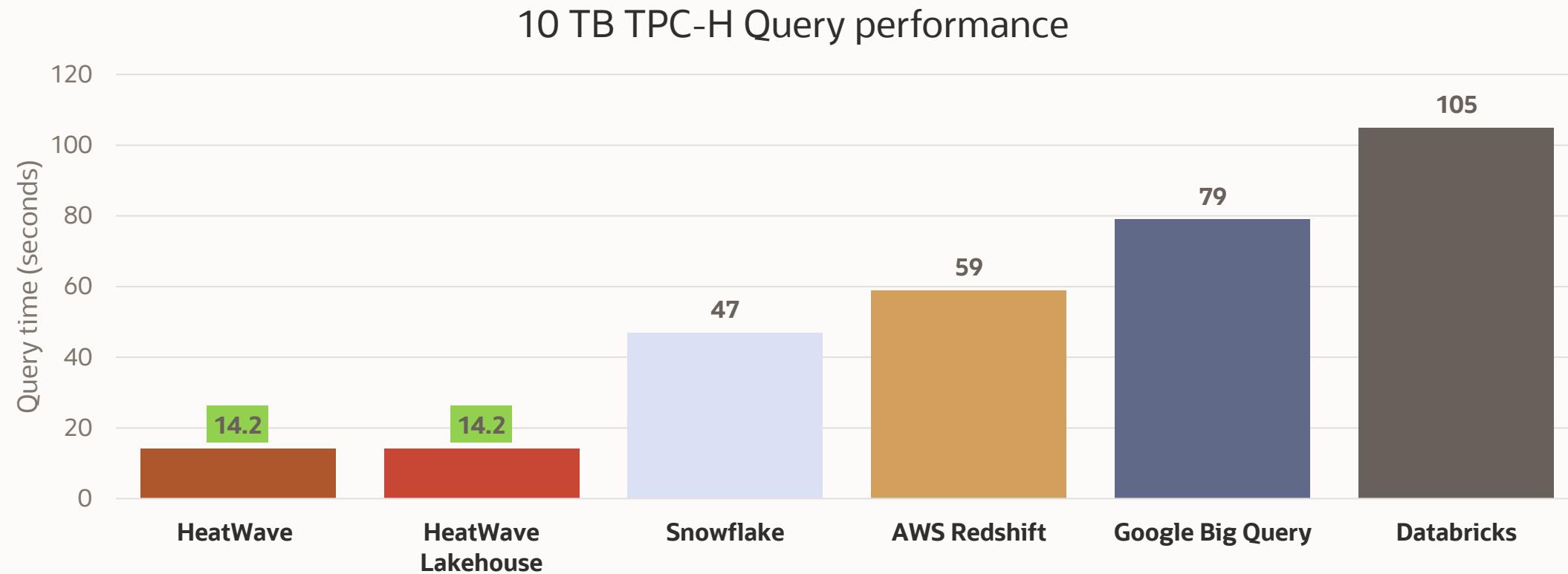
MySQL HeatWave Lakehouse saves valuable time... **But, how?**

Configuration: MySQL HeatWave Lakehouse: 512 nodes; Snowflake: 4X-Large Cluster; Databricks: 3X-Large Cluster; Amazon Redshift: 20-ra3.16xlarge; Google BigQuery: 6400 slots

*Benchmark queries are derived from the TPC-H benchmarks, but results are not comparable to published TPC-H benchmark results, as these do not comply with the TPC-H specifications.

Same query performance when data inside MySQL DB or in object store

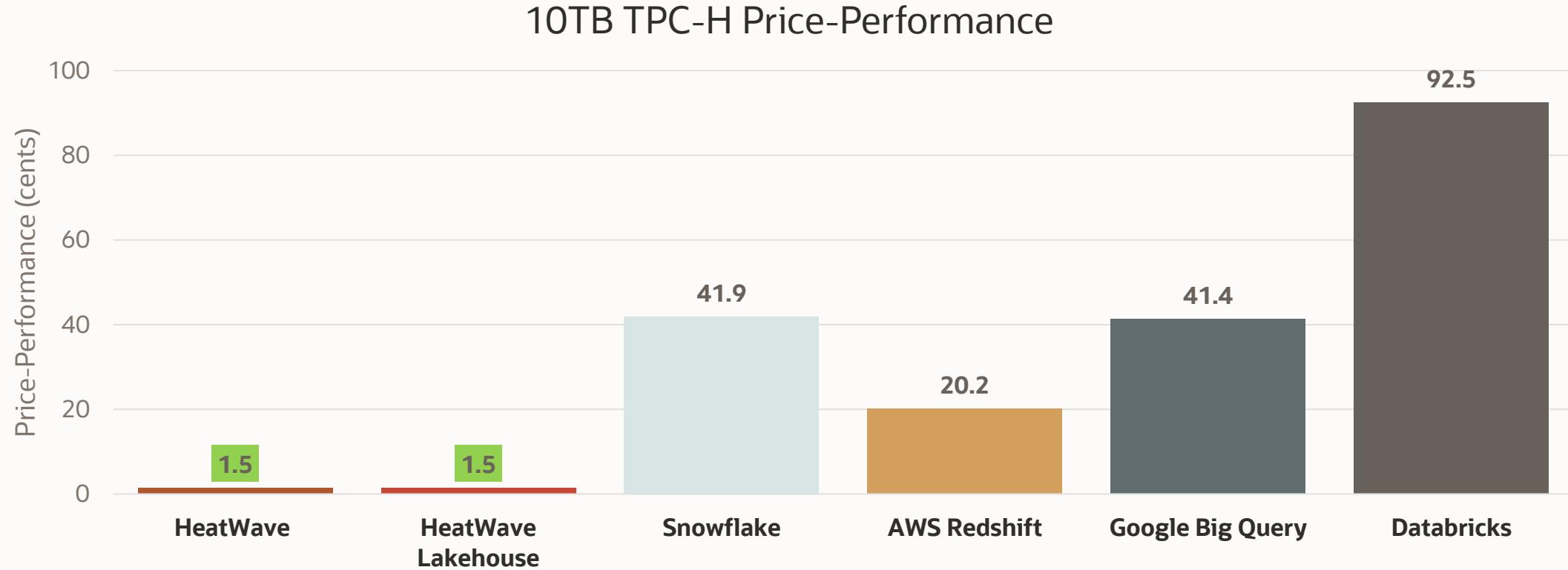
Provides flexibility to develop applications on object store without any performance, cost impact



10 HeatWave nodes, X-Large cluster for Snowflake; 10 nodes of ra3.4xlarge for Redshift; 800 slots for Google BigQuery; Large cluster for Databricks

*Benchmark queries are derived from the TPC-H benchmark, but results are not comparable to published TPC-H benchmark results since these do not comply with the TPC-H specifications.

Same price-performance when data inside MySQL DB or in object store



10 HeatWave Nodes, X-Large cluster for Snowflake; 10 nodes of ra3.4xlarge for Redshift; 800 slots for Google BigQuery; Large cluster for Databricks
Standard edition price for Snowflake; 3 yr upfront price for Redshift; 1 year reserved price for Google BigQuery and Databricks

Deloitte.

“HeatWave Lakehouse scales out very well for loading data from object storage and for running queries on object store... This scale out characteristic of HeatWave Lakehouse for data management is key to efficiently process very large amounts of data.”

Henry Tullis

Leader, Cloud Infrastructure and Engineering
Deloitte Consulting



“Data is growing exponentially and so is the amount of data we store in our data lake. Obtaining real-time insights from this data is very important for Natura, and MySQL HeatWave Lakehouse could represent a new competitive weapon if we can do so faster than our competition.”

Fabricio Rucci

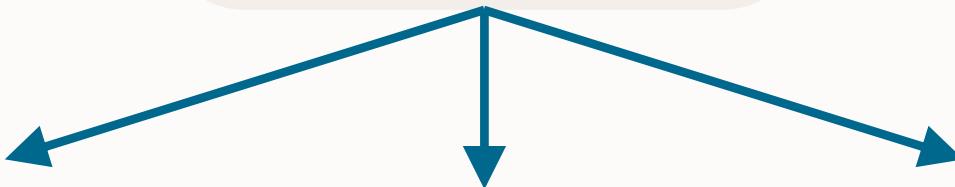
Senior Solution Architect
Natura

When and where you need!

You
choose
where to
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MySQL™ HeatWave



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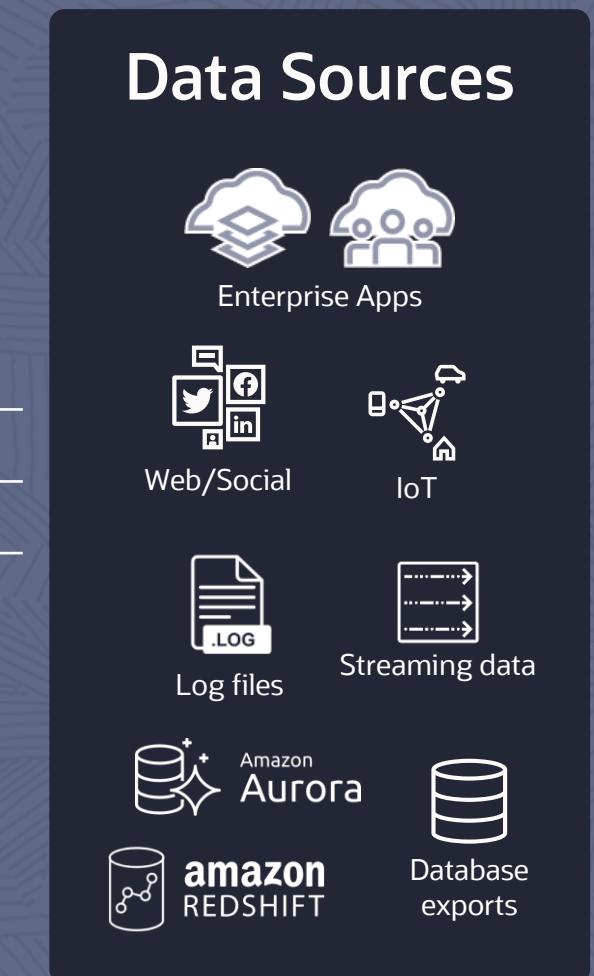
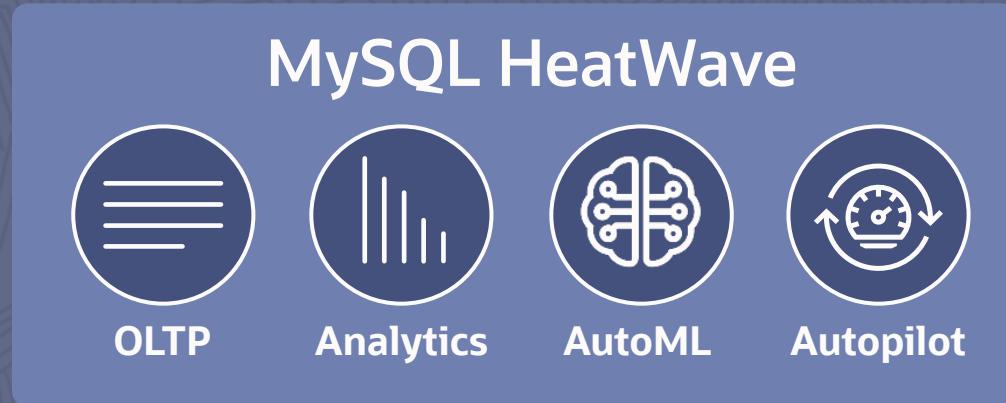
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Benefits of
MySQL
HeatWave
Lakehouse



MySQL HeatWave Lakehouse

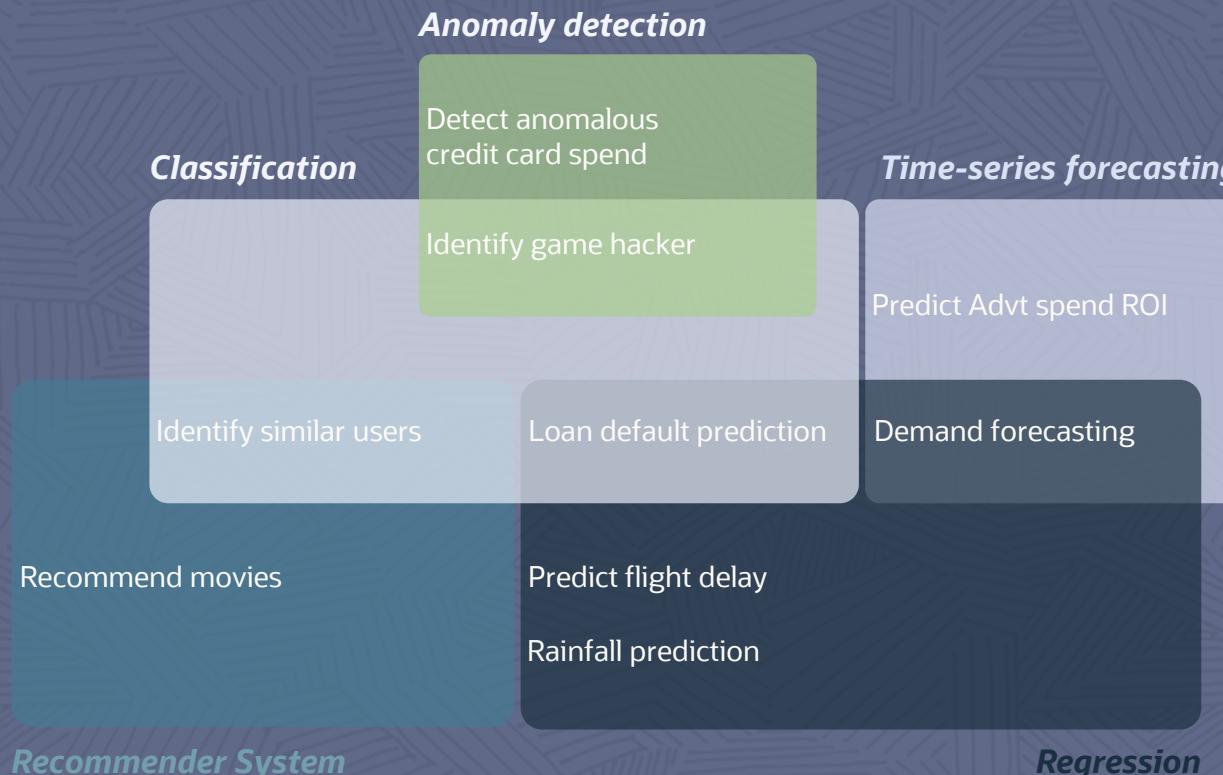
PROCESS DATA IN OBJECT STORE AND TRANSACTIONAL DATABASE



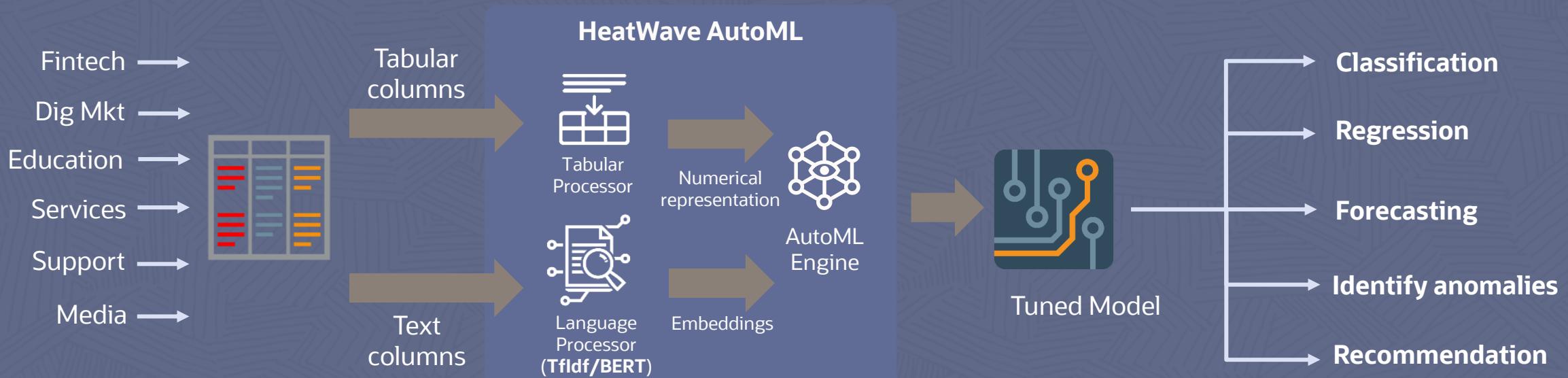
HeatWave AutoML also supports Lakehouse files

TRAINING, INFERENCE AND EXPLANATIONS ON DATA IN OBJECT STORE

- 25X faster training than Redshift
- Enables models to be kept up to date often
- In-database
- Fully automated training
- Explainable
- No additional cost



Text processing with HeatWave AutoML

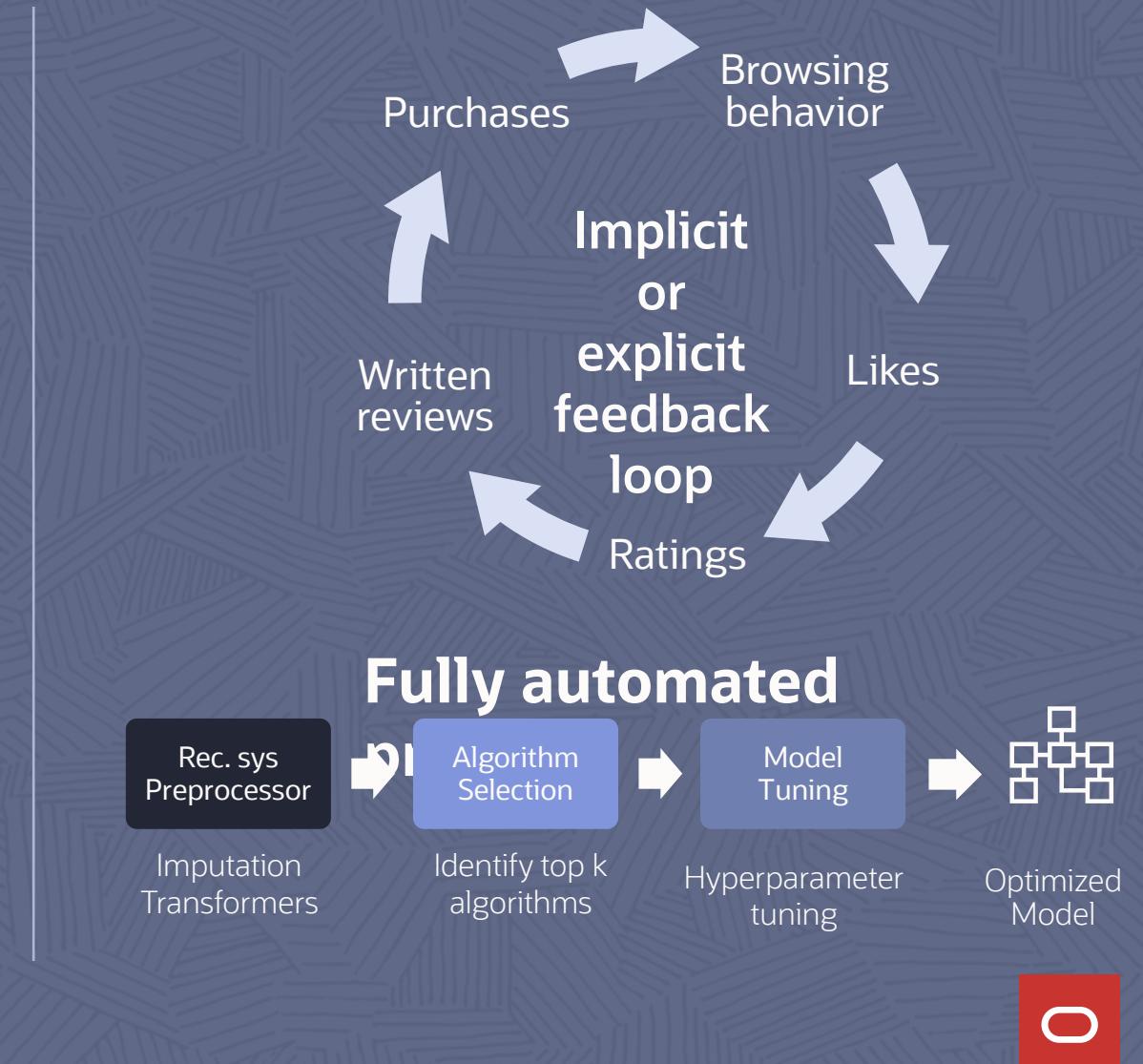


- Relevance of words in documents
- Understand the context of words in a sentence

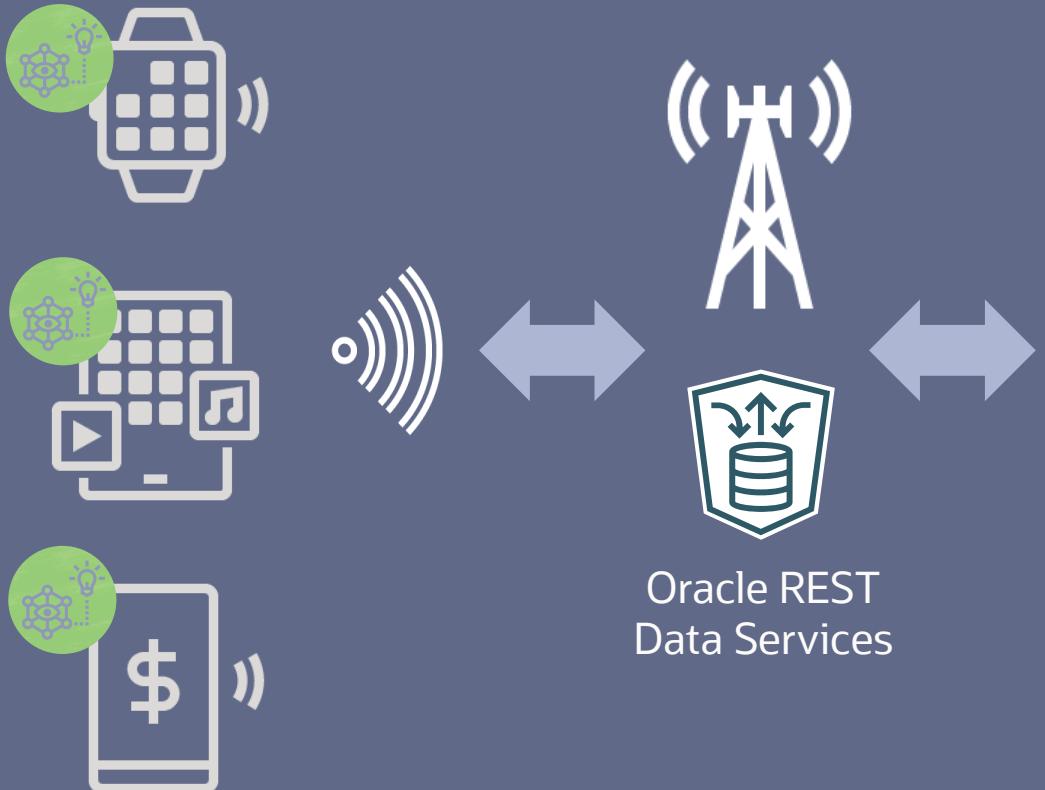
Enables users to perform machine learning tasks on text columns

Recommender system in HeatWave AutoML

- Provides personalized suggestions based on user activities, e.g. movie recommendations
- Considers both implicit feedback (past purchases, browsing behavior) and explicit feedback (ratings)
- Predicts
 - Items a user will like
 - Users who will like an item
 - Ratings an item will receive
 - Similar items
- Redshift ML and Snowflake do not provide recommender systems



REST access to HeatWave



MySQL HeatWave



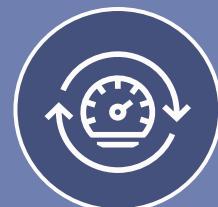
OLTP



Analytics



AutoML

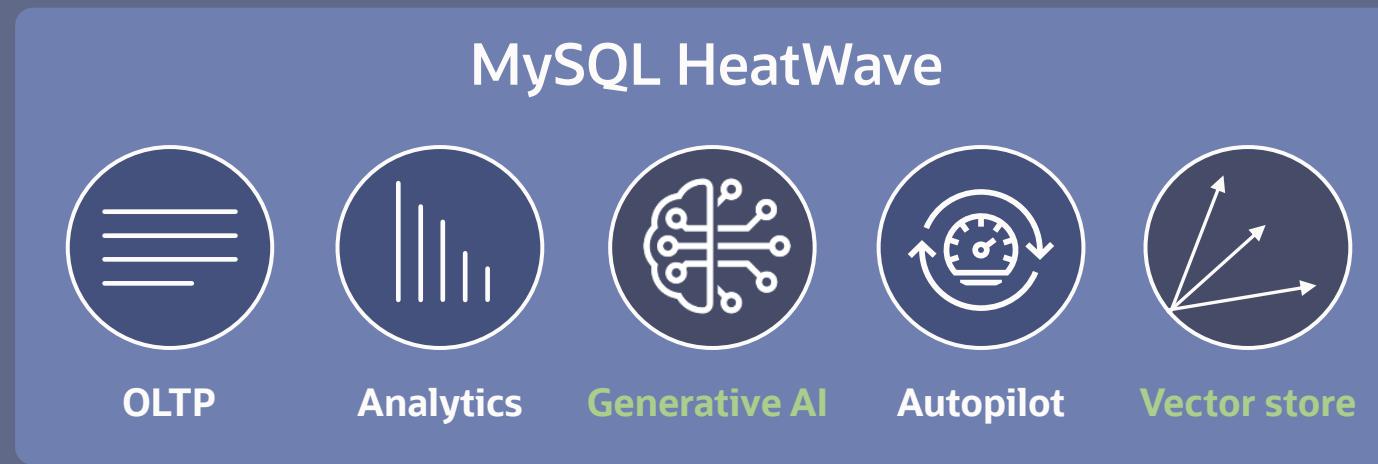


Autopilot

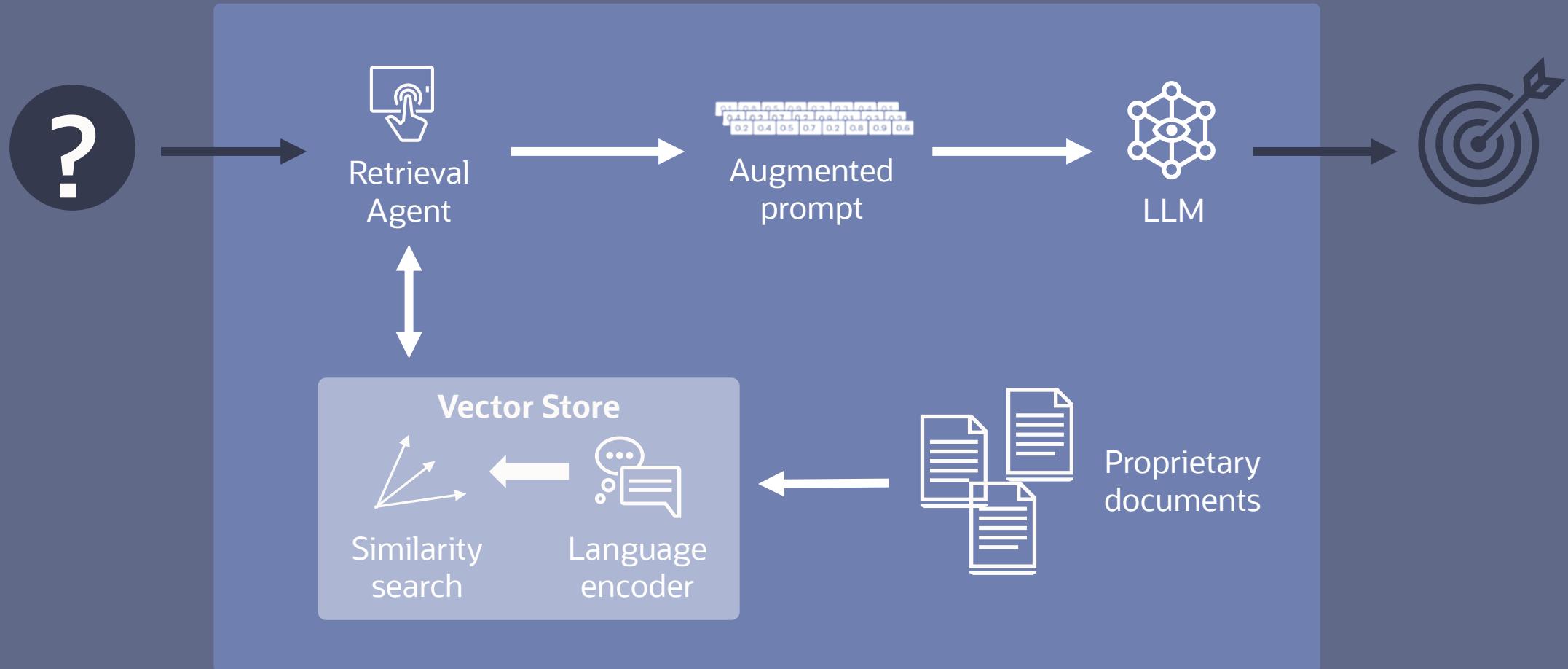
Scalable and flexible
access to
MySQL HeatWave

Generative AI with MySQL HeatWave vector store

- Users can query and retrieve information in natural language
- Efficient searching of documents in HeatWave Lakehouse



Vector store provides context to LLM for more relevant results



Using Generative AI and Vector store with MySQL HeatWave



TETRIS·CO

Tetris.co simplifies real-time analytics

"MySQL HeatWave dramatically reduced our AWS Aurora and Redshift cost by more than 50%. We are no longer moving data around so no with no effort. M expansion plan p and new clients true."

Answer without Vector Store

```
ask_question('How much cost saving Tetris.co achieved by using MySQL HeatWave?', color='blue')
```

The cost saving is around 50%.

Answer with Vector store

```
ask_question('How much cost savings did Tetris.co achieved by using MySQL HeatWave?', color='green')
```

It migrated from Amazon Aurora and Redshift to Oracle MySQL HeatWave, cutting its out-of-pocket costs in half.

Business Challenge:

Tetris.co offers analytical software that unifies massive amounts of data from several sources to help Brazilian clients understand how digital marketing investments perform. It needed a data platform that is easy to use, low cost, and scalable.

Results:

- ✓ Migrated to MySQL HeatWave from AWS Aurora and Redshift and GCP BigQuery in one month
- ✓ Accelerated complex queries from minutes to milliseconds
- ✓ Reduced costs by more than 50% and eliminated ETL processes
- ✓ Onboard new clients of any size at no cost impact

Using Generative AI and Vector store with MySQL HeatWave



"MySQL HeatWave improved our complex query performance 300X for responses in seconds and at 85% of the cost compared to Google changes. Now we can better a scale of 3 million users an application to enhance student

Vitor Freitas

CTO, Estuda.com

Business Challenge:

Brasil's leading ed-tech serves over 8 million students from more than 500 K-12 schools to enhance student performance. It needed a data platform to deliver real-time insights by reducing ETL complexity and costs in moving data from AWS RDS to Google BigQuery to scale for 3 million users per month.

Results:

- ✓ 300X faster performance from migrating from BigQuery to MySQL HeatWave with no code changes and low-latency
- ✓ 85% cost reduction by eliminating ETL processes and pay-for-use consumption model
- ✓ Real-time analytics enable faster development to improve

Answer without Vector Store

```
ask_question('Why did Estuda pick MySQL HeatWave?', color='blue')
```

Estuda picked MySQL HeatWave because it was the best choice for his project.

Answer with Vector store

```
ask_question('Why did Estuda pick MySQL HeatWave?', color='green')
```

The superior query speed, on-demand scalability, and affordable costs of MySQL HeatWave enabled Estuda to quickly expand its business to impact more students.

JavaScript Stored Programs (LA)

```
CREATE FUNCTION construct_url (path VARCHAR(50),  
search VARCHAR(20)) RETURNS VARCHAR(100)  
LANGUAGE JAVASCRIPT AS $$  
let url = `${path}${search} &&  
!search.startsWith('?') ? '?' : ''}${search ?? ''}`;  
return encodeURI(url);  
$$
```

```
SELECT construct_url('/page', 'query=шел лы');  
/page?query=%D1%88%D0%B5%D0%BB%D0%BB%D1%8B
```

```
CREATE PROCEDURE update_item_urls(OUT url_count INT)  
LANGUAGE JAVASCRIPT AS $$  
let result = mysql.getSession().runSql(  
`UPDATE my_table  
SET url = construct_url(path, CONCAT('item=',product))  
WHERE product IS NOT NULL`  
);  
url_count = result.getAffectedItemCount();  
$$
```

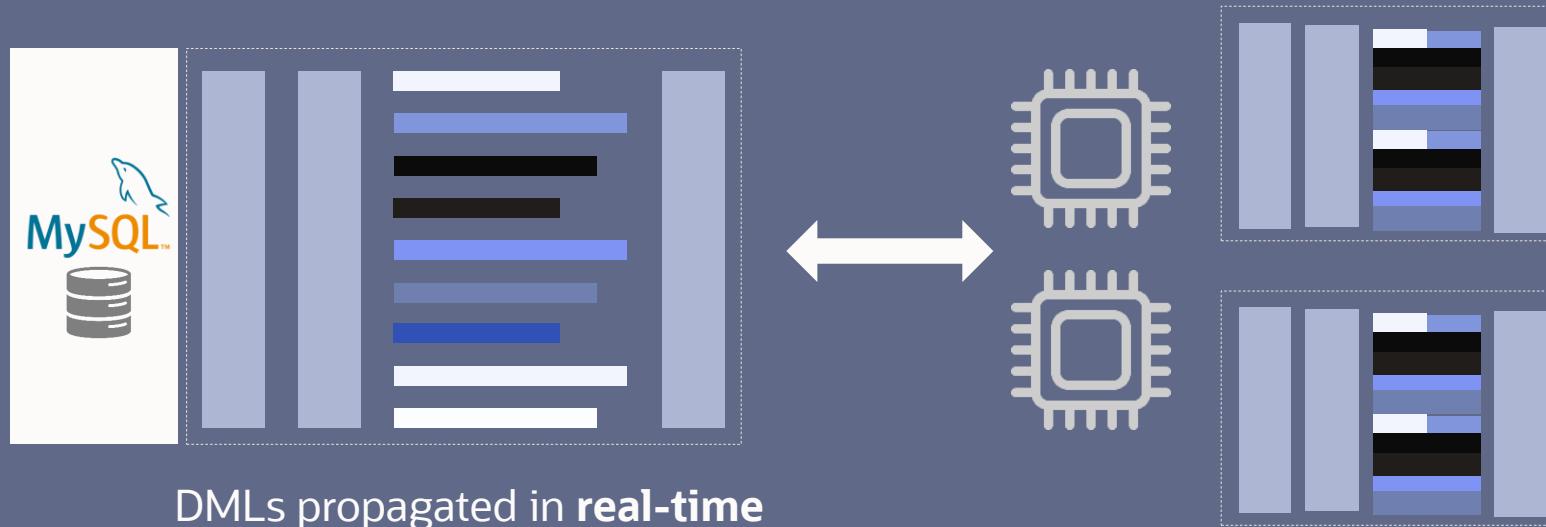
- Seamless MySQL ↔ JavaScript type conversion for input / output arguments
- Can be used anywhere a SQL stored function can be used – e.g. SELECT, WHERE, ORDER BY
- Support for DML, DDL, Views
- Existing XDevAPI used to execute SQL inside JavaScript
- Queries that call stored procedures written in JavaScript can be accelerated by HeatWave—simplifying the execution of complex operations.

JavaScript stored programs are first-class objects in MySQL HeatWave – simplify the execution of complex operations



Announcing JSON acceleration in HeatWave

QUERY PROCESSING AND REAL-TIME ANALYTICS ON JSON DOCUMENTS

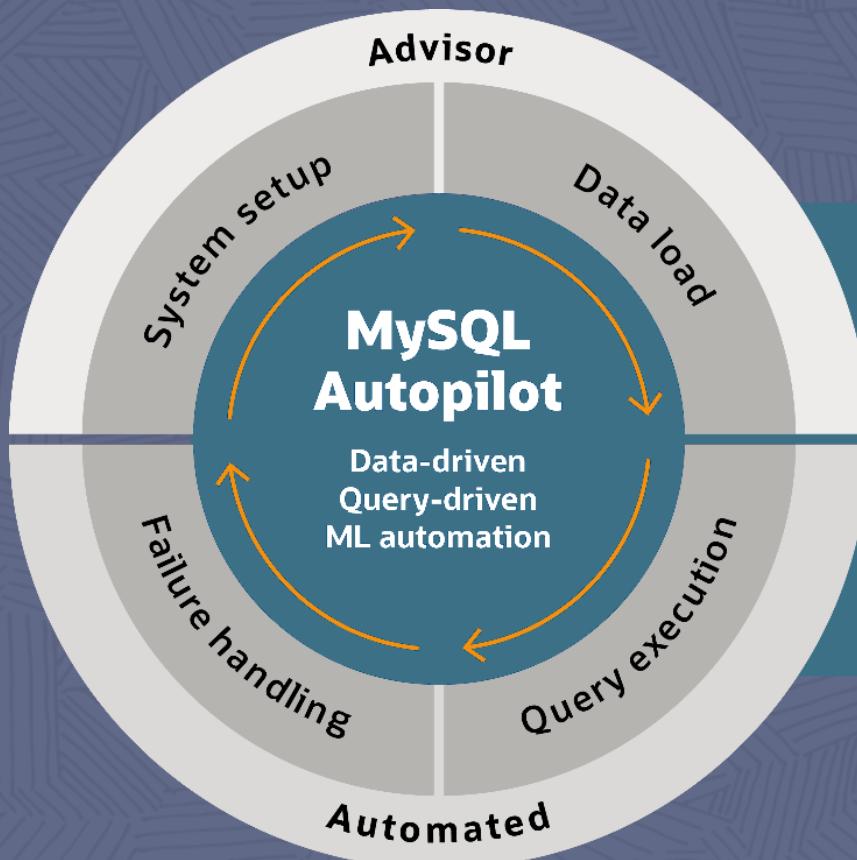


- Data compressed up to **3X**
- Scales across nodes

JSON Queries (512 GB)	MySQL (sec)	HeatWave (sec)	Speedup
Simple Filter Queries	5200	240	20X
Aggregation Queries	5500	250	22X
Large Join Queries	>10 hrs	300	144X

Workload-aware ML-powered automation

INCREASES PRODUCTIVITY AND HELPS ELIMINATE HUMAN ERRORS



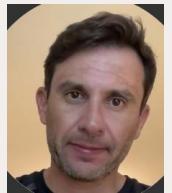
4 new

- Autopilot indexing
- Auto compression
- Adaptive query execution
- Auto unload

Q&A

MySQL LAD team

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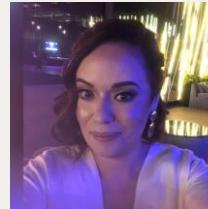
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Channels & Alliances

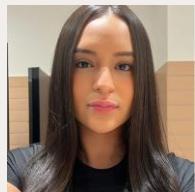


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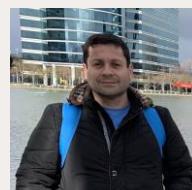


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Sales Engineering



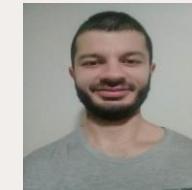
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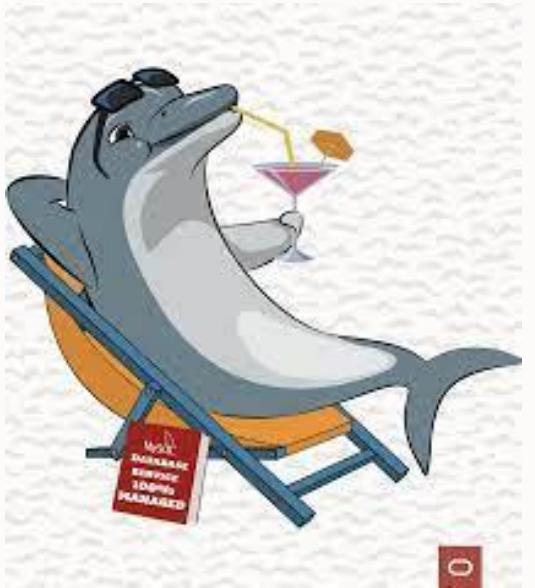


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“Count on MySQL LAD team to support you!”

Narciso Junior
MySQL Cloud Evangelist
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Thank YOU!



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