ORACLE

Oracle Database

Strategy and Roadmap

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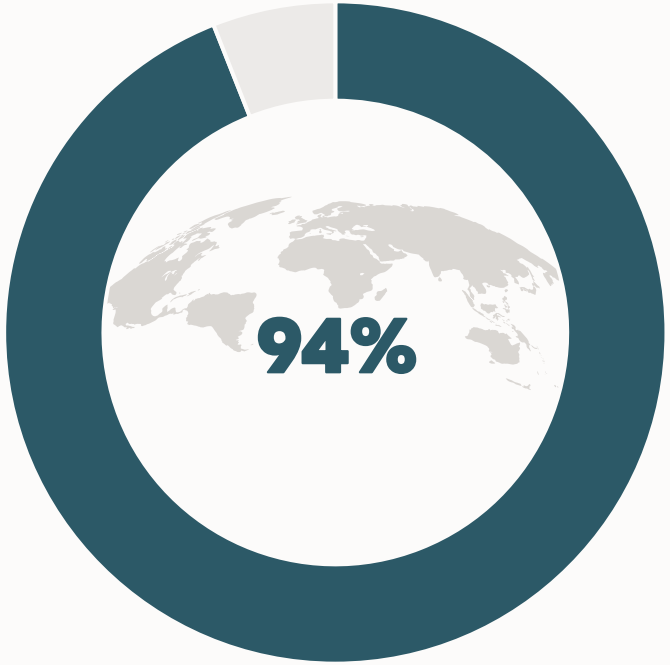
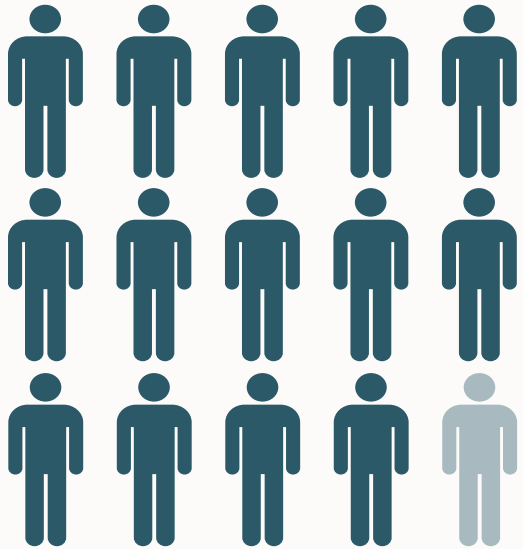
The World Runs on Oracle Databases



94% of the Fortune Global 100
use **Oracle Database**



14 of the top 15 banks
in the Fortune Global 500 list use
Oracle Database on the **Exadata Platform**

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Oracle Database Vision

Make modern apps and analytics
easy to develop and run
for all use cases at any scale

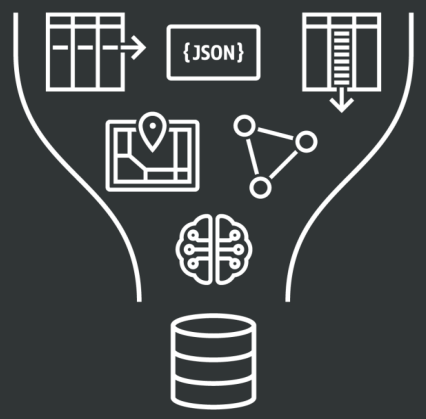
Oracle Database Vision

With Generative AI (LLM)

Make modern apps and analytics
easy to **generate** and run
for all use cases at any scale

How we deliver the Vision

Complete and Simple Platform for All Data Management Needs



Converged Database

Complete: all modern data types, workloads, and development styles

Simple: Add a SQL Statement, not a database to support any need of modern applications

Running on

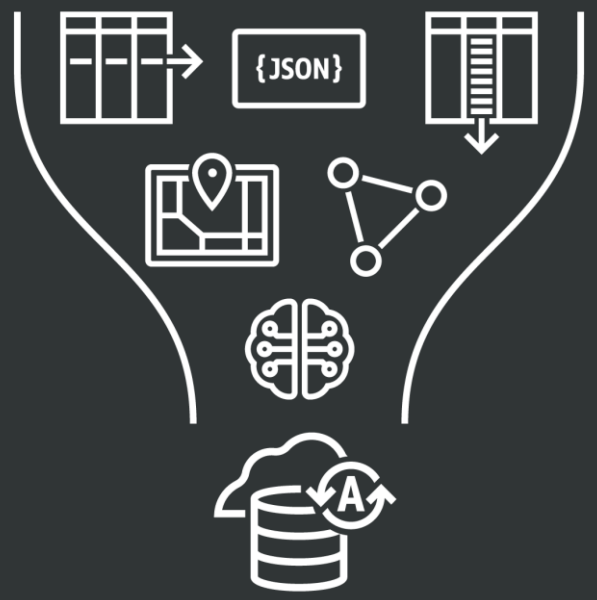
Autonomous Database

Powerful: All the benefits of converged database running on Exadata

Simple: Fully-managed cloud service

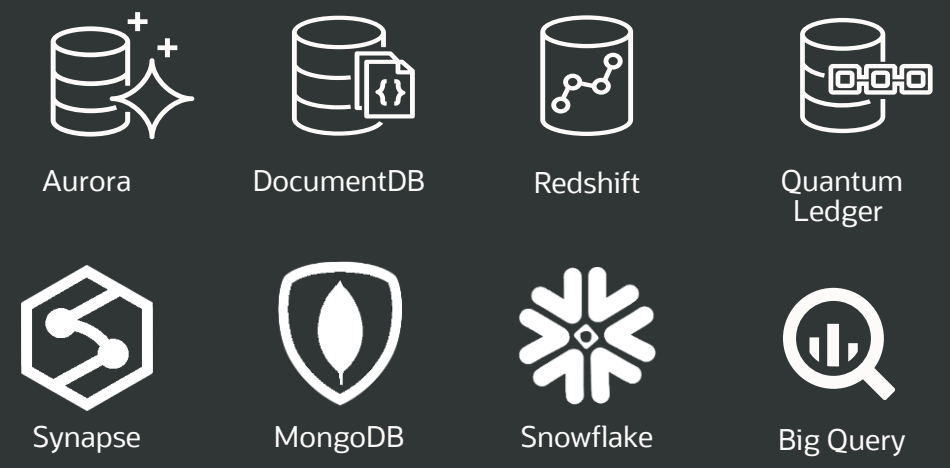
Comparing Database Strategies

Run converged, open, SQL Database



Developers and IT focus on Innovation

Instead of single-use proprietary databases



Developers and IT focus on Integration

New | Multicloud - Oracle Database@Azure

Builds on success of OCI Azure Interconnect (available since 2019)

Exadata and Autonomous DB cloud services on Exadata systems in Azure regions
  Low latency between app and database

Purchase and bill using Azure Consumption Commitments

Service metrics, events, logging shipped to Azure

Integrated identity

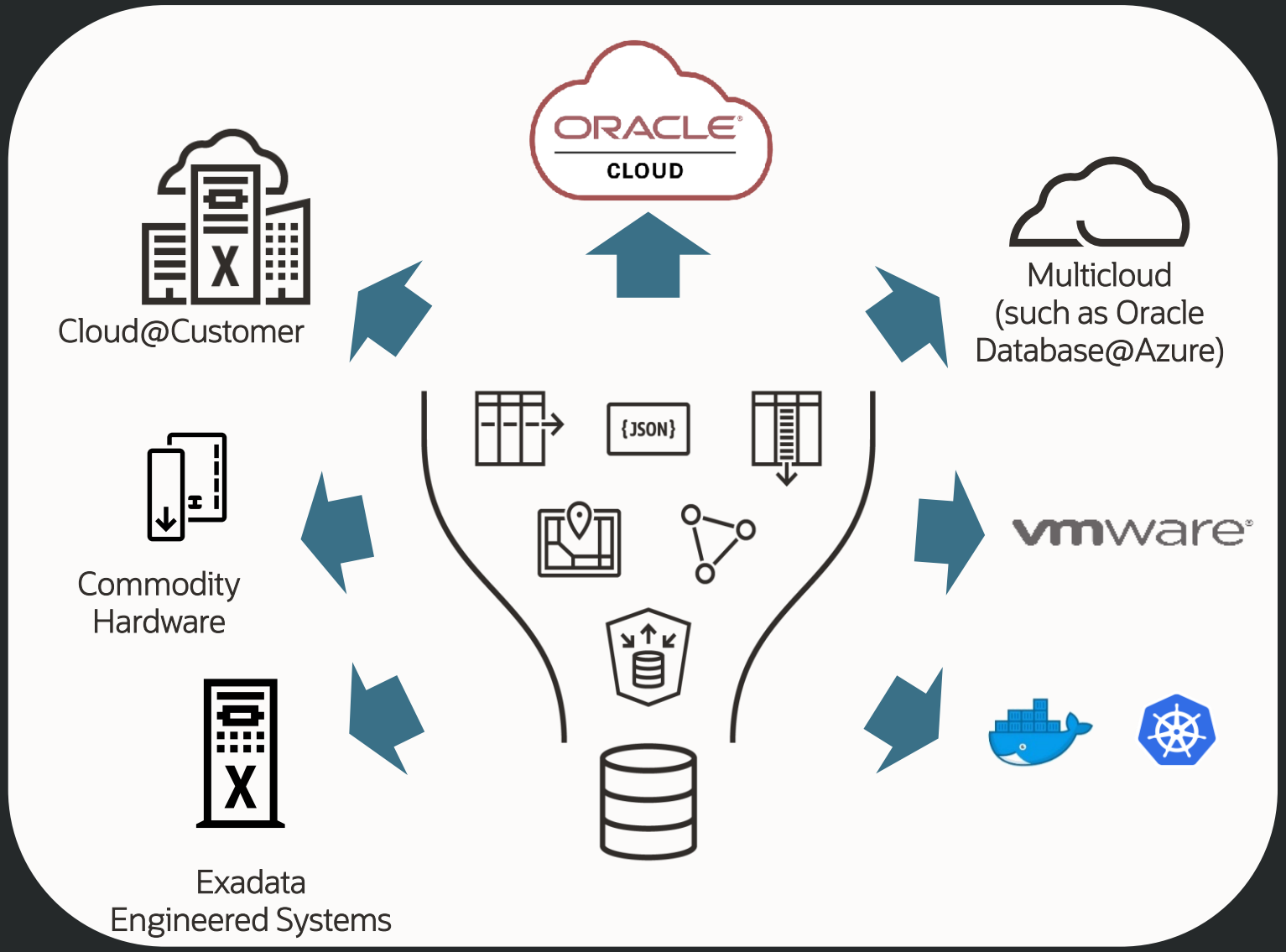
Oracle Support Rewards available

No egress fees for bi-directional data movement

ORACLE | Microsoft

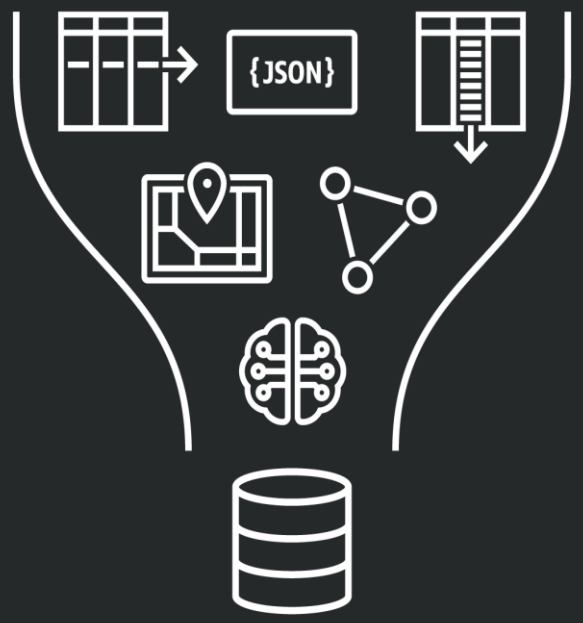
Oracle Database Deployment Choices

Develop and deploy Oracle anywhere – extreme portability



Same database,
same skills

Next Generation Converged Database – Database 23ai



The Converged Database approach has been very successful

- But there are still tradeoffs that make it tempting to deploy solutions which sacrifice the data consistency and efficiency of the relational data model for easier app development

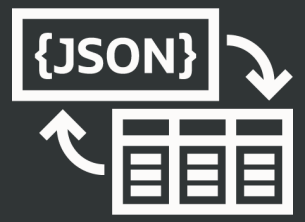
Oracle is introducing revolutionary new Converged Database technologies that unify data models at a more fundamental level

These definitively eliminate the remaining tradeoffs

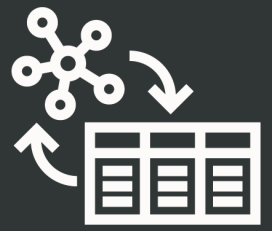
Next Generation Converged Database – Database 23ai

Unifies JSON Document, Graph, and AI with Relational Models

Unification of
JSON and Relational



Unification of
Graph and Relational



Unification of
AI and Databases

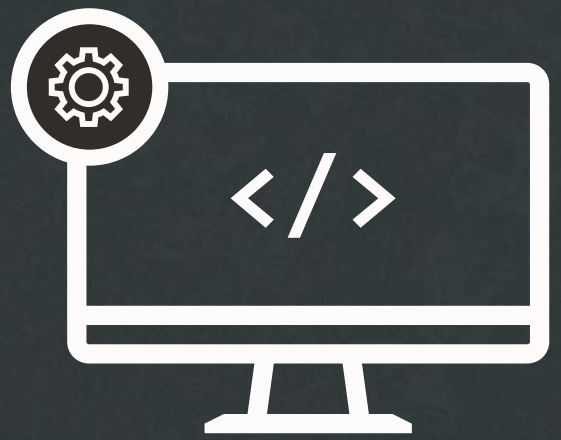
Next-Generation Converged Database

Over 300 major new features plus thousands of enhancements

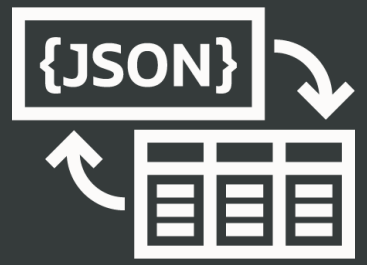
The latest long-term support release of Oracle's flagship Database

Customers with support contracts get free upgrade

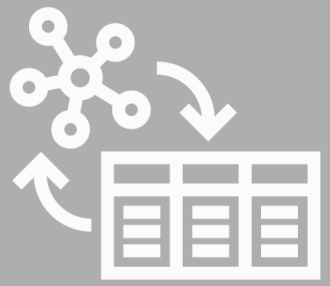
What’s new in Oracle Database 23ai for App Dev?



JSON Relational Duality Views



Property Graph Views



JSON Relational Duality Views allow the generation of JSON format and APIs from relational tables

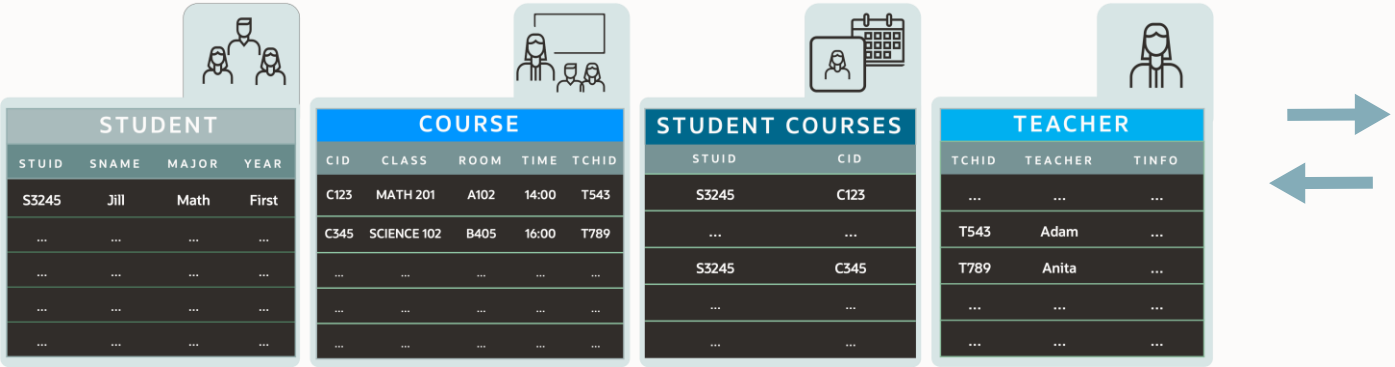
The data for this app can be stored in normalized relational tables

- Great for storage independence, data consistency, declarative SQL

The app can simply GET a JSON document with all the needed data in a hierarchical format

The app can then edit the document and PUT it back

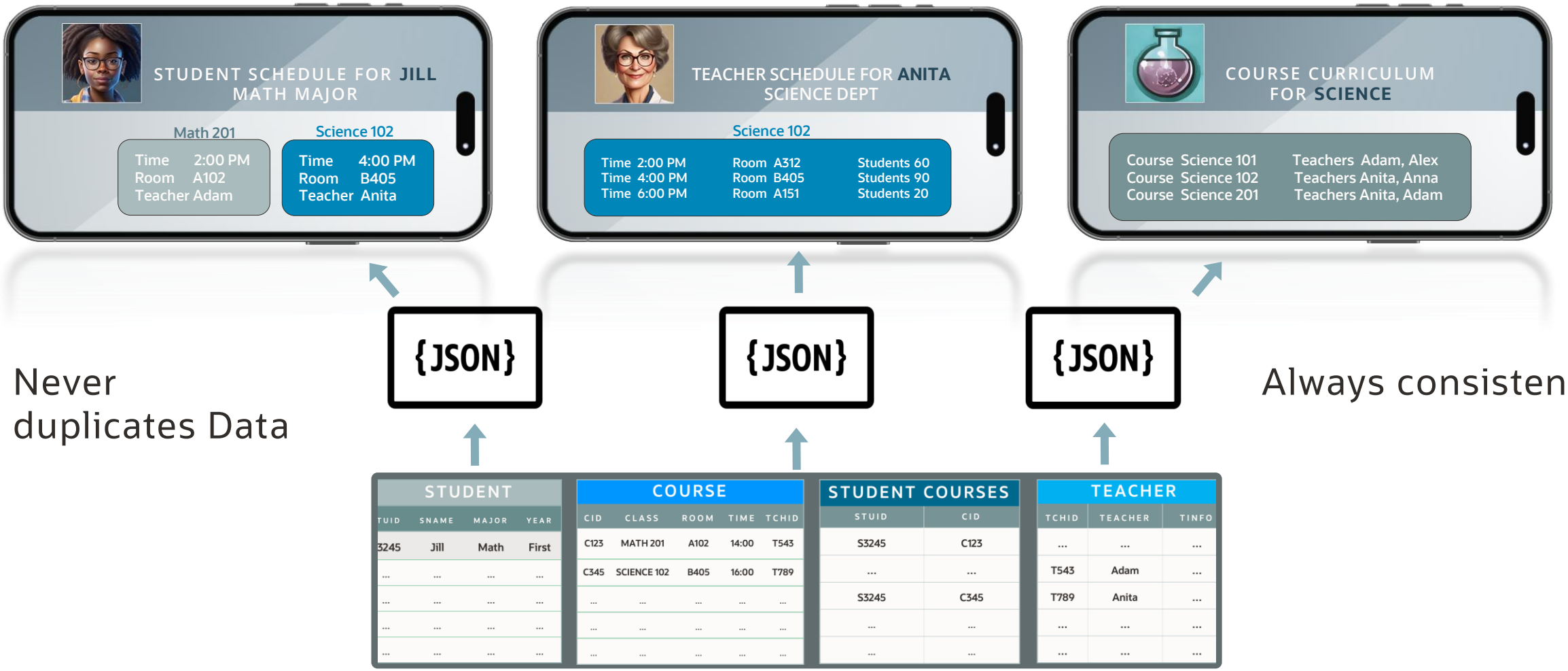
- The database automatically takes care of updating the tables



SCHEDULE FOR: JILL

```
{
 "student"     : "S3245",
 "name"        : "Jill",
 "major"       : "Math",
 "schedule"    :
   [  {
        "time"    : "14:00",
        "course"  : "Math 201",
        "room"    : "A102",
        "teacher" : "Adam"
      },
      {
        "time"    : "16:00",
        "course"  : "Science 102",
        "room"    : "B405",
        "teacher" : "Anita"
      }
   ]
}
```

JSON Duality views allow the same underlying data to be customized to match the needs of each app use case



Never duplicates Data

Always consistent

Oracle Database 23ai JSON Relational Duality

Storage Format

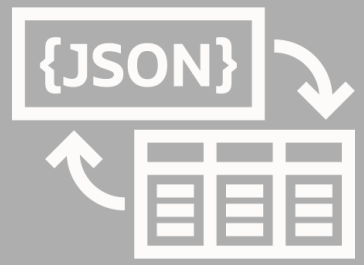
first_name	order	quantity
Jake	{ “product” : ”TV”, “price” : 250 }	1

Access Formats

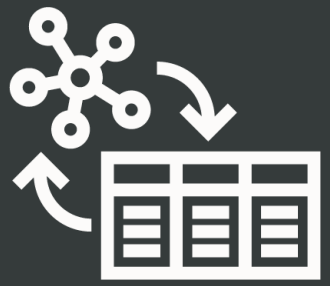
```
{
 "first_name" : “Jake",
 "order" :
    {
        "product" : "TV",
        "price" :  250
    },
 "quantity" : 1
}
```

JSON Relational Duality delivers the simplicity of JSON for accessing data plus the simplicity of relational for storing and manipulating data

JSON Relational Duality Views

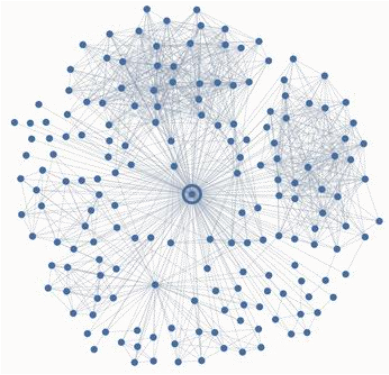


Property Graph Views

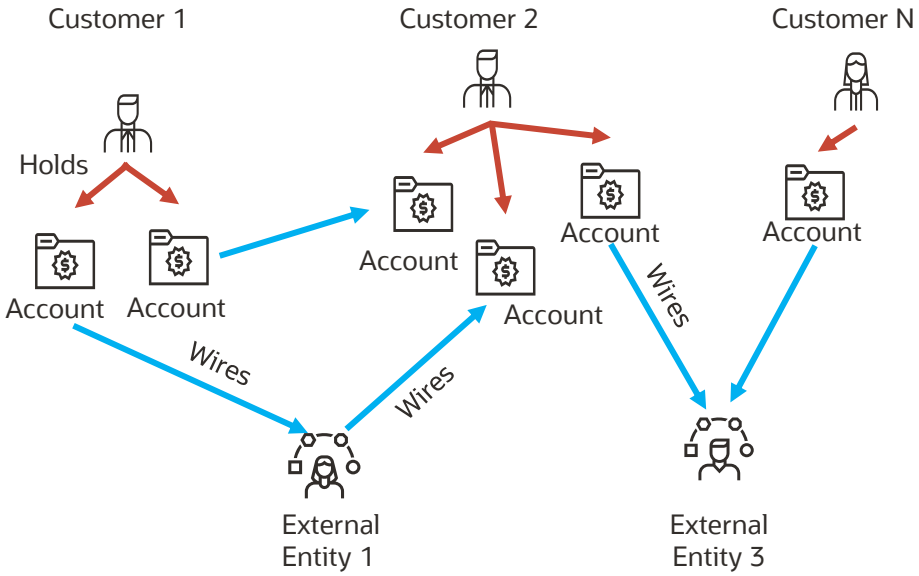


Connections between entities are everywhere

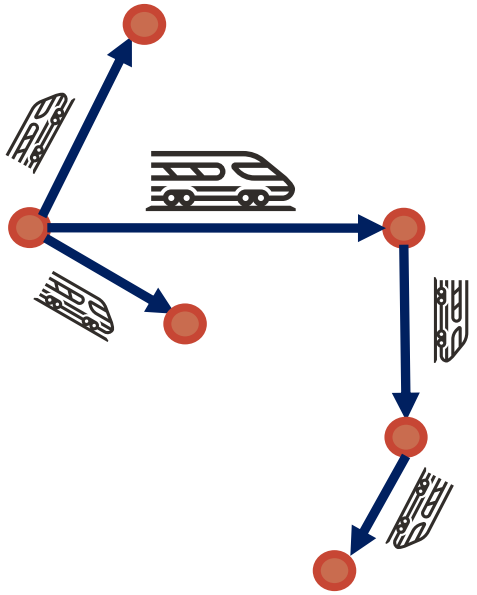
Social networks



Customer Interactions



Transportation Networks



Graphs are a powerful way to query connections and relationships between data

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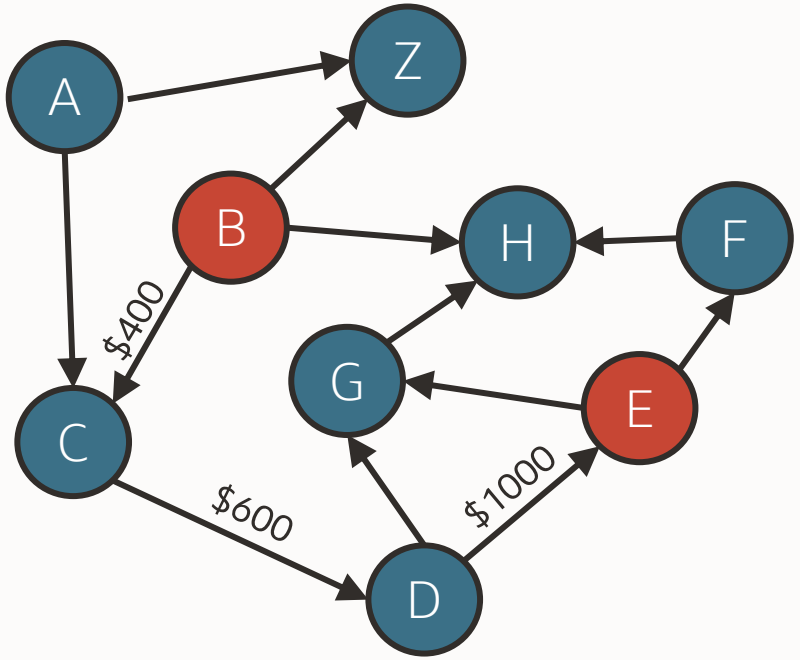
New Property Graph Views in Oracle Database 23ai declare intent to treat data as vertices or edges in a graph

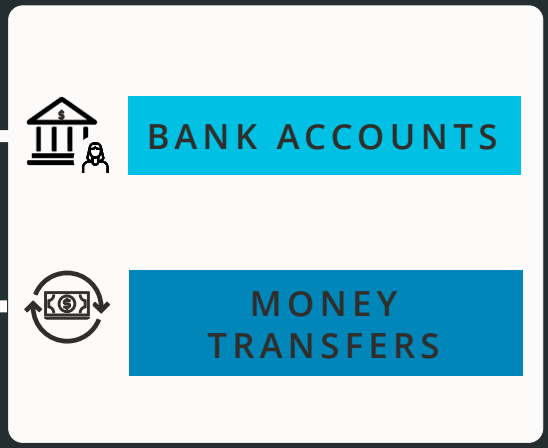
For example, to discover indirect money movements from bank account 'B' to bank account 'E'



Defining a property graph view is simple

Just declare the tables whose rows represent vertices or edges in the graph

```
CREATE PROPERTY GRAPH bank_graph
       VERTEX TABLES (
         bank_accounts as accounts
         PROPERTIES (id, balance))
       EDGE TABLES  (
         bank_transfers
         SOURCE KEY      (from_acc) REFERENCES ACCOUNTS(ID)
         DESTINATION KEY (to_acc)   REFERENCES ACCOUNTS(ID)
         PROPERTIES (amount, to_acc))
;
```



Querying the view is simple

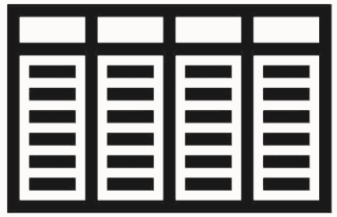
This query finds money flows from account ‘B' to account ‘E

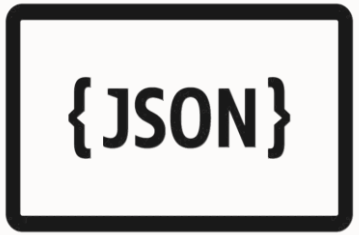
```
SELECT graph.path
FROM   GRAPH_TABLE (
       bank_graph
        MATCH (v1)-[e is BANK_TRANSFERS]->{1,3} (v2)
         WHERE  v1.id = 'B'
         AND    v2.id = 'E'
        COLUMNS LISTAGG(e.to_acc, ',') AS path)
       ) graph
;
```

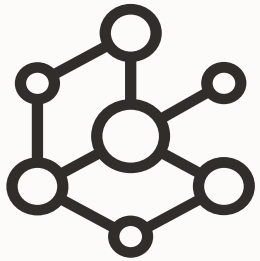
The database understands the intent and generates the code to get it by walking the graph

Writing the same query using relational SQL requires 12 joins and 3 unions

With Oracle Database 23ai, one part of an app can treat the data as relational, while other parts treat the same data as a document, and others treat it as a graph







You get the best of all these worlds, at the same time
Another huge benefit for app dev

Oracle Database 23ai – Additional Features For App Dev

Boolean Datatype

A more intuitive way of storing and manipulating logical values within the database

```
CREATE TABLE customers(
        cust_id number,
        Active boolean);

SELECT cust_id
FROM customers
WHERE active;
```

JavaScript Stored Procedures

JavaScript joins PL/SQL & Java as first-class server-side dev languages

Executed by our fast Multilingual Engine (MLE), powered by GraalVM

Reduces the number of roundtrips to the database

Wider Tables

Support for up to 4096 columns per table

Simplifies development of applications that need large numbers of attributes such as for ML and IoT workloads

```
ALTER SYSTEM SET
max_columns = EXTENDED;
```

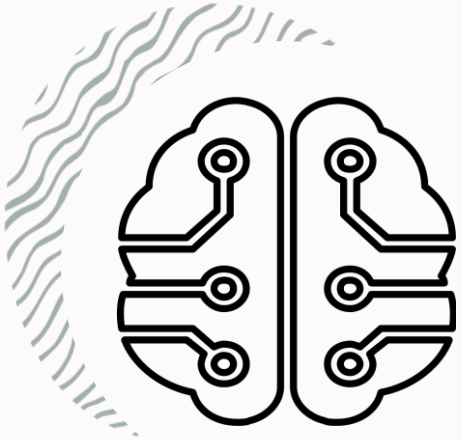
Lock-free Column Value Reservations

Allows applications to reserve part of a value in a column without locking the row

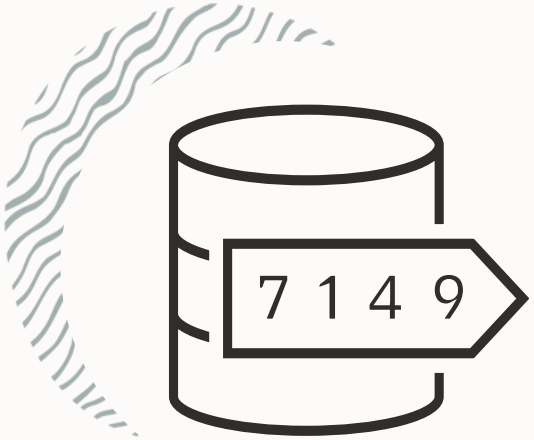
For example, reserve part of a bank account balance or reserve an item in inventory without locking out all other operations on the bank account or item

What’s new in Oracle Database 23ai for AI?

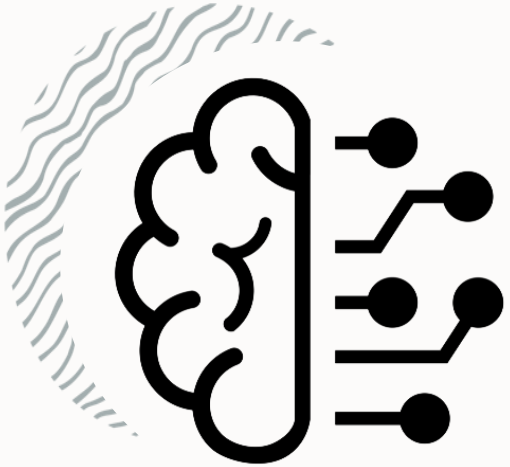
Native AI in Oracle Database



In-database AI/ML
Predictive models



AI Vector Search



Generative AI

Oracle Database is a Machine Learning Engine

Continuously Enhanced for over 20 years

Oracle makes it simple to make data-driven predictions

- Use declarative SQL to build models and run Machine Learning directly on business data

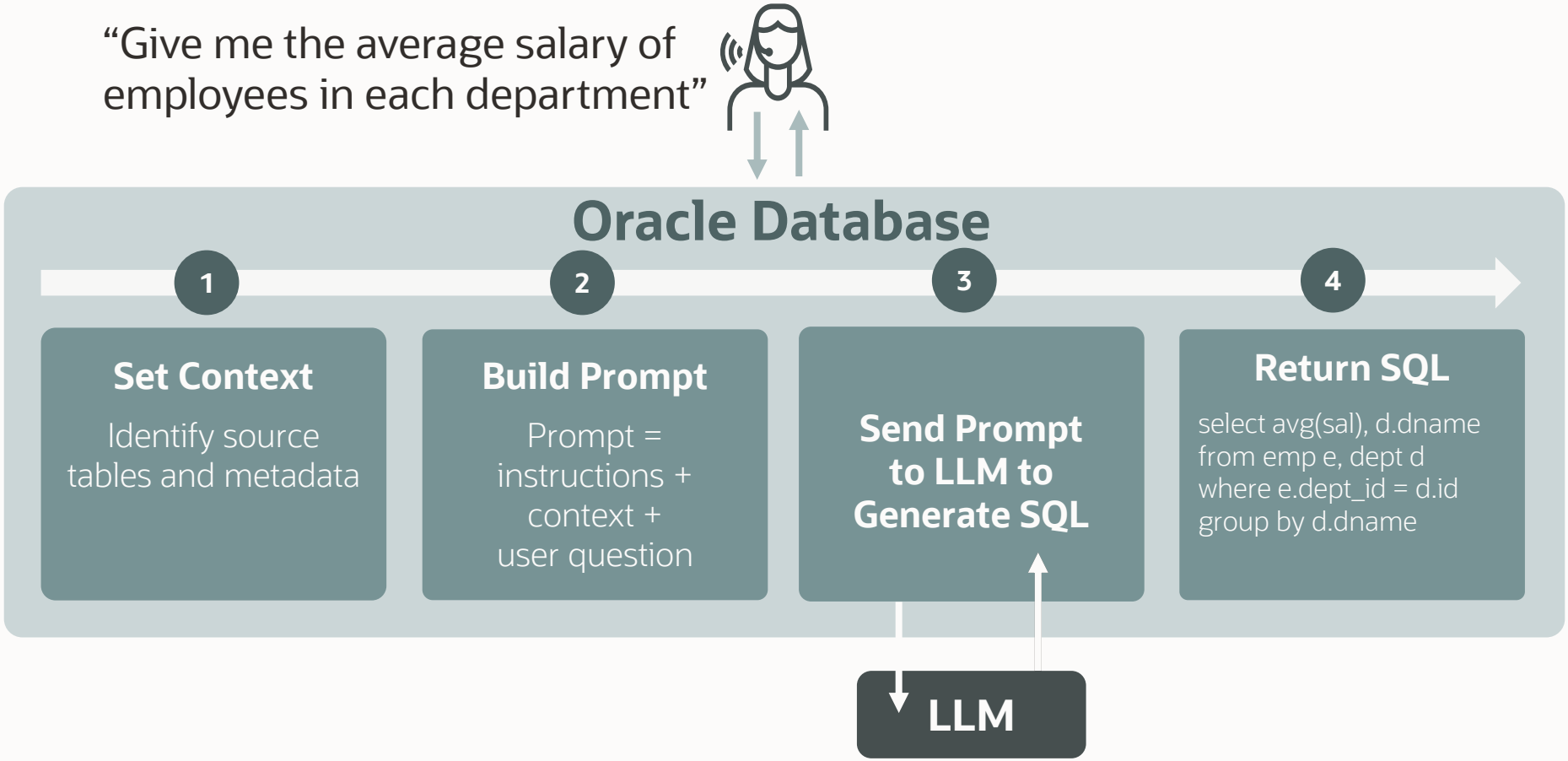
Over 30 in-database parallel and scalable ML algorithms

- Eliminates costly, risky, and slow data movement to separate ML engine

Business Use Case	ML Technique	Oracle ML Algorithms
Customer Loyalty and Retention	Classification	SVM, GLM, Random Forest, XGBoost, et al.
Customer Segmentation	Clustering Classification	K-Means, Expectation Maximization Decision Tree
Demand Forecasting	Time Series Regression	Exponential Smooth SVM, GLM, Neural Networks, XGBoost
Cross-sell / Up-sell	Association Rules Classification	A priori SVM, GLM, Random Forest, XGBoost, et al.
Credit Risk	Regression Classification	SVM, GLM, Neural Networks, XGBoost SVM, GLM, Random Forest, XGBoost, et al.

Generative AI Use Case

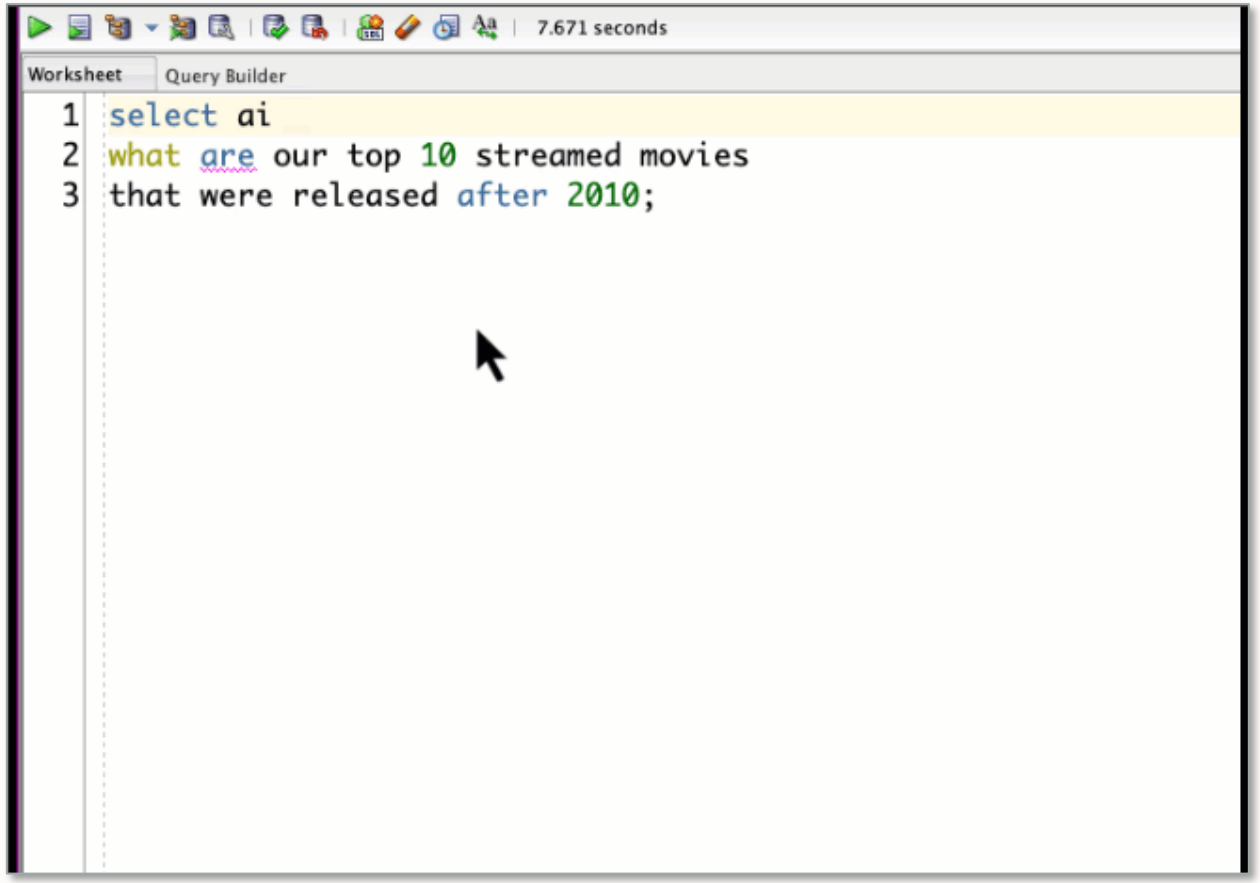
SQL code generation from natural language using LLM



New | SQL Generation with Select AI

Available today on Oracle Autonomous Database

- Use natural language to query data with the help of LLMs
- Increase application developer productivity
- Enable non-technical users to query information from their database
- Invoke from SQL command line and PL/SQL function
- Inherit security and authentication of the database

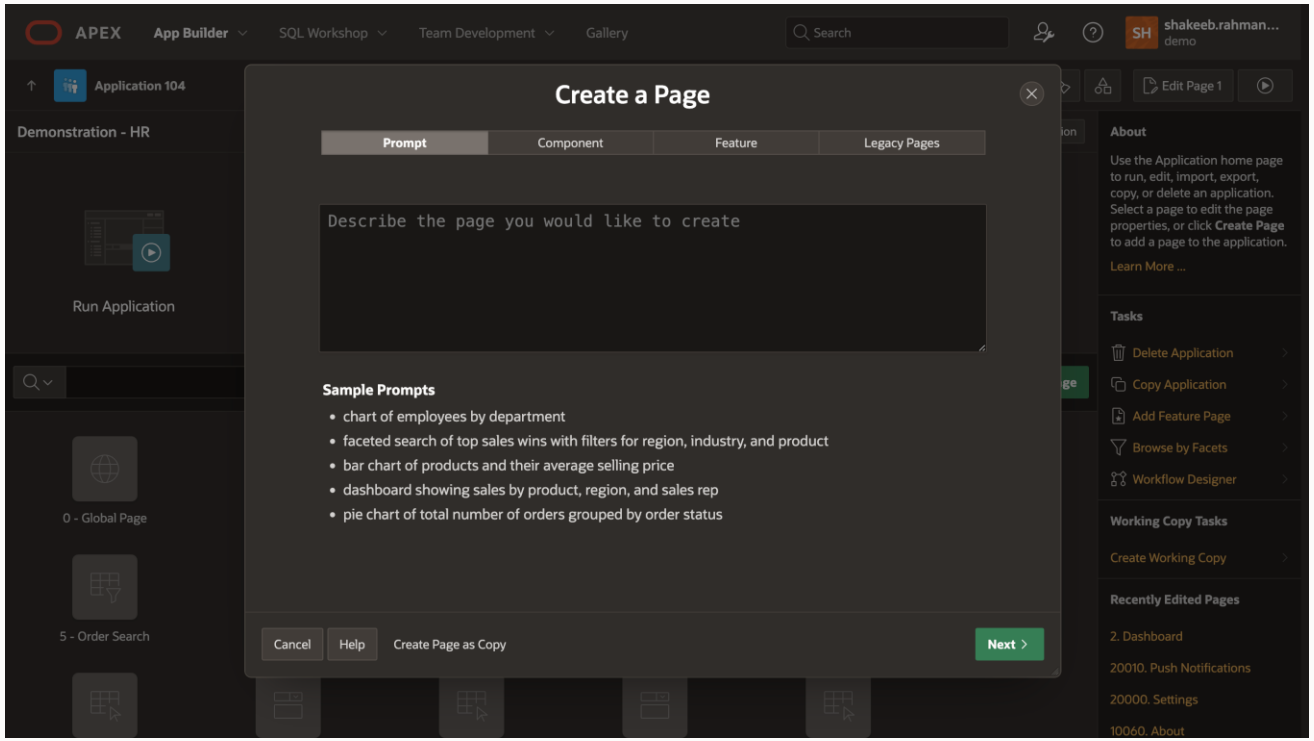


https://blogs.oracle.com/machinelearning/post/introducing-natural-language-to-sql-generation-on-autonomous-database

Next | Augmenting Oracle APEX with Generative AI

Coming in CY2024

- As a low-code app development platform, Oracle APEX already enables 700k+ developers and analysts to rapidly create 19M+ operational and analytic apps
- 75% of Fortune 500 use Oracle APEX
- Adding generative AI capabilities in Oracle APEX further improves user productivity
- **APEX Assistant** will support the use of natural language in both generating SQL and generating app components
- Integrates easily with OCI AI services to develop AI-powered applications

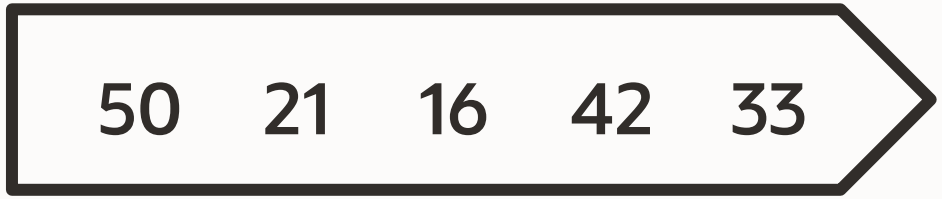


Make it easy to generate and run modern apps and analytics for all use cases at any scale

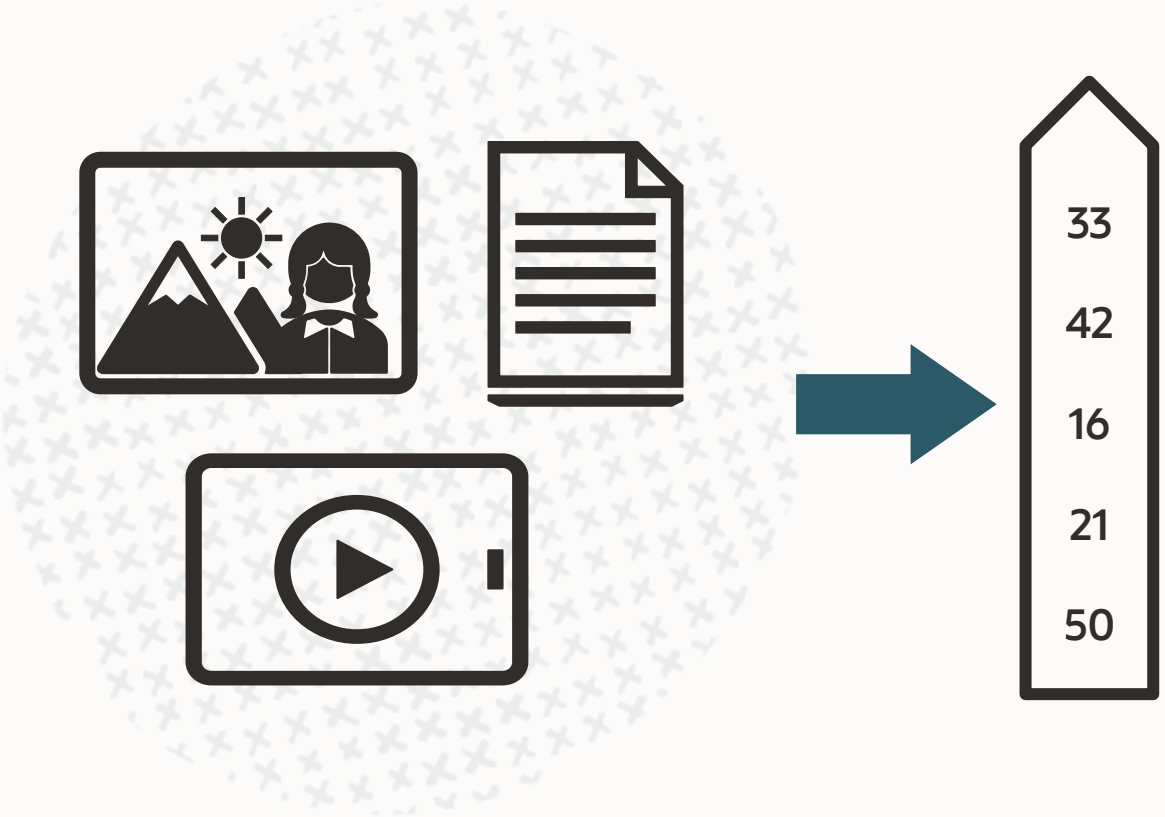
Oracle Database Vision

with Generative AI

A new technology called AI Vector Search enables semantic searches on unstructured data



Vectors are used in AI to encode unstructured data such as images, documents, videos, etc.

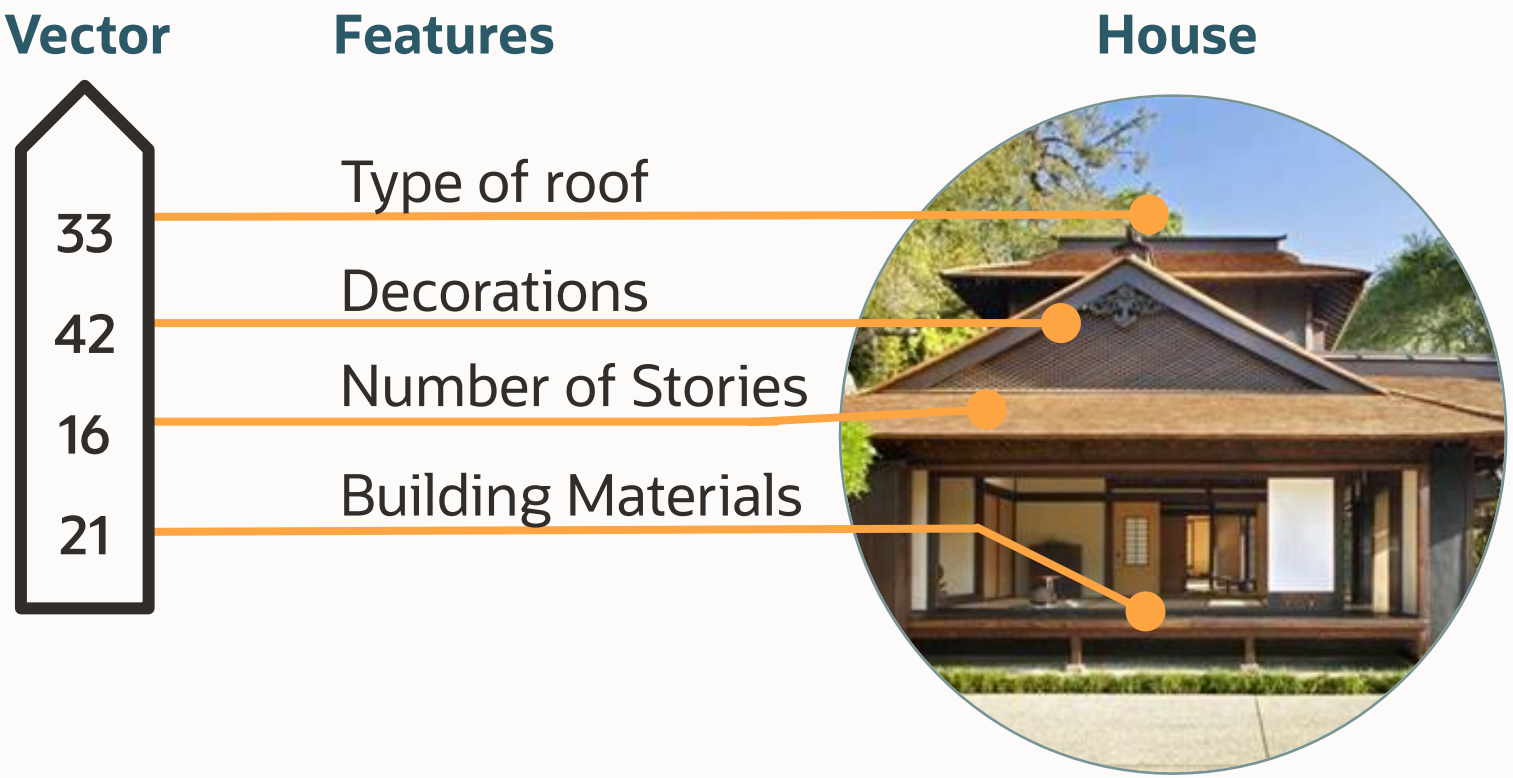


A vector is a sequence of numbers, called dimensions, representing the important “features” of the data

Vectors represent the semantic content of data, not the actual words in a document or pixels in an image

Vectors are produced from unstructured data by AI models such as Neural Networks

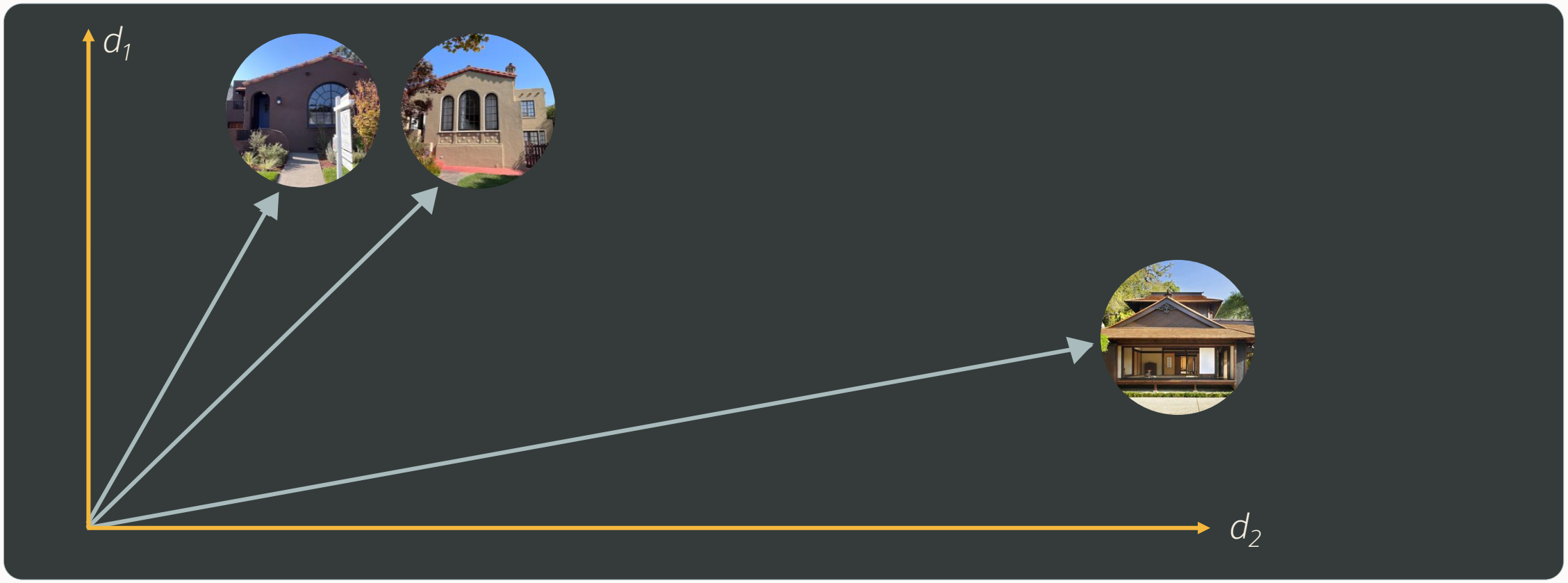
Example: the features for a house image could be



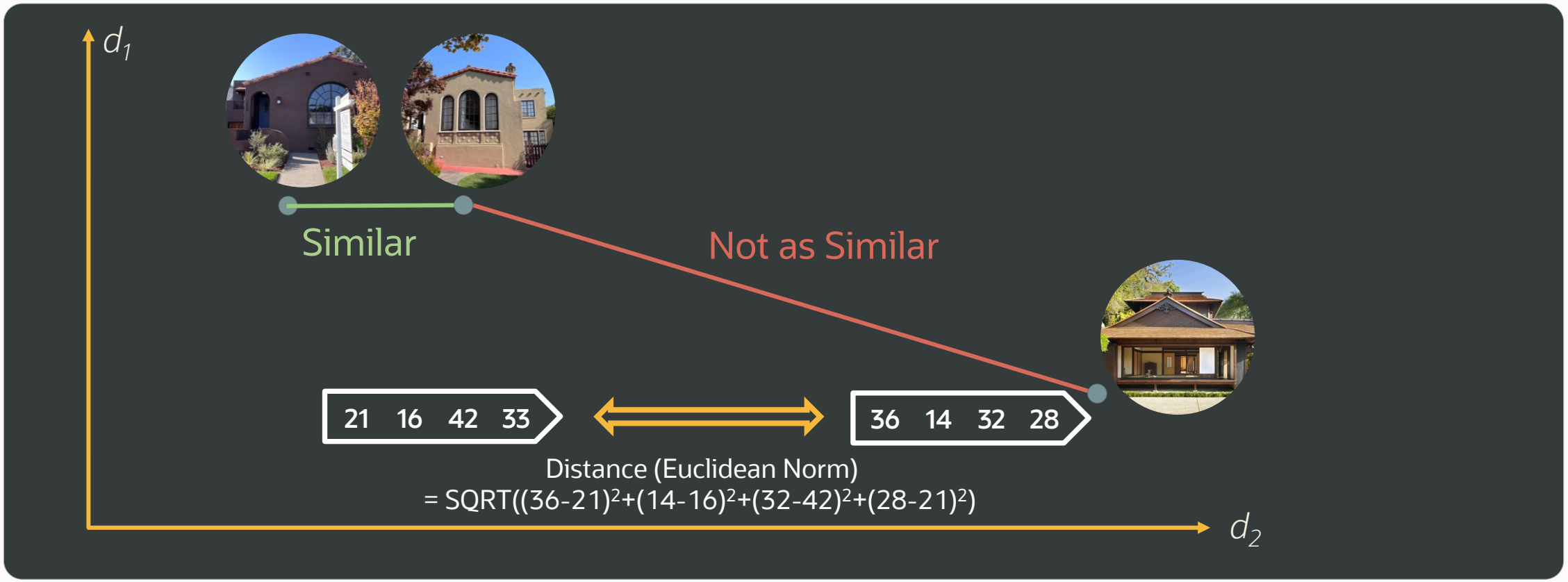
Each dimension (number), represents a different feature of the house

Note: In reality, ML algorithms determine features, so they are not as simple as shown here

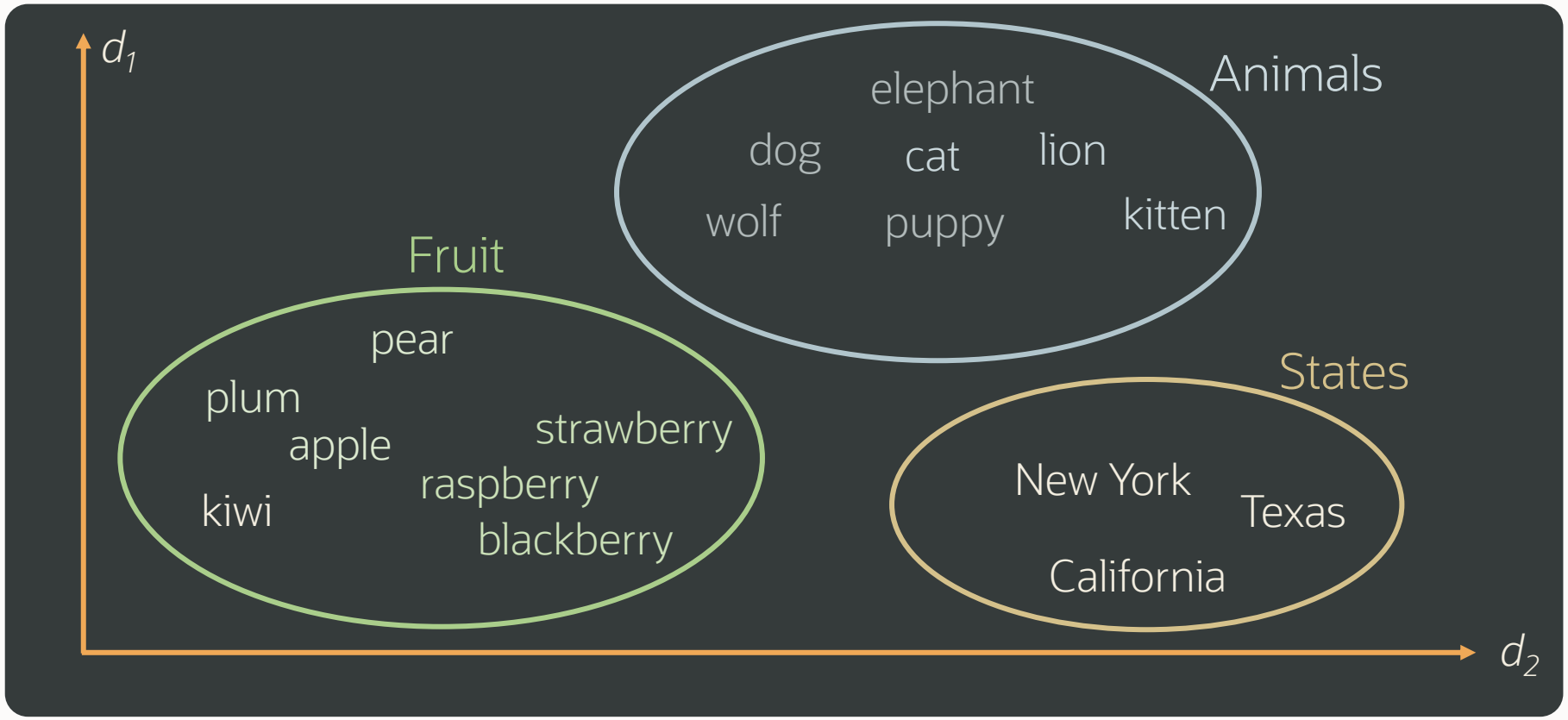
House vectors when collapsed into 2 dimensions instead of hundreds could look like this



The distance between the vectors is proportional to their semantic similarity



Word similarity works the same way
Word vectors that are close are more semantically similar



Documents and images also work the same way

Document vectors that represent similar content are closer than those representing dissimilar content

Introducing Oracle AI Vector Search

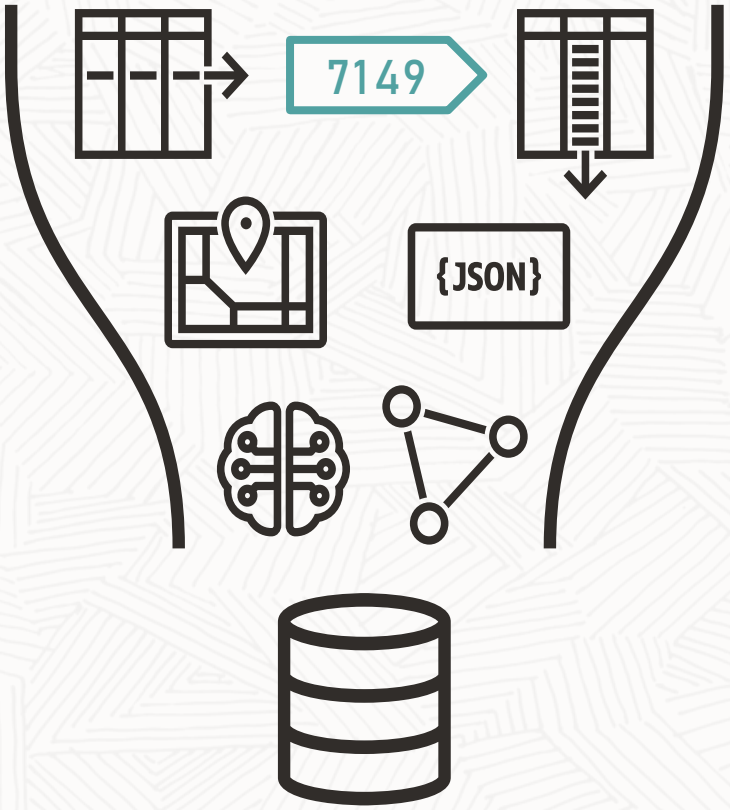
New set of capabilities coming in Oracle Database 23ai

Process vector search and other workloads in same Oracle converged database

Designed to be simple to use and easy to understand

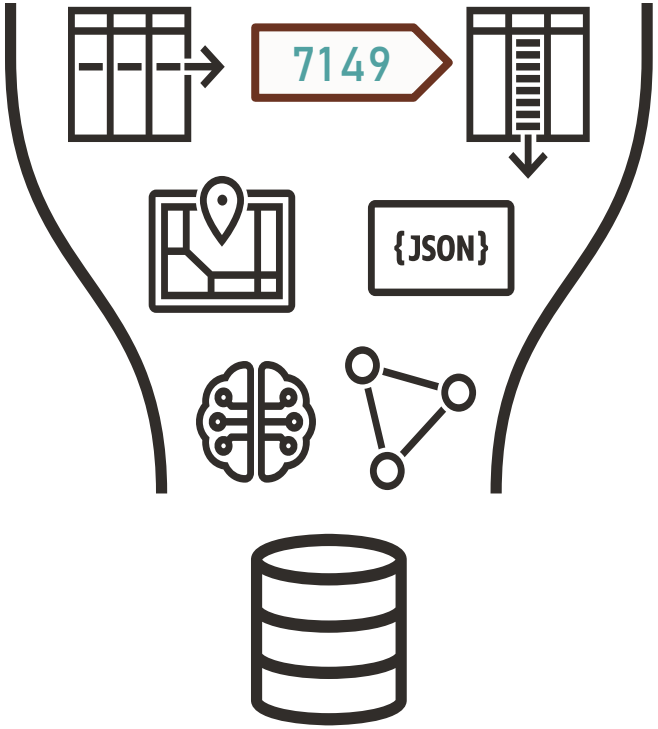
- **New** VECTOR data type for storing vectors
- **New** SQL syntax and functions express similarity search with ease
- **New** Approximate search indexes packaged and tuned for high performance and quality

Perform vector search in queries alongside business data about customers and products



Converged Database

Oracle Database 23ai can store vectors using a new vector data type



```
CREATE TABLE house_for_sale (house_id     number,
                             price        number,
                             city         varchar2(400),
                             house_vector vector
);
```

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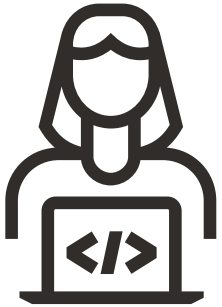
Allows finding data that is semantically similar to an input



No ML expertise required

DBAs and Developers can learn and use AI Vector Search in minutes

Find houses that are similar to this picture

```
SELECT    …
FROM      house_for_sale
ORDER BY  vector_distance(house_vector, :input_vector);
```

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Allows queries that combine AI vector search with business data about customers and products

Combines customer data, product data, and AI search in a few lines of SQL!

A single integrated solution, all data is fully consistent

Find houses that are similar to this picture and match the customer's preferred city and budget

```
SELECT …
FROM   house_for_sale
WHERE  price <= (SELECT budget      FROM customer …)
AND    city  in (SELECT search_city FROM customer …)
ORDER BY vector_distance(house_vector, :input_vector)
FETCH APPROX FIRST 10 ROWS ONLY
WITH TARGET ACCURACY 95 PERCENT;
```

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AI Vector Search can augment Generative AI by retrieving additional, often private, content needed to answer questions more accurately

Called: Retrieval Augmented Generation (RAG)

Oracle AI Vector Search is Fully Integrated

Seamless Integration with core database features for enterprise-grade performance and reliability

RAC

Sharding

Partitioning

Exadata

Transactions

Parallel Execution

Analytics

Security

AI Vector Search provides organizations with a unique competitive advantage

Using Oracle Database with Vector Search can be up to an order of magnitude simpler to…

Enable more effective searches on a combination of business and semantic data

Augment Generative AI with up-to-date and private content needed to answer questions

Get AI Vector Search benefits on top of all core database capabilities

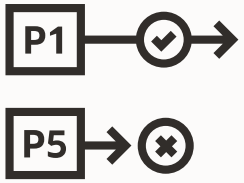
IDC

"Oracle is bringing generative AI to customer workloads and their data—not asking customers to move their data to a separate vector database."

Ritu Jyoti
GVP, Worldwide AIand Automation Research Practice and Global AI Research Lead, IDC.

What’s new in Oracle Database 23ai for DBAs / IT Operators?

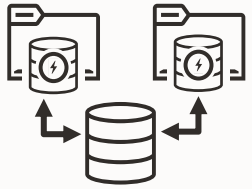
Oracle Database 23ai Mission Critical Apps Enhancements



Priority Transactions

Automatically prioritizes high-priority transactions over low-priority transactions

Low-priority transactions that block high-priority transactions will be automatically aborted

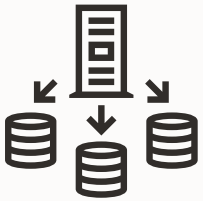


True Cache

A (nearly) disk-less Oracle database instance that is deployed as a cache

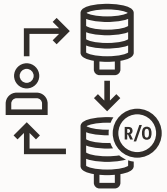
Unlike conventional mid-tier caches such as Redis, data in True Cache is automatically updated

ANY SQL Query can be transparently directed to the cache instead of the database



Active-Active Globally Distributed Database

Database sharding with Raft replication supports applications that require low latency and high availability plus helps meet data sovereignty requirements



Readable Per-PDB Standby

Per-PDB standby databases can now be opened for read-only workloads

Improving production database performance by offloading resource-intensive backup and reporting operations to standby systems

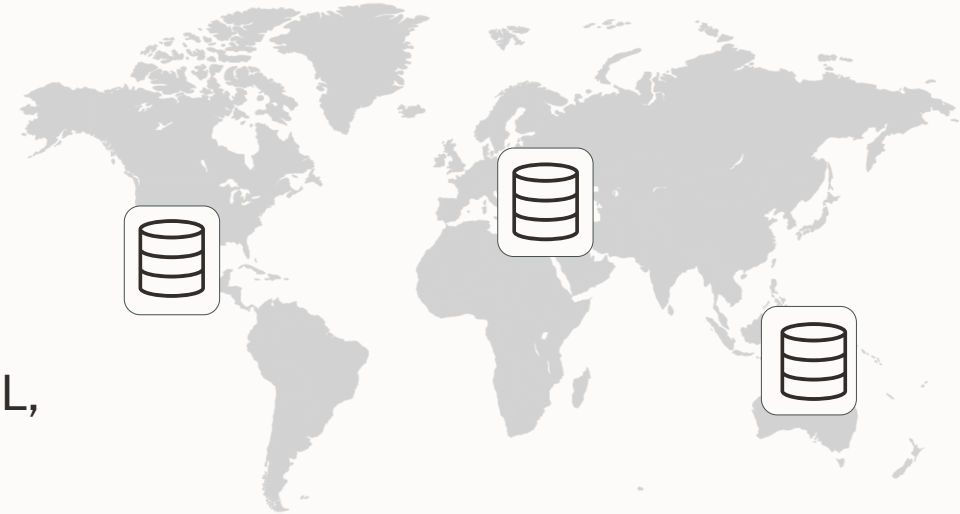
Oracle Globally Distributed Database

Oracle Globally Distributed Database

Fault Tolerance, Hyperscale, and Data Sovereignty

A distributed database designed for fault tolerance, hyper-scale, and data sovereignty

- Breaks a centralized database into a set of smaller distributed databases (Shards)
- Shards can be distributed across countries or regions
- Linear scalability of data and users
- Supports online addition/removal/upgrade of shards
- Supports all the Oracle Enterprise features, including full SQL, availability, security, manageability, etc.



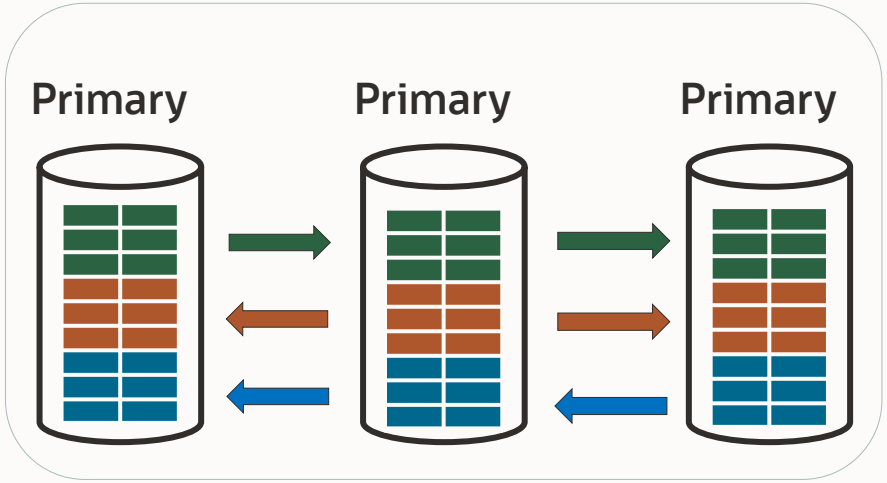
Oracle Globally Distributed Database with Raft Replication

Raft replication is built-in & integrated with transaction execution

Fast and automatic sub 3-second failover with zero data loss & external consistency

- Each shard accepts writes and reads for a subset of data

Easy: no need for Data Guard or GoldenGate



Uses popular Raft distributed consensus protocol

- The leader sends changes to its followers
- Changes committed when the majority (quorum) have the data
- Guarantees consistency among replicas in case of failures, network partition, message loss, or delay
- Fast, automatic reconfiguration after failure, or when the number of shards changes

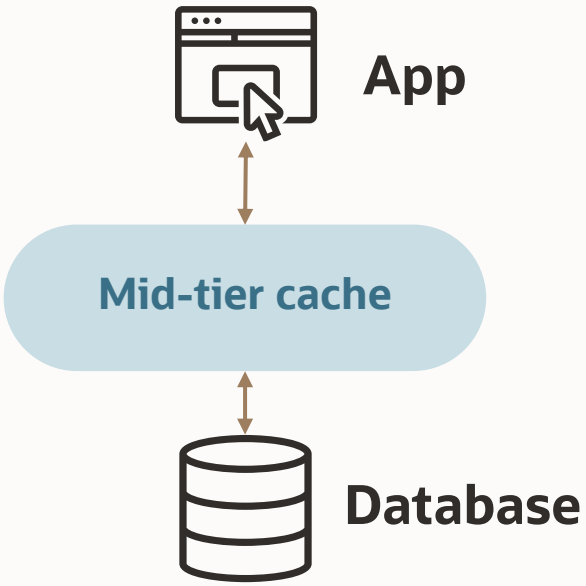
True Cache

Mid-Tier Data Caching

High-end apps often configure mid-tier caches to improve app response times and reduce the load on back-end databases

Today's mid-tier data caches **are not caches**

- They are **app developer maintained** inconsistent database subsets



Calling this a cache is like calling a file system a database

True Cache

An in-memory, consistent, read-only cache for rows and objects that can run full Oracle SQL

Oracle True Cache is a light-weight (nearly) disk-less Oracle database instance that is deployed as a cache

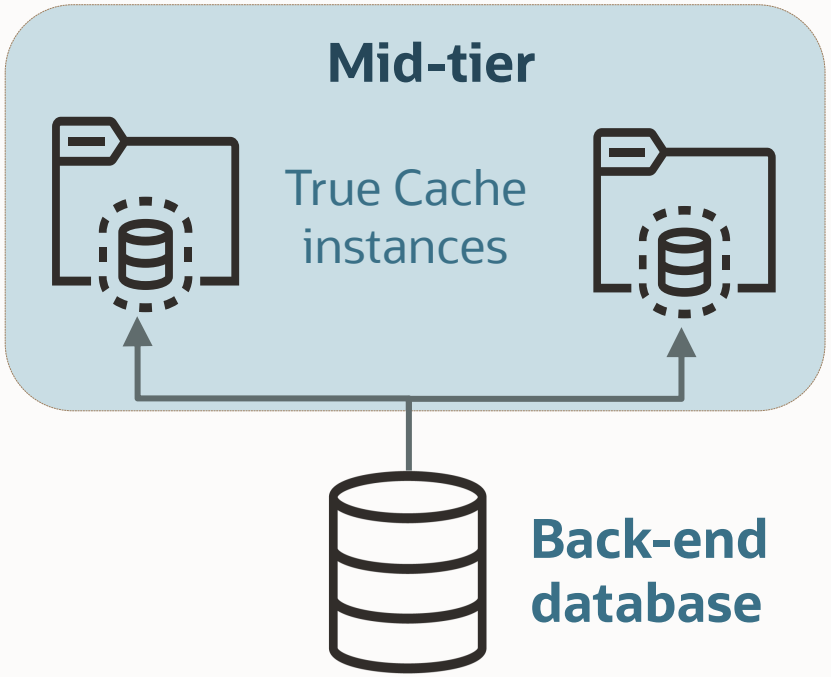
Unlike conventional mid-tier caches such as Redis and Memcached, data in True Cache instances is automatically updated

ANY SQL Query can be easily directed to the cache instead of the back-end database

- **Unique** transparent full-function data cache

Data requested by queries not found in True Cache is **automatically** retrieved from the back-end database

- Changes to data are **automatically** propagated to True Cache in **real-time**
- All data in True Cache is **consistent** as of a point in time



Not a Faux Cache, a True Cache

True Cache Use Cases

True Cache can be deployed as a :

Mid-Tier Cache

Edge Cache

Cross-Region Cache

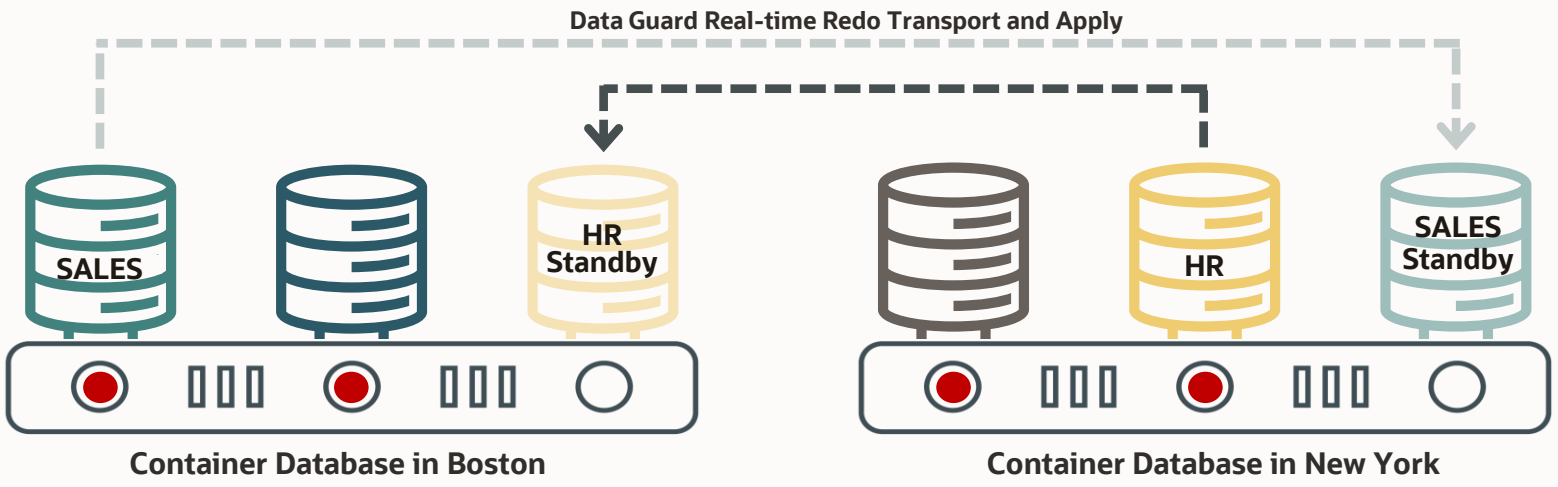
Cross-Cloud Cache

Readable Per-PDB Standbys

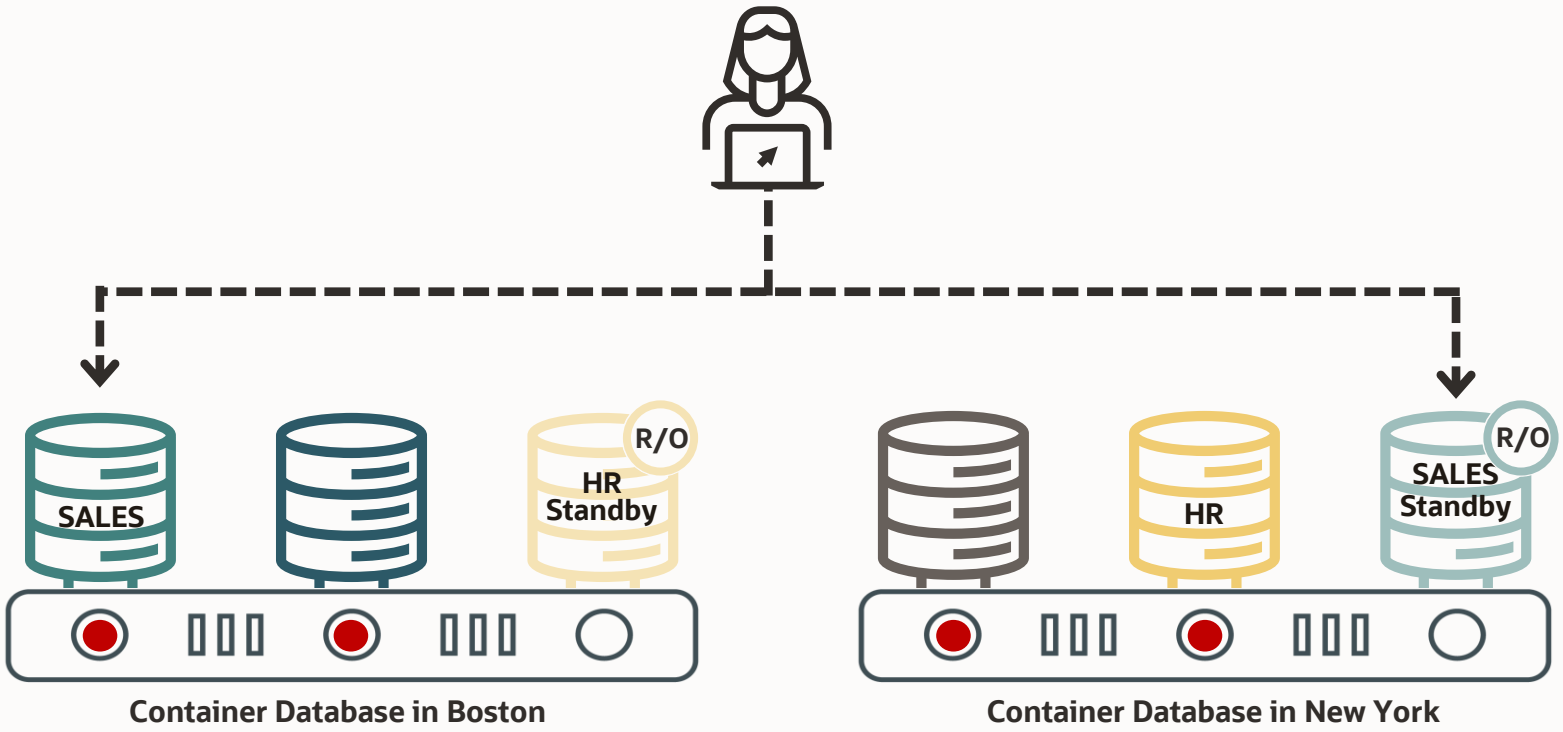
Oracle Active Data Guard for Pluggable Databases

Provides Data Guard disaster recovery, and availability features at the pluggable database (PDB) level

- Each PDB can switchover or failover independently to the remote CDB
- No need to fail over all the PDBs when an issue occurs that only impacts one PDB
- Redo is shipped and applied in real-time



Oracle Readable PDB Standbys



Per-PDB standby databases can now be opened for read-only workloads

Improves production database performance by offloading resource-intensive backup and reporting operations to standby systems

Priority Transactions

Priority Transactions

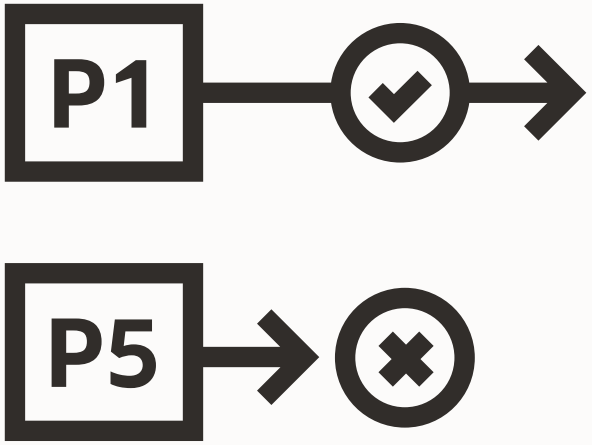
If a transaction acquires row locks and is not committed or aborted, it can block other transactions trying to update the same rows

This can lead to lengthy application stalls and typically requires the hands-on involvement of a DBA

In 23ai, users can now enable functionality that automatically prioritizes high-priority transactions over low-priority transactions

Low-priority transactions that block high-priority transactions will be automatically aborted

Reduces the admin burden on the DBA and avoids long transactions stalls



Oracle Database 23ai Security Enhancements

In-Database Firewall

An easy-to-use firewall solution, with minimal perf and operational overhead

Built-in to ensure it cannot be bypassed

Protection against attacks by monitoring and blocking “unauthorized SQL” and SQL injection attacks

Read-Only Users

Users may be created as, or altered to, `READ ONLY` status (default `READ WRITE`)

```
ALTER USER joe
READ ONLY;
```

Read-only users can not insert or update data, nor can they create database objects

Developer Role

It’s complex to grant all the privileges developers need to create, debug, etc.

Now it’s simple using the new DB_DEVELOPER_ROLE :

```
GRANT DB_DEVELOPER_ROLE
TO    scott;
```

Schema Privileges

Managing the privileges on all the tables, views, and procedures used by an app can be tricky

Now this is simple using `GRANT` on a schema

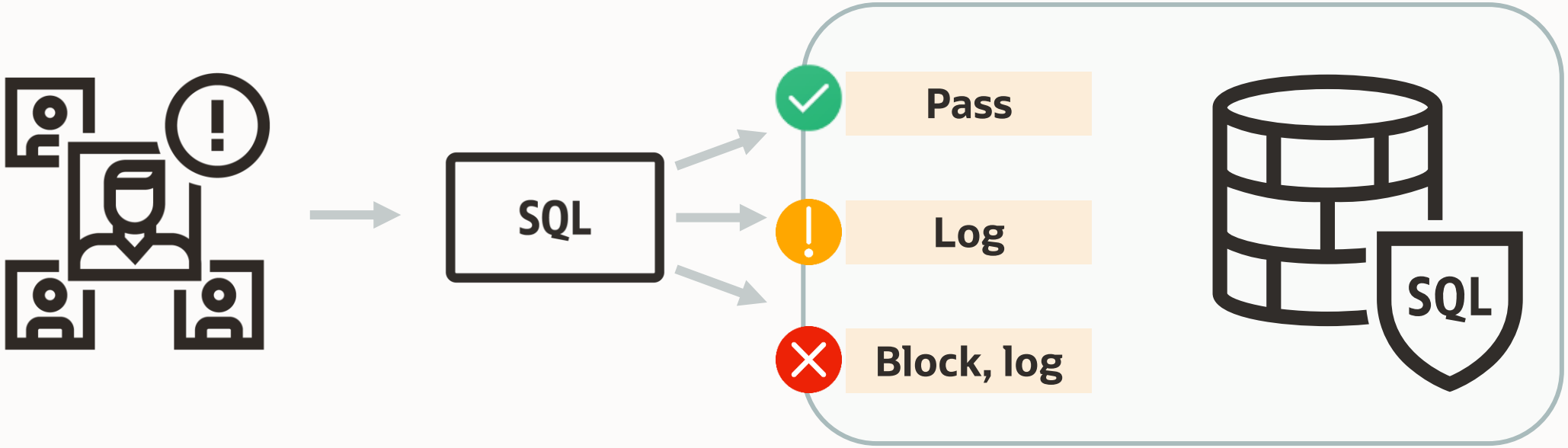
```
GRANT SELECT ANY TABLE
   ON SCHEMA sales
   TO mary;
```

SQL Firewall

Demo

Oracle In-Database SQL Firewall

Oracle SQL Firewall offers protection against common database attacks by monitoring and blocking **“unauthorized SQL”** and SQL injection attacks



SQL Firewall is **built into** the database, ensuring that it **cannot be bypassed**
No extra hops, management, installation, patching, etc. of a mid-tier database firewall

Oracle Database 23ai Manageability and Availability Enhancements

Shrink Tablespace

A simple way to reclaim unused or free space in a tablespace

Optimizes the storage of big file tablespaces by moving objects to the datafile head, and then resizing the datafile by removing the tail

Real-time SQL Plan Management

Automatically repairs SQL performance regressions

The optimizer detects a plan regression and tries to find a previous plan with better performance

If an alternative plan is found to perform better, a SQL plan baseline is automatically created and that plan will be used

Rolling Patching for Complex Changes

Enables non-rolling patches to be applied online in stages

Phase 1:
The patch is applied to all instances but not enabled

Phase 2:
The patch is enabled via a SQL command

Enhanced Error Messages & Logging

Improved error messages that provide useful problem diagnosis in context and suggest actionable solutions. Easily searchable error message portal.

New attention log that highlights issues requiring prompt remediation

SQL Plan Management

Resolving SQL execution plan performance regressions

Real-time SQL Plan Management

Oracle Database 23ai

Real-time SPM repairs SQL performance regressions without manual intervention

Imagine we have the following scenario

- A SQL statement has acceptable performance
- A change in the database environment or data causes the execution plan to change
- The new SQL execution plan performs poorly
- The optimizer automatically detects the plan (leveraging auto SQL tuning set)
- The optimizer identifies a previous reference plan and checks to see which has the best performance
- The better plan is accepted as a SQL plan baseline
- The SQL statement subsequently uses the better plan, controlled by SQL plan management

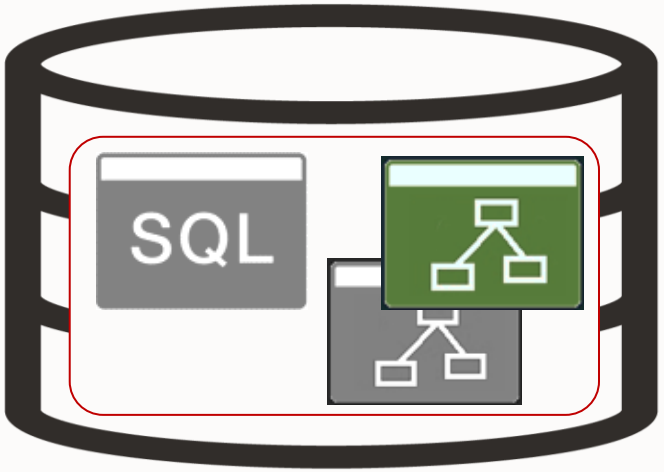
Enable real-time SQL plan management

```
EXEC dbms_spm.configure('AUTO_SPM_EVOLVE_TASK', 'AUTO');
```

Real-time SQL Plan Management

A new plan is found for the SQL statement and will be used for the initial execution

The Automatic SQL Tuning Set



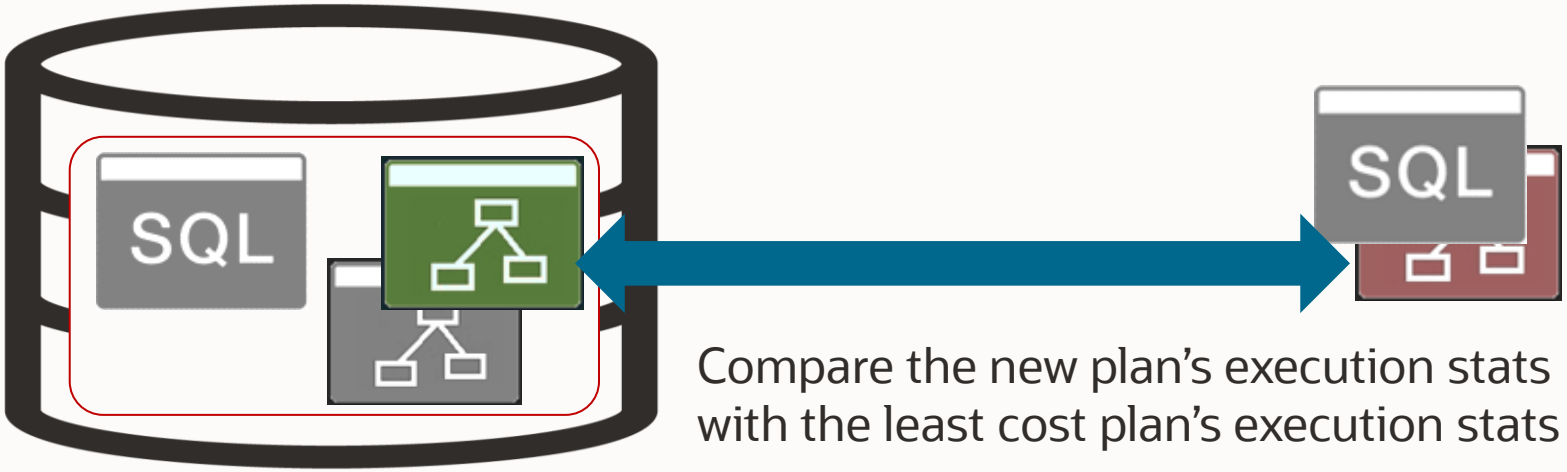
Execute the SQL statement

Using the new plan

Real-time SQL Plan Management

After initial execution the performance statistics are compared with those of previous plans

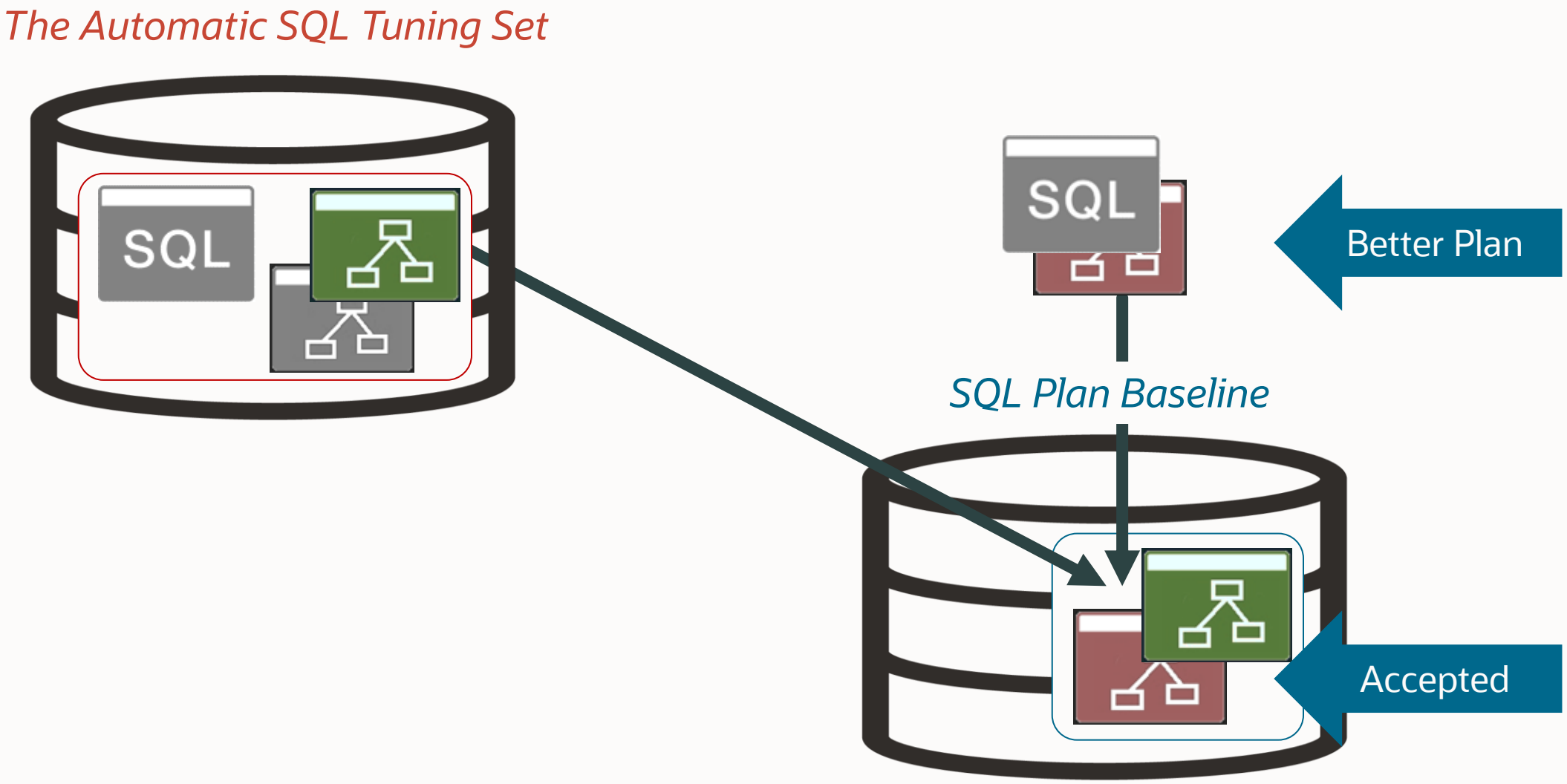
The Automatic SQL Tuning Set



Compare the new plan's execution stats with the least cost plan's execution stats

Real-time SQL Plan Management

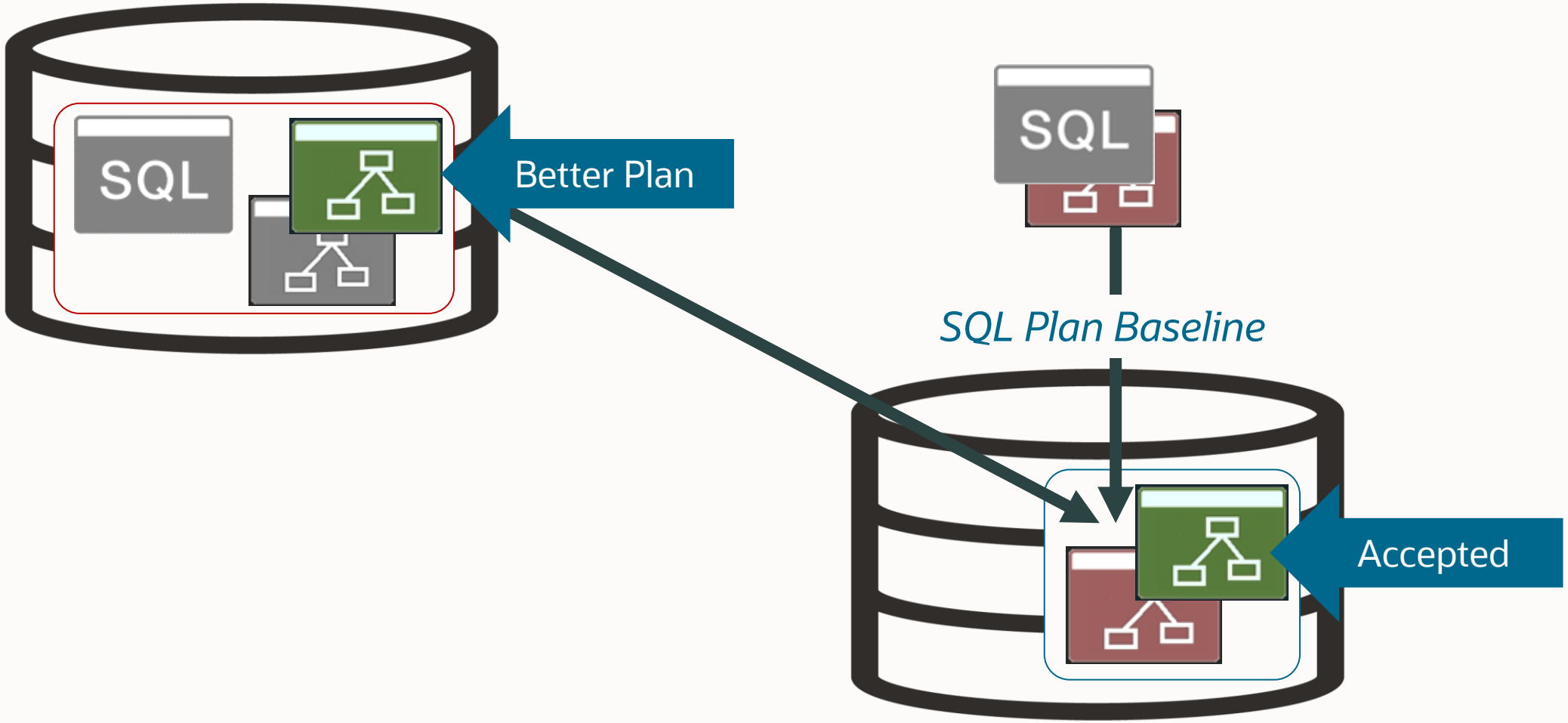
If the new plan is better than the previous plans, create a SQL plan baseline using the new plan



Real-time SQL Plan Management

If the new plan is worse than the previous plans, create a SQL plan baseline using the previous plan

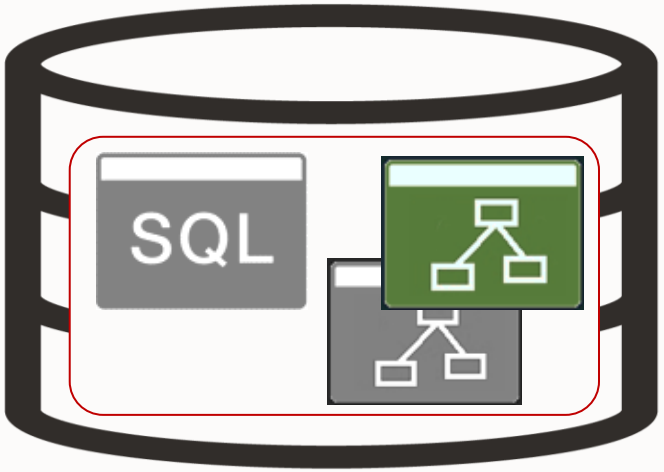
The Automatic SQL Tuning Set



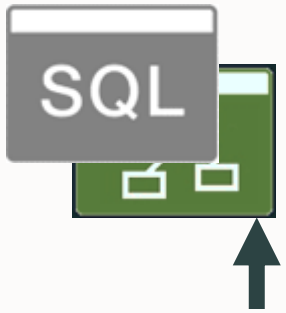
Real-time SQL Plan Management

Going forward the previous plan is used

The Automatic SQL Tuning Set

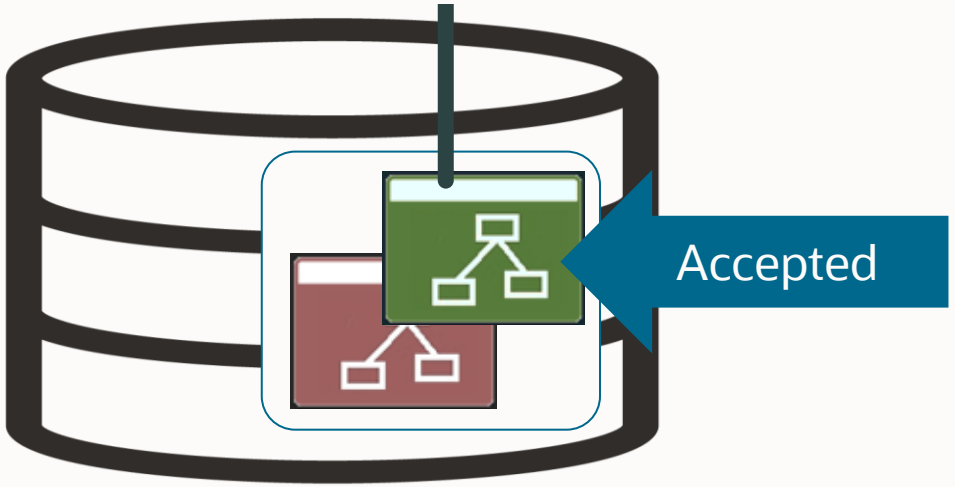


The SQL statement is hard parsed



The accepted SQL plan baseline is used

SQL Plan Baseline



Ultimately, all plans will be captured in ASTS

Rolling Patching

RAC Rolling Patching for Complex Changes

Rolling Patching across RAC instances already eliminates most maintenance-related downtime

Unfortunately, some patches cannot be applied in a rolling fashion since they require all instances to be at the same patch level

23ai introduces two features that enable most non-rolling patches to be applied in stages

- Oracle RAC Two-Stage Rolling Updates and Deferred SQL Patching

RAC Rolling Patching for Complex Changes

Rolling Patching across RAC instances already eliminates most maintenance-related downtime

Unfortunately, some patches cannot be applied in a rolling fashion since they require all instances to be at the same patch level

23ai introduces two features that enable most non-rolling patches to be applied in stages

- Oracle RAC Two-Stage Rolling Updates and Deferred SQL Patching

How it works

The update operation separates applying binary changes and activating the change into phases:

Phase 1:
The patch is applied in a rolling fashion to all instances but not enabled

Phase 2:
The patch is enabled via a SQL command

```
ALTER SYSTEM enable rac two_stage rolling updates all;
```

Increases availability by avoiding downtime due to previously non-rolling patches

Oracle Database 23ai – The Next Long Term Support Release

Oracle Database 23ai

Bring AI to your data

- Data Use Case Domains
- Boolean Datatype
- Real-time SQL Plan Management
- JSON Schema
- Microservice Sagas
- JSON / Relational Duality
- AI Vector Search
- True Cache
- Priority Transactions
- Rolling Patching
- JS Stored Procedures
- Developer Role
- Shrink Tablespace
- Schema Privileges
- Readable PDB Standby
- Property Graphs
- SQL Firewall
- Globally Distributed Database

Oracle Database 23ai is available TODAY

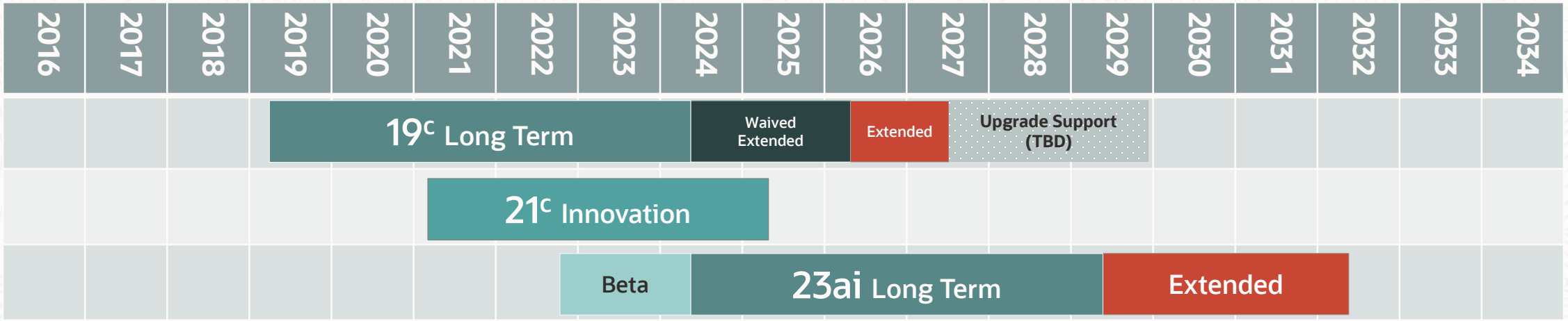
In the Oracle Public Cloud

FREE

On-Premises via Oracle Database Free

Coming Soon Everywhere

Projected Database Release and Support Timeline



- Innovation Release - 2 years of Premier Support, and no Extended Support
- Long Term Release - 5 years of Premier Support, and 3 years of Extended Support
- Always refer to MOS Note: Release Schedule of Current Database Releases (Doc ID 742060.1)

Summary: Oracle Database Strategy & Roadmap

Focused on increasing productivity for Developers, DBAs, and Data Analysts

Converged Oracle Database

Simplifies development of operational and analytical applications today, and for tomorrow

Oracle Exadata

Delivers extreme performance and availability for all data workloads

Oracle Autonomous Database

Delivers all the benefits of converged Oracle Database in the cloud, on-premises and in multicloud configurations

Generative AI

Makes it easy to generate and run modern apps and analytics for all use cases at any scale

Oracle Database 23ai

The next Long Term Release that continues to deliver converged database innovations for both cloud and on-premises

Thank you!

Checkout Oracle Database 23ai
http://www.oracle.com/database/23ai