

ORACLE

Data Deep Dive
at AI World

Data Deep Dive at Oracle AI World 25

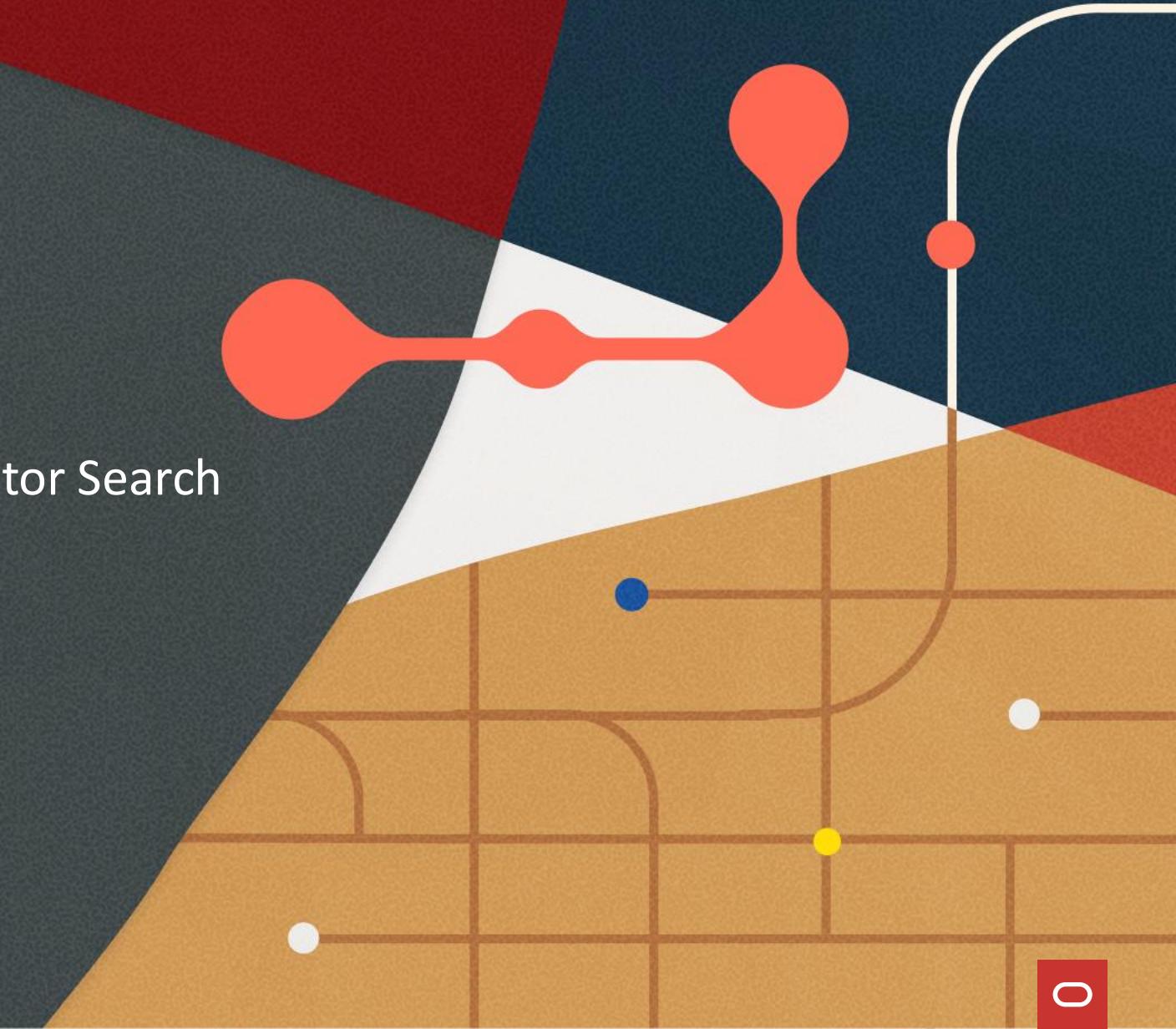
HOL3731 - Getting Started with AI Vector Search

Andy Rivenes, Sean Stacey

AI Vector Search Product Management

Oracle

October 13-16, 2025



Getting Started with AI Vector Search HOL Agenda

- 1 Welcome and Introduction
- 2 Overview: AI Vector Search
- 3 Introduction to the Workshop Environment
- 4 How AI Vector Search Works
- 5 Wrap Up and Next Steps

Welcome and Introduction

HOL3731 - Getting Started with AI Vector Search



Speakers



Andy Rivenes

Product Manager



Sean Stacy

Product Manager Database AI Engine

Overview: AI Vector Search

HOL3731 - Getting Started with AI Vector Search



Vector Search is a breakthrough capability for searching data by semantics



AI Vector Search



Find similar documents, images, and other unstructured data based on their **semantic content**, rather than their words or pixels



AI Vector Search works by representing the **semantic content** of a document, image, video, or even relational data as a sequence of numbers, called a **vector**

Developers create a vector for an object by just passing the object to a built-in vectorization function

Oracle Vector Database natively **stores** vectors and **compares** vectors to find objects with **similar semantic content**

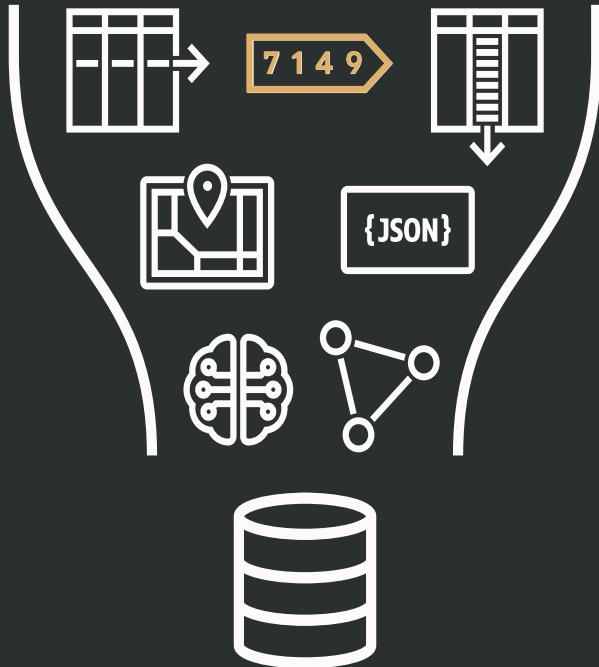
The main operation on vectors is the Mathematical Distance between them



Distance (Euclidean Squared)
= $((3-2)^2 + (1-6)^2 + (2-2)^2 + (8-3)^2)$

There are many mathematical distance formulas

Better Together: Business Data and Business Vectors



Oracle's Converged
Data Architecture

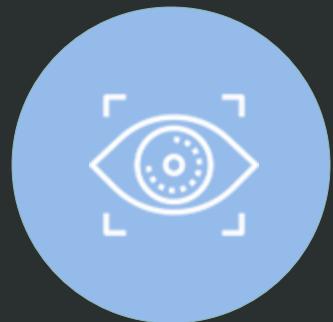
Uniquely combines sophisticated business data search with vector similarity search using simple SQL

There is no need to move and synchronize data, manage multiple products, etc.

Enterprise Similarity Search Use-Cases



**Find Similar
Support Tickets**



Biometric pattern
recognition



**Find Similar
Products**



**Detect manufacturing
anomalies**



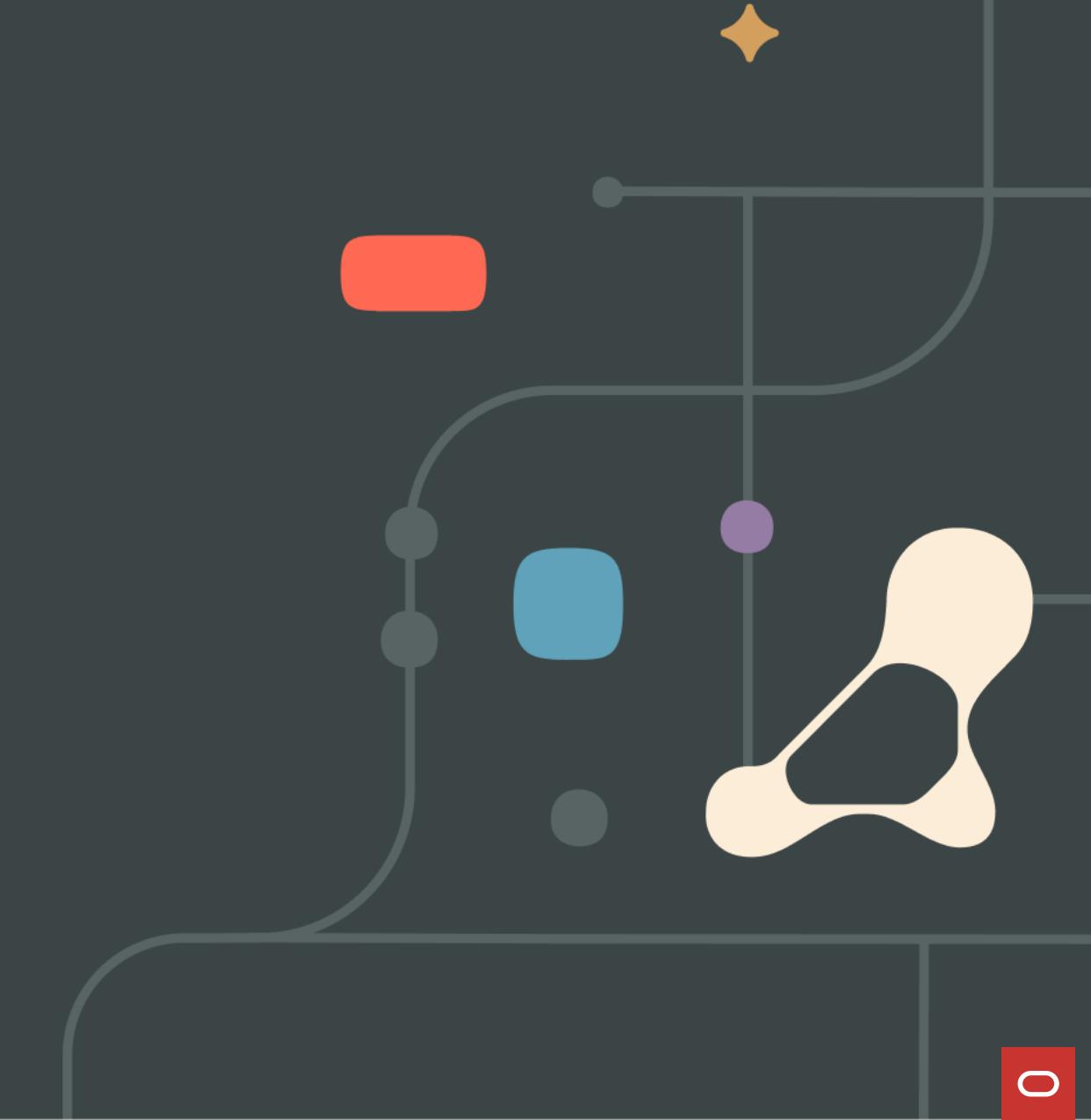
**Product
Recommendation**



**Natural language catalog
search**

Introduction to the Workshop Environment

HOL3731 - Getting Started with AI Vector Search



Requirements for running a Hands-on-Lab



Laptop



Oracle Account



livelabs.oracle.com/ai-world25/HOL3731

Getting Started with AI Vector Search

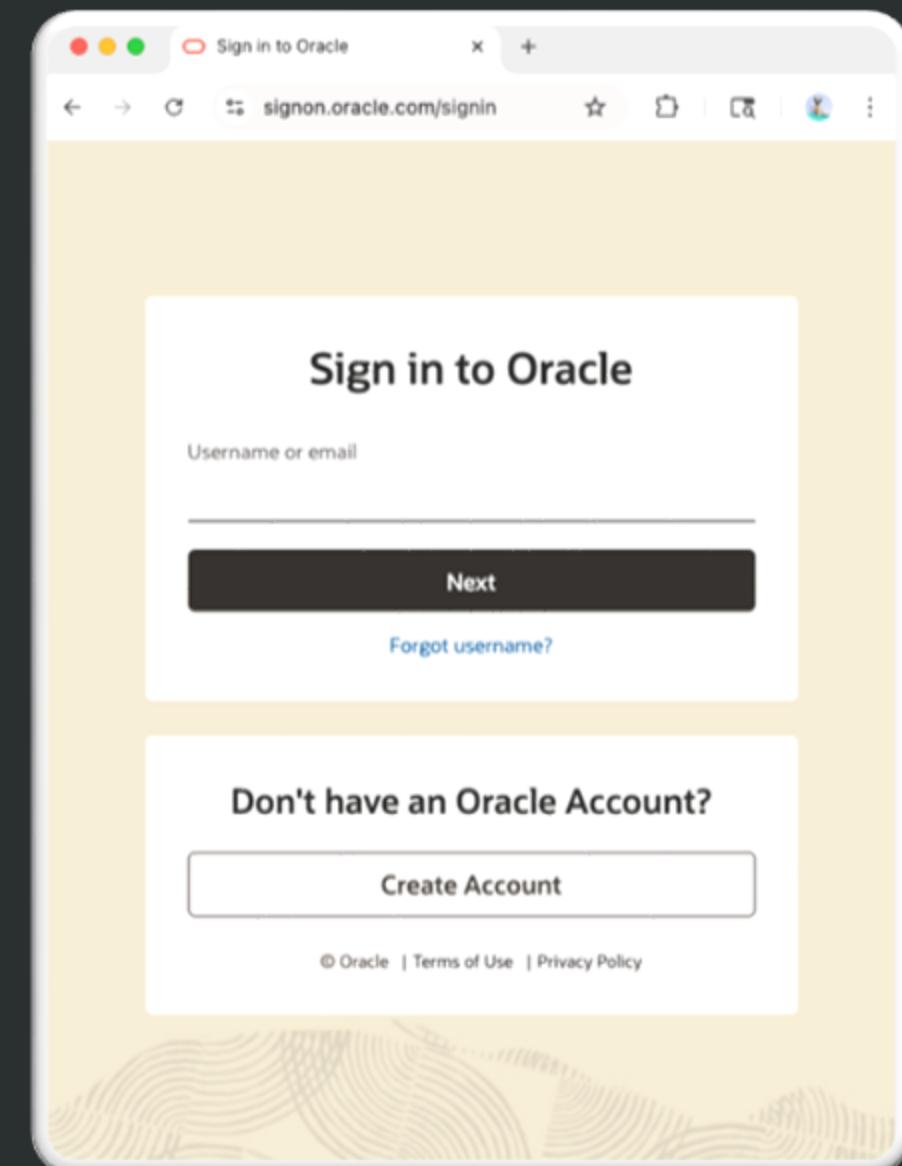
Let's get started

livelabs.oracle.com/ai-world25/HOL3731

- Open a web browser
- Navigate to the provided URL
- Login with your Oracle

SSO account

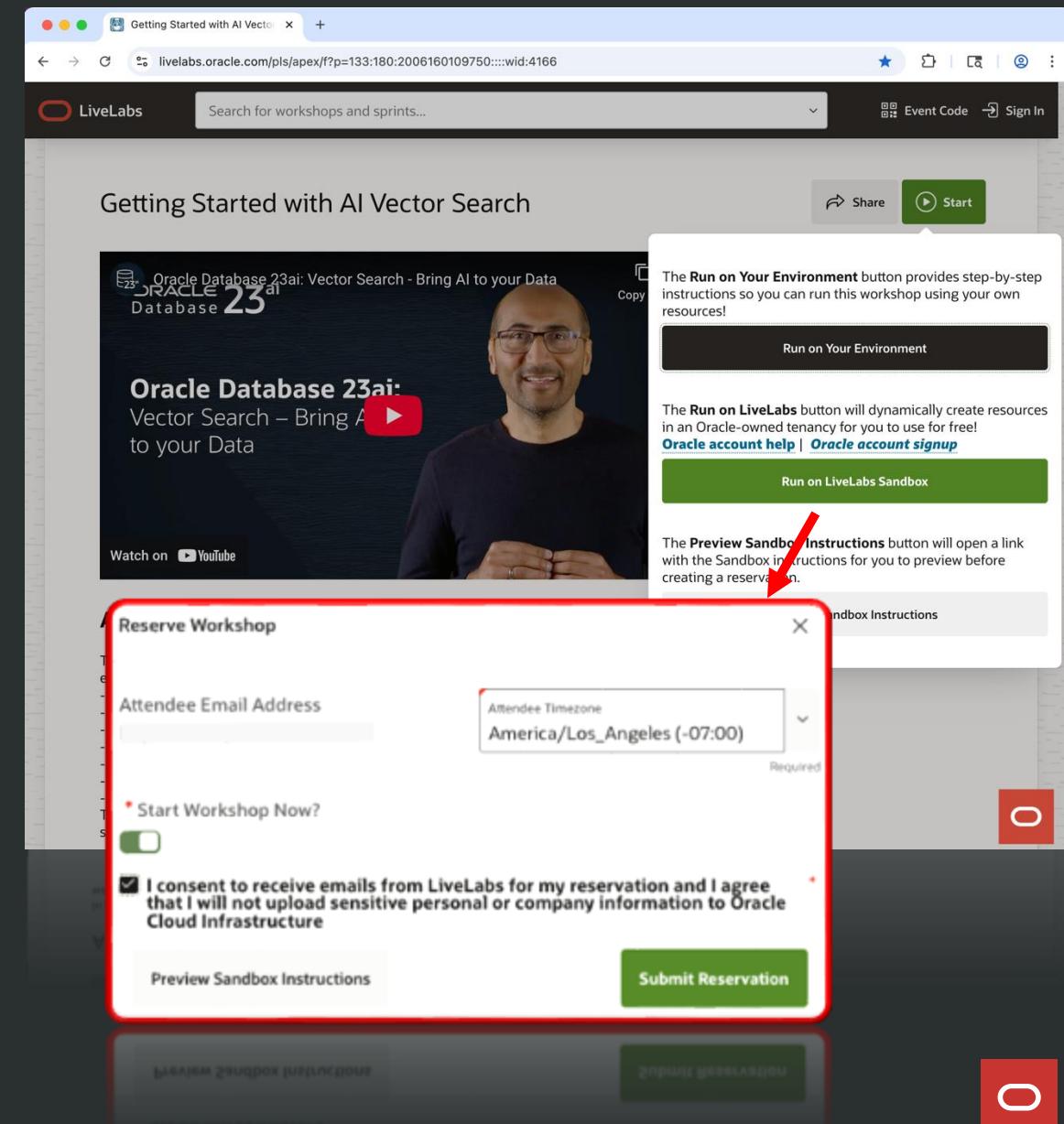
PLEASE NOTE: This is NOT your Oracle Cloud Infrastructure account



Let's get started

livelabs.oracle.com/ai-world25/HOL3731

1. Click the **Start** button Click **Run** on LiveLabs Sandbox
2. Toggle the **Start Workshop Now** radio button
3. Check the consent box
4. Click **Submit Reservation**



Let's get started

livelabs.oracle.com/ai-world25/HOL2804

Click **Launch Workshop** once available

Please note:

The environments are available within a couple of minutes.

Refresh the page.

The screenshot shows the 'My Reservations' page from the Oracle LiveLabs website. At the top, there is a navigation bar with the 'LiveLabs' logo, a search bar, and an 'Event Code' dropdown set to 'HOL2804'. Below the header, the main title 'My Reservations' is displayed. A descriptive text block explains that current workshop reservations are shown, and users can edit active or pending reservations, view workshop details, attend an available workshop, or delete a reservation. A note states that the status of reservations will be emailed to the user. A specific reservation is listed: 'Getting Started with AI Vector Search' on Wednesday, October 8th, at 12:46pm (12:46) US/Eastern. Below the listing are three buttons: 'Launch Workshop' (highlighted in black), 'Details', and 'Delete'. At the bottom of the page, there are links for Resources, Partners, Solutions, What's New, and Contact Us, along with copyright information and a footer menu.

Let's get started

livelabs.oracle.com/ai-world25/HOL3731

Start with the **Introduction lab** once the workshop is available

Note: Skip the Get Started lab

The screenshot shows the Oracle AI Vector Search Workshop interface on the LiveLabs platform. The top navigation bar includes the LiveLabs logo, a search icon, an event code field, and user profile icons. A red arrow points from the text above to the '+ Introduction' link in the sidebar menu. The main content area displays the 'Introduction' section, which includes a brief description of the workshop, estimated lab time (5 minutes), and details about the Oracle AI Vector Search Fundamentals workshop. It also lists key components of AI Vector Search and defines terms like Vector Data Type, Similarity Search, and Vector Indexes.

View Login Info

Time Remaining: 0h 57m 8s
Extend Workshop Reservation

Getting Started with AI Vector Search › Introduction

+ Get Started

+ Introduction

+ Database Connection

+ Lab 1: Vector Embeddings

+ Lab 2: Exhaustive Search

+ Lab 3: Approximate Search

+ Lab 4: Image Search

+ Lab 5: APEX Demo

+ Need Help?

Introduction

Introduction

This will introduce you to the Oracle AI Vector Search Workshop.

Estimated Lab Time: 5 minutes

About This Workshop

The **Oracle AI Vector Search Fundamentals** workshop will show you how you can combine the ability to perform similarity search on unstructured data like text and images with relational data to enable a whole new class of applications.

Oracle AI Vector Search is a sophisticated suite of capabilities, empowering developers to seamlessly store, index, and search vector data within Oracle Database. Vector data, represented as arrays of numbers, plays a pivotal role in capturing diverse features within unstructured data, including images, text, audio and video.

Key components of AI Vector Search include:

Vector Data Type: A data type designed to store vector data directly within Oracle Database, facilitating seamless integration.

Similarity Search: The ability to search for semantic similarity on structured or unstructured data.

Vector Indexes: Specialized indexing optimized for rapid and efficient retrieval of similar vectors, enhancing the database's search efficiency.

I need help!



Watch the video below for a quick walk through of the lab.

Capture and Preserve SQL

Task 1: Collect statements from AWR

Task 2: Collect statements from Cursor Cache

Task 3: Optional - export AWR

Learn More

Acknowledgements

Lab 4: Capture and Preserve SQL

Introduction

Task 1: Collect statements from AWR

Task 2: Collect statements from Cursor Cache

Task 3: Optional - export AWR

Learn More

Acknowledgements

Lab 5: AutoUpgrade

Lab 6: AWR Compare Report

Lab 7: SQL Performance Analyzer

Lab 8: SQL Plan Management

Lab 9: SQL Tuning Advisor

Lab 10: Plugin UPGR into CDB2

Watch on YouTube

About SQL Tuning Sets

A SQL tuning set (STS) is a database object that you can use as input to tuning tools. An STS includes:

- A set of SQL statements
- Associated execution context, such as a user schema, application module name and action, list of bind values, and associated basic execution statistics, such as elapsed time, CPU time, buffer gets, disk reads, rows processed, cursor ID, and more.
- Associated execution plans and raw source statistics for each SQL statement (optional)

An STS allows you to transport SQL between databases. You can export SQL tuning sets from one database to another, e

Need help?

Introduction

This page is designed to help you solve some common problems users face in this LiveLab.

After reading those troubleshooting tips, if you still find yourself stuck or would like to report an issue, click the question mark icon in the upper right corner to contact the LiveLabs team directly via email.

Common Issues Table of Contents

- Can't Log in to Oracle Cloud
- Can't Create An Oracle Database? Nothing In Your Compartment?
- Connectivity Issues? Unable to Upload Data or Connect to the Database? Hmm... can't reach open to gain access to the workshop?
- Cannot Access Cloud Shell?
- Cannot Connect to the Marketplace Compute Instance Using a Private SSH Key?
- Cannot Create Passwords for Database Users?

How to Format Your Support Email Request



Self-Service

Check the workshop for helpful videos and details

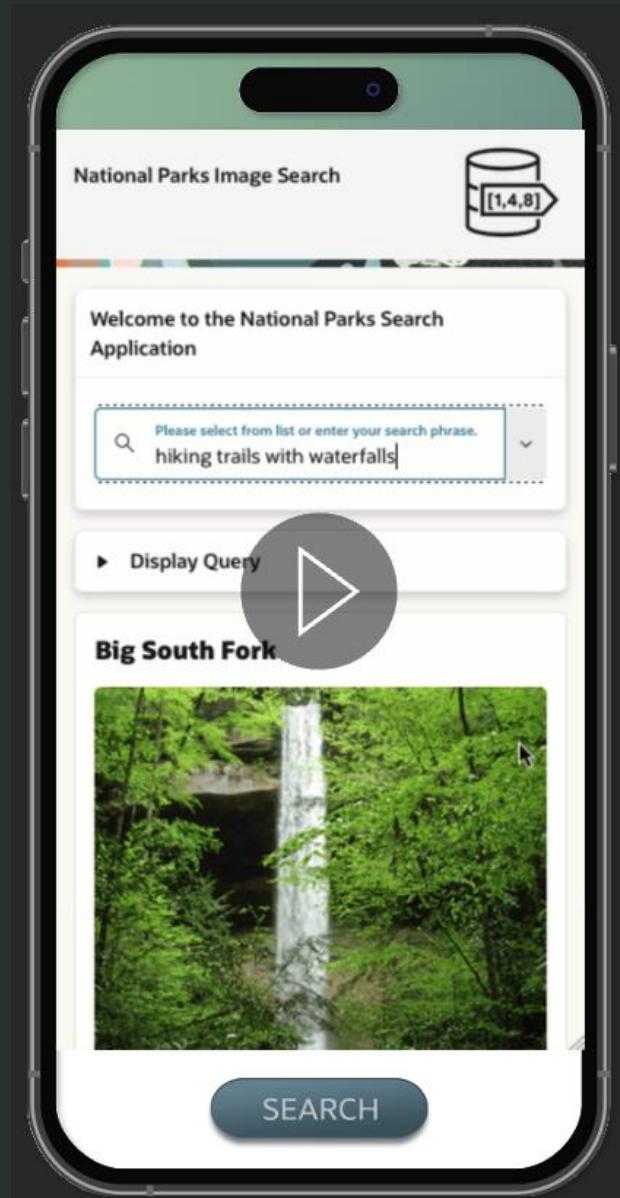
Get help — Self-Service

Find the 'Need help?' section in the sidebar of the workshop

Ask us!



AI Vector Search In Action



**Let's take a look at
vector search in action:**

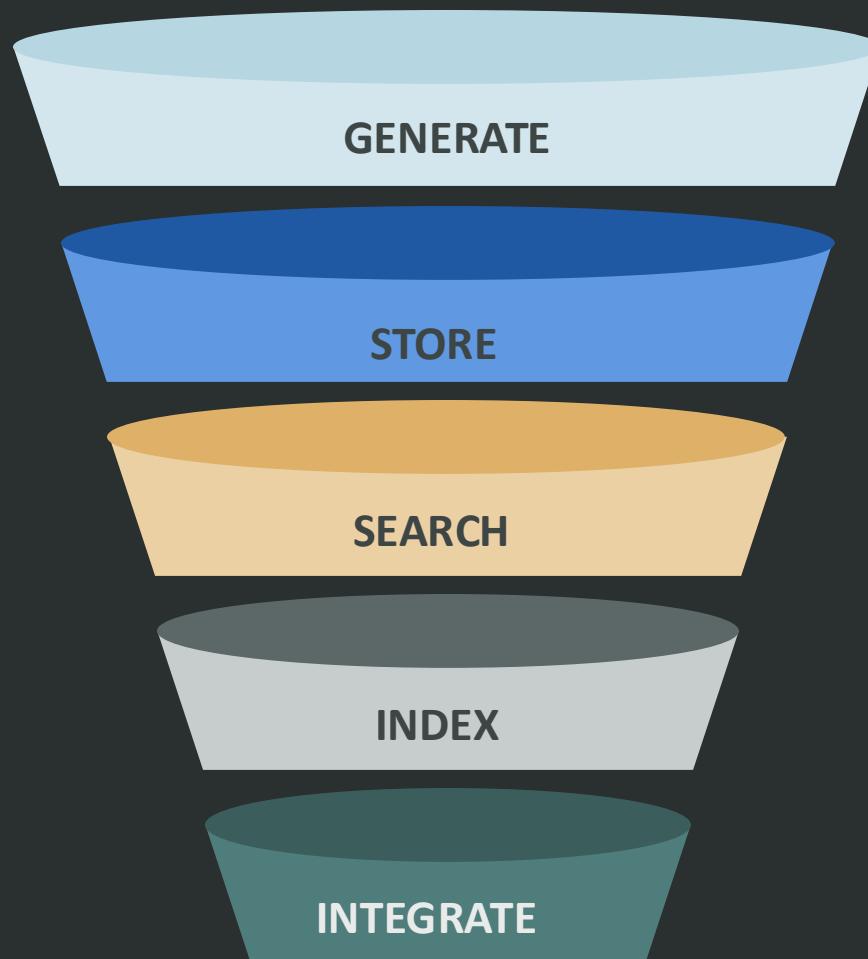
**Imagine a National Parks app
that helps users find nearby
parks featuring similar views or
activities to their search criteria**

How AI Vector Search Works

HOL3731 - Getting Started with AI Vector Search



AI Vector Search Highlights



Generate vector embeddings from unstructured data

Store vectors in table columns using new VECTOR type

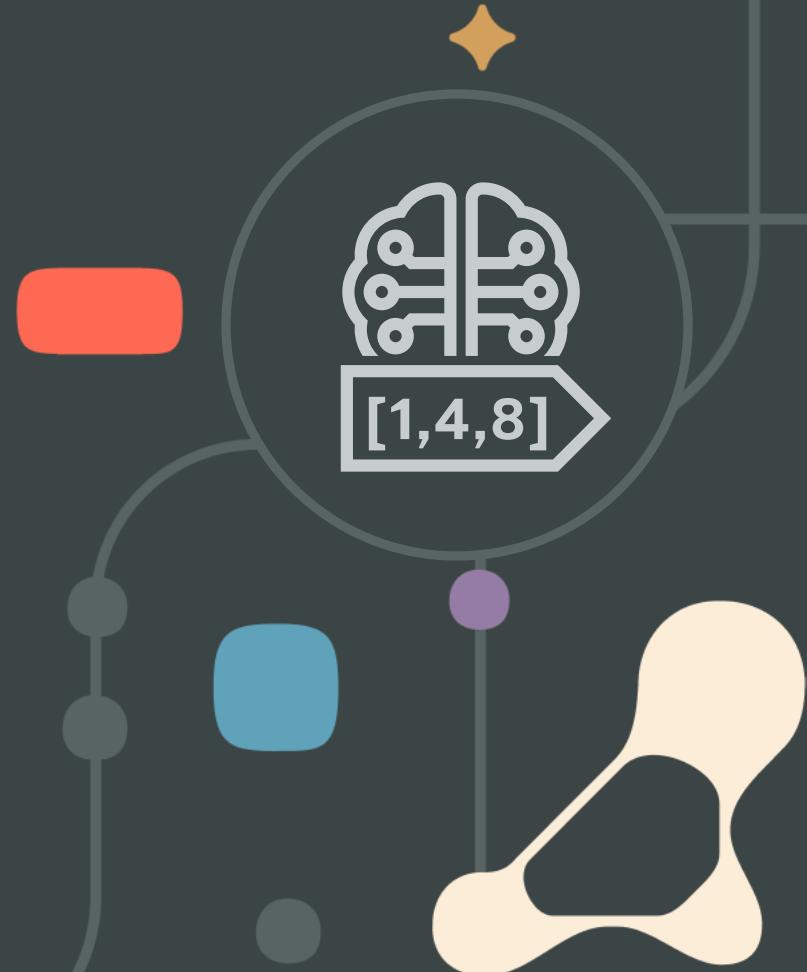
Perform AI Vector Search on VECTOR columns using SQL

Build approximate vector indexes on VECTOR columns

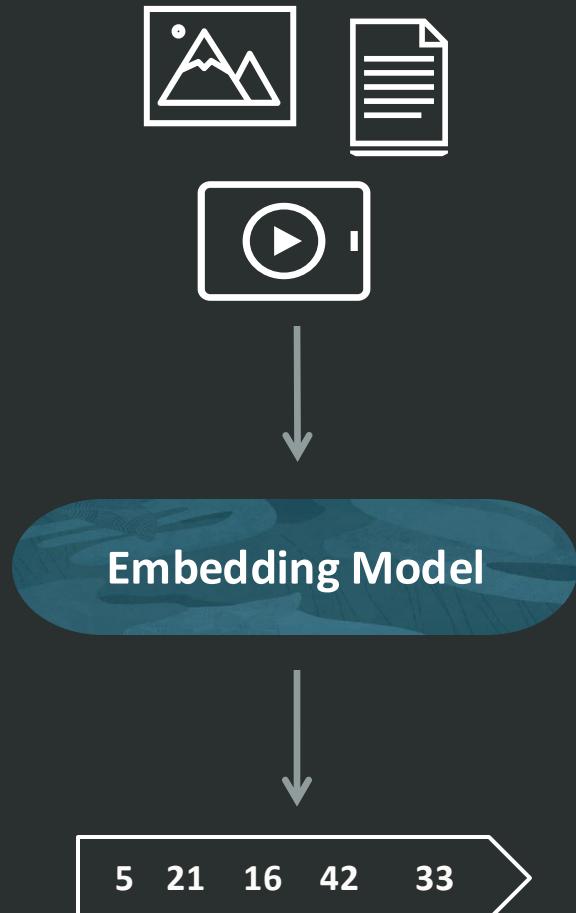
Integrate with Mission-Critical Enterprise Capabilities

Vector Embeddings

—
Lab 1 Review



What is Vector Generation or Embedding?



The process of converting unstructured data (text, images, etc.) into vectors

Vectors are generated using deep-learning embedding models

Vector embedding models can be obtained commercially, from Open Source, or can be created

There may be no *BEST* embedding model, and different data may need different models

- No one size fits all
- Evaluate a model based on your data

Vector Embedding Generation | Your Way

AI Vector Search offers **4 alternatives** for vector embedding generation

1

Use
Pre-created
embeddings

2

Use an external
embedding
cloud-service

3

Use an external
embedding
library in the mid-
tier

4

Use a database
resident
embedding model

Vector Embedding Generation | Your Way

Load vectors directly from external files

1 Use Pre-created embeddings

Load vectors directly from external files into database into VECTOR columns or map the data as external tables

```
CREATE TABLE ext_vec_table (ID      number,  
                           VECT    vector)  
ORGANIZATION EXTERNAL (  
    TYPE ORACLE_LOADER  
    DEFAULT DIRECTORY DATA_PUMP_DIR  
    ACCESS PARAMETERS (  
        RECORDS DELIMITED BY NEWLINE  
        FIELDS TERMINATED BY ":"  
        MISSING FIELD VALUES ARE NULL )  
    LOCATION ('vecdata.csv') )  
REJECT LIMIT UNLIMITED;
```

Vector Embedding Generation | Your Way

Generate vector embeddings using a callout to a cloud service

2

Use an external embedding cloud-service

Generate embeddings using external callouts via the `UTL_TO_EMBEDDING()` function in the `DBMS_VECTOR` package

```
-- Initialize parameters to specify provider
var params CLOB;
DBMS_VECTOR.CREATE_CREDENTIAL("OPENAI_CRED", auth_params);
params := '
{
  "provider": "openai",
  "credential_name": "OPENAI_CRED",
  "url": https://api.openai.example.com/embeddings,
  "model": "embed-model"
}
-- Generate vectors from park descriptions
UPDATE parks
SET desc_vector = DBMS_VECTOR.UTL_TO_EMBEDDING(description, json(params));
```

Vector Embedding Generation | Your Way

Generate vector embeddings using an embedding model on the mid-tier

3 Use an external embedding library in the mid-tier

Generate embeddings using a language -specific function calls

These embedding libraries can be from HuggingFace or use the ONNX Runtime

```
import openai

# Set your OpenAI API key (replace with your actual key)
openai.api_key = 'YOUR_OPENAI_API_KEY'

# Define your text
text = "Creating vector embeddings in Python is straightforward."

# Generate embedding using the OpenAI API
response = openai.embeddings.create(
    input=text,
    model="text-embedding-ada-002" # Or another suitable model
)

embedding = response.data[0].embedding
print(embedding)
print(f"Embedding dimension: {len(embedding)})")
```

Vector Embedding Generation | Your Way

Generate vector embeddings inside the database

4

Use a database resident embedding model

Generate embeddings using the **VECTOR_EMBEDDING()** SQL function using an imported **ONNX** embedding model, so that no data leaves the database

```
-- import onnx embedding model
DBMS_VECTOR.load_onnx_model(
    directory => <database directory>
    file_name => 'all_MiniLM_L12_v2.onnx'
    model_name => 'minilm_l12_v2',
    metadata => <source>
);

-- generate vectors from park descriptions
UPDATE parks
SET desc_vector = VECTOR_EMBEDDING(minilm_l12_v2 USING description AS data);
```

VECTOR Datatype to store and process vectors

New VECTOR datatype

```
CREATE TABLE parks(  
    park_id VARCHAR2,  
    description VARCHAR2,  
    desc_vector VECTOR(768, FLOAT32));
```

Optional
of dimensions

Optional
format

Format for dimension values can be FLOAT32, FLOAT64, and INT8
Additional formats coming ...

Vector Operations

Insert

`TO_VECTOR()` converts a string representing an array of vector dimensions into a native VECTOR

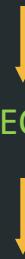


```
CREATE TABLE parks(  
    park_id      VARCHAR2,  
    description   VARCHAR2,  
    desc_vector   VECTOR(3, 'FLOAT32'));  
  
INSERT INTO parks VALUES  
(1, 'Valley Forge' TO_VECTOR('[1.1, 2.2, 3.3]'));
```

Fetch

`FROM_VECTOR()` converts a vector into a CLOB or VARCHAR2 – default behavior for pre-23ai clients



```
SELECT desc_vector  
FROM   parks;  
  
SELECT FROM_VECTOR(desc_vector)  
FROM   parks;  
  
'[1.1, 2.2, 3.3]'  

```

Exhaustive Search

—
Lab 2 Review



Exhaustive Similarity Search for top-K matches
will be 100% accurate but slow as data volumes
grow

Vector Search SQL | Distance Function

- The main operation on vectors is to find how similar they are



```
VECTOR_DISTANCE(VECTOR1, VECTOR2, <distance metric>)
```

The Distance between two vectors is smaller for entities that are more similar

Distance functions supported are:

COSINE (Default), EUCLIDEAN, EUCLIDEAN_SQUARED, HAMMING, MANHATTAN, DOT

Vector Search SQL | Specifying an Exhaustive Similarity Search

Parks DESCRIPTION Search Example

Find the top 10 matching descriptions



```
SELECT ...
  FROM   parks
 ORDER BY VECTOR_DISTANCE(desc_vector,
                           VECTOR_EMBEDDING(minilm_l12_v2 USING 'rock climbing' AS data), COSINE)
        FETCH FIRST 10 ROWS ONLY;
```

Exhaustive Similarity Search | Execution Plan

The screenshot shows an Oracle SQL Developer interface with the following details:

Query:

```
1 SELECT name, description
2 FROM parks
3 ORDER BY VECTOR_DISTANCE(desc_vector,
4 . . . VECTOR_EMBEDDING(minilm_l12_v2 USING 'rock climbing' AS data), COSINE)
5 FETCH EXACT FIRST 10 ROWS ONLY;
```

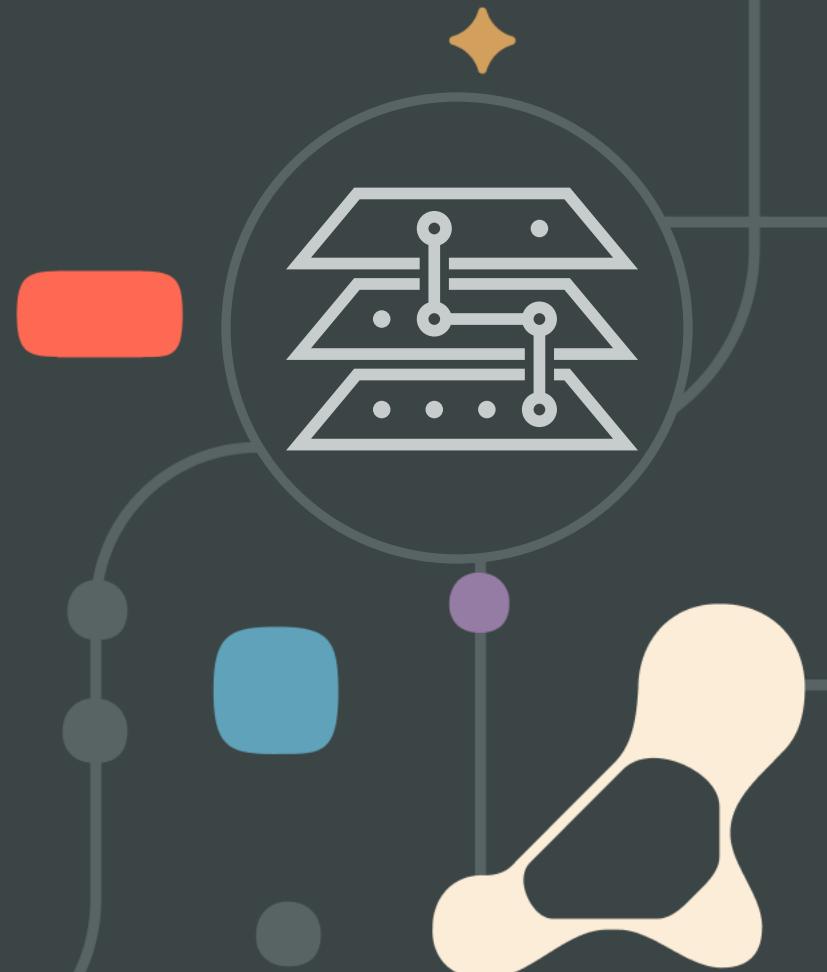
Execution Plan:

OPERATION	OBJECT NAME	OBJECT TYPE	CARDINALITY	COST	PARTITION START	PARTITION STOP
SELECT STATEMENT	null	(null)	10	324	(null)	(null)
COUNT	null	(null)	(null)	(null)	(null)	(null)
VIEW	null	(null)	472	324	(null)	(null)
SORT	null	(null)	472	324	(null)	(null)
TABLE ACCESS	PARKS	TABLE	472	70	(null)	(null)
Other XML	(null)	(null)	(null)	(null)	(null)	(null)

The row for "TABLE ACCESS PARKS TABLE" is highlighted with a red box.

Approximate Search

—
Lab 3 Review

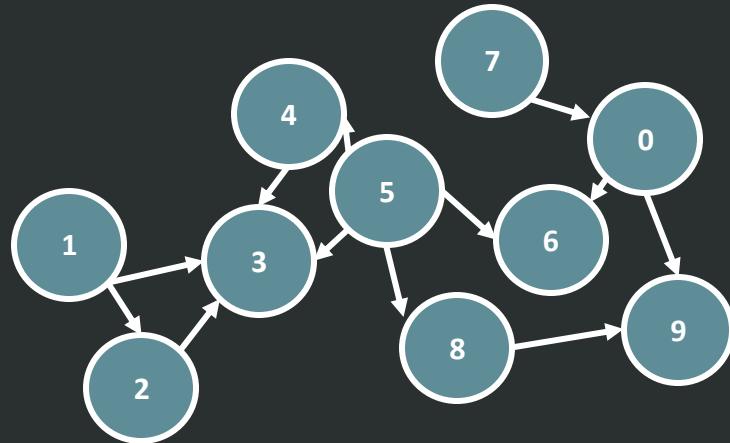


An exhaustive search
for top-K matches
will be 100% accurate
but slow as data
volumes grow

New vector indexes trade-off some search
accuracy for up to **100x** speed up

Vector Indexes | Neighbor Graph Vector Index

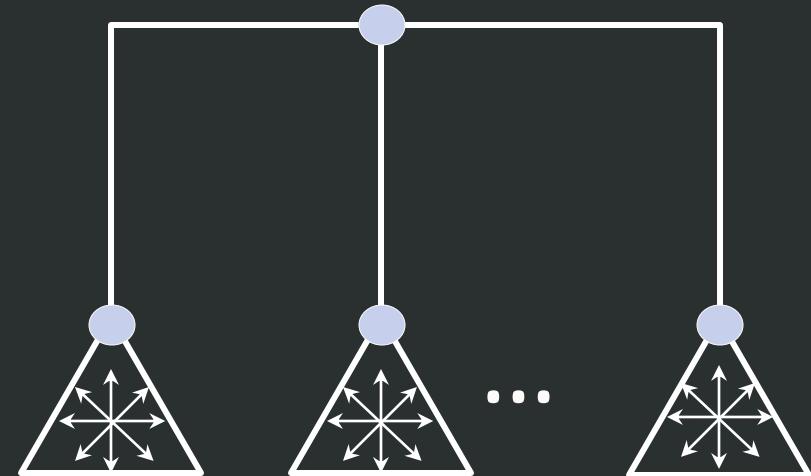
- Graph-based index where vertices represent vectors and edges between vertices represent similarity
- In-Memory only index - highly efficient for both accuracy and speed



Graph Vector Index (e.g.
HNSW Index)

Vector Indexes | Neighbor Partition Vector Index

- Partition-based index with vectors clustered into table partitions based on *similarity*
- Efficient scale-out index for unlimited data size



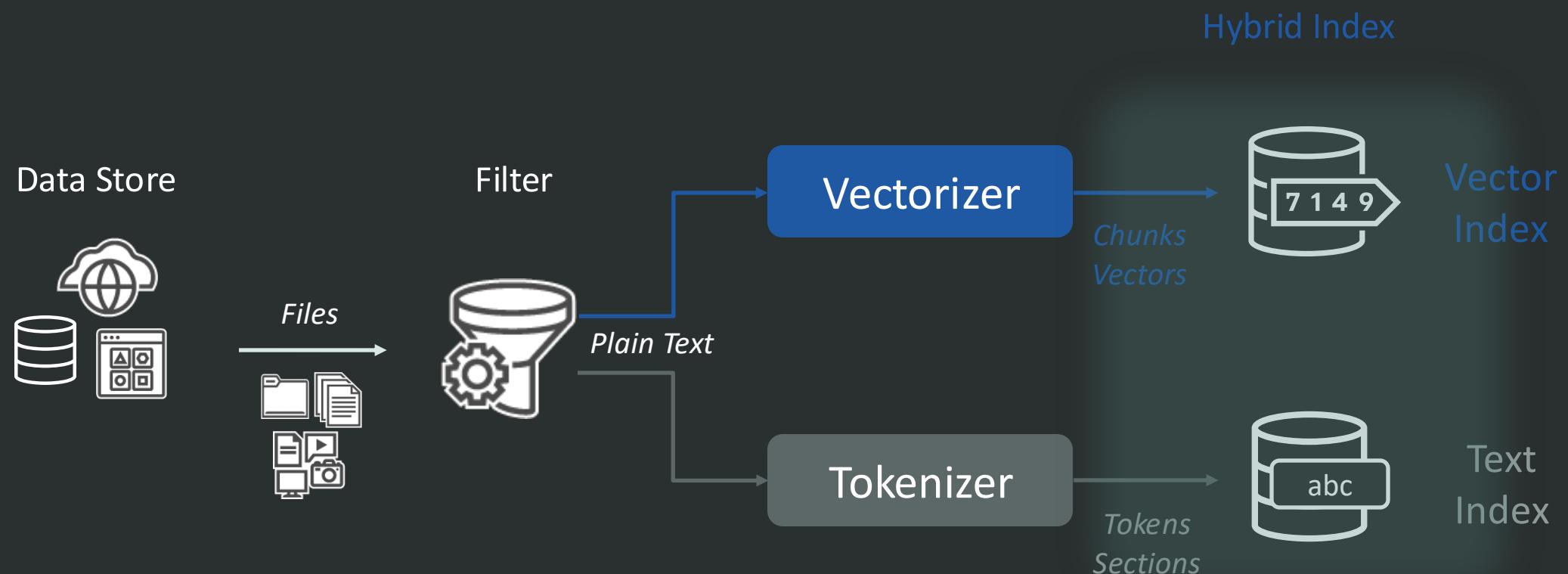
Partition Vector Index (e.g.
IVF_FLAT index)

Vector Index | Hybrid Vector Index

Indexing Pipeline

Hybrid Vector Index is a single index for searching by **Similarity** and by **Keywords**

- Combines the power of AI Vector Search with Text Search



Vector Index Creation

Basic index creation syntax:



```
CREATE VECTOR INDEX parks_hnsw_idx ON parks(desc_vector)
  ORGANIZATION INMEMORY NEIGHBOR GRAPH
  DISTANCE COSINE WITH TARGET ACCURACY 95;
```

Choosing the **ORGANIZATION** for an index is simple:

- If the index data will fit in memory, it is best to use an **INMEMORY NEIGHBOR GRAPH** index

The **DISTANCE** clause is optional (the default is **COSINE**)

As a rule of thumb, the distance function should be chosen based on the embedding model used to generate the vectors

Vector Search SQL | Specifying an Approximate Similarity Search

Parks DESCRIPTION Search Example

Find the top 10 matching descriptions



```
SELECT ...
FROM   parks
ORDER BY VECTOR_DISTANCE(desc_vector,
                           VECTOR_EMBEDDING(minilm_l12_v2 USING 'rock climbing' AS data), COSINE)
FETCH APPROX FIRST 10 ROWS ONLY;
```

Approximate Similarity Search | Execution Plan

The screenshot shows an Oracle SQL Developer interface with a query editor and an execution plan viewer.

Query Editor:

```
1 SELECT name, city, states, description
2 FROM parks
3 ORDER BY VECTOR_DISTANCE(desc_vector,
4   VECTOR_EMBEDDING(minilm_l12_v2 USING 'rock climbing' AS data), COSINE)
5 FETCH APPROX FIRST 10 ROWS ONLY;
```

Execution Plan:

OPERATION	OBJECT NAME	OBJECT TYPE	CARDINALITY	COST	PARTITION START	PARTITION STOP
SELECT STATEMENT	null	(null)	10	2	(null)	(null)
COUNT	null	(null)	(null)	(null)	(null)	(null)
VIEW	null	(null)	10	2	(null)	(null)
SORT	null	(null)	10	2	(null)	(null)
TABLE ACCESS	PARKS	TABLE	10	1	(null)	(null)
VECTOR INDEX	PARKS_HNSW_IDX	INDEX (VECTOR)	10	1	(null)	(null)
Other XML	(null)	(null)	(null)	(null)	(null)	(null)

The last row, 'VECTOR INDEX PARKS_HNSW_IDX INDEX (VECTOR)', is highlighted with a red box.

Image Search

—
Lab 4 Review



AI Vector Search works on all types of unstructured data

- AI Vector Search can search on all types of unstructured data
- Previous labs searched on TEXT based data using text searches
- The Image Search lab searched IMAGE based vector embeddings using text phrases
- Depending on the embedding model, the search could also have used an image to search for an image of a waterfall, rock climbing, etc.

Vector Search SQL | Image Based Similarity Search



```
SELECT ...  
FROM park_images  
ORDER BY VECTOR_DISTANCE(image_vector,  
VECTOR_EMBEDDING(clip_vit_txt USING  
'Civil War' AS data), COSINE)  
FETCH EXACT FIRST 10 ROWS ONLY;
```



Vector Search SQL | Combine value-based and semantic search

Value-based Attribute
Filters can be combined
seamlessly with Vector
Search in SQL

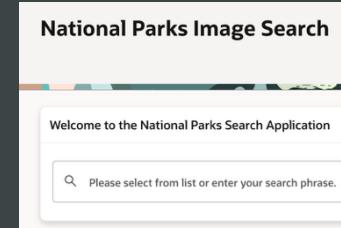
Find the top 10 matching parks with waterfalls in the Western U.S.



```
SELECT ...
FROM   park_images pi, parks p
WHERE  pi.park_code = p.park_code AND p.states IN
('CA','OR','NV','WA','AZ','CO')
ORDER BY VECTOR_DISTANCE(pi.image_vector,
VECTOR_EMBEDDING(clip_vit_txt USING
'waterfall' AS data), COSINE)
FETCH EXACT FIRST 10 ROWS ONLY;
```

APEX Demo

—
Lab 5 Review



National Parks Image Search with AI Vector Search

National Parks Image Search

Welcome to the National Parks Search Application

Please select from list or enter your search phrase:
picnic tables

▶ Display Query

Fort Washington



Built to defend the river approach to Washington, DC, Fort Washington has stood as silent sentry for over 200 years. As technologies advanced so did Fort Washington, from the brick and stone of the 19th century to the concrete and steel of the 20th century. Joining the National Park Service in 1946, the park continues to protect the Potomac River.

Salinas Pueblo Missions



Tucked away in the middle of New Mexico you'll find Salinas Pueblo Missions National Monument. Its three distinct sites offer a glimpse into a unique time in history—a time entrenched with cultural borrowing, conflict and struggles. These sites continue to stand as reminders of the Spanish and Pueblo peoples' early encounters and prompt exploration of today's interactions among different people.

New River Gorge



A rugged, whitewater river flowing northward through deep canyons, the New River is among the oldest rivers on the continent. The park encompasses over 70,000 acres of land along the New River, is rich in cultural and natural history, and offers an abundance of scenic and recreational opportunities.

Buffalo



Established in 1972, Buffalo National River flows freely for 135 miles and is one of the few remaining undammed rivers in the lower 48 states. Once you arrive, prepare to journey from running rapids to quiet pools while surrounded by massive bluffs as you cruise through the Ozark Mountains down to the White River.

Chamizal



Chamizal is more than just an urban park to recreate or enjoy a quiet afternoon. These grounds are a reminder of the harmonious settlement of a 100-year boundary dispute between the United States and Mexico. We celebrate the cultures of the borderlands to promote the same mutual respect that helped to diplomatically resolve an international disagreement.

Catoctin Mountain



President Franklin D. Roosevelt created programs to give people a chance to rebuild their lives from the Great Depression. The Works Progress Administration and the Civilian Conservation Corps gave this land a second opportunity and through re-growth, a new role as a recreation area.

Yellowstone



On March 1, 1872, Yellowstone became the first national park for all to enjoy the unique hydrothermal wonders. Today, millions of people come here each year to camp, hike, and enjoy the majesty of the park.

Florissant Fossil Beds



Beneath a grassy mountain valley in central Colorado lies one of the richest and most diverse fossil deposits in the world. Petrified redwood stumps up to 14 feet wide and thousands of detailed fossils of insects and plants reveal the story of a very different, prehistoric Colorado.

Gulf Islands



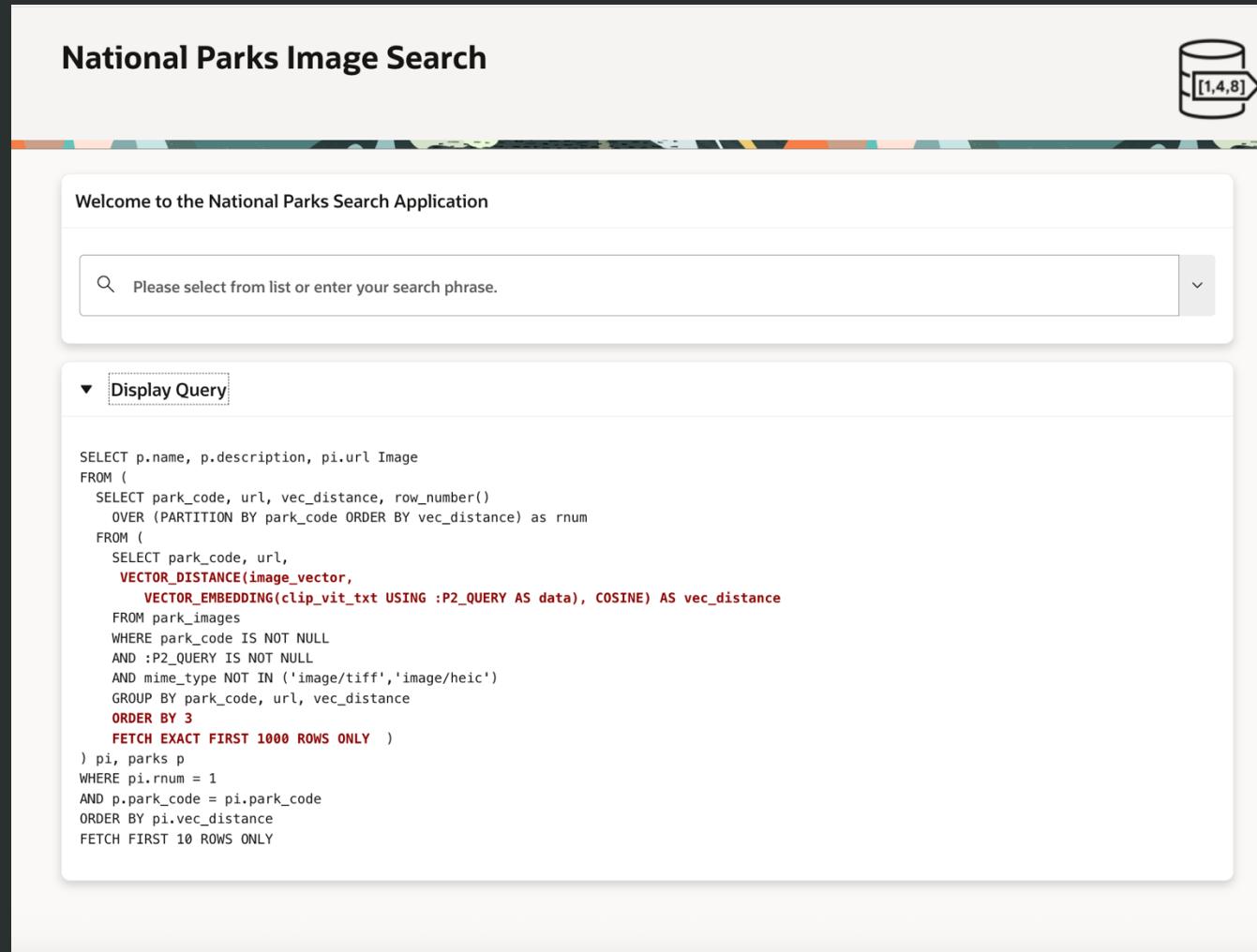
Millions of visitors are drawn to the Gulf of Mexico for Gulf Islands National Seashore's emerald coast waters, magnificent white beaches, fertile marshes and historical landscapes. Come explore with us today!

George Washington



The George Washington Memorial Parkway was designed for recreational driving. It links sites that commemorate important episodes in American history and preserve habitat for local wildlife. The parkway and its associated trails provide a scenic place to play and rest in the busy Washington, DC metropolitan area.

Query Used for the National Parks Image Search



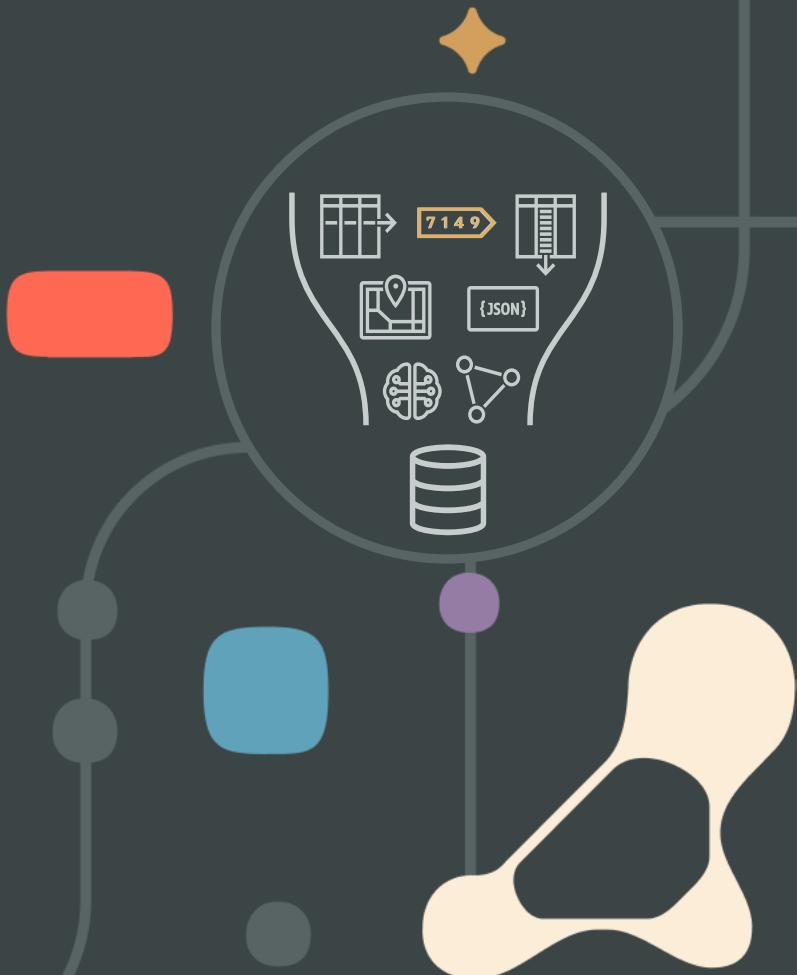
The screenshot shows a web-based application titled "National Parks Image Search". The main header features the title and a small icon of a cylinder with a vector arrow labeled "[1,4,8]". Below the header is a search bar with the placeholder text "Please select from list or enter your search phrase.". A dropdown menu is open, showing the option "Display Query". The query itself is a complex SQL statement:

```
SELECT p.name, p.description, pi.url Image
FROM (
  SELECT park_code, url, vec_distance, row_number()
  OVER (PARTITION BY park_code ORDER BY vec_distance) as rnum
  FROM (
    SELECT park_code, url,
    VECTOR_DISTANCE(image_vector,
      VECTOR_EMBEDDING(clip_vit_txt USING :P2_QUERY AS data), COSINE) AS vec_distance
    FROM park_images
    WHERE park_code IS NOT NULL
    AND :P2_QUERY IS NOT NULL
    AND mime_type NOT IN ('image/tiff','image/heic')
    GROUP BY park_code, url, vec_distance
    ORDER BY 3
    FETCH EXACT FIRST 1000 ROWS ONLY
  ) pi, parks p
  WHERE pi.rnum = 1
  AND p.park_code = pi.park_code
  ORDER BY pi.vec_distance
  FETCH FIRST 10 ROWS ONLY
```



Integrate Vectors

HOL3731 - Getting Started with AI Vector Search





Every mission-critical feature
of Oracle Database works
transparently with AI Vectors

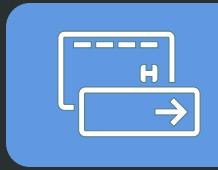
Allowing AI Vectors to be used
immediately in enterprise apps
of any scale or criticality



Real-Application Cluster



Parallel SQL



Transactions



Security



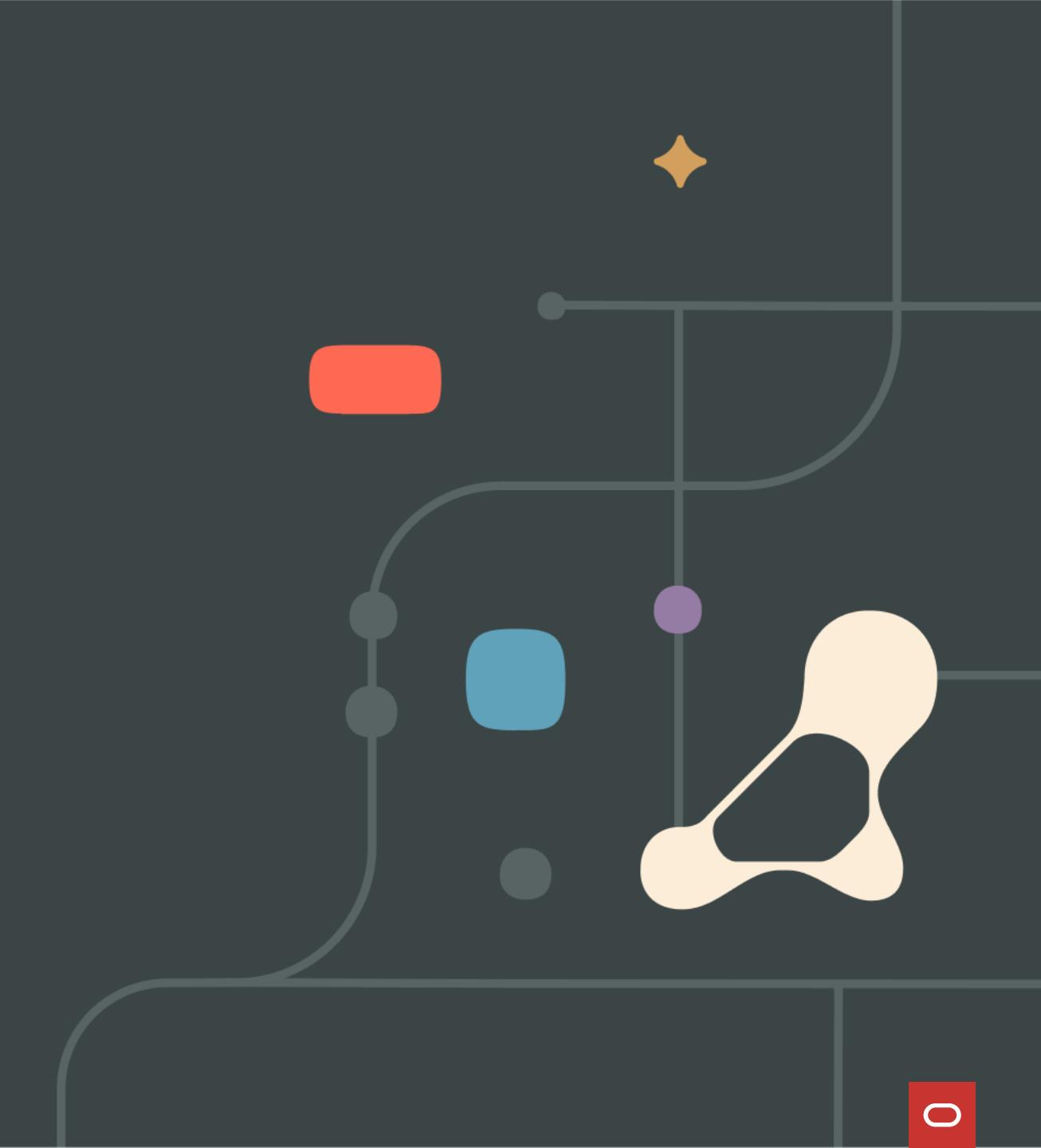
Analytics



Disaster Recovery

Wrap Up and Next Steps

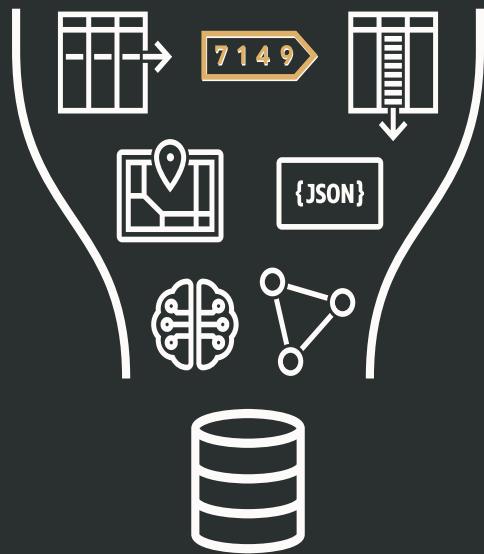
HOL3731 - Getting Started with AI Vector Search





Key Takeaways

Oracle brings AI vector search to your business data accelerating the development of AI-enabled applications



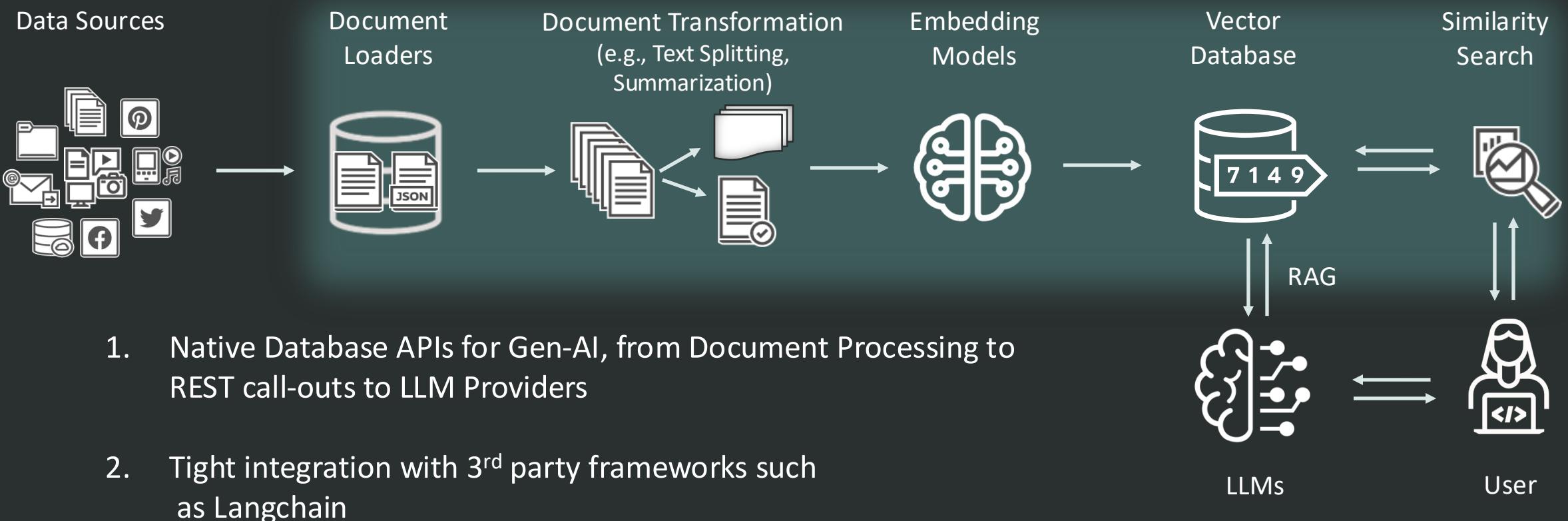
NEW Vector data type for storing vectors

NEW SQL syntax and functions express similarity search with ease

NEW vector indexes for high-performance

AI Vector Search powers Complete Gen AI pipeline

AI Vector Search powers Complete Gen AI pipeline



To learn more and try Oracle AI Vector Search yourself



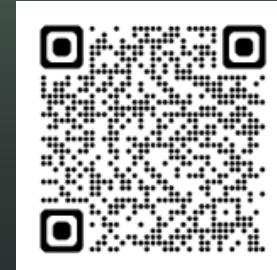
AI Vector Search
on Oracle.com



oracle.com/database/ai-vector-search/



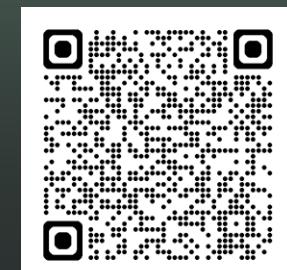
Oracle
Vector Search Blog



blogs.oracle.com/database/category/db-vector-search



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