

A person is visible from the chest up, wearing a yellow and black horizontally striped shirt. The background is a plain, light color.

ORACLE



Base de Datos Convergente: Machine Learning, Spatial and Graph Workshop



Guillermo Best

Cloud Platform Presales Manager

16, 17 y 18 de Junio de 2020 Zoom sessions

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Safe harbor statement

The following is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions.

The development, release, timing, and pricing of any features or functionality described for Oracle's products may change and remains at the sole discretion of Oracle Corporation.

Agenda

OVERVIEW



Agenda

OVERVIEW



Data Gravity

Data Volume is Exponentially Growing

Moving Data is Slow and Expensive

Leave Data In Place

The illustration features a large yellow rock on the left, a red scale-like gauge in the center, and a red weight labeled "Data". Below these elements is the equation $e=mc^2$, where "e" is represented by the rock, "m" by the weight, and "c²" by the gauge. This visual metaphor emphasizes that data has mass and gravity.

Avoid Storing Data in Different **Locations** or **Technologies**

It's Easier to **Move Apps to Data** rather than Moving Data to Apps

Process Data In Place



Single-Purpose **vs.** Multi-Purpose

Instead of

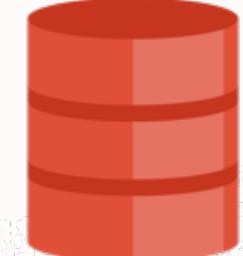
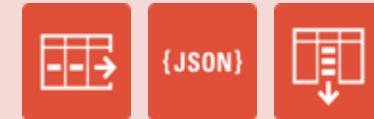
Phones,
Messaging,
Camera, Calendar,
Music, Navigator,
Notepad,
Calculator...



Smart Phone

Instead of

Relational, No-SQL,
JSON, XML,
Transactional,
Analytics, In-Memory,
IoT, ML, Blockchain,
Spatial, Sharding...



Converged Database

Oracle Converged Database Multi-Model and Multi-Workload

Converged Database

Multi-Model

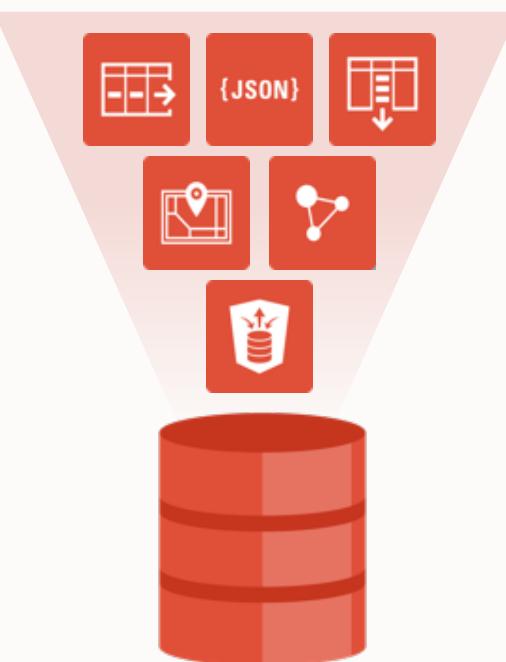
Multi-Workload

**Multiple Data Types
(models and semantics)**

Relational, Document, JSON, XML,
OLAP, Spatial, Graph, Object-
Oriented, Text, etc.

**Multiple Application Types
(workloads and technologies)**

Operational, Analytics, **Translytics**,
Transactional, IoT, ML, In-Memory,
Block-Chain, **HTAP**, etc.



Oracle runs one **Converged Multi-Purpose Database** supporting multiple data types and workloads
Amazon runs many **Specialized Single-Purpose Databases** for each data type and workload

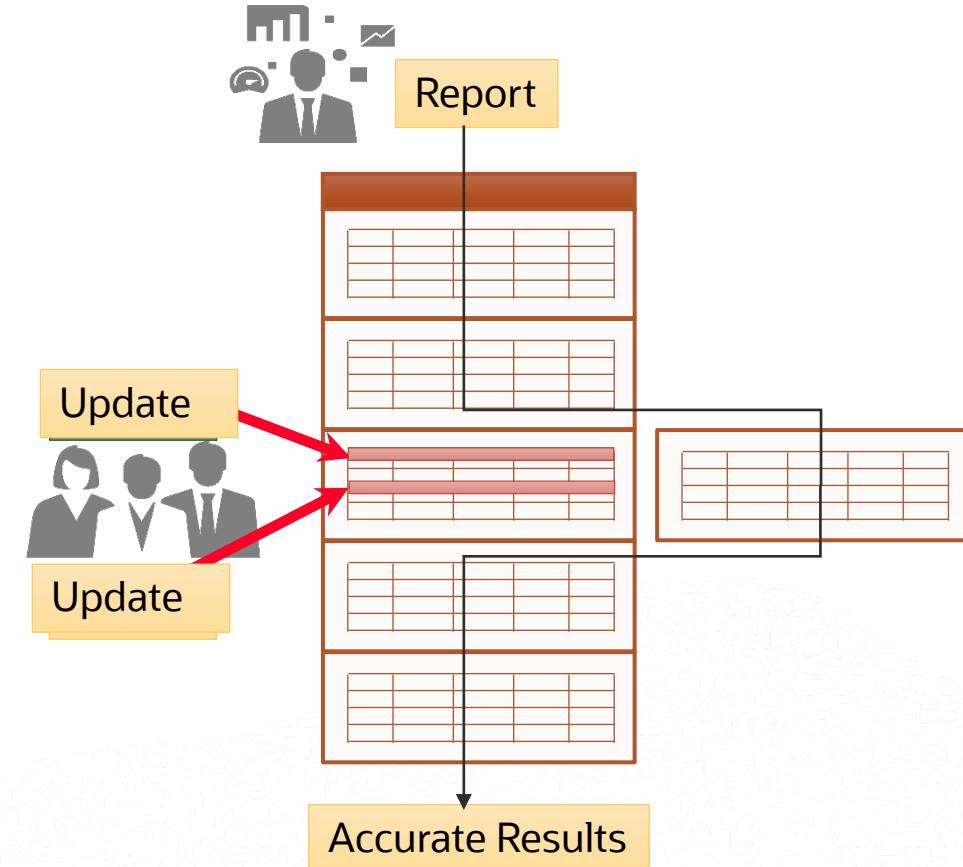
Oracle Database Multi-Version Consistency for OLTP and Analytics

Unique architecture built for concurrency

Maximum throughput with correct results

No lock escalation

- Readers don't block writers
- Writers don't block readers
- See only committed data via Multi-Versioning
- No waiting and no dirty reads!
- Scalable row level lock management

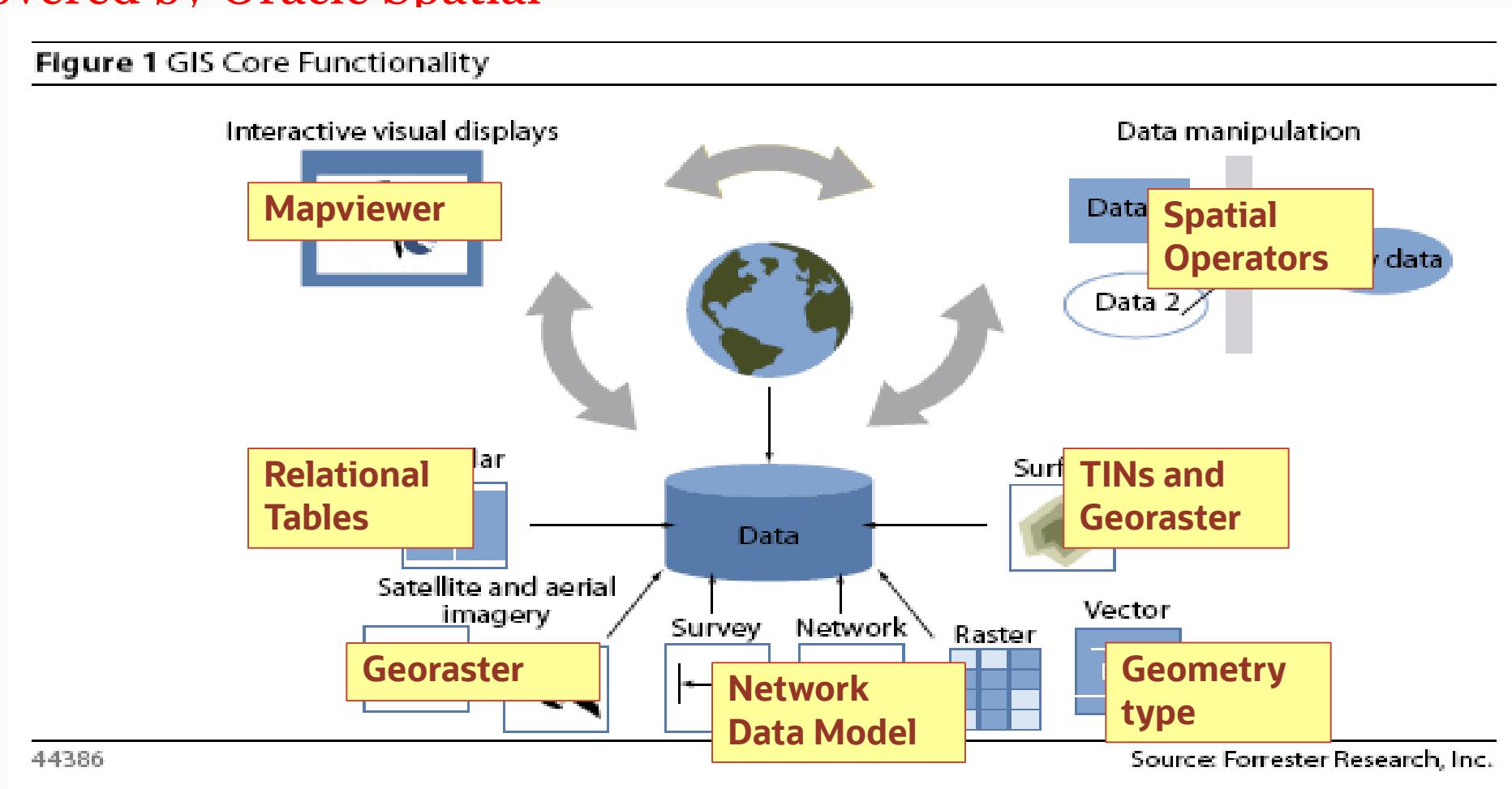


Multi-Workload

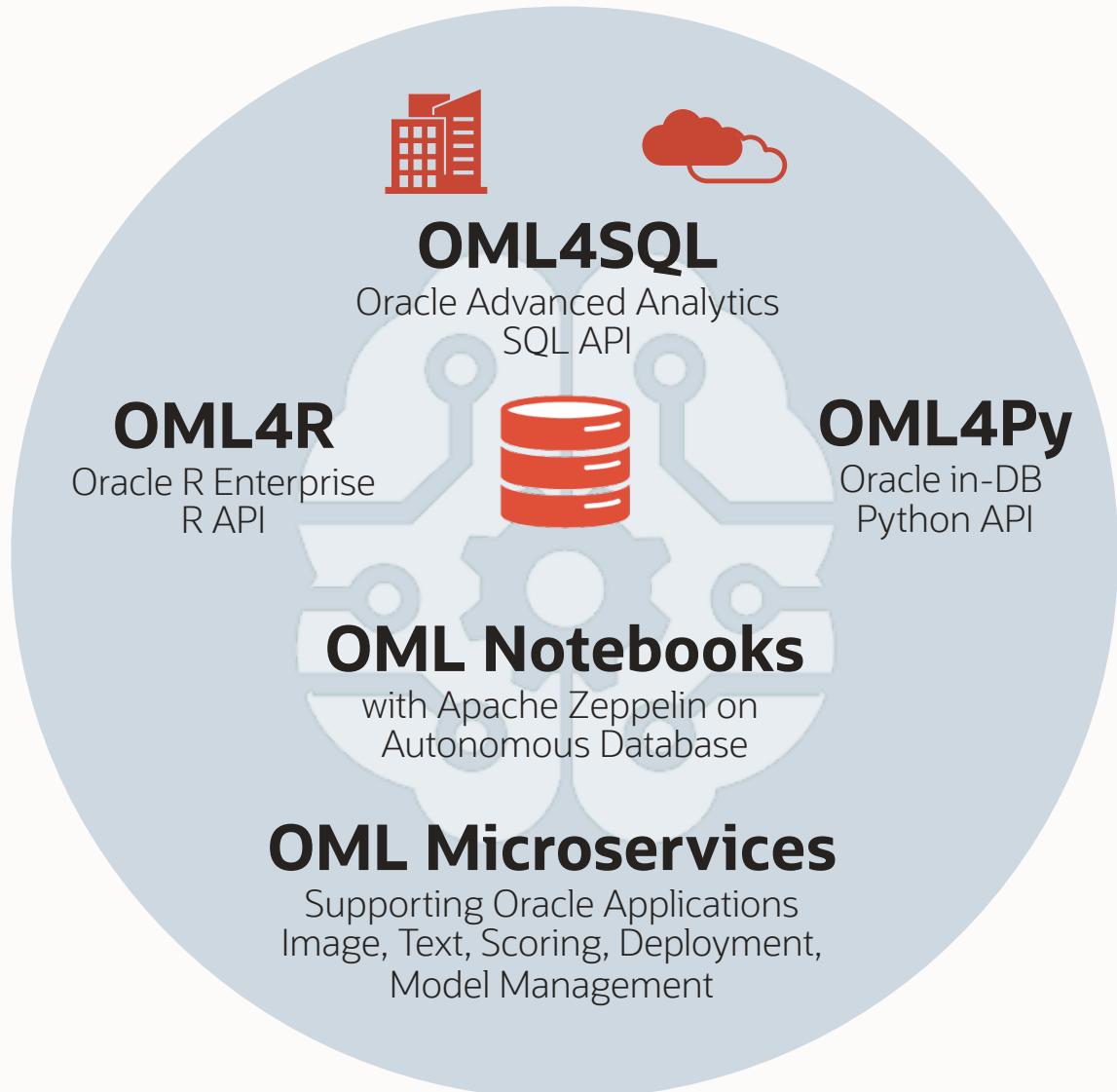
GIS Core Functionality

All Covered by Oracle Spatial

Figure 1 GIS Core Functionality



Oracle Machine Learning



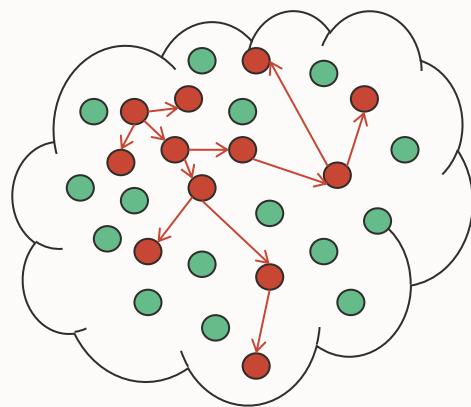
- In-DB Parallel ML Framework
- Python, R or PLSQL
- Cloud Notebook Interface
- Model Lifecycle Management
- Auto-ML and Model Explanation
- Leverage DB Security
- REST and SQL APIs for Scoring

Multi-Workload



Oracle Machine Learning and Graph Analytics

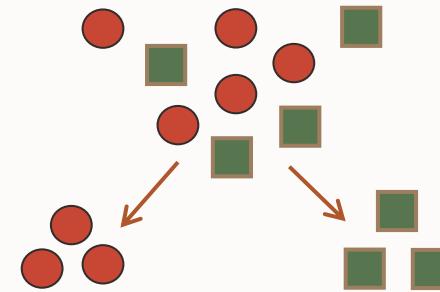
Graph Analytics



Compute graph metric(s)

Explore graph or compute new metrics using ML result

Machine Learning



Add to structured data

Add to graph

Build predictive model using graph metric

Use models to score or classify data

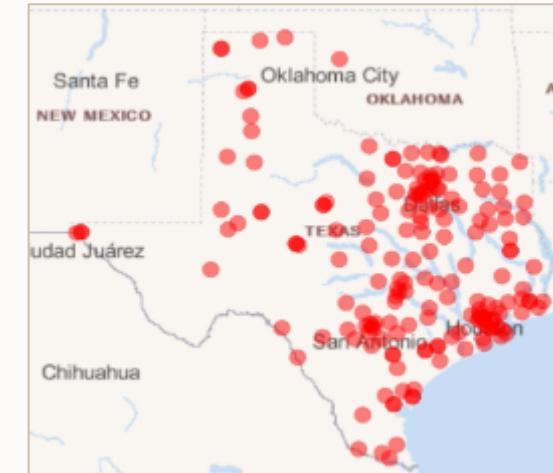


Agenda



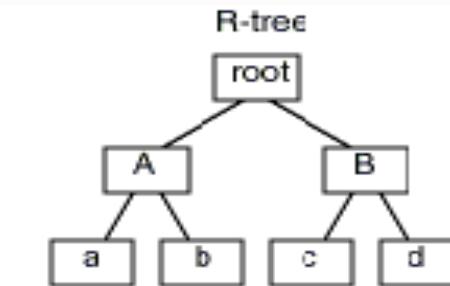
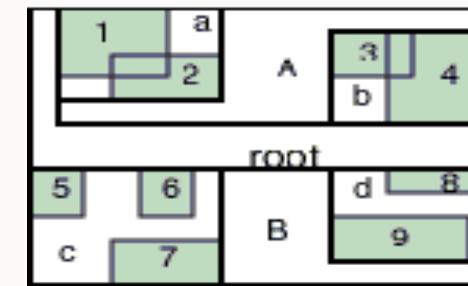
Oracle Spatial– Key Spatial Features

- In-database support for different kinds of geospatial data
- Vector Data (Points, Lines, Linestrings, Areas)
- Geo-referenced Raster Imagery (Orthophotos, Satellite Images, ...)
- 3D Point Cloud Data (Laser scanning, Photogrammetry)
- Network Data (Road Networks, Utility Networks)
- Topology Data (Land management)
- Streaming Point Data (Location tracking)
- Deployable Services
- Map visualization
- Geocoding
- Routing
- Publishing (OGC Web Services)



Database Capabilities for Geospatial Analysis

- Data type to store points, lines, areas, solids, ...
 - In two or three dimensions
 - Taking into account coordinate system
- Topological operators
 - Point-in-polygon, intersecting linestrings, overlapping areas, ...
- Geometric functions
 - Calculating areas, distances, buffer zones, ...
- Spatial indices
 - Fast access to relevant data



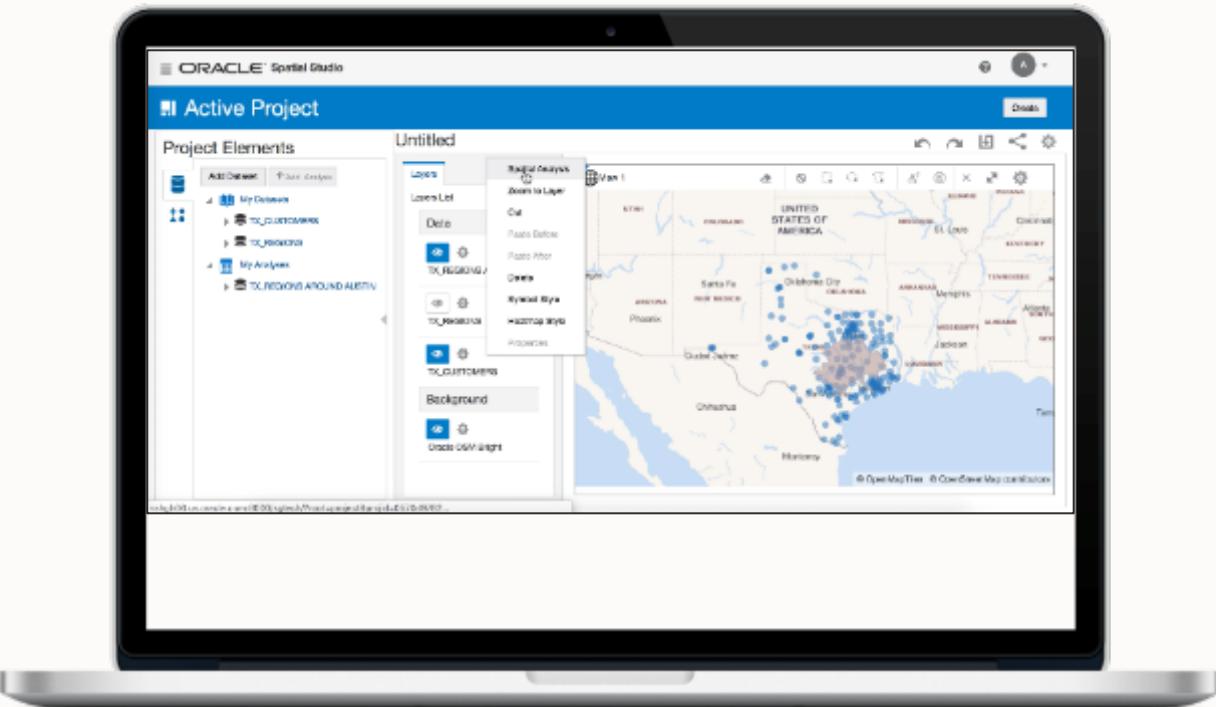
```
SELECT a.owner_name, a.acquisition_status  
FROM properties a, projects b  
WHERE sdo_within_distance (a.property_geom1,  
b.project_geom,  
    'distance = 25 unit = meter') = 'TRUE'  
and b.project_id=189498;
```

Benefits of Managing Spatial Data in Oracle DB

- **Multi-model database, integrating all kinds of data**
 - Relational data, XML or JSON documents, spatial data, images, ...
- **Comprehensive server-side ETL and analytics capabilities**
 - Data integration, geospatial analysis, machine learning, graph analysis, ...
- **Secure datastore**
 - Multi-level access control, encryption, redaction, auditing, ...
- **Highly available, scalable infrastructure**
 - Clustering, parallelization, Maximum Availability Architecture (MAA), ...
- **Core component of data management platform for analytics**
 - Tools integration, standards support, open interfaces, Big Data connectivity, ...

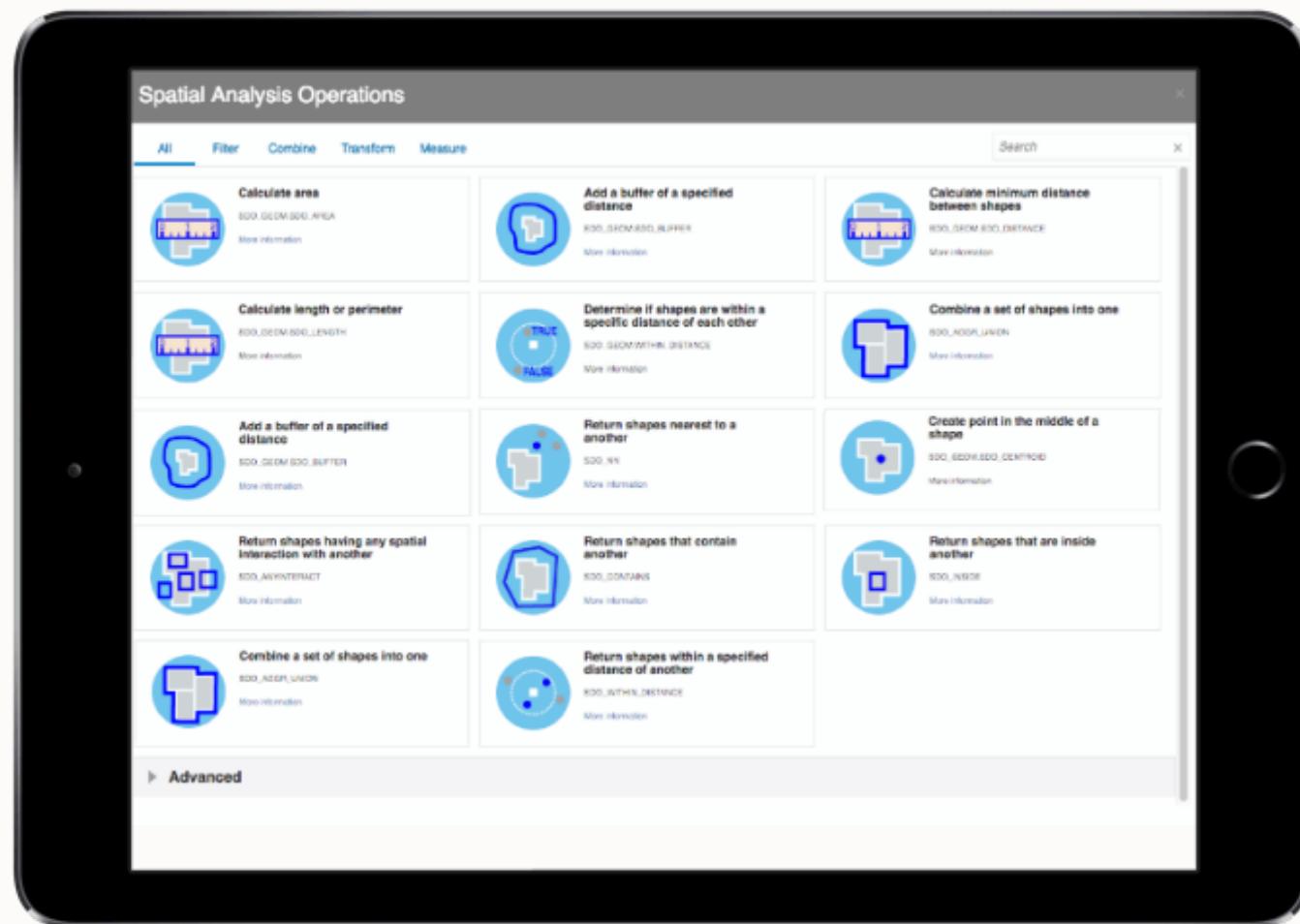
Typical Data Analysis Workflow

- Data ingestion
 - Spatial and non-spatial data
- Data enrichment
 - Address geocoding
 - Converting placenames
- Geospatial processing
 - Creating analytical workflows
- Interactive analysis
 - Map visualization
- Publication of results



Spatial Studio – Self-service spatial analytics

Spatial Studio – Simple Geospatial Analysis



Major New Spatial Features

Ease of Use

- Spatial Studio - Self-service development tool
- Improved JSON and Oracle REST Data Services
- Enhanced Location Tracking Server
- Map Visualization
- Improved web services support (CSW, WFS)
- Georaster enhancements

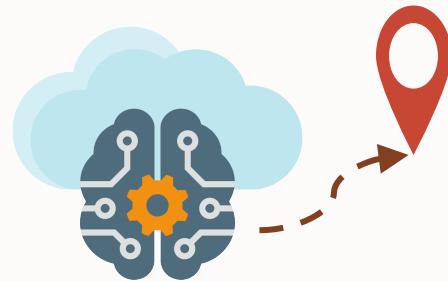
Performance

- Spatial index performance improvements
 - 3x faster queries for large point data sets
- Map visualization dynamic tile layer
 - Save storage overhead on large, complex queries

Improved Database Integration

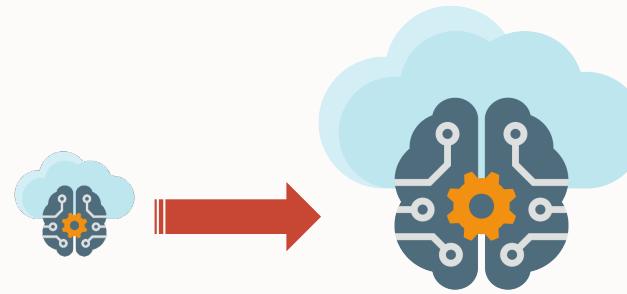
- Spatial support for all partitioning methods
- Spatial support for distributed transactions
- Spatial support for database sharding
- Improved support for queries on external tables

Oracle Machine Learning Key Attributes



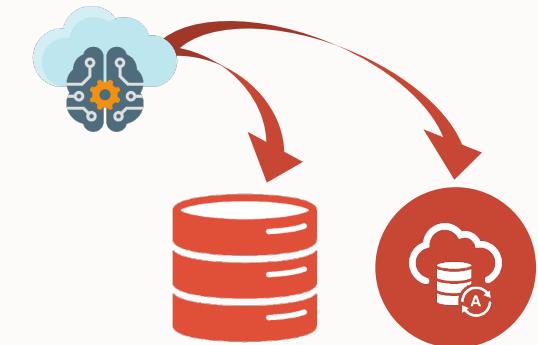
Automated

Get better results faster
with less effort –
even non-expert users



Scalable

Handle big data volumes using
parallel, distributed algorithms –
no data movement



Production-ready

Deploy and update data
science solutions faster with
integrated ML platform

Increase productivity | Achieve enterprise goals | Innovate More

Oracle Machine Learning Algorithms and Analytics

• CLASSIFICATION

- Naïve Bayes
- Logistic Regression (GLM)
- Decision Tree
- Random Forest
- Neural Network
- Support Vector Machine (SVM)
- Explicit Semantic Analysis

• CLUSTERING

- Hierarchical K-Means
- Hierarchical O-Cluster
- Expectation Maximization (EM)

• ANOMALY DETECTION

- One-Class SVM

• TIME SERIES

- Forecasting - Exponential Smoothing
- Includes popular models
e.g. Holt-Winters with trends, seasonality, irregularity, missing data

REGRESSION

- Linear Model
- Generalized Linear Model (GLM)
- Support Vector Machine (SVM)
- Stepwise Linear regression
- Neural Network
- LASSO

ATTRIBUTE IMPORTANCE

- Minimum Description Length
- Principal Component Analysis (PCA)
- Unsupervised Pair-wise KL Div
- CUR decomposition for row & AI

ASSOCIATION RULES

- A priori/ market basket

PREDICTIVE QUERIES

- Predict, cluster, detect, features

SQL ANALYTICS

- SQL Windows
- SQL Patterns
- SQL Aggregates

• FEATURE EXTRACTION

- Principal Comp Analysis (PCA)
- Non-negative Matrix Factorization
- Singular Value Decomposition (SVD)
- Explicit Semantic Analysis (ESA)

• TEXT MINING SUPPORT

- Algorithms support text columns
- Tokenization and theme extraction
- Explicit Semantic Analysis (ESA) for document similarity

• STATISTICAL FUNCTIONS

- Basic statistics: min, max, median, stdev, t-test, F-test, Pearson's, Chi-Sq, ANOVA, etc.

R AND PYTHON PACKAGES

- Third-party R and Python Packages through Embedded Execution
- Spark MLlib algorithm integration

Internal Supported Algorithms Product Matrix

Oracle Machine Learning Notebooks



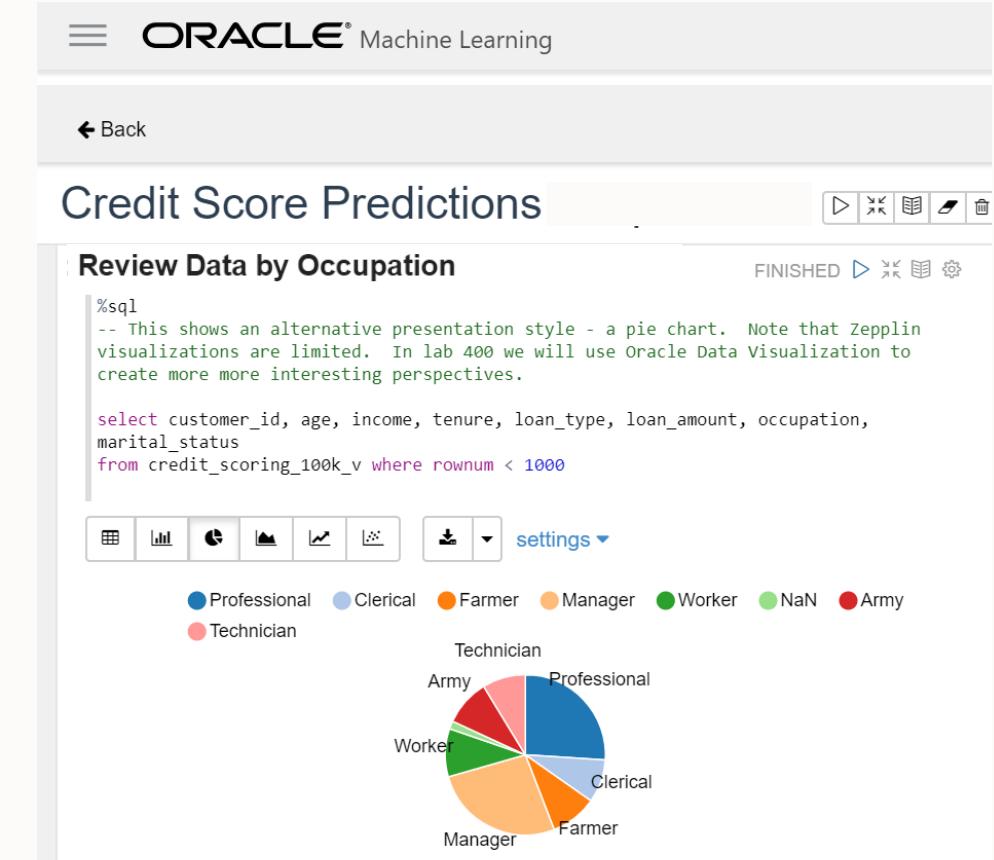
Autonomous Database as a Data Science Platform

- **Collaborative UI**

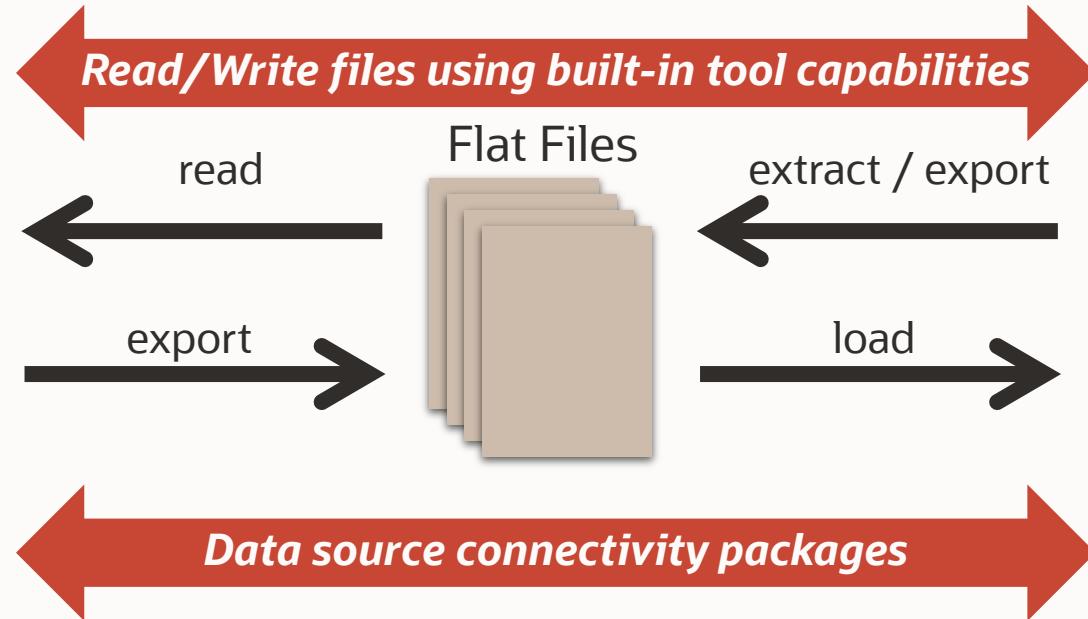
- Based on Apache Zeppelin
- Supports data scientists, data analysts, application developers, DBAs
- Easy sharing of notebooks and templates
- Edits made in one notebook immediately appear in other open shared notebooks
- Permissions, versioning, and execution scheduling

- **Included with Autonomous Database**

- Automatically provisioned, managed, backed up
- In-database SQL algorithms and analytics functions
- Explore and prepare, build and evaluate models, score data, deploy solutions
- Soon to be augmented with Python and R



Traditional Analytics and Data Source Interaction

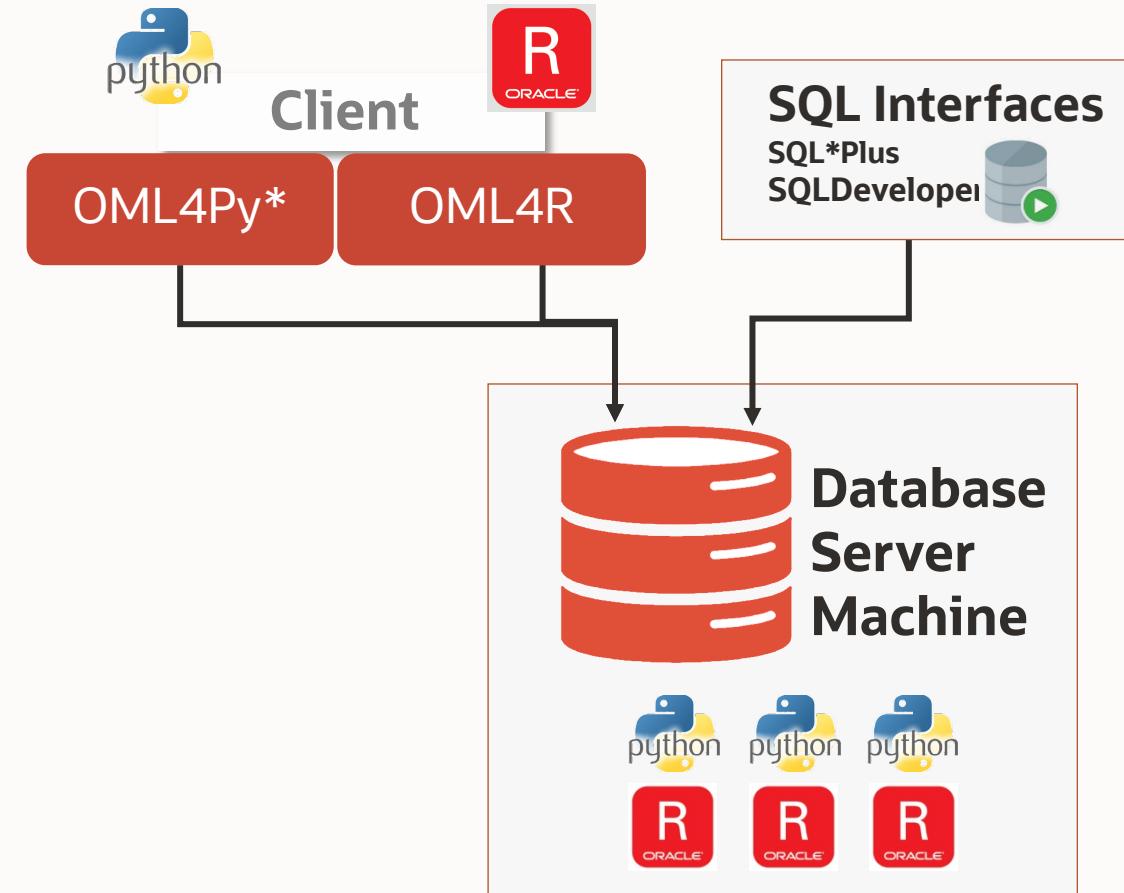


Deployment
Ad hoc
cron job

- **Access latency**
- **Paradigm shift: R/Python → *Data Access Language* → R/Python**
- **Memory limitation – data size, in-memory processing**
- **Single threaded**
- **Issues for backup, recovery, security**
- **Ad hoc production deployment**

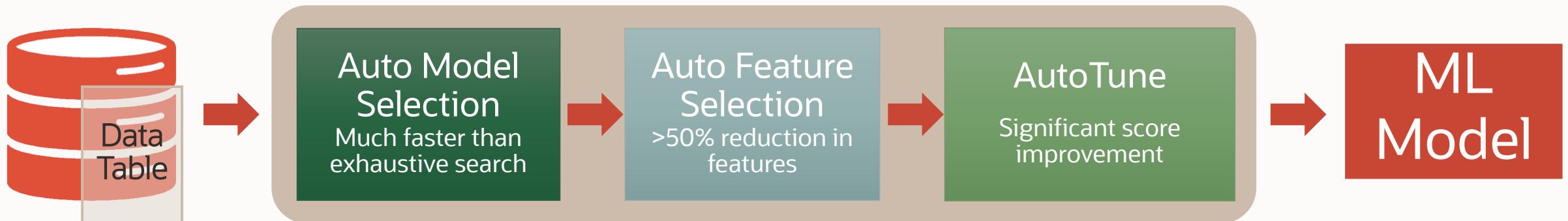
Oracle Machine Learning for R and Python

- **Transparency layer**
 - Leverage proxy objects so data remain in database
 - Overload native functions translating functionality to SQL
 - Use familiar R / Python syntax on database data
- **Parallel, distributed algorithms**
 - Scalability and performance
 - Exposes in-database algorithms available from OML4SQL
- **Embedded execution**
 - Manage and invoke R or Python scripts in Oracle Database
 - Data-parallel, task-parallel, and non-parallel execution
 - Use open source packages to augment functionality
- **OML4Py AutoML**
 - Model selection, feature selection, hyper-parameter tuning
 - Supports Classification and Regression



AutoML – *new* with OML4Py

Increase data scientist productivity – reduce overall compute time



Auto Model Selection

- Identify in-database algorithm that achieves highest model quality
- Find best model faster than with exhaustive search

• Auto Feature Selection

- Reduce # of features by identifying most predictive
- Improve performance and accuracy

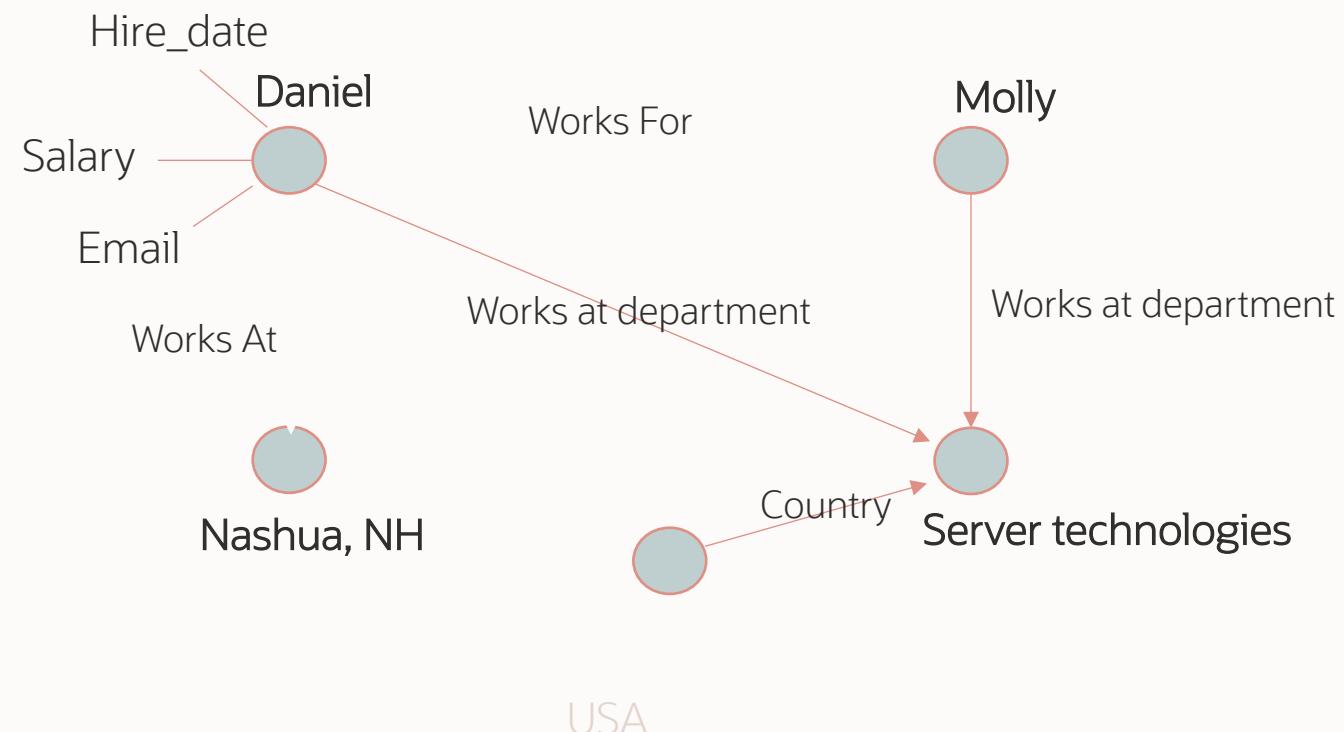
Auto Tune Hyperparameters

- Significantly improve model accuracy
- Avoid manual or exhaustive search techniques

Enables non-expert users to leverage Machine Learning

Graph Analytics

- Analytics based on **connections** and **relationships** between data entities



Property Graph Product Overview

Store, manage, query and analyze graphs

- **Enterprise capabilities:** Built on Oracle Infrastructure
- Manageability, fine-grained security, high availability, integration and more

High scalable

- In-memory query and analytics and in-database query
- 10s of billions of edges and vertices

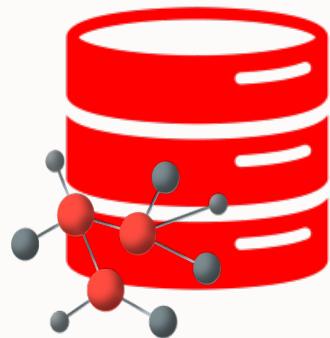
PGQL: Powerful SQL-like graph query language

Analytics Java API: 50+ pre-built graph analytics algorithms

Visualization:

- Light-weight web application: UI accessible from a browser

Oracle Database as a Graph Store

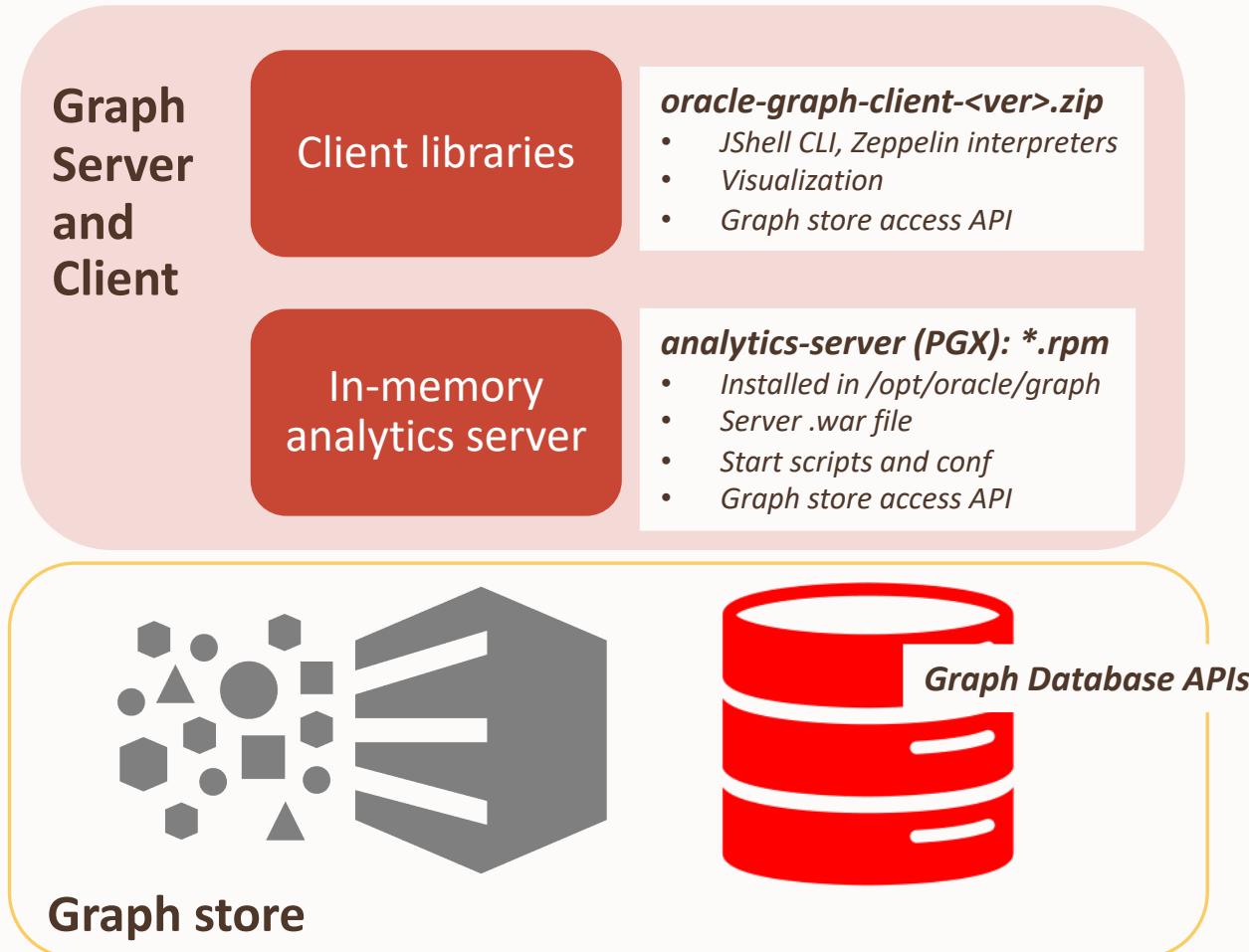


Database stores and manages Graph Nodes, Edges and Properties

Database provides graph traversal and query language and API's

- Java API to develop applications
- Command-line submission of graph queries
- Graph visualization tool
- APIs to update graph store
- PGQL language for Property Graph
- SPARQL language for RDF Triple Store

Now: Graph Server, Client and Storage



- **Graph Server and Client kit**
 - Separate download from e-delivery and oracle.com
(not shipped with \$ORACLE_HOME)
 - 20.1 (first kit) released **Jan 2020**
- Graph Server and Client works with **both Database and Big Data**

PGQL Graph Query Language

Graph pattern matching

(person)-[:works_for]->(person)

Basic patterns and reachability patterns

Can we reach from A to B with an arbitrary number of hops?

Familiarity of SQL users

- Similar language construct and syntax

SELECT ... WHERE ...

GROUP BY ... ORDER BY ...

- ‘Result set’ (table) as output

PGQL Graph Query

```
1 SELECT n, n0, n1, e0, e1, e2, n.pageRank, n0.pageRank, n1.pageRank  
2 MATCH (n)-[e0]-(n0)-[e1]-(n1), (n)-[e2]-(n1)  
3 WHERE ID(n0) = 'IRON MAN/TONY STARK'  
4 ORDER BY n.pageRank DESC, n0.pageRank DESC, n1.pageRank DESC LIMIT 30
```

Graph

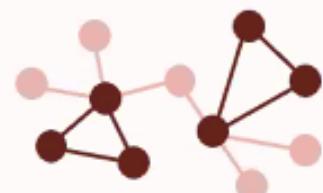
Graph Analytics: 50+ Pre-built Algorithms

Detecting Components and Communities



Strongly Connected Components,
Weakly Connected Components,
Label Propagation,
Conductance Minimization,

Evaluating Structures

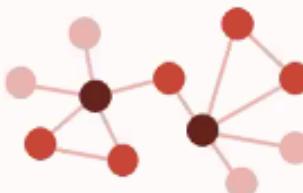


Adamic-Adar Index, Conductance,
Cycle Detection, Degree Distribution,
Eccentricity, K-Core, LCC, Modularity,
Reachability Topological Ordering,
Triangle Counting

Link Prediction

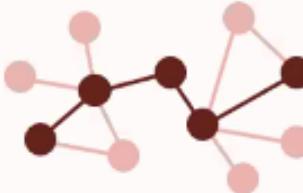
WTF (Who to follow)

Ranking and Walking



PageRank, Personalized PageRank,
Degree Centrality, Closeness Centrality,
Vertex Betweenness Centrality,
Eigenvector Centrality, HITS, SALSA,
Random Walk with Restart

Path-Finding



Shortest Path (Bellman-Ford, Dijkstra,
Bidirectional Dijkstra), Fattest Path,
Compute Distance Index,
Enumerate Simple Paths,
Fast Path Finding, Hop Distance

Others

Minimum Spanning-Tree,
Matrix Factorization

Interaction with the Property Graph

- Access through APIs
 - Implementation of Apache Tinkerpop Blueprints APIs
 - Based on Java, REST plus SolR Cloud/Lucene support for text search
- Scripting
 - Groovy, Python, JavaScript, ...
 - Apache Zeppelin integration, JavaScript (node.js) language binding
- Graphical UIs
 - Cytoscape, plug-in available
 - Commercial tools such as TomSawyer Perspectives



Agenda

Converged Database Workshop Series



Converged Database Workshop Series

Marketing Campaign on going

1. Oracle Converged Database: Multitenant, Multimodel, In-Memory

- For DBAs, Solutions Architects and Developers, including CTOs
- One day in Torre Picasso or
- Remote Zoom sessions (3 consecutive days, 2 hours each)



110 attendees

Scoring 4.8/5

Last: 21, 22, 23 April

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2. Oracle Converged Database: Multicloud ECX with Autonomous DB

- For Data Engineers and Cloud Solutions Architects
- One morning in Torre Picasso or
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36 attendees

Scoring 4.9/5

Last: 2, 3 y 4 Junio

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36 attendees

Scoring 4.9/5

Last: 2, 3 y 4 Junio

3. Oracle Converged Database: Spatial, Graph & ML with Python and R

- For Data Engineers, Data Scientists, Business Analysts and Solutions Architects
- One day in Torre Picasso or
- Remote Zoom sessions (3 consecutive days, 2 hours each)



Opening:

16, 17, 18 Junio

Agenda

Machine Learning, Spatial and Graph



Oracle Converged Database: Multicloud ECX with Autonomous DB Hands On Labs

HOL0 – TBD (Spatial Web Services) – Not included

HOL1 – Spatial and Spatial Studio

HOL2 – Machine Learning with Phyton and R

HOL3 - Graph



Hand-on Labs Breakout Rooms



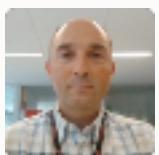
Andrés



Room 1



Guillermo



Francisco



Room 2



Serena



Manel



Room 3



Pablo



Room 4



Daniel



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Inspiration & Innovation



Our mission is to help people
see data in new ways, discover
insights, unlock endless possibilities.



Thank you!

Oracle Spain

