Big Data SQL and Query Franchising
An Architecture for Query Beyond Hadoop

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Agenda

1. Fixing the fashion problem
2. Why Unified Query Matters
3. Query Franchising: an architecture for unified query
4. Customer 360 Live!
“Oracle has a fashion problem”

Every industry analyst I’ve ever talked with.
We thought everything went with black.
Risk Removal, Not Empire Building

• Make the Big Data ecosystem easy to consume
  – Simplified operations
  – Databricks’ certified Spark environment
  – Cloudera’s Enterprise Data Hub

• Encourage and support the use of new technologies
  – We build on Hadoop!
  – You should build on Hadoop!

• De-risk new innovations with bridges to the business
@ Oracle Global Support Services

- Cloudera’s Distribution captures HW failures
- Integrate with customer telemetry, configurations, service history, diagnostics
- Predict failures, save money, and serve customer better

Anticipate  Detect  Predict  Automate  Delight
Oracle Big Data Discovery: Built on Spark

Find
Explore
Discover
Transform

Sales Analysis: Customer Churn

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Oracle Data Enrichment Cloud Service: Uses

Scalable Machine Learning Pipeline
Natural Language Processing
Knowledge Graph-driven Repair and Blending

Interactive Recommendations and Visual Profiling to Transform Noisy Signal Into Refined Information Sets for Analytics
Data Analytics Challenge (2012)

Separate data access interfaces
Tables on NoSQL

SQL on Hadoop
Data Analytics Challenge: 2013

No comprehensive SQL interface across Oracle, Hadoop and NoSQL
Oracle Big Data Management System

Unified SQL access to all enterprise data
What Does Unified Query Mean for You?

Before

PhD

{MapReduce}

sql

{MapReduce}

???

Data Science

Anyone

After

SQL

???
What Does Unified Query Mean for You?

Before  Application Development  After

SQL

{MapReduce}

ORACLE

SQL

ORACLE
How Does Unified Query Work?

• Unify Metadata
  – Catalog data sources
  – Translate queries into plans

• Distribute Execution
  – Distribute the plan
  – Do work
  – Return answer
Unifying Metadata
Why Unify Metadata?

CREATE TABLE customers...

SELECT name FROM customers

CREATE TABLE sales...

SELECT customers.name, sales.amount

Query across sources → Integrate new metadata
Metadata: InputFormats and SerDes

- Scan and row creation needs to be able to work on “any” data format
- Data definitions and column deserializations are needed to provide a table

RecordReader => Scans data (keys and values)
InputFormat => Defines parallelism
SerDe => Makes columns
Metastore => Maps DDL to Java access classes
SQL-on-Hadoop Engines Share Metadata, not MapReduce

Hive Metastore

Table Definitions:
- movieapp_log_json
- Tweets
- avro_log

Metastore maps DDL to Java access classes
CREATE TABLE movielog (  
click VARCHAR2(4000))  
ORGANIZATION EXTERNAL (  
  TYPE ORACLE_HIVE  
  DEFAULT DIRECTORY DEFAULT_DIR  
  ACCESS PARAMETERS  
  (  
    com.oracle.bigdata.tablename logs  
    com.oracle.bigdata.cluster mycluster  
  ))  
REJECT LIMIT UNLIMITED;

- New types of external tables
  - ORACLE_HIVE (inherit metadata)
  - ORACLE_HDFS (specify metadata)

- Access parameters for Big Data
  - Hadoop cluster
  - Remote Hive database/table
  - DBMS_HADOOP Package for automatic import
Enhance Oracle External Tables

CREATE TABLE ORDER (  
cust_num VARCHAR2(10),  
order_num VARCHAR2(20),  
order_total NUMBER(8,2))  
ORGANIZATION EXTERNAL (  
  TYPE ORACLE_HIVE  
  DEFAULT DIRECTORY DEFAULT_DIR  
)  
PARALLEL 20  
REJECT LIMIT UNLIMITED;

• Transparent schema-for-read
  – Use fast C-based readers when possible
  – Use native Hadoop classes otherwise

• Engineered to understand parallelism
  – Map external units of parallelism to Oracle

• Architected for extensibility
  – StorageHandler capability enables future support for other data sources
  – Examples: MongoDB, HBase, Oracle NoSQL DB
That just makes a good client.
Distribute Execution
But how?
Language-level Federation Fails

Been there, done that.

Hadoop Part

```
with sites as
(
    select s.custid as cust_id, 
    listagg(s.site, ',')
    within group (order by 
    s.custid) site_list
    from shortcodes s
    group by custid
),
select c.first_name,
c.last_name, c.AGE,
c.state_province, s.site_list
from customers c, sites s;
```

Database Part
Language-level Federation Fails

Been there, done that.

```
select s.custid as cust_id,
    listagg(s.site, ',')
  within group (order by
    s.custid) site_list
from shortcodes s
  group by custid
```

- Operators exist in both places?
- Is their behavior consistent?
- How do you negotiate resources?
We have to do better
Query Franchising – *dispatch of query processing to self-similar compute agents on disparate systems without loss of operational fidelity*
What does *that* mean?
Query Franchising: Uniform Behavior, Disparate Location

1. Top-level plan created
   - Holistic plan for all work
   - Distribute to franchises based by location

2. Franchisees carry out local work
   - Franchises secure and utilize resources
   - All franchises speak the internal language

3. Global operations optimized
   - Adapts to local variation
   - Nothing “lost in translation”
What Can Big Data Learn from Exadata?

Query Federation for Oracle Database

```
SELECT name, SUM(purchase) 
FROM customers 
GROUP BY name;
```

1. Oracle SQL query issued
   - Plan constructed
   - Query executed

2. Smart Scan Works on Storage
   - Filter out unneeded rows
   - Project only queried columns
   - Score data models
   - Bloom filters to speed up joins
Big Data SQL Server: A New Hadoop Processing Engine

Processing Layer
- MapReduce and Hive
- Spark
- Impala
- Search

Resource Management (YARN, cgroups)

Storage Layer
- Filesystem (HDFS)
- NoSQL Databases (Oracle NoSQL DB, Hbase)
Smart Scan for Hadoop: Optimizing Performance

“Oracle on top”
- Apply filter predicates
- Project columns
- Parse semi-structured data

“Hadoop on the bottom”
- Work close to the data
- Schema-on-read with Hadoop classes
- Transformation into Oracle data stream
Big Data SQL Query Execution

How do we query Hadoop?

1. Query compilation determines:
   - Data locations
   - Data structure
   - Parallelism

2. Fast reads using Big Data SQL Server
   - Schema-for-read using Hadoop classes
   - Smart Scan selects only relevant data

3. Process filtered result
   - Move relevant data to database
   - Join with database tables
   - Apply database security policies
Big Data SQL Dataflow

1. Read data from HDFS Data Node
   - Direct-path reads
   - C-based readers when possible
   - Use native Hadoop classes otherwise

2. Translate bytes to Oracle

3. Apply Smart Scan to Oracle bytes
   - Apply filters
   - Project Columns
   - Parse JSON/XML
   - Score models
But How Does Security Work?

1. Database security for query access
   - Virtual Private Databases
   - Redaction
   - Audit Vault and Database Firewall

2. Hadoop security for Hadoop jobs
   - Kerberos Authentication
   - Apache Sentry (RBAC)
   - Audit Vault

3. System-specific encryption
   - Database tablespace encryption
   - BDA On-disk Encryption

```
DBMS_REDACT.ADD_POLICY(
    object_schema => 'MCLICK',
    object_name => 'TWEET_V',
    column_name => 'USERNAME',
    policy_name => 'tweet_redaction',
    function_type => DBMS_REDACT.PARTIAL,
    function_parameters => 'VVVVVVVVVVVVVVVVVVVVVVVVV,*,3,25',
    expression => '1=1'
);
```
Customer 360, **Live!**
Unified Query Means **Less** Lock-in

• Unified Query means
  – More innovation
  – Less risk

• Use the right tools for your job
  – Hadoop, NoSQL, and whatever’s next
  – We’ll query all of it

• Explore and adopt new technologies
  – Focus on creating value using your data
  – We’ll build bridges back to the business
Hardware and Software
Engineered to Work Together