ONEWAY

SOLUTION

One Way Solution

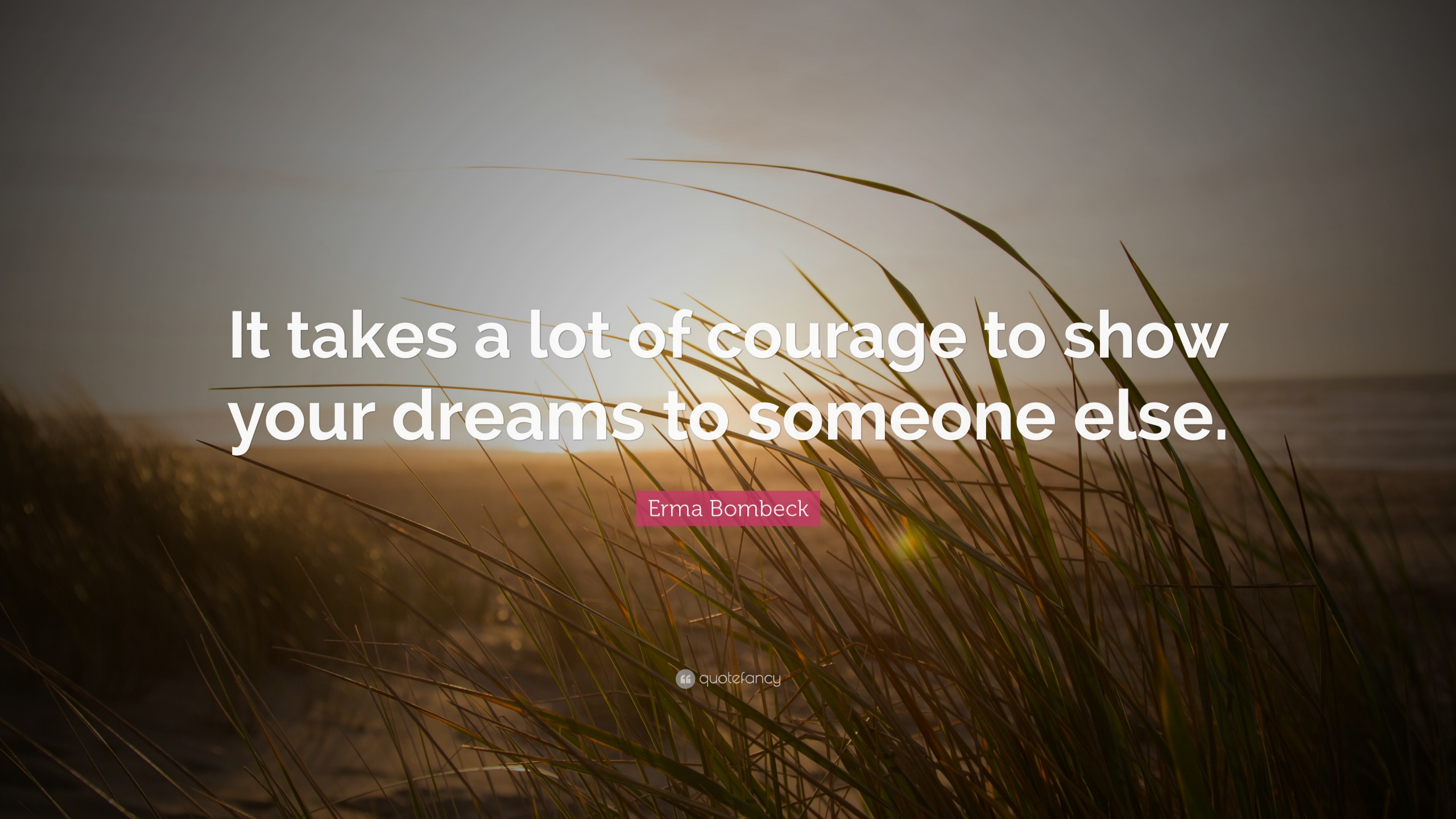
TDW, MDW & Lakehouse

Data Engineering – [Day 4]

LUAN MORENO

CEO & CDO

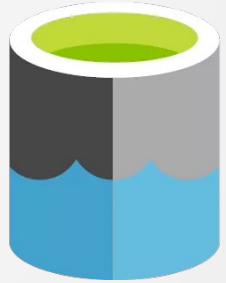
Data Engineer & Data Platform MVP


It takes a lot of courage to show your dreams to someone else.
Erma Bombeck
quotefancy

ETL vs. ELT

Extract/Transform/Load (ETL) is an integration approach that pulls information from remote sources, transforms it into defined formats and styles, then loads it into databases, data sources, or **Data Warehouses**.

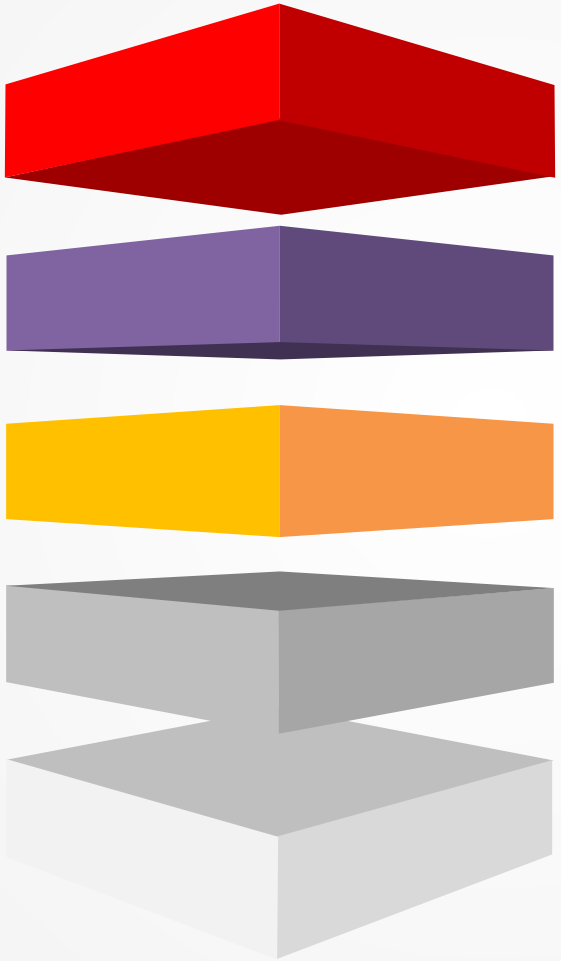
Extract/Load/Transform (ELT) similarly extracts data from one or multiple remote sources, but then loads it into the target **Data Lake** without any other formatting. The transformation of data, in an ELT process, happens within the target database. ELT asks less of remote sources, requiring only their raw and unprepared data.



Traditional Data Warehouse [Dw]

History

- 1980s from IBM Researchers
- Operational System for Decision Support
- Bill Inmon



EDW [Enterprise Data Warehouse]

- Used for Reporting & Data Analysis
- Component of Business Intelligence Solution
- Central Repository from Multiple Data Sources

Techniques

- ETL [Extract, Transform & Load]
- Apply Business Logic
- Use Stage Area [Stage]
- Use [ODS] to Keep Relational Structure

Dimensional Modeling

- Business Process
- Grain
- Dimensions
- Facts
- Star & Snowflake Schema

Data Storage & Retention

- Store Current & Historical Data
- GB to TB of Data in a Single Place

Design Methods

Bottom-Up = Data Mart [Ralph Kimball]
Top-Down = Data Warehouse [Bill Inmon]

Star Schema Model

Model

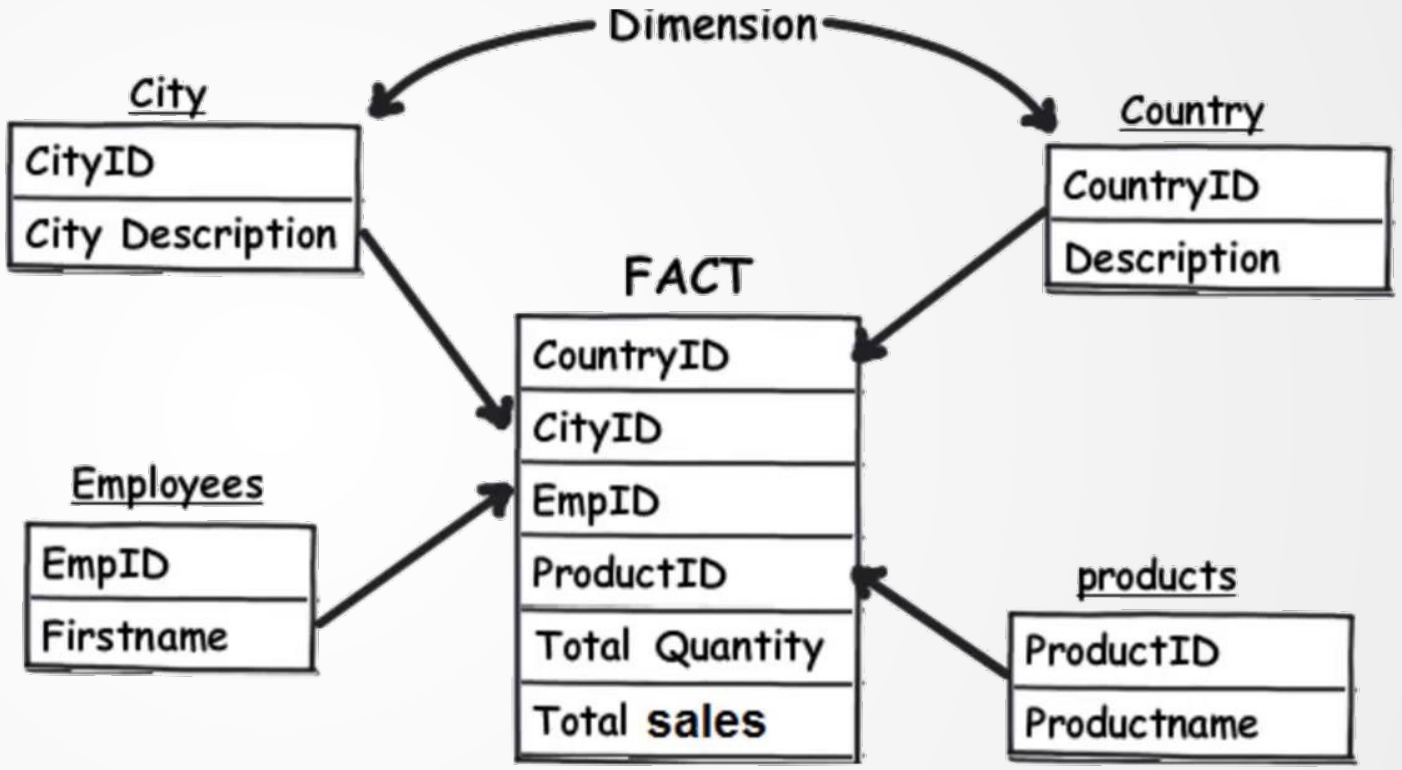
- Separates Business Process Data into **Facts**
- **Dimensions** with Descriptive Attributes
- Measurable & Quantitative Data

Benefits

- Simpler Queries
- Simplified Business Reporting Logic
- Query Performance Gains
- Fast Aggregations
- Feeding Cubes [OLAP]

Disadvantages

- Data Integrity [De-Normalized State]
- Batch Processing Load Fashion



Azure SQL DB

Cloud Database as a Service

Intelligent Relational Cloud DB

- Managed by Microsoft Azure
- Intelligent Features for Performance & Administration

Fully Managed

- General Purpose Database
- Global Scalability
- Near-Zero Administration
- Dynamic Scalability with Zero Downtime

Cloud-First Strategy

- Microsoft SQL Server Code Base
- New Features

Features

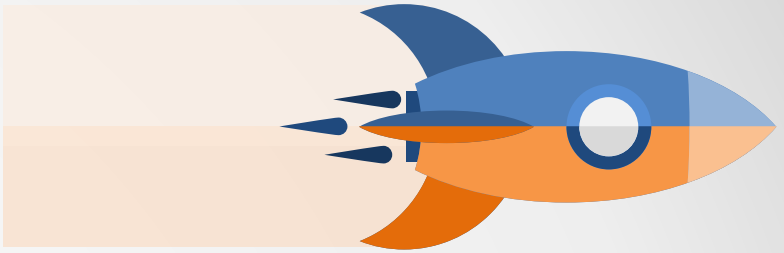
- Columnar Storage [**ColumnStore**]
- In-Memory Technologies
- Data Sync
- Multi-Model Capabilities
- Job Automation
- Transactional Replication
- Temporal Tables
- HyperScale [100 TB]

Azure SQL DB as a Traditional Data Warehouse [TDW]

Doubt kills more dreams than failure ever will.

Suzy Kassem

Data Warehouse [2.0] – Modern Data Warehouse [Dw]



A modern data warehouse lets you bring together all your data at any scale easily, and to get insights through analytical dashboards, operational reports, or advanced analytics for all your users

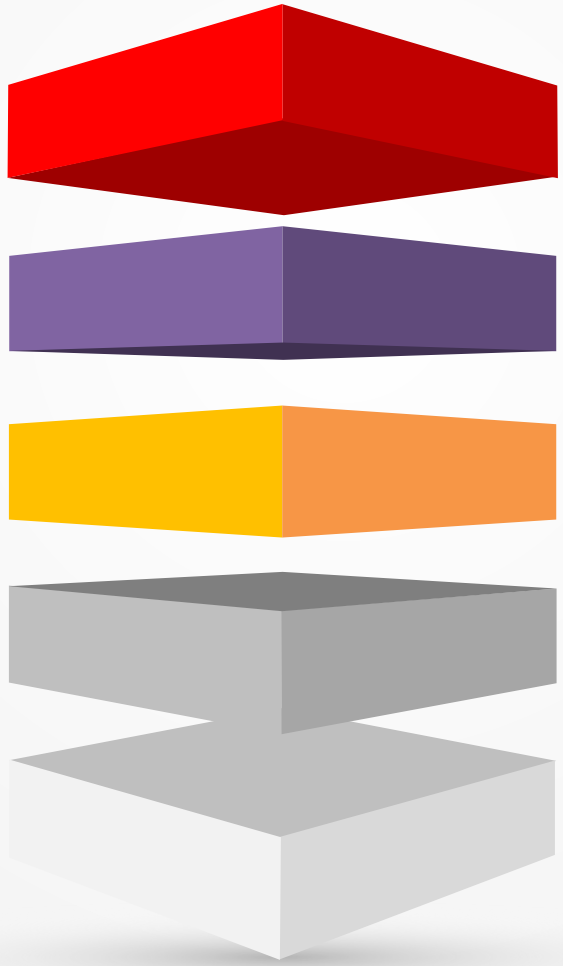
- Analytics Platform for Enterprises
- Scalability – Horizontally vs. Vertically
- PaaS & SaaS
- SQL-Like Interface [SQL]

Physical Hardware

- Massively Parallel Processing [MPP]
- "Loosely Coupled" & "Shared Nothing"

Columnar Data Storage Type

- Batch-Processing Mode
- Compression Benefits
- I/O Reduction Operations
- Index Bitmap



Cloud-Based Data Warehouses Systems

- Amazon Redshift
- Azure Synapse Analytics
- Google BigQuery
- Snowflake

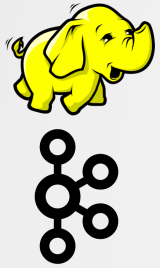
Elastic Compute & Storage

- [PaaS] – Platform-as-a-Services
- Distributed Computation Architecture
- Computation <> Storage

Caching

- Sub-Second Response Time
- Performance Boost

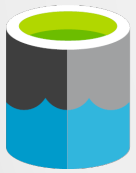
Use-Case for Microsoft Azure



HDInsight

Easy & Cost-Effective for Open-Source Analytics with Apache Hadoop 3.0

- Apache Hadoop
- Apache Kafka



Azure Data Lake Storage [Gen2]

Designed for Big Data Analytics
File System Semantics & File Level Security for Scalability & Low-Cost

Stream

Batch

Spark Pools for Synapse

Parallel Processing Framework In-Memory to Boost Performance of Big-Data Analytic Applications

Azure Synapse Analytics

Fast, Flexible, & Secure Cloud Data Warehouse for Enterprises
SQL & PolyBase Features with Fast Loading Operations

Use-Case for Google Cloud Platform [GCP]

Google Pub/Sub

Global Messaging & Event Ingestion
Scale without Provisioning, Partitioning, or Load Isolation
Expand Pipelines to New Regions Simply with Global Topics

Google Cloud Storage [GCS]

Unified Object Storage for Developers & Enterprises
Optimize Price & Performance with 4 Storage Classes

Stream

Batch

Cloud DataProc

Faster, Easier, Cost-Effective for Running Spark & Hadoop
Fast & Scalable Data Processing within 90 Seconds

Google BigQuery

ServerLess [SaaS], Highly-Scalable, & Cost-Effective Cloud Dw
In-Memory BI Engine & ML
Gartner 2019 – Magic Quadrant for Data Management Solutions

Use-Case for Amazon AWS

Amazon Kinesis

Easily Collect, Process & Analyze Streams in Real-Time

- Kinesis Data Streams
- Kinesis Data Firehose

Databricks

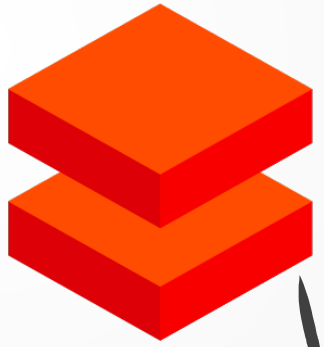
Fast, Easy, & Collaborative Apache-Spark Analytics Service
Simplify Big Data & AI with Unified Analytics Platform

Amazon Redshift

Fast, Simple, Cost-Effective Modern Data Warehouse
MPP | ML | Result Caching & S3 Query Access

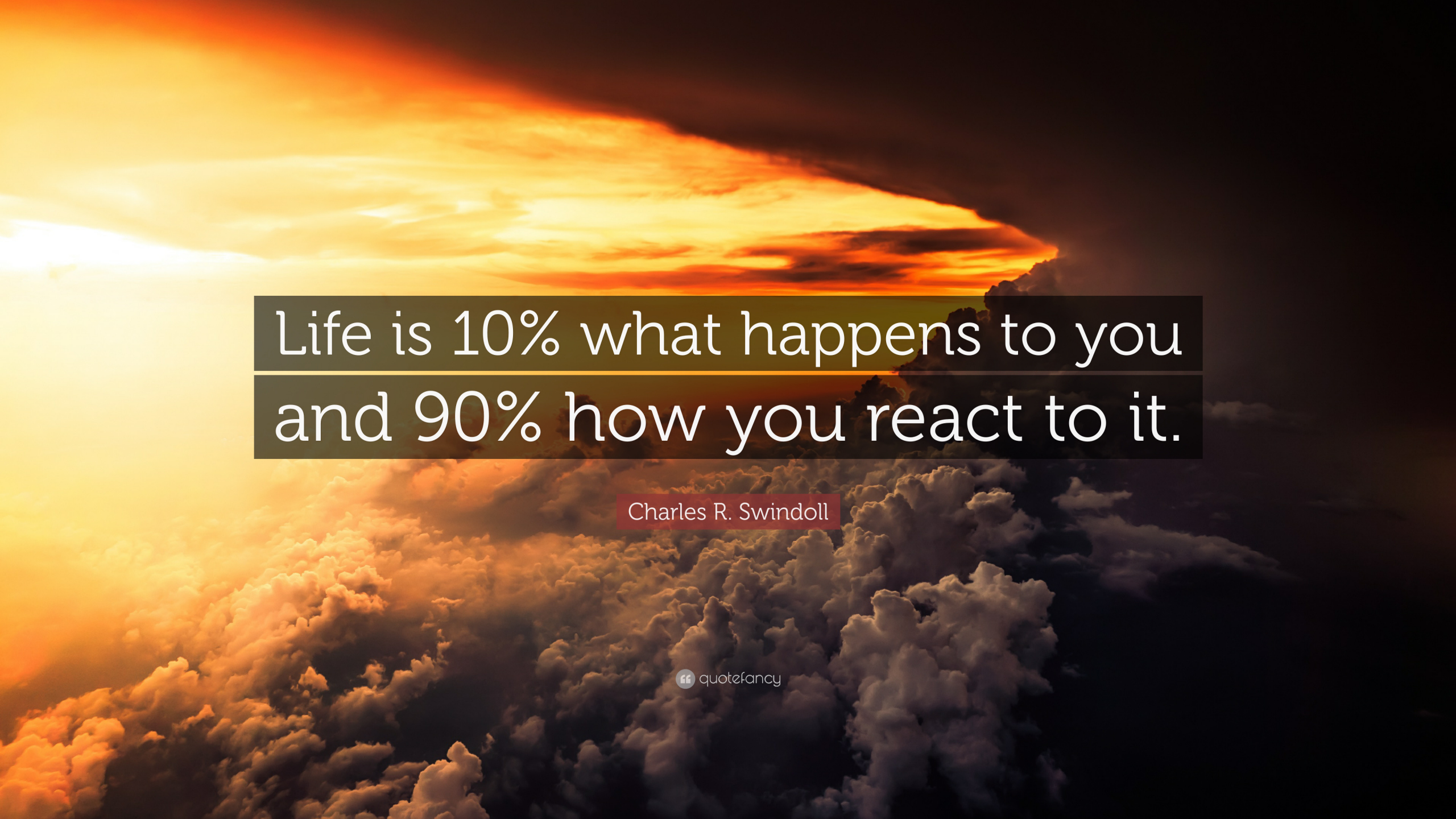
Stream

Batch



Amazon S3

Object Storage Built to Store & Retrieve any Amount of Data
Storage Classes
Netflix & AirBnB


Life is 10% what happens to you
and 90% how you react to it.
Charles R. Swindoll
quotefancy

Apache Hive [The Godfather]

Stinger Initiative

- 30/06/2014 by HortonWorks & Microsoft
- Human-Time [5-30 secs]

Open-Source Dw Offering

- Initially Developed by Facebook
- Used By Netflix

Optimizations

- ORC – Optimized Row Columnar
- LLAP [Live Long & Process]
- Sub-Second SQL Analytics with Intelligent Caching In-Memory

Analytics using SQL-Like

- SQL-Like Interface
- Processing Engine [MR | Tez | Spark]

3.0

- Materialized Views
- Constraints & Default Values
- Apache Druid & Apache Kafka Connectors
- ACID v2 for Streaming Ingestion
- LLAP & Apache Spark Connector

Characteristics

- Analysis of Large Datasets
- Schema On-Read
- Structured & Unstructured Data
- Storages - HDFS | ADLS | WASB | S3 | GCS

Use-Case: Apache Hive

Apache Kafka

Distributed Streaming Platform
Real-Time Data Pipelines & Streaming Apps
Horizontally Scalable, Fault-Tolerant & Wicked Fast

Apache Spark

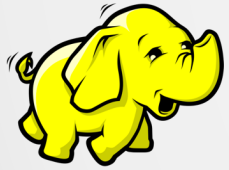
Unified Analytics Engine for Large-Scale Data Processing
Speed, Easy to Use, Generality & Runs Everywhere

Apache Hive

Data Warehouse [Dw] Open-Source with SQL-Like Interface
Hive LLAP – Sub-Second SQL Analytics with Intelligent Cache

Stream

Batch



HDFS

Hadoop Distributed File System
Run on Commodity Hardware
Designed for Large DataSets

Apache Hive [LLAP] as a Modern Data Warehouse [MDW]

Amazon Redshift

Cost-Effective

- Pay as you Go
- Predictable Cost
- Node Type

Amazon Redshift

- Most Popular Cloud Data Warehouse
- > 15K Customers using Amazon Redshift

Scalability

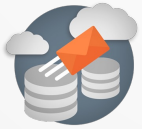
- Petabyte-Scale
- Exabyte-Scale Data Lake Analytics with **Spectrum**
- Limitless Concurrency

Faster Performance

- Massively Parallel Processing
- Machine Learning
- Result Caching

Integrations

- AWS S3 Data Lake
- AWS Glue
- Amazon Kinesis Firehose
- Amazon QuickSight
- Database Migration Service



Deploy & Manage

- Automated Provisioning
- Automated Backups
- Fault Tolerant
- Flexible Querying
- Third-Party Tools Integration

Use-Case: Amazon AWS

Amazon Kinesis

Easily Collect, Process & Analyze Streams in Real-Time

- Kinesis Data Streams
- Kinesis Data Firehose

Amazon S3

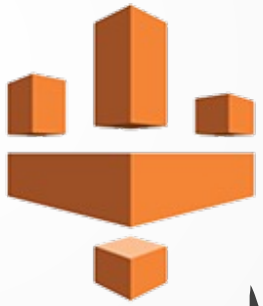
Object Storage Built to Store & Retrieve any Amount of Data
Storage Classes
Netflix & AirBnB

Stream

Batch

AWS Glue

Serverless Data Integration for Discover, Prepare and
Combine Data for Analytics, ML & Application Development



Amazon Redshift

Fast, Simple, Cost-Effective Modern Data Warehouse
MPP | ML | Result Caching & S3 Query Access

Azure Synapse Analytics

Powerful Insights

Expand discovery of insights from all your data and apply machine learning models to all your intelligent apps

Azure SQL Data Warehouse [Evolved]

- Limitless Analytics Service
- Data Warehouse & Big Data Analytics

Components

- SQL Analytics with SQL Pool & SQL on Demand
- Apache Spark Pools
- Data Integration & Studio

Limitless Scale

Deliver insights from all your data, across data warehouses and big data analytics systems, with blazing speed

Features

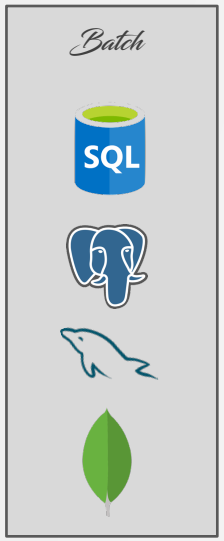
- EDW - Azure SQL Dw Engine
- Data Lake Exploration
- Languages – T-SQL, Python, Scala, Spark SQL & .NET
- Orchestration – Azure Data Factory
- Streaming Ingestion & Analytics
- Integrated AI & BI

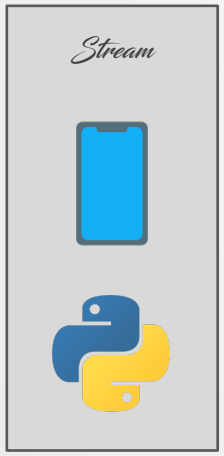
Unified Experience

Significantly reduce project development time with a unified experience for developing end-to-end analytics solutions

Big Data Architecture Proposal using Azure Synapse Analytics

simplify the modern data warehouse creation by removing the glue required to integrate,
secure and optimize the myriad of paas services that comprises the overall architecture

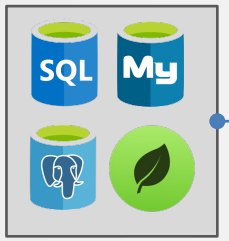




Use-Case: Microsoft Azure

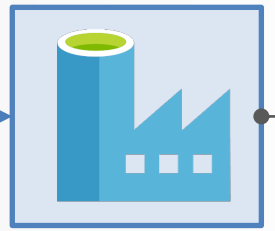
Lambda Architecture

1 *Batch Data*

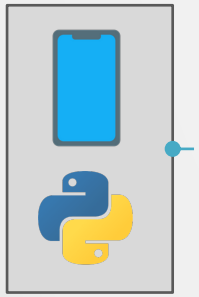


2 *Pipeline & Data Flow*

Perform ETL & ELT Operations
Orchestrate End-to-End Data Pipelines
Apply Light Transformations on Data
Properly Store Data using Big Data Data Formats

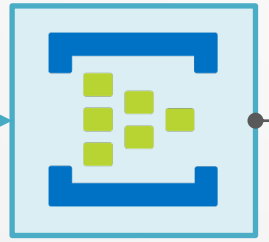


3 *Stream Data*

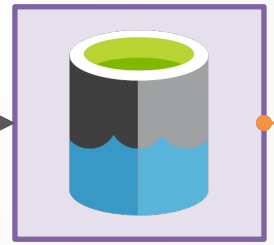


4 *Azure Event Hubs*

Receive Events in Real, Near & Batch
Ingest & Process Millions of Events per Second
Front Door for an Event Pipeline
Store Data into Data Lake
Auto-Inflate – Throughput Units



5 *Azure Data Lake Gen 2*



Data Lake

Hierarchical Namespace for Data Access
Single Atomic Metadata Operations
Hadoop Compatible Access using ABFS Driver
Extra Granularity ACL & POSIX Permissions
Low-Cost Storage with Data Lifecycle Management
Exabytes of Data

7 *Synapse SQL*

Serverless & Dedicated Pools

Use Serverless
Discovery & Exploration
Data Transformation with T-SQL

Use Dedicated
Design an Enterprise MDW
Build & Store Large DataSets
SLA Guarantee

6 *Spark Pools*

Apache Spark Pools

PySpark, Scala, C#, F#, R & SQL
Integration with Delta Lake
Auto-Scaler Feature
Data Processing at Scale ~ Large Volumes of Data
ACID Capabilities

Azure Synapse Analytics as a Modern Data Warehouse [MDW]

Google BigQuery [The Kraken]

Leader for Data Management Solutions
for Analytics in **2019**

Storage & Computation

- Separated Storage & Compute
- Choose Storage Tier
- Control Costs

Google's Serverless Offering

- Automatic Resource Provisioning
- SaaS Offering for Dw

Foundation for BI & AI

- EDW Google's Offering
- Integration, Transformation & Analyzes
- TensorFlow & BigQuery ML

Real-Time Analytics with SQL

- High-Speed Streaming Insertion API
- Standard ANSI:2011 SQL Support
- ODBC & JDBC Drivers

Programmatic Interaction

- REST API
- Java
- Python
- Node.js
- C#
- Ruby
- PHP

Big Data Ecosystem Integration

- Cloud DataProc
- Cloud DataFlow
- Apache Big Data Ecosystem
- Apache Hadoop & Apache Beam

Use-Case: Google Cloud Platform [GCP]

Google Pub/Sub

Global Messaging & Event Ingestion
Scale without Provisioning, Partitioning, or Load Isolation
Expand Pipelines to New Regions Simply with Global Topics

Google Cloud Storage [GCS]

Unified Object Storage for Developers & Enterprises
Optimize Price & Performance with 4 Storage Classes

Stream

Batch

Cloud DataFlow

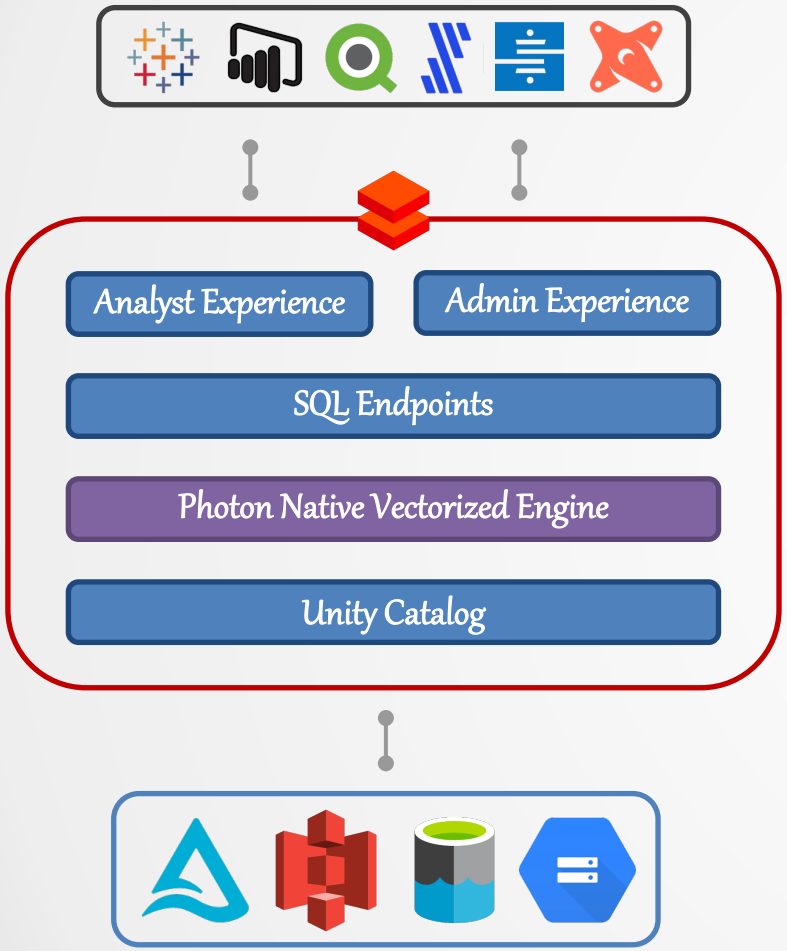
Simplified Stream & Batch Data Processing
Apache Beam [Java | Python | SQL]

Google BigQuery

ServerLess [SaaS], Highly-Scalable, & Cost-Effective Cloud Dw
In-Memory BI Engine & ML
Gartner 2019 – Magic Quadrant for Data Management Solutions

Big Query as a Modern Data Warehouse [MDW]

Databricks SQL



Integrations

Native Query and Visualization Tools, Provides Support of Existing BI Applications. Setting up Reliable Connections to Delta Lake Tables

Info

Real-World Performance & Easy to Use System for Analytics at Scale Based on SQL Workloads

Photon

Native Vectorized Engine Developed in C++ to Dramatically Improve Query Performance. Seamlessly Coordinate Work & Resources and Transparently Accelerate SQL Queries

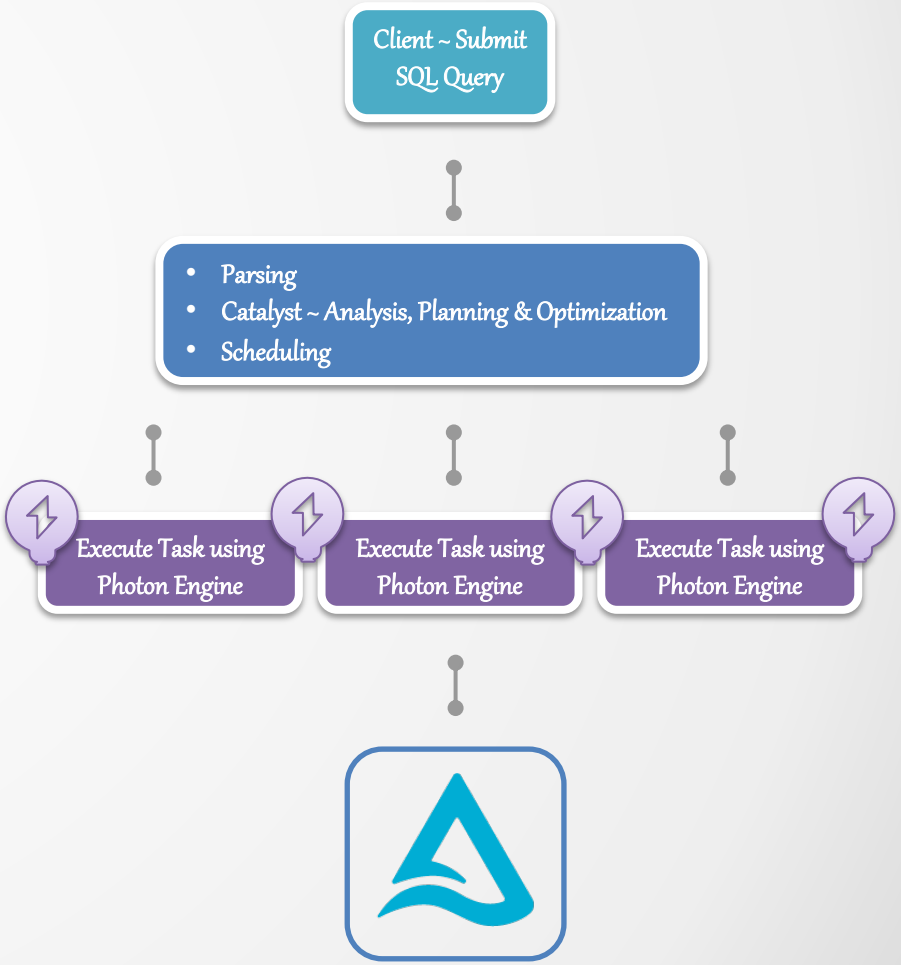
Unity Catalog

First Multi-Cloud Data Catalog Designed to Standardize Governance of Data & AI Assets on Data Lakehouse.

Curated Data

Structured, Semi-Structured, & Unstructured Data for Big Data Analytics. Open & Reliable Data Lake as Foundation

2x - 4x of Perf Improvement

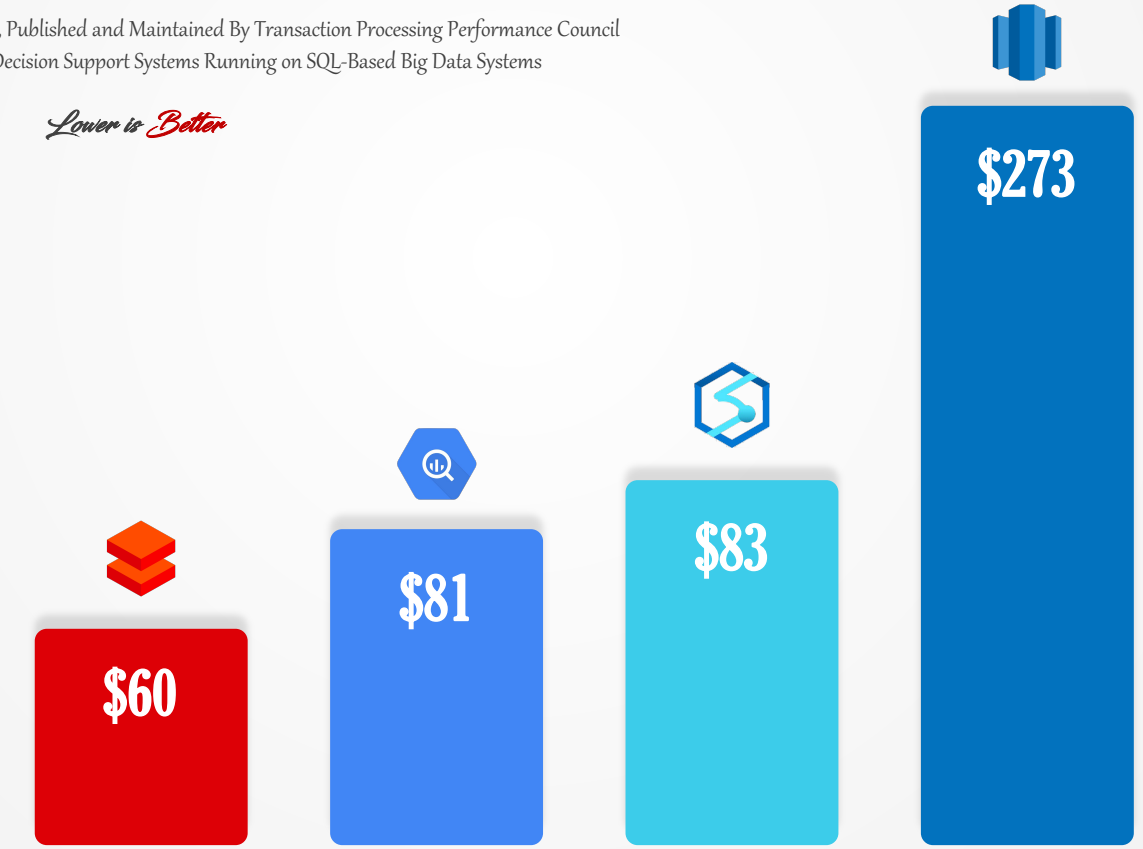


Query Performance Comparison

30 TB TPC-DS Price and Performance Comparison

TPC-DS is an Enterprise-Class **Benchmark**, Published and Maintained By Transaction Processing Performance Council (**TPC**), Measure Performance of Decision Support Systems Running on SQL-Based Big Data Systems

Lower is Better



Databricks SQL as a Modern Data Warehouse [MDW]


The only way of finding the limits of the possible is by going beyond them into the impossible.
Arthur C. Clarke
quotefancy

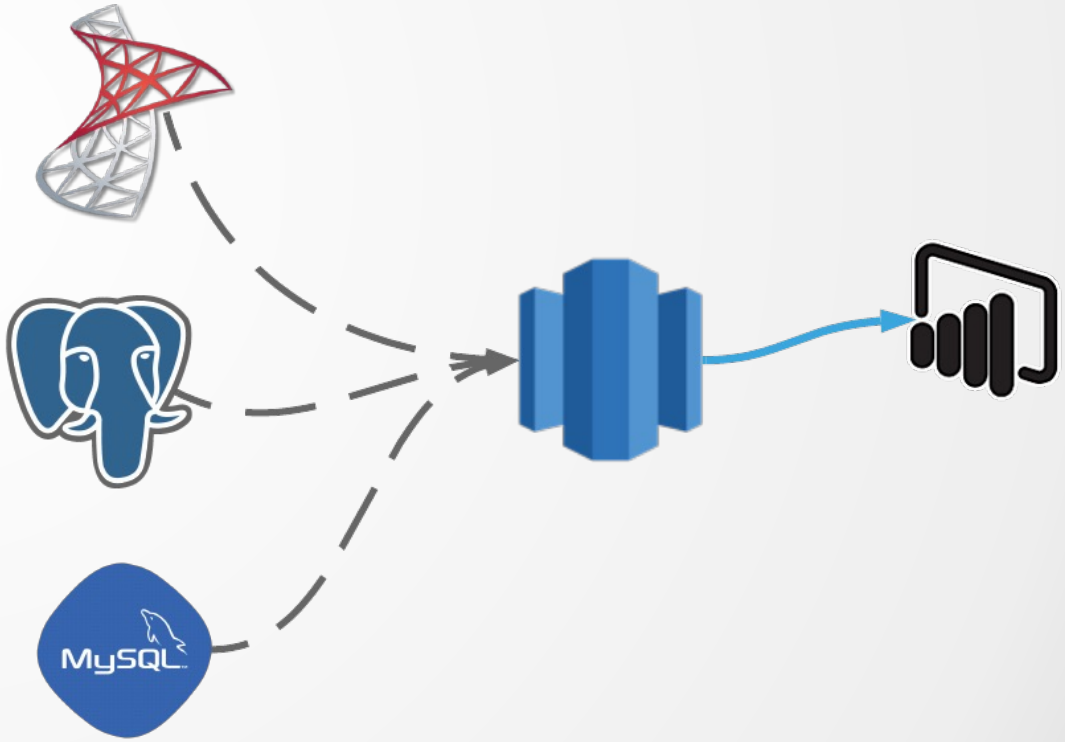
Data Warehouse Dw – (1 Gen ~ 1992)

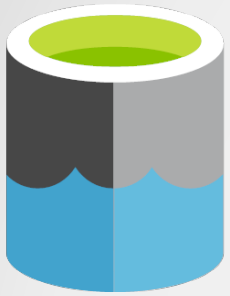
ETL for Data Centralization & BI Analysis

No Future Proof – Missing Predictions, Real-Time, Scale

- Pristine
- Fast Queries
- Transactional

- Expensive for Scale, Not Elastic
- Require ETL, Stale Data, No Real-Time
- No Predictions, No ML
- Closed Formats [Lock In]





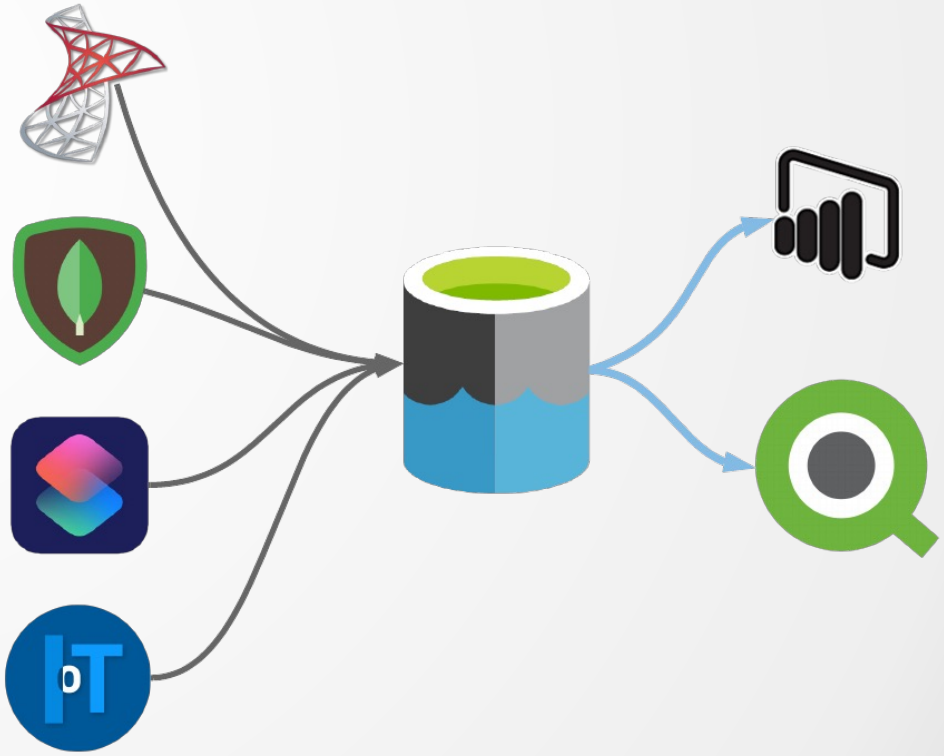
Hadoop Data Lake – (2 Gen ~ 2006)

ETL ALL Data, Scalable, Open Lake for ALL Use Cases

Become a Cheap Messy Data Store with Poor Performance

- Massive Scale
- Inexpensive Storage
- Open-Formats [Parquet, ORC]
- Promise of ML & Real-Time Streaming

- Inconsistent Data
- Unreliable for Analytics
- Lack of Schema
- Poor Performance

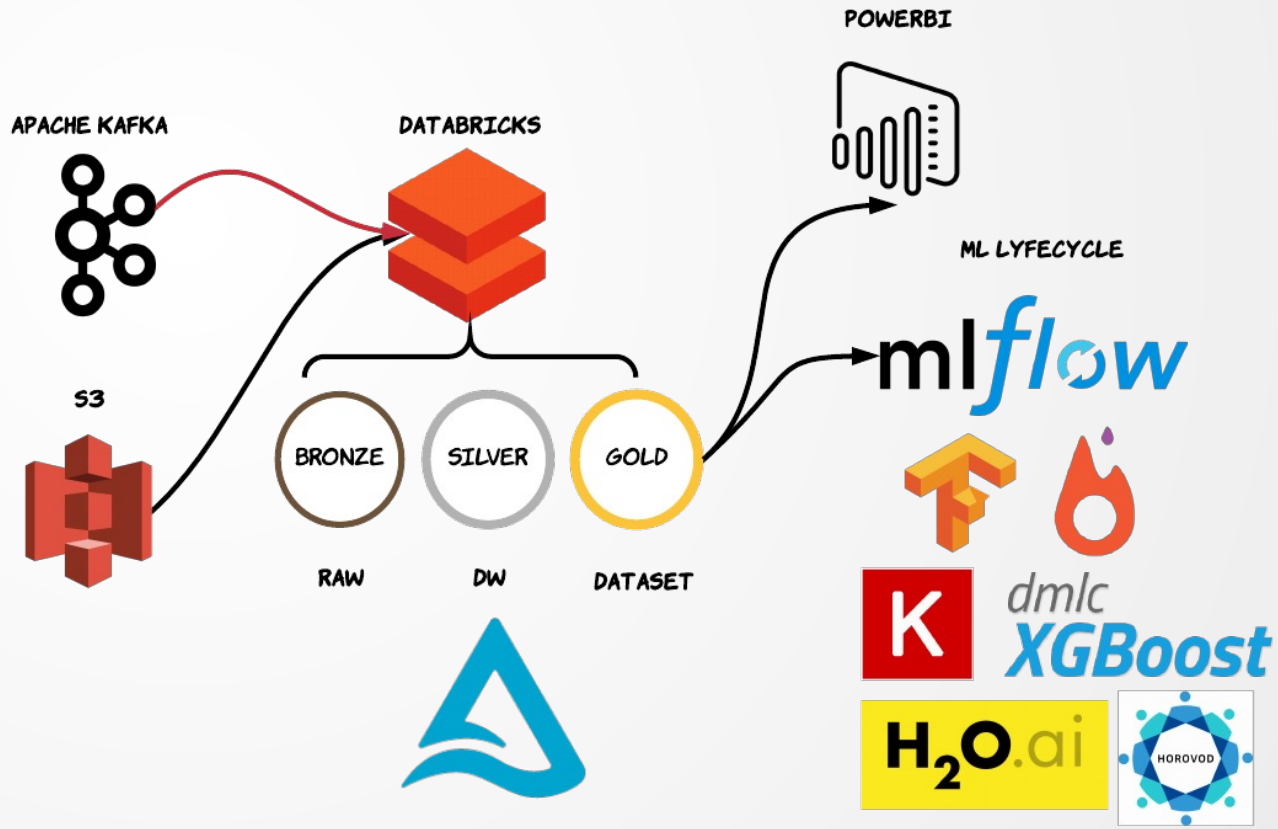


Data Lakehouse Delta Lake – (3 Gen ~ 2020)

A Unified Data Management System for Real-Time Big Data

Powerful Transactional Storage Layer

- The Good of Dw
- The Good of Data Lakes
- Decoupled Compute & Storage
- ACID Transactions & Data Validation
- Data Indexing & Caching [10x ~100x]
- Real-Time Streaming Ingest



Key Features

- ACID
- Scalable Metadata
- Time Travel
- Open Format
- Batch & Streaming Source & Sink
- Schema Enforcement & Evolution
- Audit History
- Insert, Updates, Delete & Merge

Use-Case: Open-Source Software [OSS] with Delta Lake

Apache Kafka

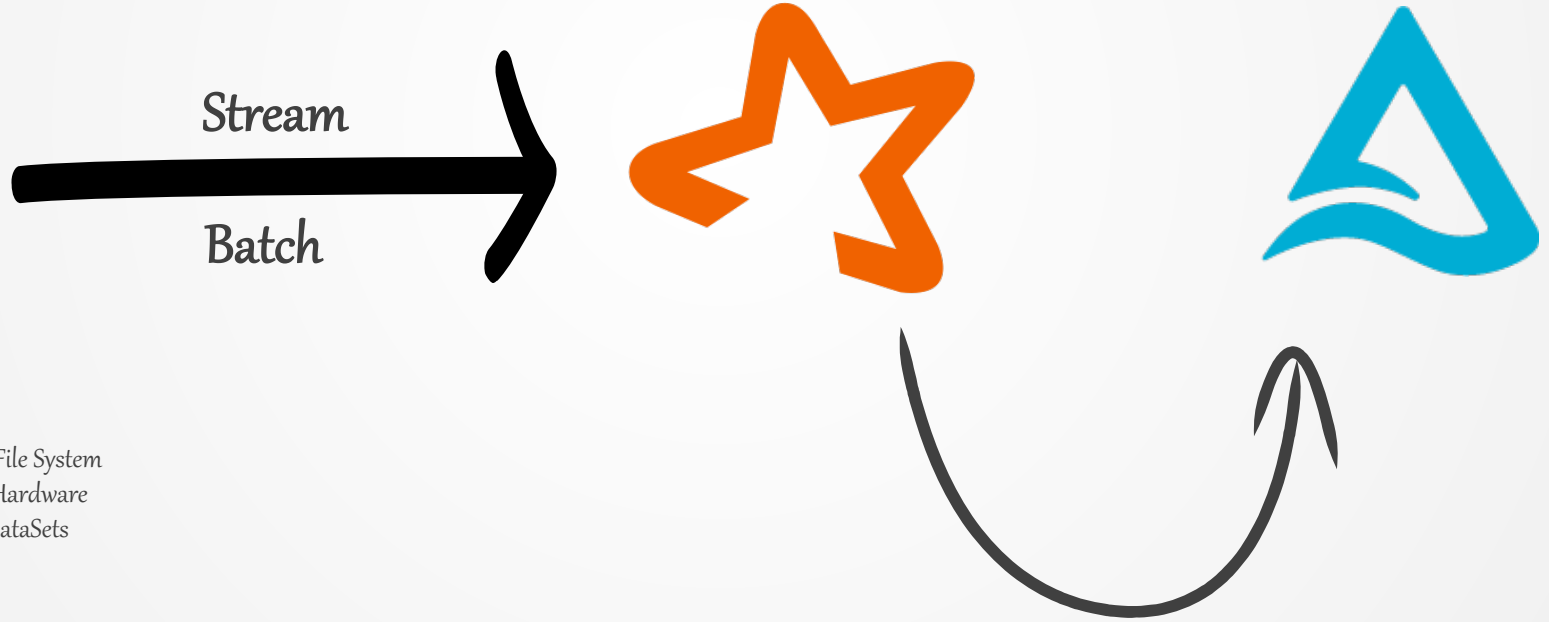
Distributed Streaming Platform
Real-Time Data Pipelines & Streaming Apps
Horizontally Scalable, Fault-Tolerant & Wicked Fast

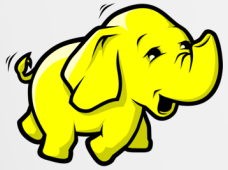
Apache Spark

Unified Analytics Engine for Large-Scale Data Processing
Speed, Easy to Use, Generality & Runs Everywhere

Delta Lake

Open-Source Storage Layer with ACID Capabilities
Batch & Streaming Unified





HDFS

Hadoop Distributed File System
Run on Commodity Hardware
Designed for Large DataSets

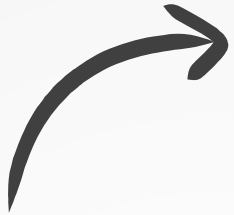
Data Lakehouse using Delta Engine for Data Analytics at Scale

Ignore the noise, focus on your work.

Anonymous

Data Virtualization

Access Data in Any Source, Shape or Structure without Copying from Source



Processing Query Engine

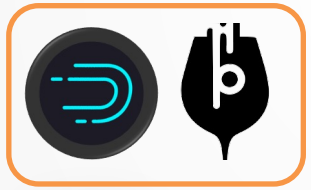
Connects, Discover, Plan and Analyze Different Data Stores for Query at Scale

Modern Data Warehouses

Redshift, BigQuery

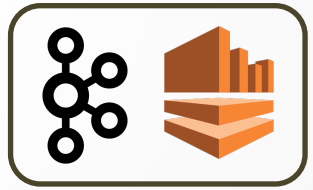
Real-Time OLAP

Apache Druid & Apache Pinot



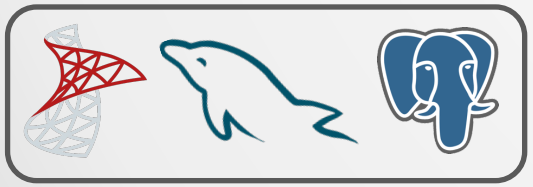
Real-Time Ingestion

Apache Kafka, Kinesis



Relational Databases

SQL Server, MySQL, Postgres



NoSql

Cassandra, MongoDB, Redis, ElasticSearch

Data Lake

HDFS, S3, Blob Storage, GCS & MinIO [S3*]

Virtualization Engines

Virtualization Engines for Querying Data at Scale

PolyBase

Transact-SQL Queries ~ Reads Data from External Sources

- SQL Server
- Oracle
- Teradata
- MongoDB
- HDFS
- Blob Storage

Microsoft Azure

Amazon Athena

Serverless, Interactive Query Service to Query Data and Analyze Big Data in Amazon S3 using Standard SQL

AWS

Redshift Spectrum

Query Data Directly from Amazon Redshift from Files on Amazon S3

AWS

Trino

Query Engine Runs at Ludicrous Speed. Fast Distributed SQL Query Engine for Big Data Analytics

Open Source

Dremio

Next-Generation Data Lake Engine for Interactive Queries Directly from Cloud Data Storage

- ADLS
- S3
- HDFS
- MongoDB
- SQL Server
- ElasticSearch

Open-Source

Google BigQuery

Query External Data Sources [Federated] Directly using a Table Reference

- Cloud BigTable
- Cloud Storage
- Google Drive
- Cloud SQL
- Omni

Google Cloud Platform [GCP]

Trino at Ludicrous Speed

Fastest Bunny on Forest, Eating Any Source of Data

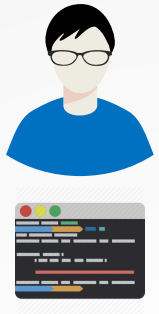
Trino

- Speed & Scale
- Simplicity
- Versatile
- In-Place Analysis
- Query Federation
- Runs Everywhere
- Trusted
- Trino Software Foundation [OSS]

Designed For

- Access Data using SQL
- Data Warehousing
- Analytics
- OLAP

Trino is a Tool Designed to Efficiently Query Vast Amounts of Data using Distributed Queries in a Terabytes & Petabytes Range

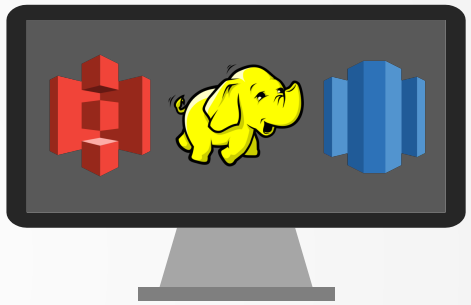


Query Execution Model

Turn SQL Statements into Queries, Executes Across a Distributed Cluster of Coordinator and Workers

Coordinator a.k.a The Brain

Parsing Statements, Planning Queries, & Managing Trino Worker Nodes

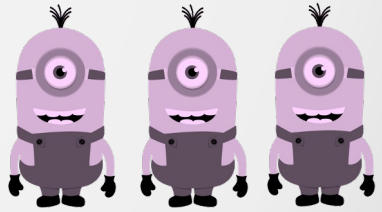


Features

- Memory Management & Spilling using Compression and Encryption
- Resource Groups
- Distributed Sort
- Dynamic Filtering ~ Query Performance, Network Traffic Reduction & Remote Load Reduction
- Cost Based Optimization - CBO
- Query Pushdown

Workers a.k.a The Slave

Responsible for Executing Tasks & Processing Data. Fetch Data from Connectors and Exchange Intermediate Data in Parallel



Apache ORC ~ Optimized Row Columnar

- Smallest, Fastest Columnar Storage for Apache Hadoop Workloads
- ACID Support
- Built-In Indexes
- Complex Types
- Integration with Apache Spark & Trino

Distributed SQL Query Engine for DW & Big Data Analytics ~ Data Virtualization

ONEWAY

SOLUTION