Delta Lake & Databricks

BI-BIG, 29.4.2025, Jan Lukány

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About Speaker

- Jan Lukany
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- CTU FIT 2014-2020 (Bc Theoretical Informatics, Mgr Knowledge Engineering)
- Datamole 2015-
  - 2015-2017 Junior Software Developer
  - 2017-2020 Data Scientist
  - 2020-2024 ML Engineer
  - 2024- ML Engineering Team lead

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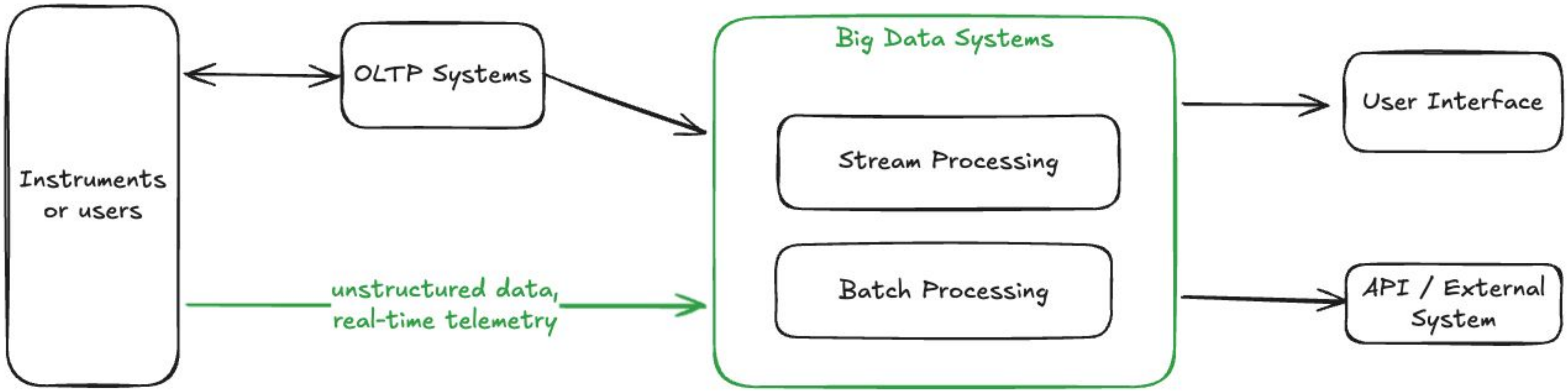
datamole.ai

a Czech **data and AI company** of **80+ people** founded in **2015.** We **develop custom AI, IoT & UI solutions** that innovate industrial companies worldwide – in agriculture, machinery or biotech.


Big Data Systems
Instruments or users
OLTP Systems
unstructured data, real-time telemetry
Stream Processing
Batch Processing
User Interface
API / External System

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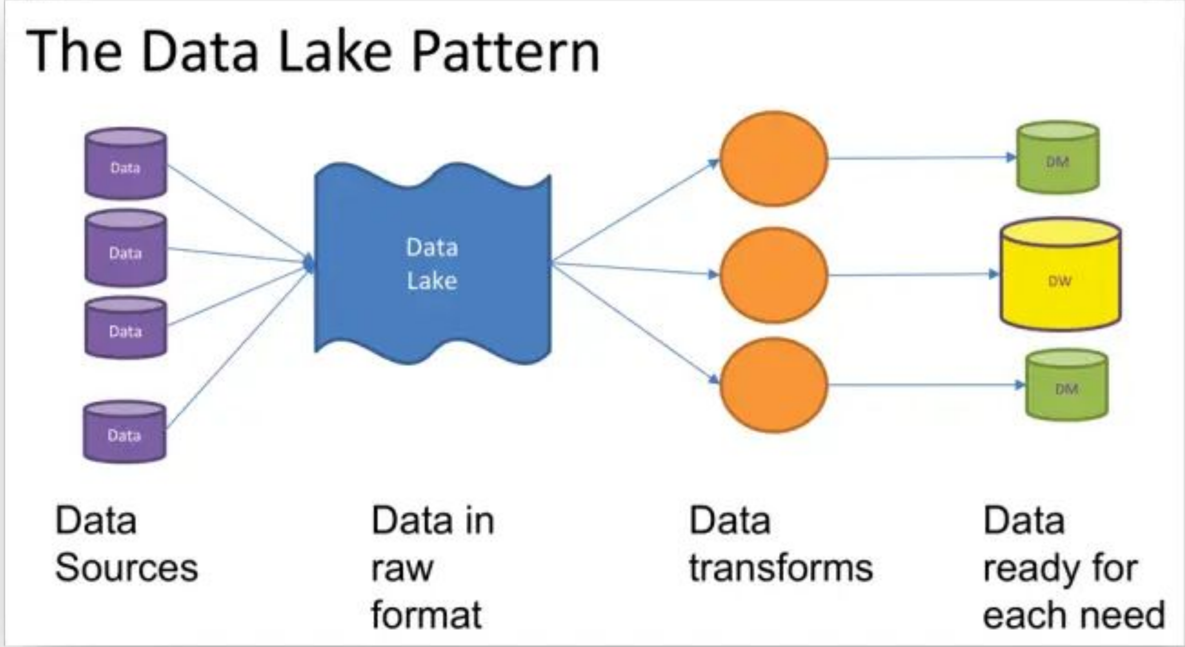
This Lecture

- Delta Lake – *Reliable* Storage Protocol/Format
  - Data Lake with ACID
  - Core concepts and practical usage (Python Polars and Pyspark)
- Databricks – Data Intelligence Platform (Spark + Delta Lake)
  - Practical example with free Community Edition


The Data Lake Pattern
Data
Data
Data
Data
Data
Lake
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DW
DM
Data
Sources
Data in
raw
format
Data
transforms
Data
ready for
each need

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Delta Lake

Key Features

ACID Transactions
Protect your data with serializability, the strongest level of isolation

Scalable Metadata
Handle petabyte-scale tables with billions of partitions and files with ease

Time Travel
Access/revert to earlier versions of data for audits, rollbacks, or reproduce

Open Source
Community driven, open standards, open protocol, open discussions

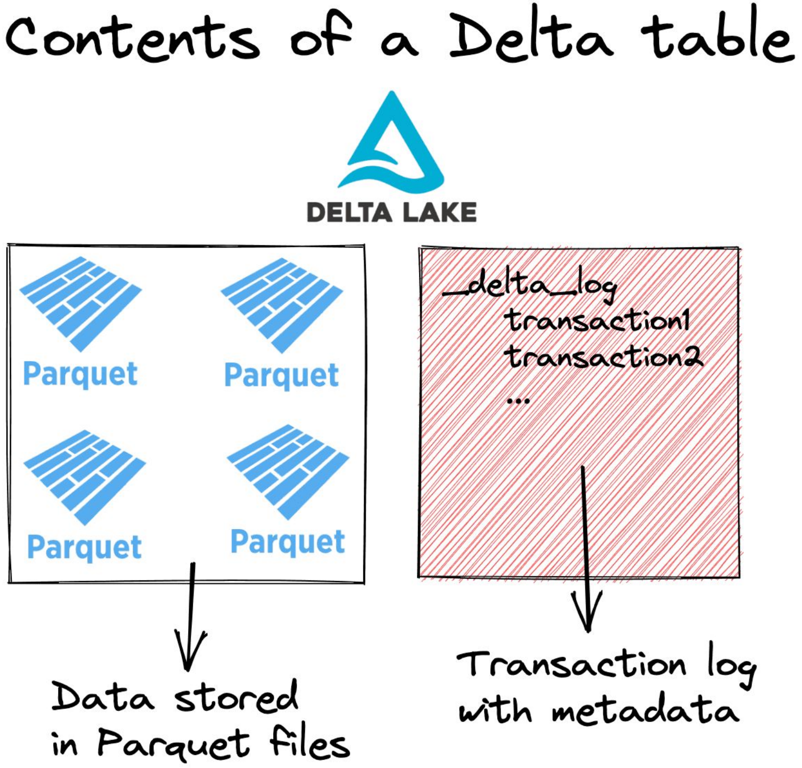
Unified Batch/Streaming
Exactly once semantics ingestion to backfill to interactive queries

Schema Evolution / Enforcement
Prevent bad data from causing data corruption

Audit History
Delta Lake log all change details providing a fill audit trail

DML Operations
SQL, Scala/Java and Python APIs to merge, update and delete datasets

Delta Lake – Delta Table



Delta Lake – Demo

Delta Lake – on cheap cloud storages

- Azure Blob Storage
- Amazon S3
- Google Cloud Storage

Delta Lake – ACID

- **A**tomicity – process all or nothing
- **C**onsistency – always valid state
- **I**solation – read while writing, safe multiple writes
- **D**urability – transactions are permanent

Guarantees **over one table only**

Delta Lake – scalability

- Data file skipping using statistics (e.g. min/max)
- Columnar format of parquets
  - Read only parts of data files
- Optimization techniques
  - Storing similar data close together
  - Liquid clustering, Z-Ordering, partitioning

Delta Lake – time travel

- transaction log
- selecting specific version from the log
- optimize and vacuum operations
  - optimize – compact multiple small files into large ones
  - vacuum – delete unused data files

```
df = spark.read.format("delta").option("versionAsOf", 0).load("data/delta_census")
```

Delta Lake – Change Data Capture/Feed

- Tracking row-level changes for updates and deletes
  - no need for append-only (no update/delete) – transaction log is enough

SQL

```sql
ALTER TABLE myDeltaTable SET TBLPROPERTIES (delta.enableChangeDataFeed = true)
```

```python
# providing a starting version
spark.readStream.format("delta") \
  .option("readChangeFeed", "true") \
  .option("startingVersion", 0) \
  .table("myDeltaTable")
```

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Delta Lake – schema evolution and enforcement

- allow adding new columns and changing (some) data types
- prevent bad data from being written

Delta Lake – Unified Batch and Streaming

- Batch – historical data processing in bulk
- Streaming – real-time data processing
- Same API for both

Example Batch Processing with Spark

```
# Read data from Delta table
input_df = spark.read.format("delta").load("input-table-path")

# Perform simple processing (e.g., filtering and adding a column)
processed_df = (
    input_df
    .filter(col("column_name") > 100)
    .withColumn("new_column", col("column_name") * 2)
)

# Write processed data back to a Delta table
(
    processed_df
    .write.format("delta")
    .mode("overwrite")
    .save("output-table-path")
)
```

Example Stream Processing with Spark

```python
# Read data from Delta table as a streaming source
input_stream = spark.readStream.format("delta").load("input-table-path")

# Perform simple processing (e.g., filtering and adding a column)
processed_stream = (
    input_stream.filter(col("column_name") > 100)
    .withColumn("new_column", col("column_name") * 2)
)

# Write processed data to Delta table as a streaming sink
query = (
    processed_stream.writeStream.format("delta")
    .outputMode("append")
    .option("checkpointLocation", "/path/to/checkpoint-dir")
    .start("output-table-path")
)
```

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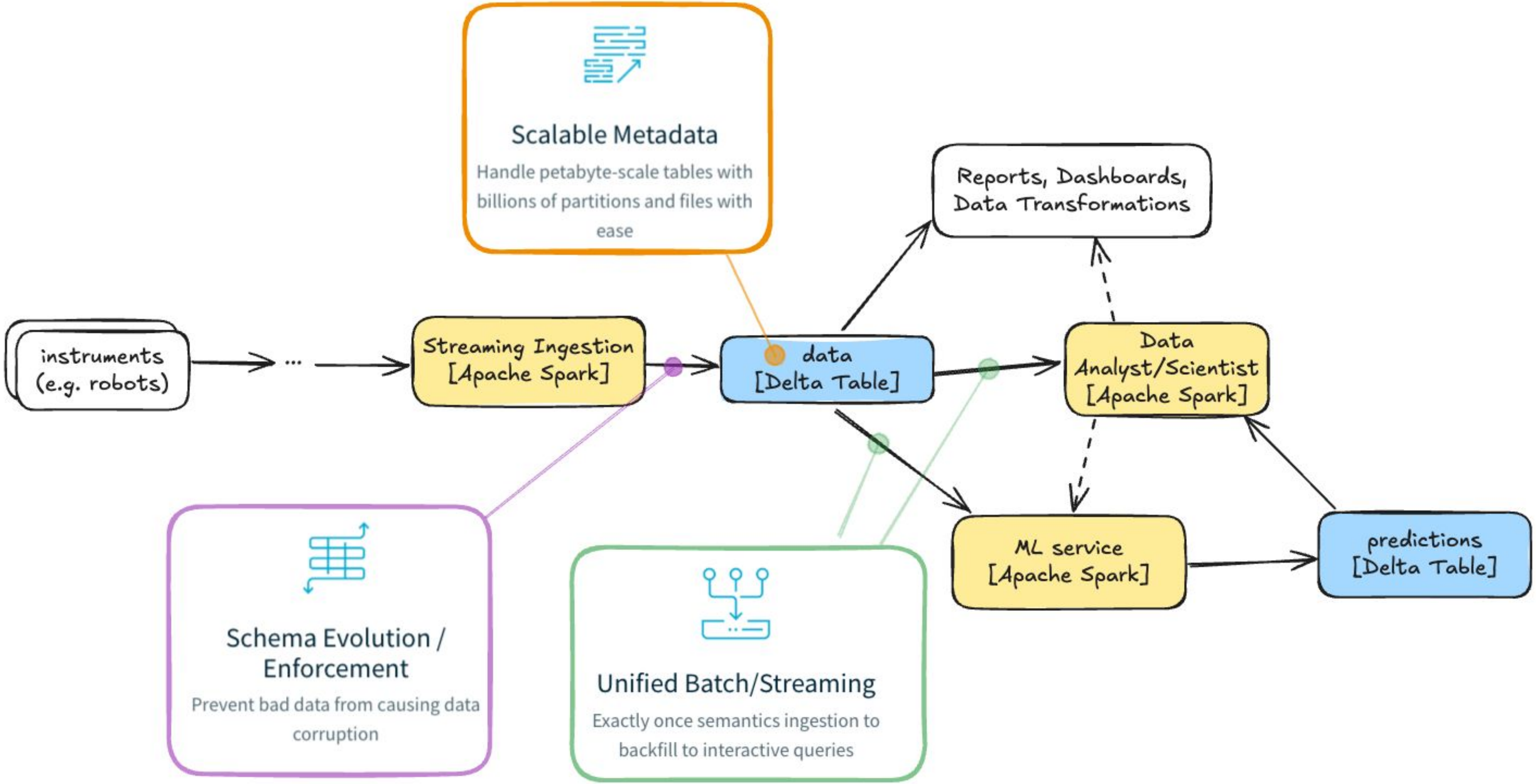
Scalable Metadata
Handle petabyte-scale tables with billions of partitions and files with ease
Reports, Dashboards, Data Transformations
instruments (e.g. robots)
...
Streaming Ingestion [Apache Spark]
data [Delta Table]
Data Analyst/Scientist [Apache Spark]
ML service [Apache Spark]
predictions [Delta Table]
Schema Evolution / Enforcement
Prevent bad data from causing data corruption
Unified Batch/Streaming
Exactly once semantics ingestion to backfill to interactive queries

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databricks

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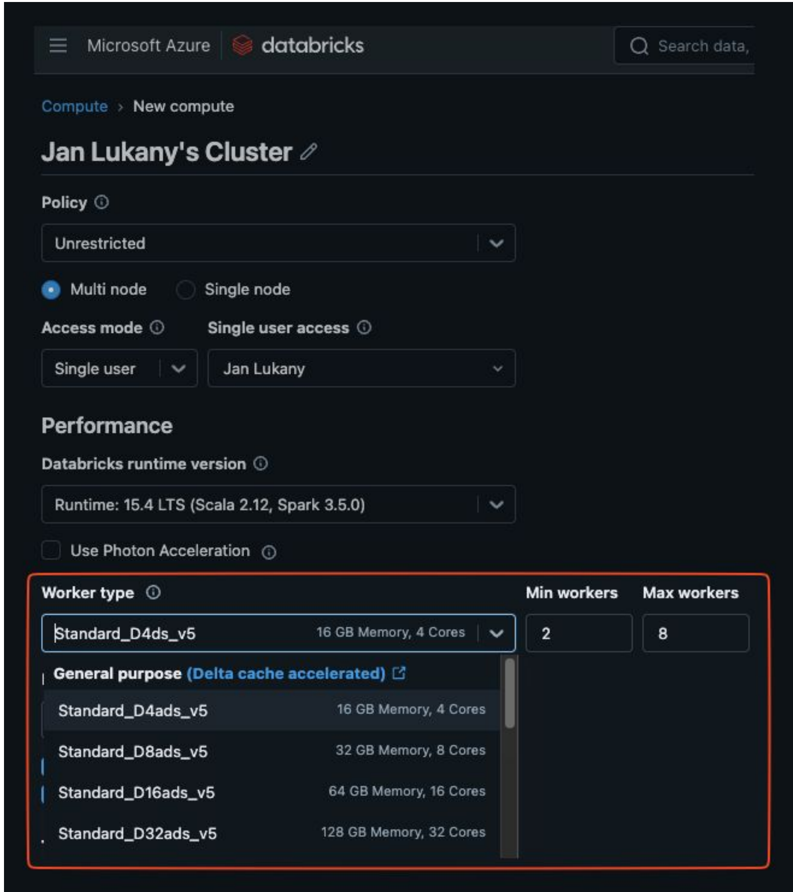
Databricks

- Compute
  - Apache Spark cluster management
  - Built-in orchestration for workflows
- Data Lakehouse
  - Delta Lake as default storage layer
  - Unity Catalog – “one” database, data governance
    - Delta tables
    - External volumes
    - Federated access
- Other
  - Development workspace (similar to Jupyter Lab) with collaborative features
  - Machine learning support (training, deployment)
  - Native integrations with major cloud providers (Azure, AWS, GCP)

Databricks – Apache Spark cluster management

- Azure VMs
- AWS EC2
- Google Compute Engine



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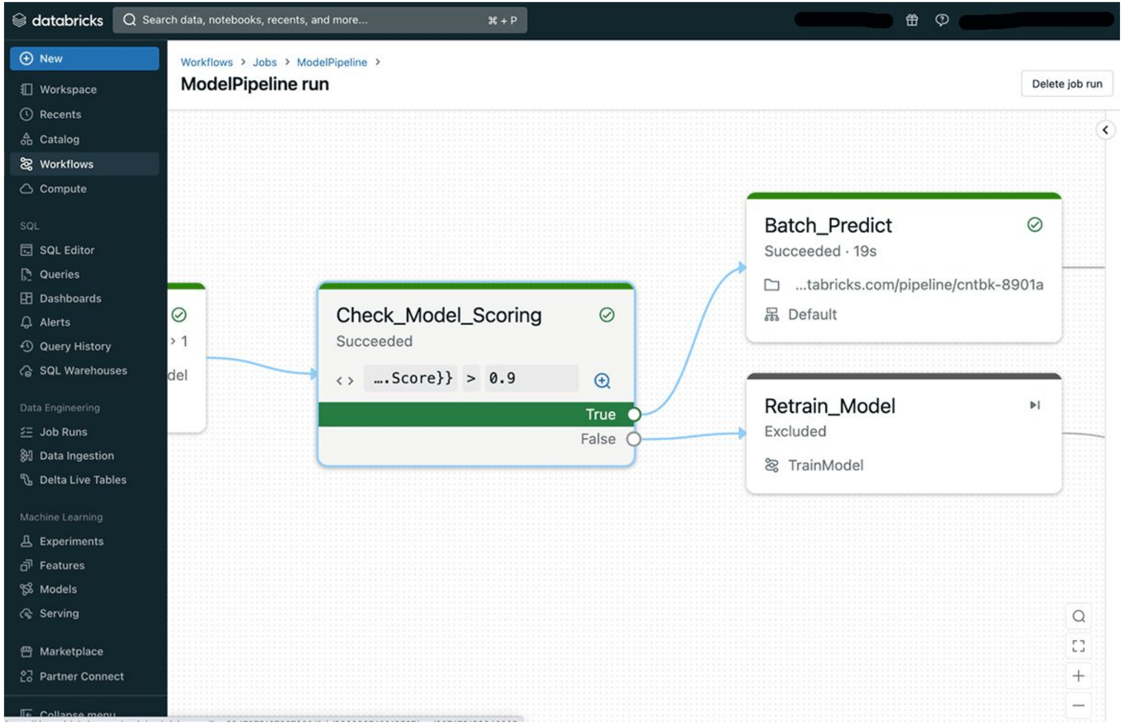
Databricks – Workflows (job orchestration)



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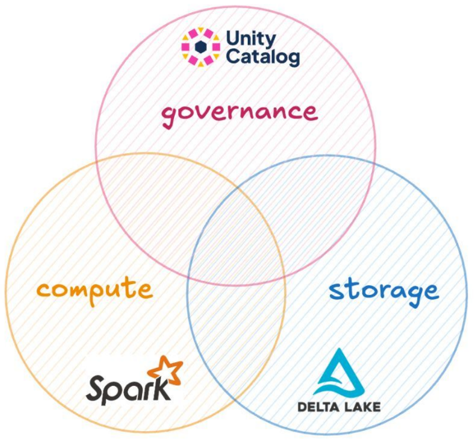
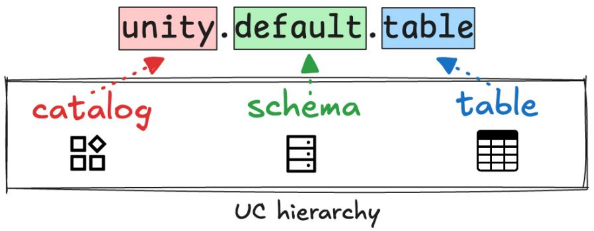
Databricks – Delta Tables on Cloud

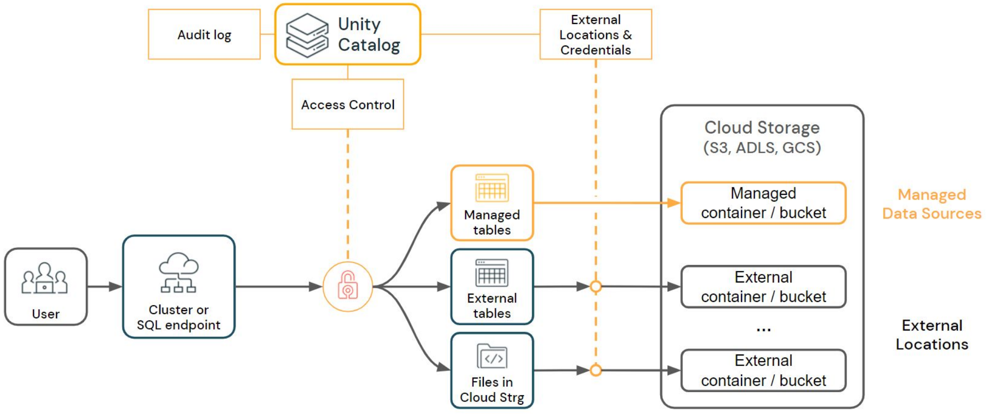
- Amazon S3
- Azure Blob Storage
- Google Cloud Platform

Databricks – Unity Catalog

- "one" database from the perspective of consumers
- data governance at one place
- can include e.g.:
    - Delta tables
    - ML models
    - Unstructured data on cloud storages
    - External databases







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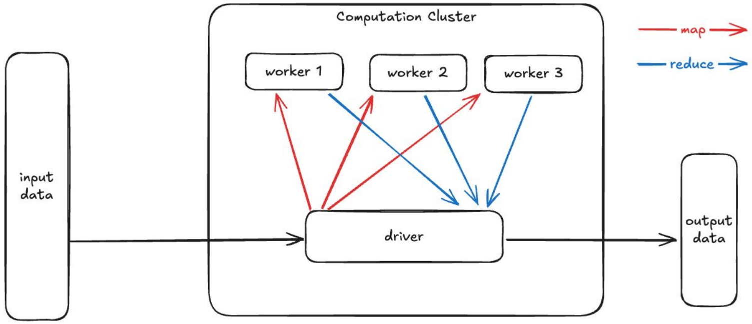
Databricks – Demo (community edition)

Summary

- Delta Lake
  - Reliable, ACID
  - Integration: Apache Spark, Python Polars, delta-rs
  - Open-source
- Unity Catalog
  - Data governance (e.g. easy access, discoverability)
  - Open-source
- Databricks
  - Cloud platform on top of Apache Spark, Delta Lake and Unity Catalog
  - Unity Catalog
  - ML experiments and serving
  - Closed-source / paid

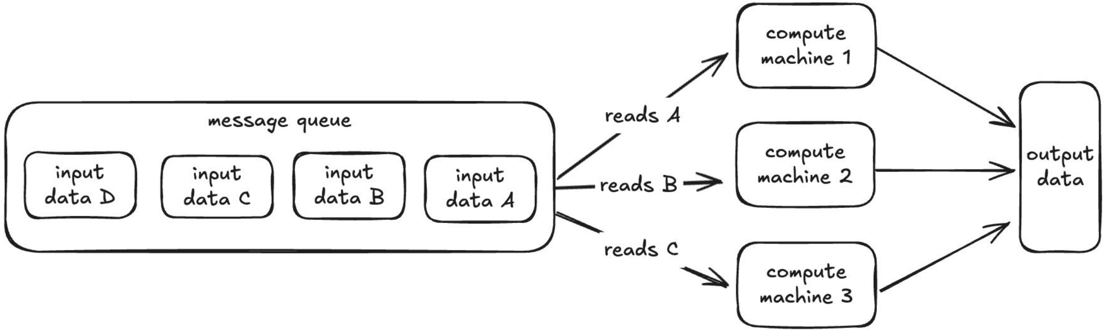
Q&A

Bonus: Map-Reduce vs Competing Consumers



Example tech stack:

- Apache Spark
- Delta Lake
- (Databricks)



Example tech stack:

- Azure Event Hub
- Kubernetes, Docker, Python
- Azure Tables (NoSQL)