Microsoft

Big Data Ecosystem

Technical Deep Dive – Day4

Sashank Pappu
Azure Data & AI Specialist

Shiva Priya
Azure Data Engineer

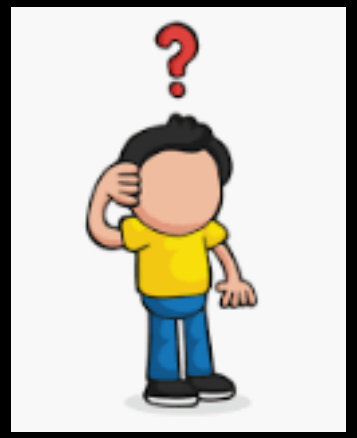
What shall we learn today ?

- Azure Data Bricks Understanding & Scalability
- Data Bricks Delta
- Data Factory with Data Bricks
- Streaming Data with Data Bricks
- Snowflake DW with Databricks for Machine Learning

More Detailed Agenda

- 10-10:30 AM : Understanding on Databricks
- 10:30-11:00 : Read & Write Data Bricks
- 11:00-11:45 : Databricks Delta
- 11:45-11:50 : BREAK !!!
- 12-1PM : ADF with Data Bricks

Distributed storage PaaS on Azure



Errr….
What are all these?
Why so many?
When do I use these?
Wait, now you have this new thing called *Delta*?
I am dizzy and ready to pass out!

MPP database

Azure SQL Datawarehouse

Object store

Azure Data Lake Store

Azure Blob Storage

No-SQL

Azure HDInsight-HBase

Azure Cosmos DB
SQL API
Cassandra API
MongoDB API

Scalable OLTP, IoT store, time series database

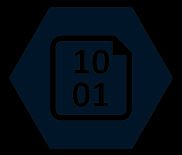
Fit for purpose

MPP database

Azure SQL Datawarehouse

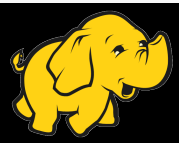
Object store

Azure
Data Lake
Store



Azure
Blob Storage

No-SQL



Azure HDInsight-HBase

Azure Cosmos DB
SQL API
Cassandra API
MongoDB API

Optimized for low latency - point reads, random CRUD, small range queries/scans, transaction guarantees

Datawarehousing

Fit for purpose

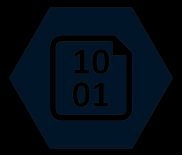
MPP database

Azure SQL Datawarehouse

Optimized for parallel processing of structured data with T-SQL, server side programmability, in-memory processing and massive scale. Complement with an RDBMS based reporting mart for supporting direct query for BI – for concurrency beyond Azure SQL Data warehouse concurrency limits. Alternately complement with Azure Analysis Services (AAS) for BI

Object store

Azure Data Lake Store



Azure Blob Storage

No-SQL

Azure HDInsight-HBase

Azure Cosmos DB
SQL API
Cassandra API
MongoDB API

Data Lake

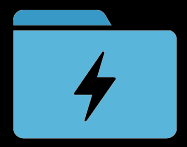
Fit for purpose

MPP database

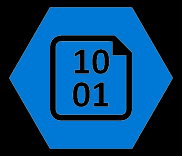
Azure SQL Datawarehouse

Optimized for structured and unstructured data storage, massively scalable; RBAC.

Object store



Azure Data Lake Store



Azure Blob Storage

No-SQL

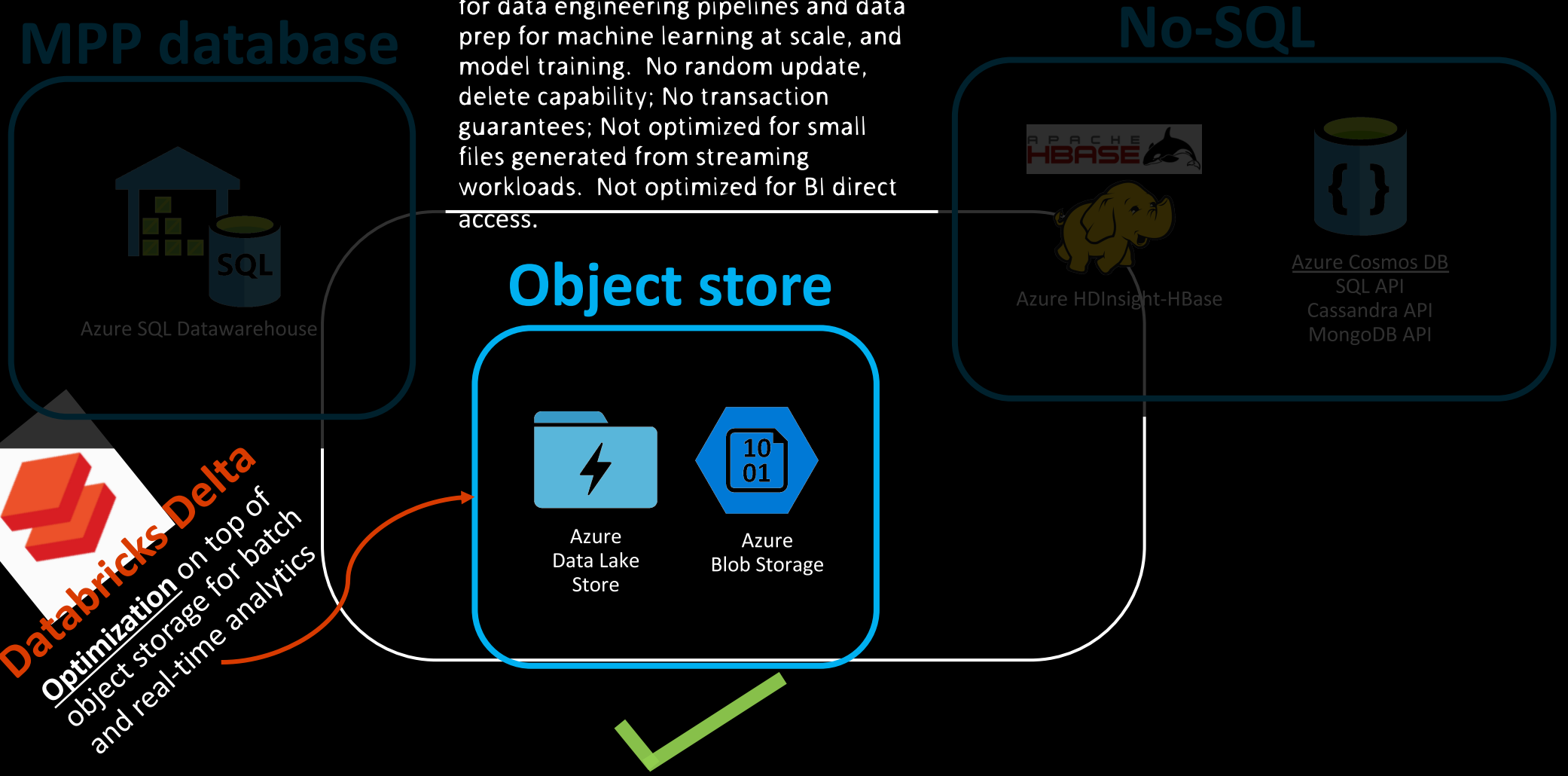
Azure HDInsight-HBase

Azure Cosmos DB
SQL API
Cassandra API
MongoDB API

Analytics store – structured, unstructured

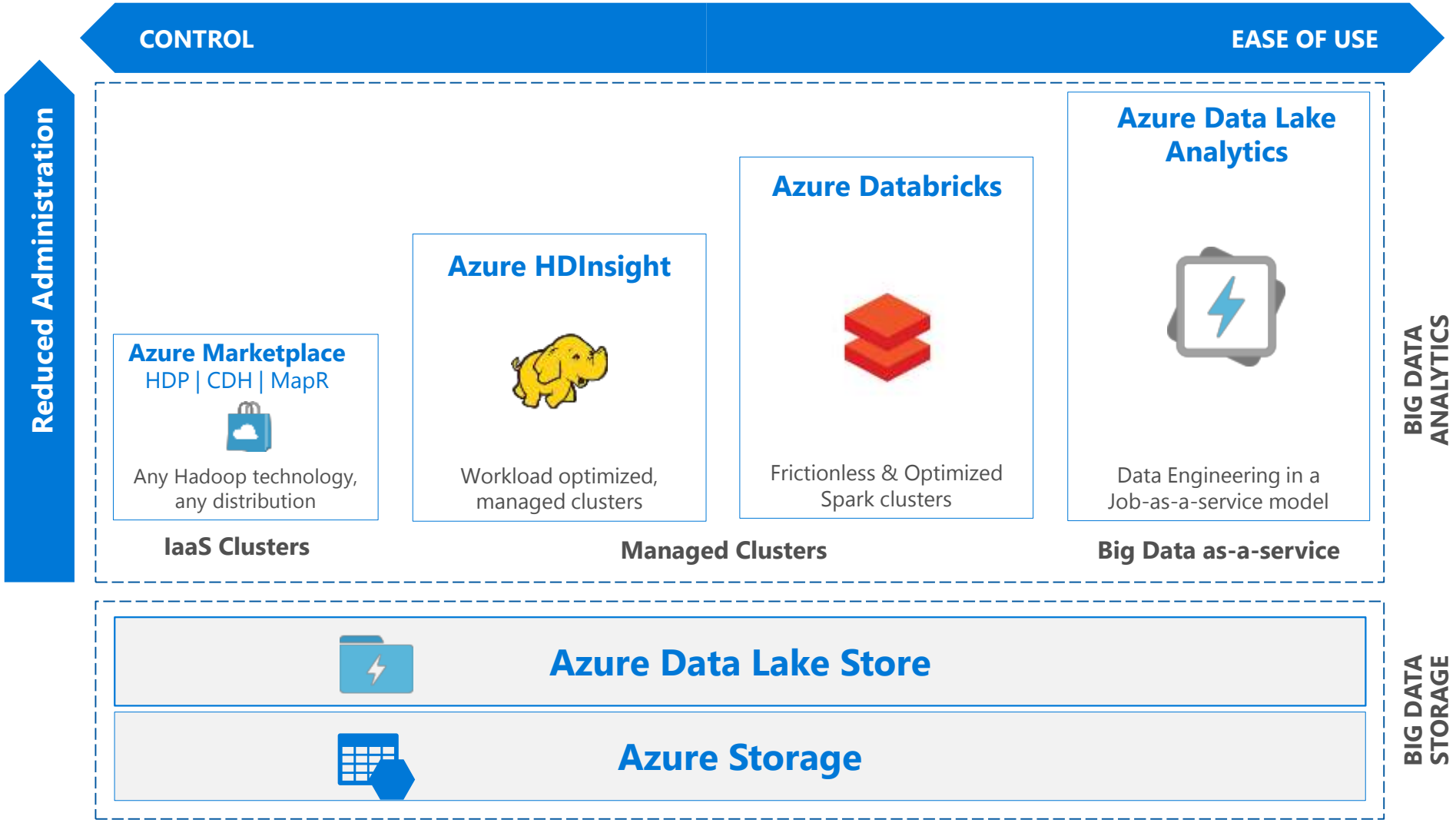
Fit for purpose

Optimized for large sequential scans, structured, unstructured data - typical for data engineering pipelines and data prep for machine learning at scale, and model training. No random update, delete capability; No transaction guarantees; Not optimized for small files generated from streaming workloads. Not optimized for BI direct access.

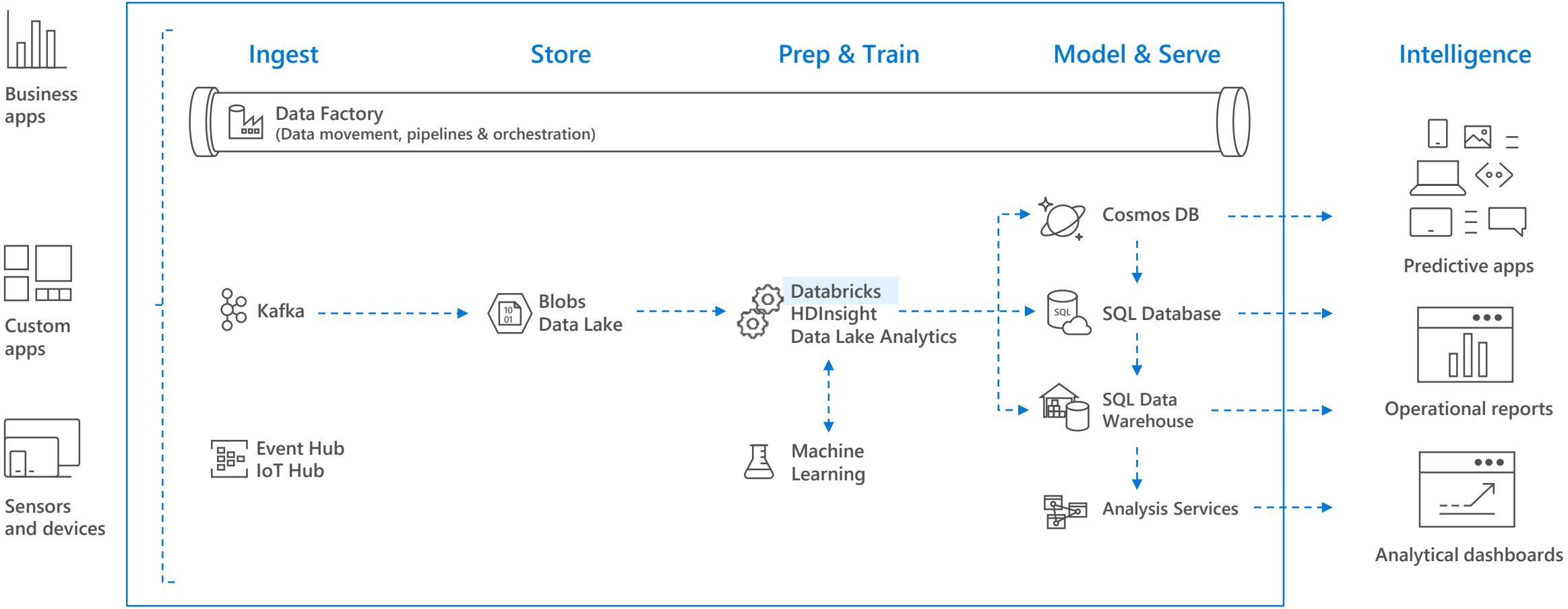


Big Data & Advanced Analytics in Azure

KNOWING THE VARIOUS BIG DATA SOLUTIONS



BIG DATA & ADVANCED ANALYTICS AT A GLANCE



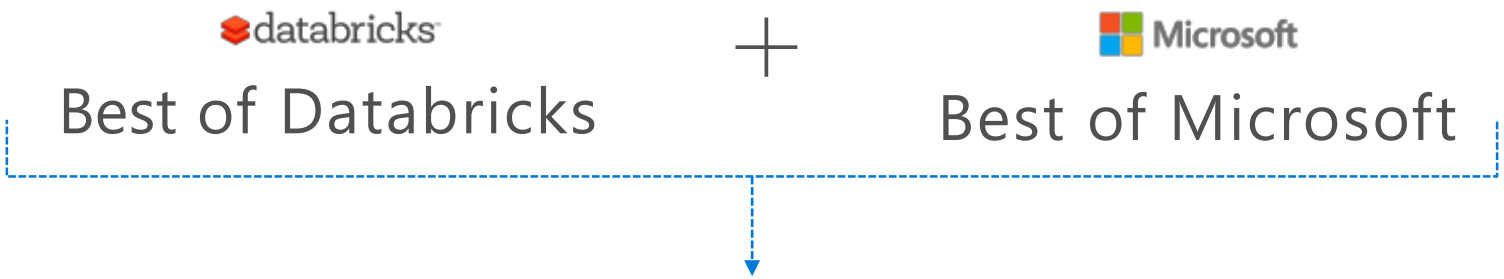
Azure Databricks
Powered by Apache Spark

Why Spark?

- Open-source data processing engine built around **speed, ease of use, and sophisticated analytics**
- In memory engine that is up to **100 times faster than Hadoop**
- **Largest open-source data project** with 1000+ contributors
- **Highly extensible** with support for Scala, Java and Python alongside Spark SQL, GraphX, Streaming and Machine Learning Library (Mllib)

What is Azure Databricks?

A fast, easy and collaborative Apache® Spark™ based analytics platform optimized for Azure



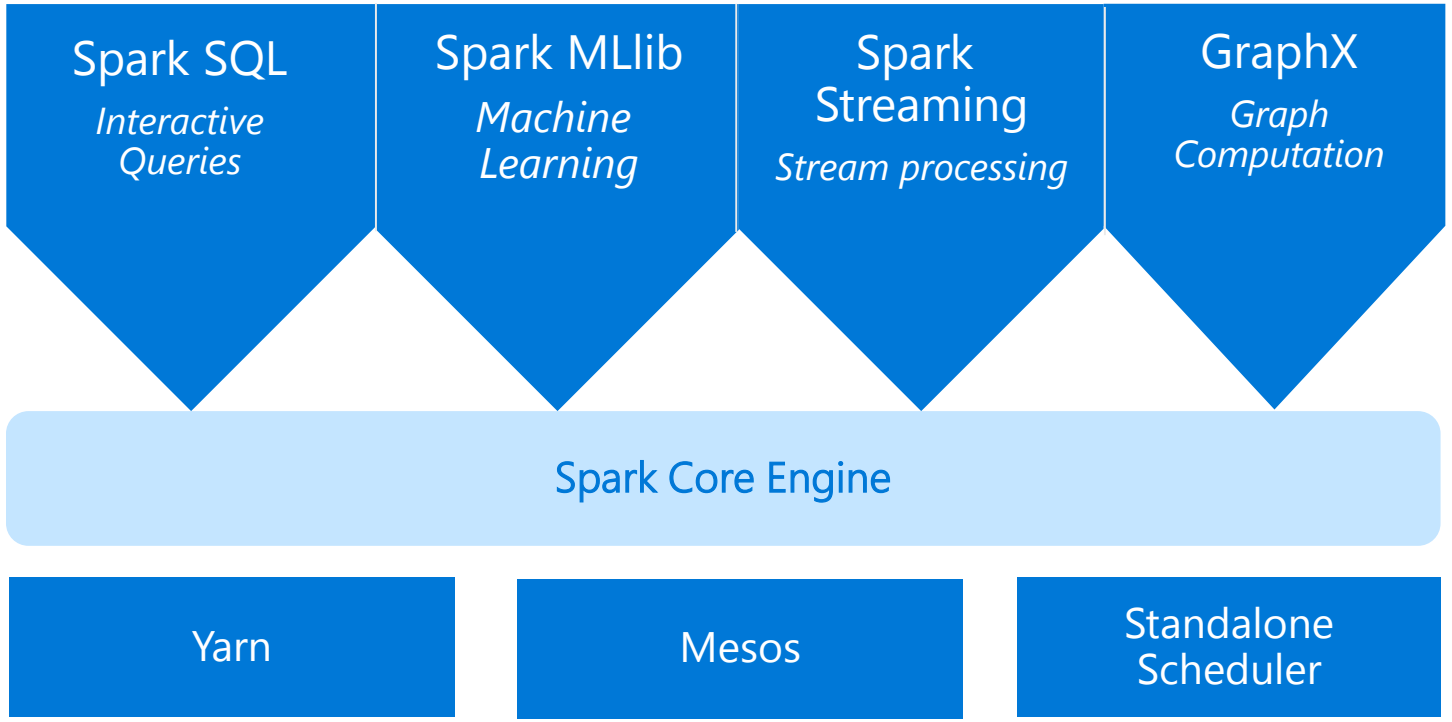
- Designed in collaboration with the founders of Apache Spark
- One-click set up; streamlined workflows
- Interactive workspace that enables collaboration between data scientists, data engineers, and business analysts.
- Native integration with Azure services (Power BI, SQL DW, Cosmos DB, Blob Storage)
- Enterprise-grade Azure security (Active Directory integration, compliance, enterprise-grade SLAs)

APACHE SPARK

An unified, open source, parallel, data processing framework for Big Data Analytics

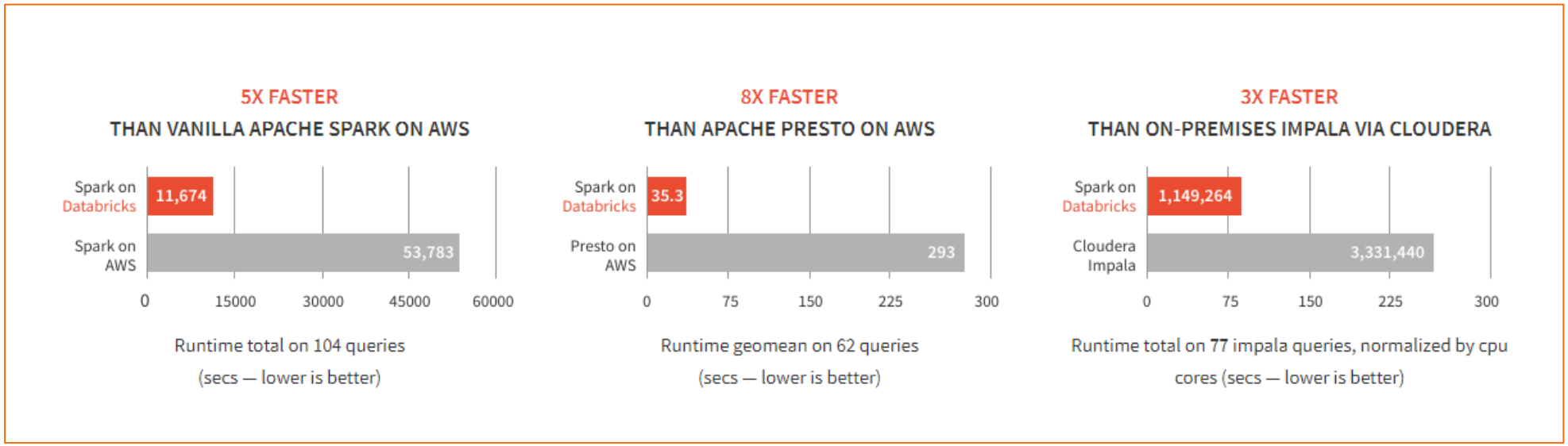
Spark Unifies:

- Batch Processing
- Interactive SQL
- Real-time processing
- Machine Learning
- Deep Learning
- Graph Processing



DATABRICKS SPARK IS FAST

Benchmarks have shown Databricks to often have better performance than alternatives



SOURCE: Benchmarking Big Data SQL Platforms in the Cloud

Differentiated experience on Azure

ENHANCE PRODUCTIVITY

Get started quickly by launching your new Spark environment with one click.

Share your insights in powerful ways through rich integration with Power BI.

Improve collaboration amongst your analytics team through a unified workspace.

Innovate faster with native integration with rest of Azure platform

BUILD ON THE MOST COMPLIANT CLOUD

Simplify security and identity control with built-in integration with Active Directory.

Regulate access with fine-grained user permissions to Azure Databricks' notebooks, clusters, jobs and data.

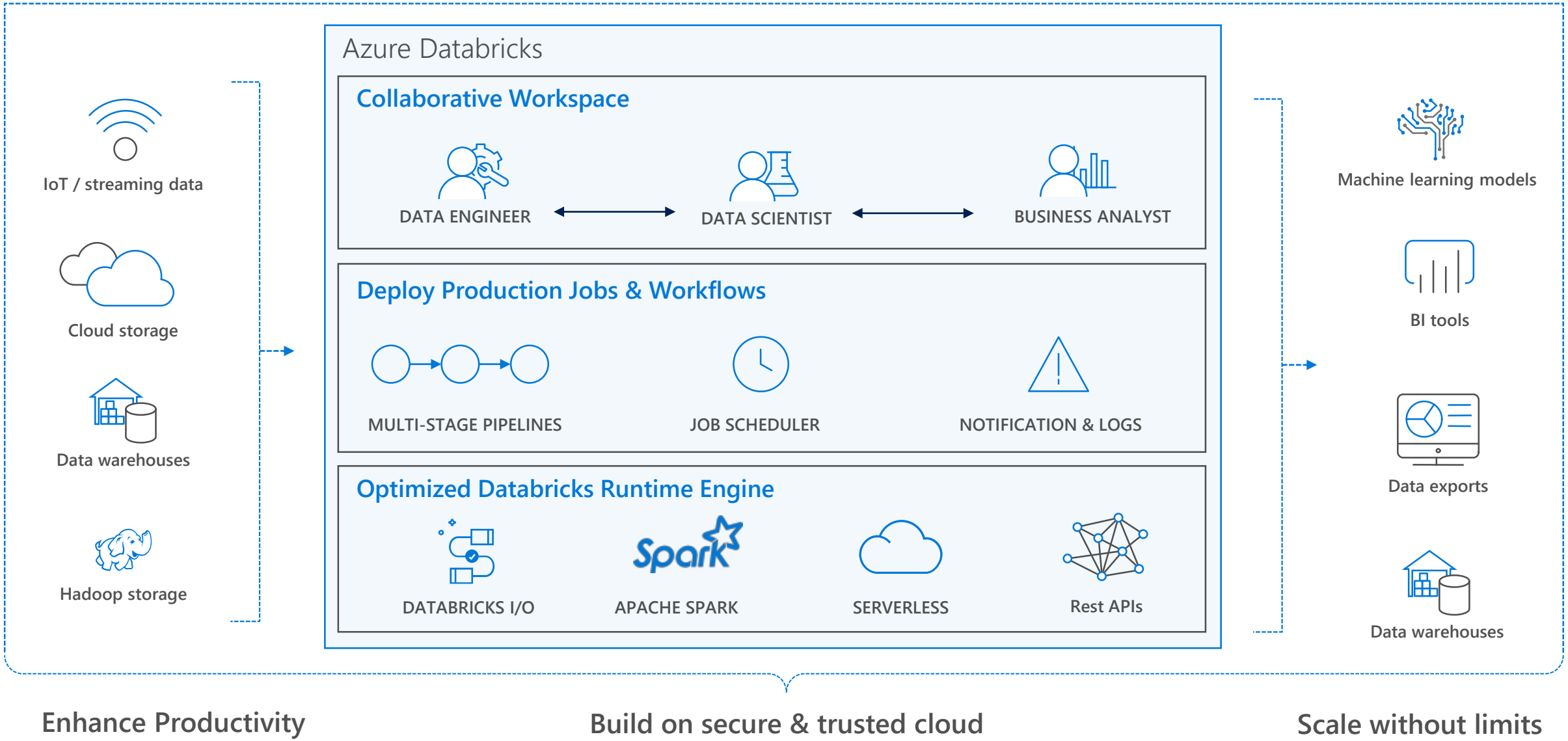
Build with confidence on the trusted cloud backed by unmatched support, compliance and SLAs.

SCALE WITHOUT LIMITS

Operate at massive scale without limits globally.

Accelerate data processing with the fastest Spark engine.

Azure Databricks



Enhance Productivity

Build on secure & trusted cloud

Scale without limits

Collaborative Workspace

GET STARTED IN SECONDS

Single click to launch your new Spark environment

INTERACTIVE EXPLORATION

Explore data using interactive notebooks with support for multiple programming languages including R, Python, Scala, and SQL

COLLABORATION

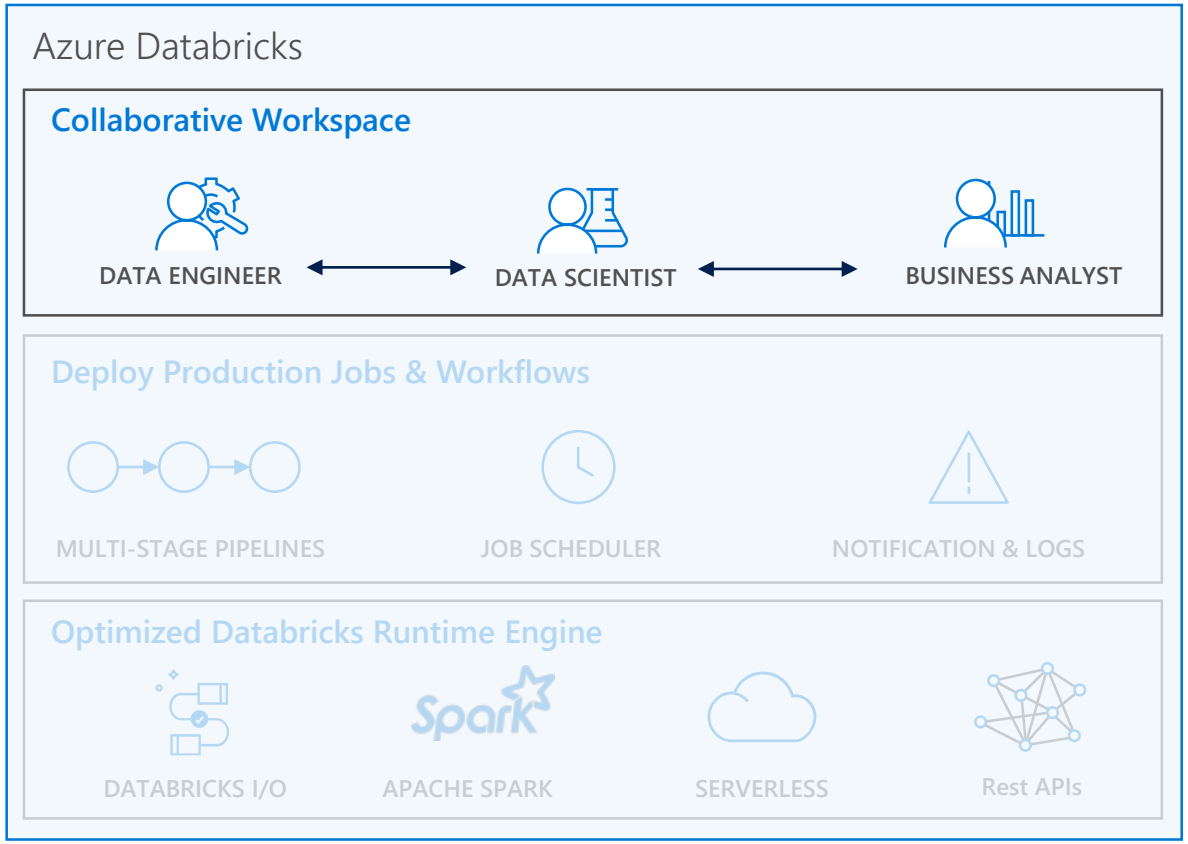
Work on the same notebook in real-time while tracking changes with detailed revision history, GitHub, or Bitbucket

VISUALIZATIONS

Visualize insights through a wide assortment of point-and-click visualizations. Or use powerful scriptable options like matplotlib, ggplot, and D3

DASHBOARDS

Rich integration with PowerBI to discover and share your insights in powerful new ways



Deploy Production Jobs & Workflows

JOBS SCHEDULER

Execute jobs for production pipelines on a specific schedule

NOTEBOOK WORKFLOWS

Create multi-stage pipelines with the control structures of the source programming language

RUN NOTEBOOKS AS JOBS

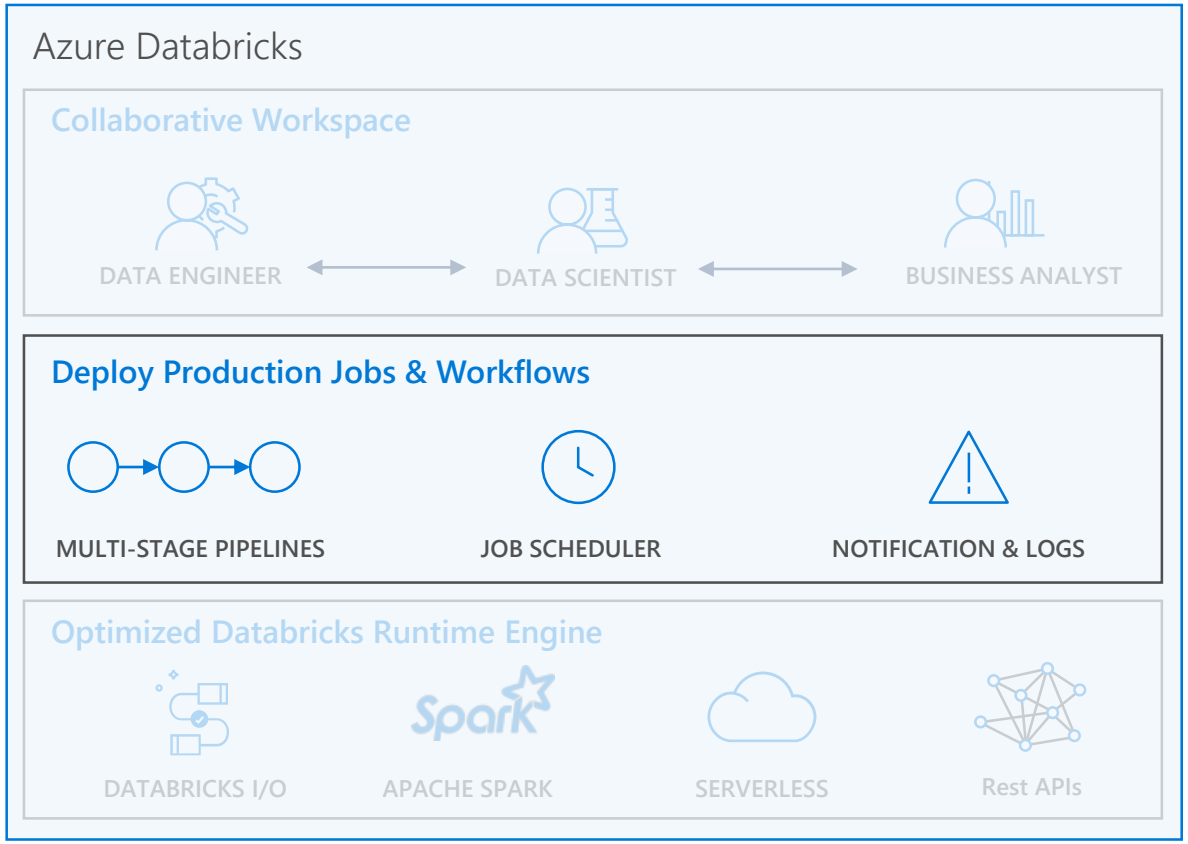
Turn notebooks or JARs into resilient Spark jobs with a click or an API call

NOTIFICATIONS AND LOGS

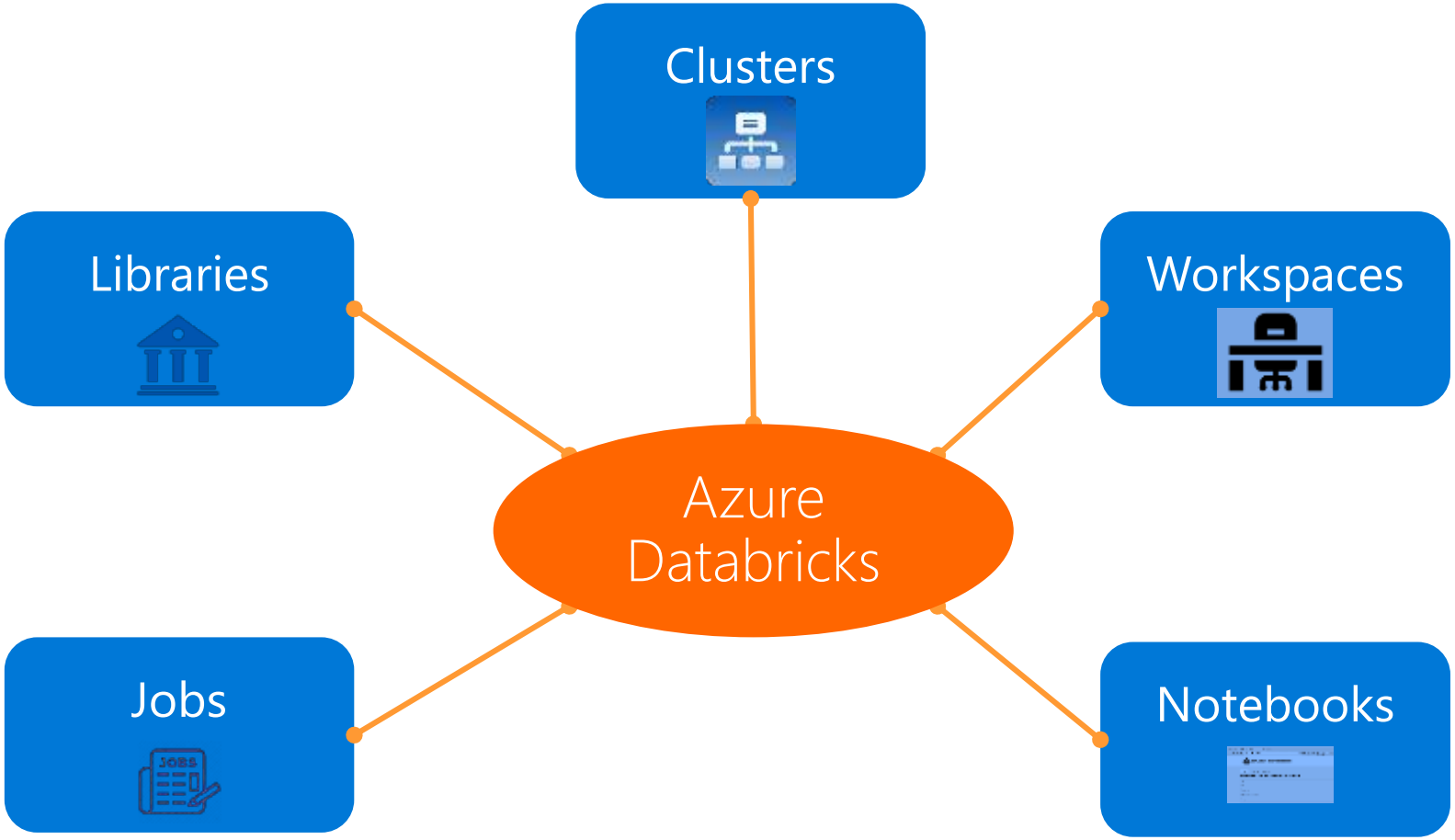
Set up alerts and quickly access audit logs for easy monitoring and troubleshooting

INTEGRATE NATIVELY WITH AZURE SERVICES

Deep integration with Azure SQL Data Warehouse, Cosmos DB, Azure Data Lake Store, Azure Blob Storage, and Azure Event Hub



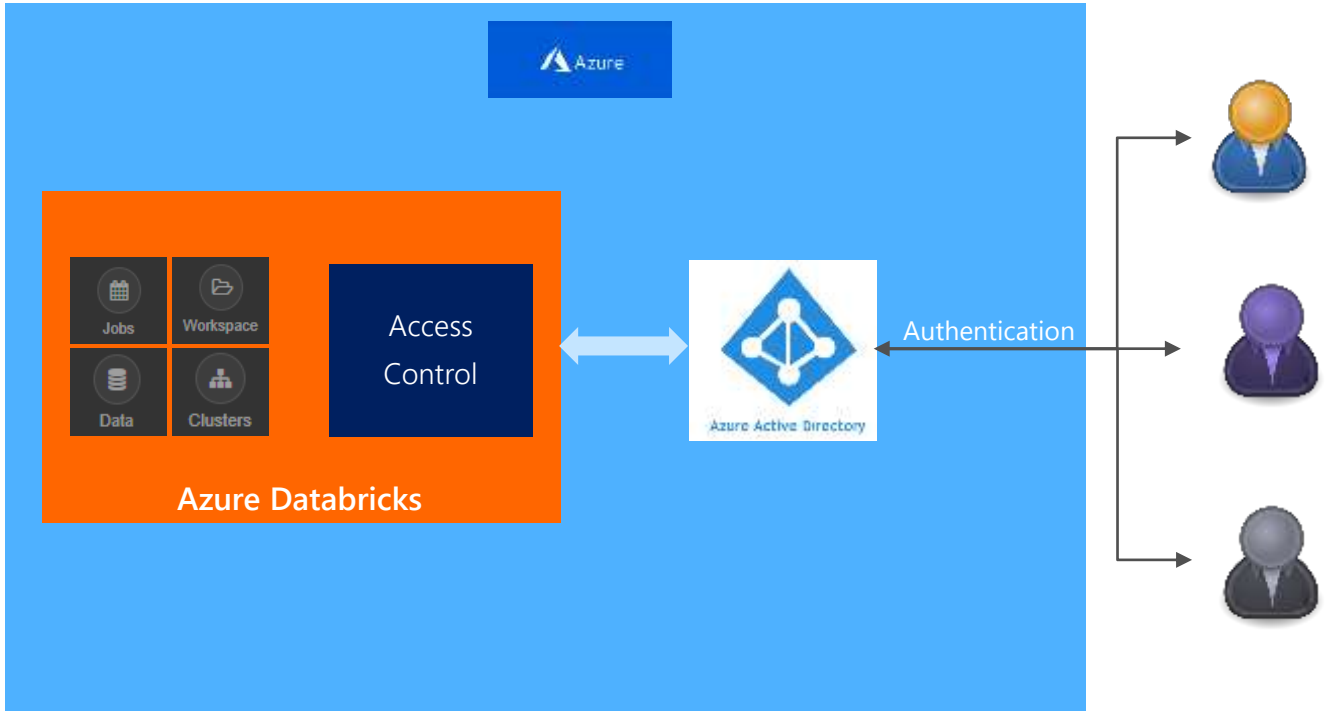
AZURE DATABRICKS CORE ARTIFACTS



AZURE DATABRICKS INTEGRATION WITH AAD

Azure Databricks is integrated with AAD—so Azure Databricks users are just regular AAD users

- There is no need to define users—and their access control—separately in Databricks.
- AAD users can be used directly in Azure Databricks for all user-based access control (Clusters, Jobs, Notebooks etc.).
- Databricks has delegated user authentication to AAD enabling single-sign on (SSO) and unified authentication.
- *Notebooks, and their outputs, are stored in the Databricks account*. However, AAD-based access-control ensures that only authorized users can access them.



CLUSTERS: AUTO SCALING AND AUTO TERMINATION

Simplifies cluster management and reduces costs by eliminating wastage

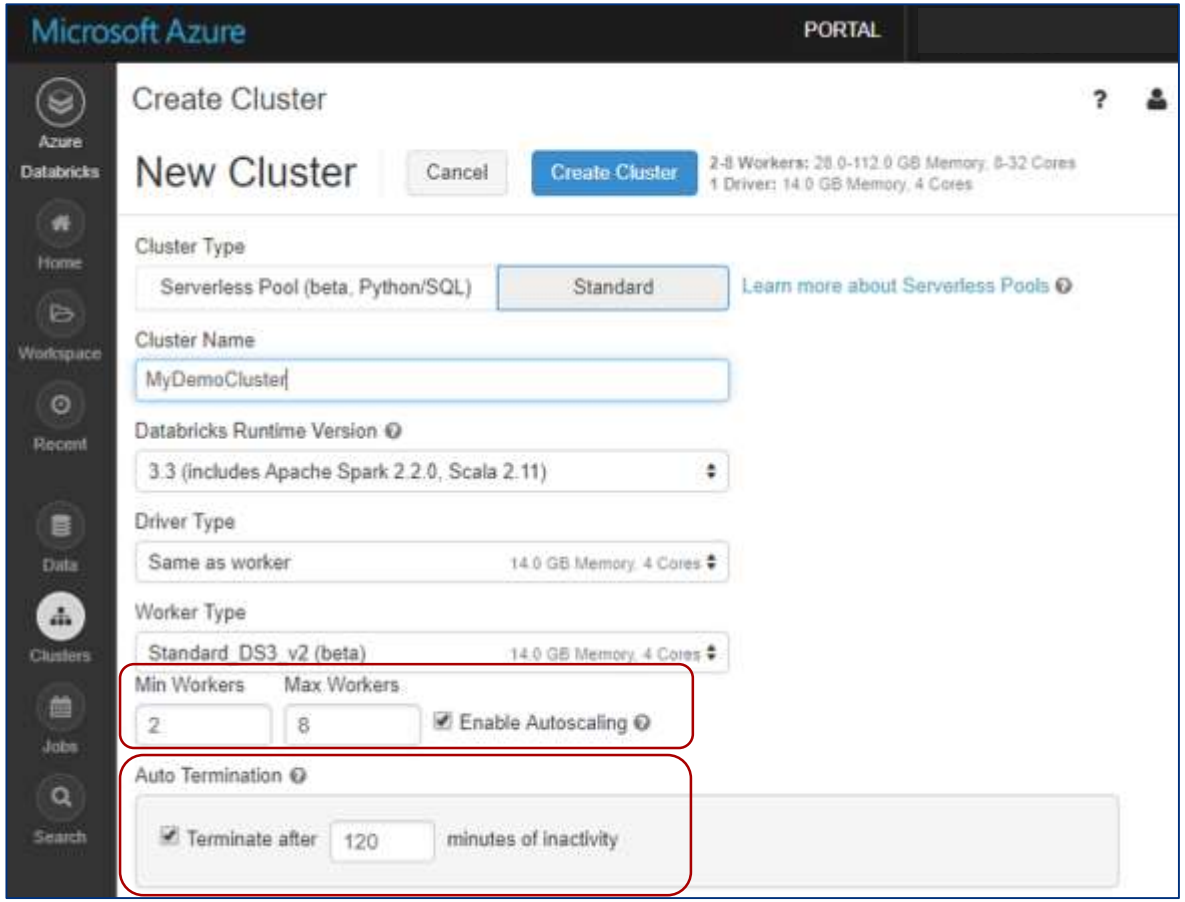
When creating Azure Databricks clusters you can choose Autoscaling and Auto Termination options.

Autoscaling: Just specify the min and max number of clusters. Azure Databricks automatically scales up or down based on load.

Auto Termination: After the specified minutes of inactivity the cluster is automatically terminated.

Benefits:

- You do not have to guess, or determine by trial and error, the correct number of nodes for the cluster
- As the workload changes you do not have to manually tweak the number of nodes
- You do not have to worry about wasting resources when the cluster is idle. You only pay for resource when they are actually being used
- You do not have to wait and watch for jobs to complete just so you can shutdown the clusters



J O B S

Jobs are the mechanism to submit Spark application code for execution on the Databricks clusters

- Spark application code is submitted as a ‘Job’ for execution on Azure Databricks clusters
- Jobs execute either ‘Notebooks’ or ‘Jars’
- Azure Databricks provide a comprehensive set of graphical tools to create, manage and monitor Jobs.

AZURE DATABRICKS NOTEBOOKS OVERVIEW

Notebooks are a popular way to develop, and run, Spark Applications

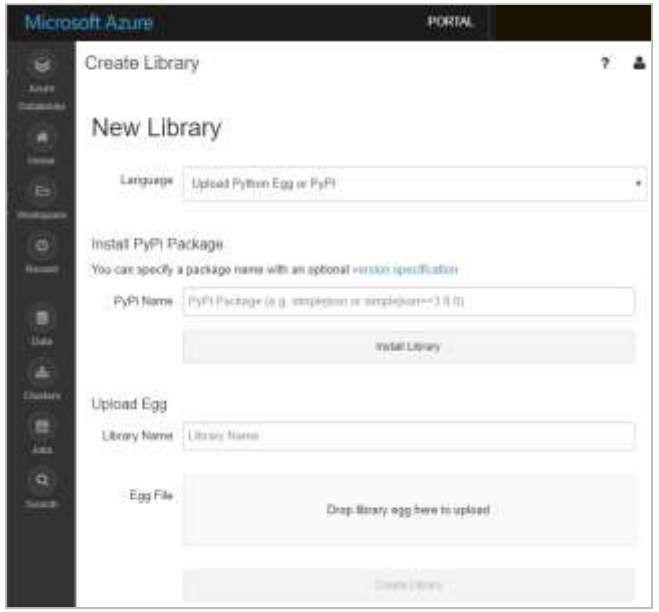
- Notebooks are not only for authoring Spark applications but can be *run/executed directly* on clusters
  - Shift+Enter
  - click the ▶ at the top right of the cell in a notebook
  - Submit via Job
- Notebooks support fine grained permissions—so they can be *securely shared* with colleagues for collaboration (see following slide for details on permissions and abilities)
- Notebooks are well-suited for prototyping, rapid development, exploration, discovery and iterative development

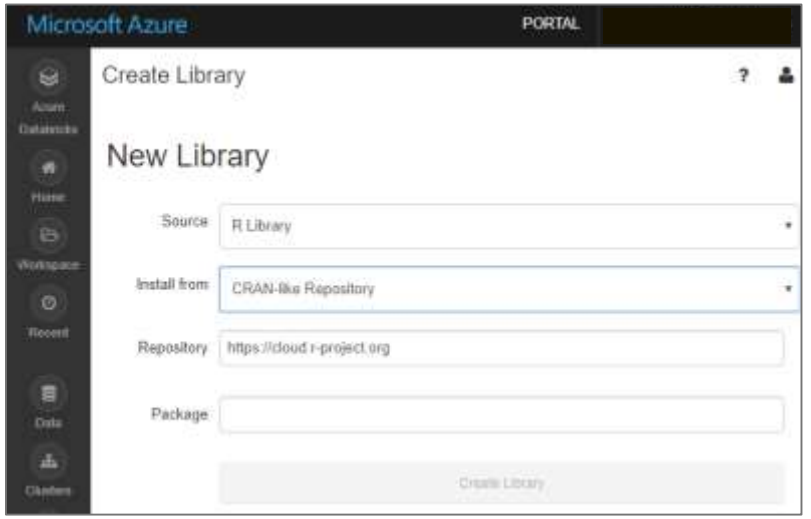
Notebooks typically consist of code, data, visualization, comments and notes

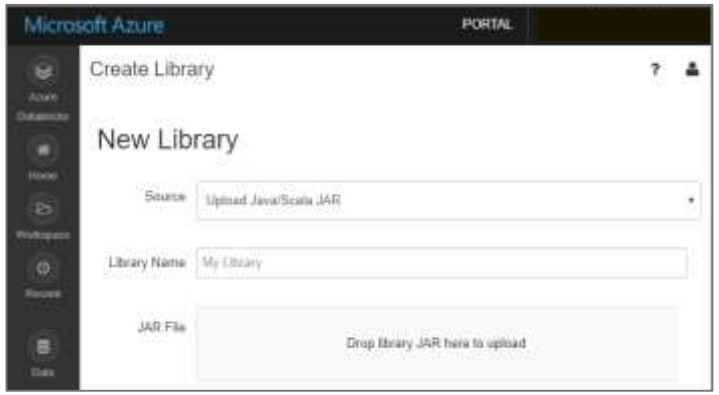
LIBRARIES OVERVIEW

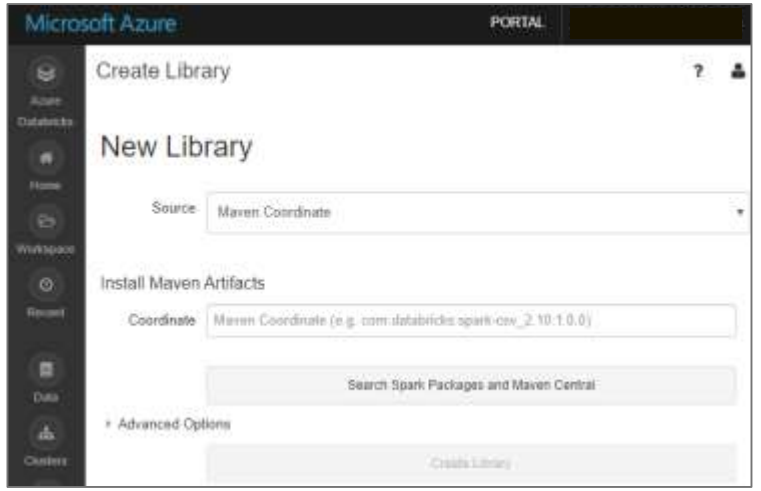
Enables external code to be imported and stored into a Workspace

- Libraries are containers to hold all your *Python, R, Java/Scala* libraries.
- Libraries resides within workspaces or folders.
- Libraries are created by importing the source code
- After importing libraries are immutable—can be deleted or overwritten only.
- You can customize installation of libraries via Init Scripts by writing custom UNIX scripts
- Libraries can also be managed via the Library API





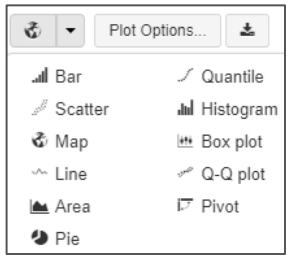


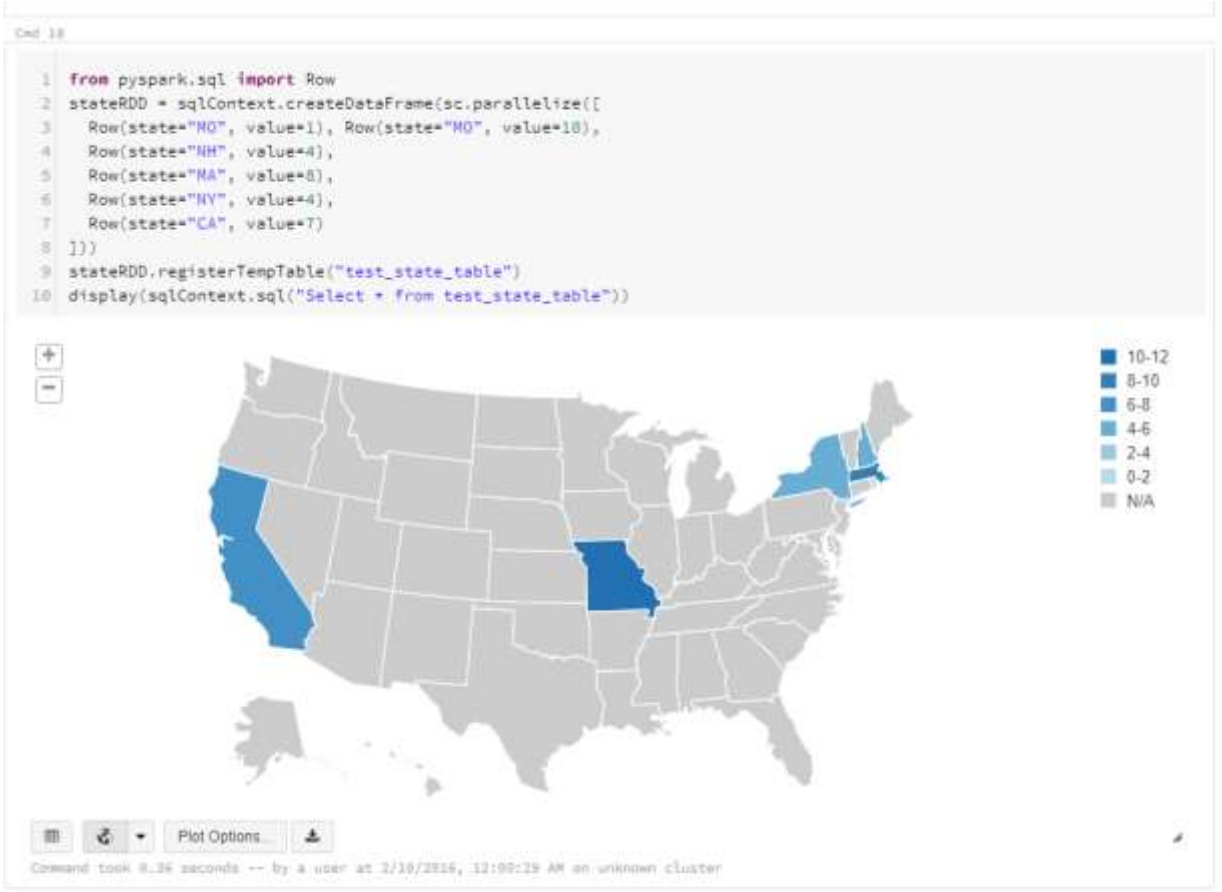


VISUALIZATION

Azure Databricks supports a number of visualization plots out of the box

- All notebooks, *regardless of their language*, support Databricks visualizations.
- When you run the notebook the visualizations are rendered inside the notebook in-place
- The visualizations are written in HTML.
  - You can save the HTML of the entire notebook by exporting to HTML.
  - If you use Matplotlib, the plots are rendered as images so you can just right click and download the image
- You can change the plot type just by picking from the selection

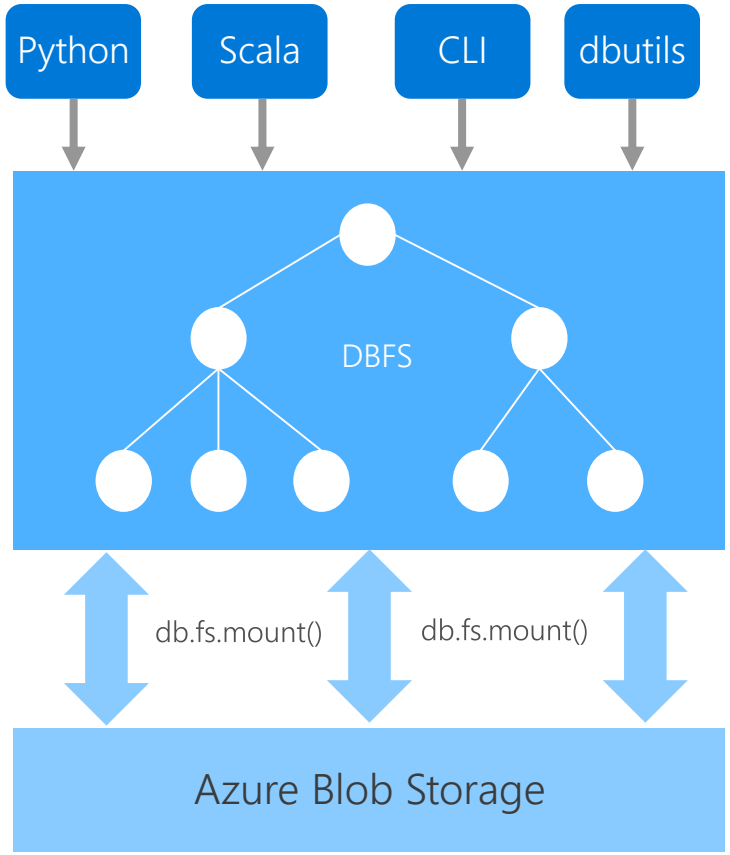




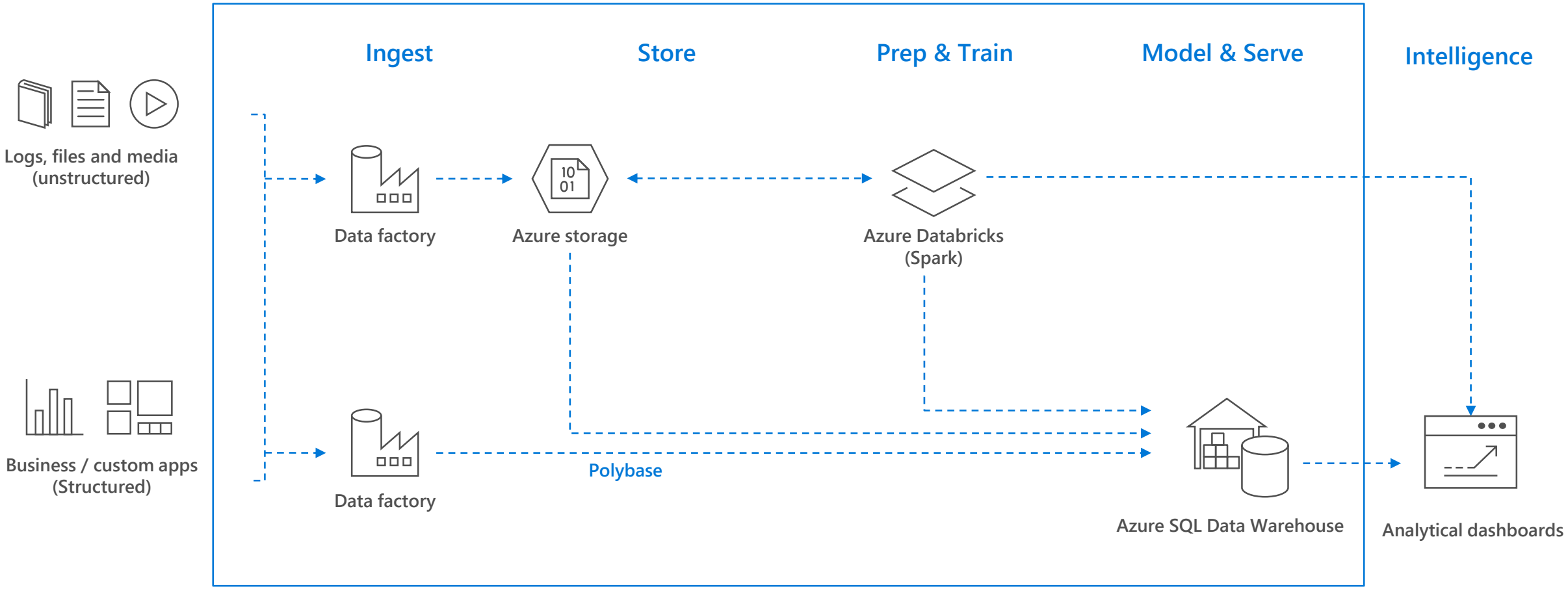
DATABRICKS FILE SYSTEM (DBFS)

Is a distributed File System (DBFS) that is a layer over Azure Blob Storage

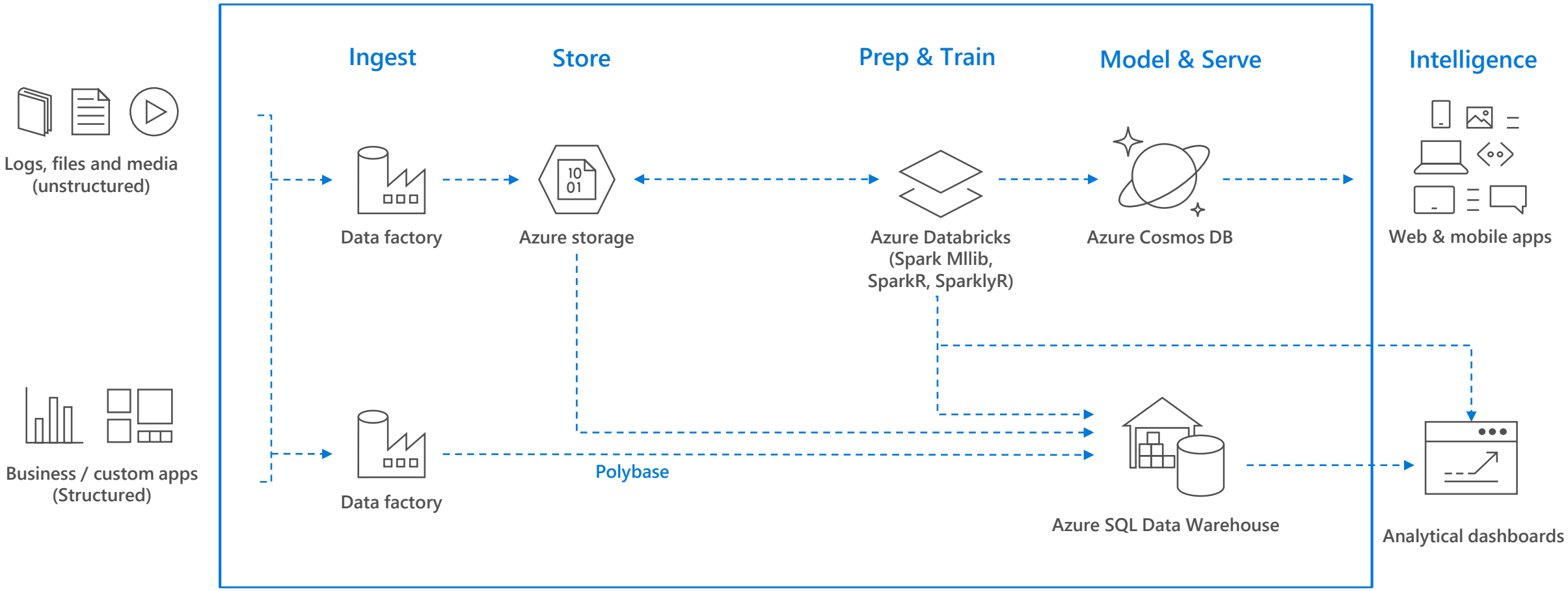
- Azure Storage buckets can be mounted in DBFS so that users can directly access them without specifying the storage keys
- DBFS mounts are created using *dbutils.fs.mount()*
- Azure Storage data can be cached locally on the SSD of the worker nodes
- Available in both Python and Scala and accessible via a DBFS CLI
- Data persist in Azure Blob Storage – is not lost even after cluster termination
- Comes pre-installed on Spark clusters in Databricks



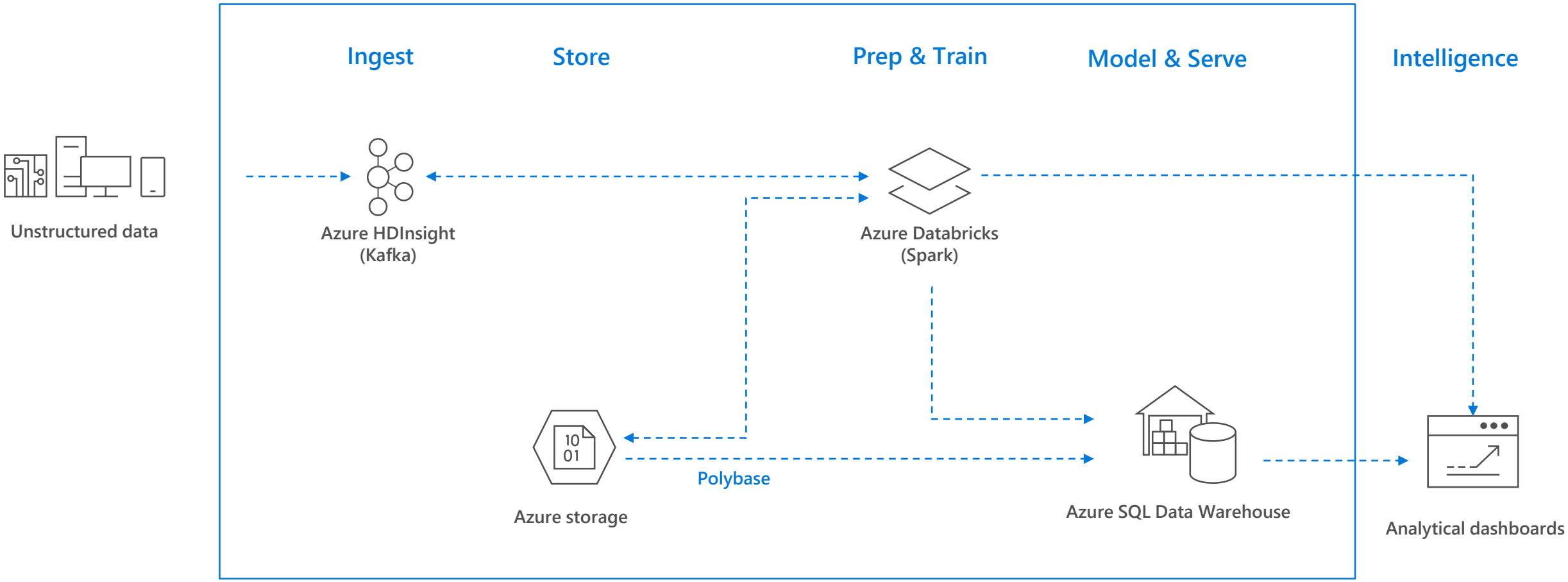
Modern Big Data Warehouse



Advanced Analytics on Big Data



Real-time analytics on Big Data



Big Data OSS - Comparison

Azure HDInsight (1st party + Support)

What it is

- **Hadoop** (Hortonworks' Distribution) as a managed service supporting a variety of open-source analytics engines such as Apache Spark, Hive LLAP, Storm, Kafka, HBase.
- Security via Ranger (Kerberos based)

Pricing

- Priced to compete with AWS EMR. Standard offering.

Use When

- Customer prefers a **PaaS** like experience to address big data use cases by working with different OSS analytics engines to address big data use cases. Cost sensitive.

Azure Databricks (1st party + Support)

What it is

- Databricks **Spark**, the most popular open-source analytics engine, as a managed service providing an easy and fast way to unlock big data use cases. Offers best-in-class notebooks experience for productivity and collaboration as well integration with Azure Data Warehouse, Power BI, etc
- Security via native Azure AD integration

Pricing

- Priced to match Databricks on AWS. Premium offering.

Use When

- Customer prefers **SaaS** like experience to address big data use cases and values Databricks' ease of use, productivity & collaboration features.

3rd Party Offerings

What it is

Hadoop distributions from Cloudera, MapR & Hortonworks available on Azure Marketplace as IaaS VMs.

Pricing

- N/A. Vendor prices their products.

Use When

- Customer wants to move their on premises Hadoop distribution to Azure IaaS using their existing licenses.

Analytics store

Nuances and data engineering challenges

Era Of Big Data

How it evolved and what is is for us in current market trends

Big Data was the Missing Link for AI

BIG DATA

Customer Data

Emails/Web pages

Click Streams

Sensor data (IoT)

Video/Speech

…

GREAT RESULTS

Most companies are Struggling with Big Data

BigData is not only Hadoop

Hardest part of AI isn't AI

"Hidden Technical Debt in Machine Learning Systems", Google NIPS 2015

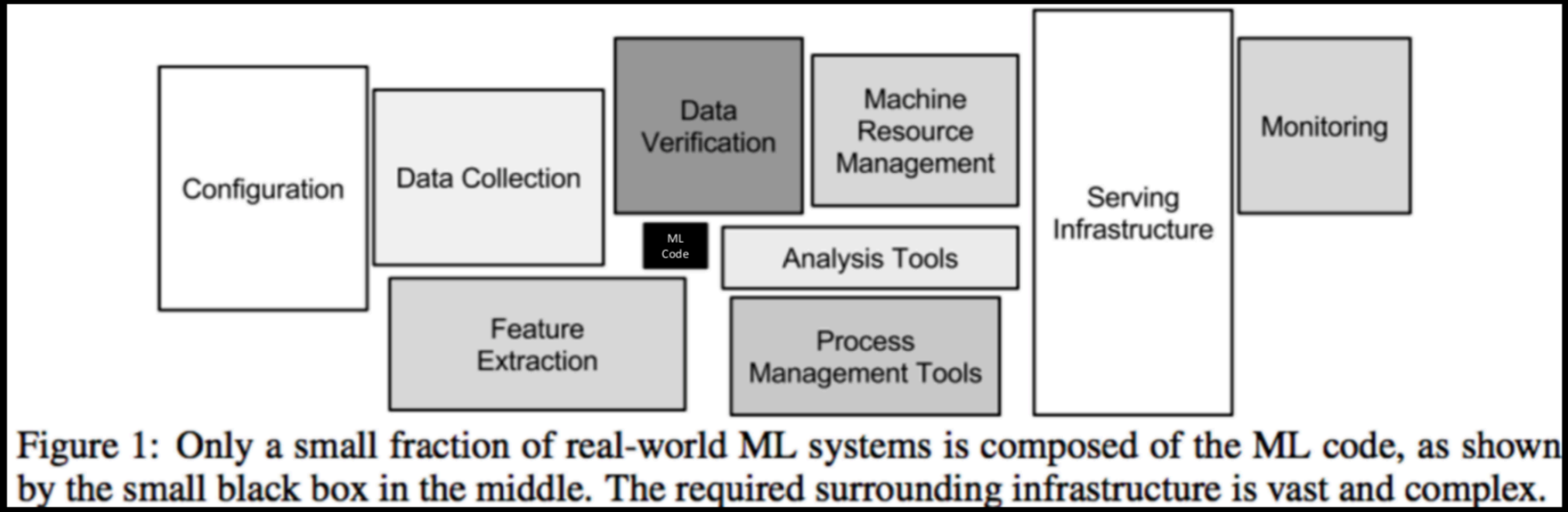


Figure 1: Only a small fraction of real-world ML systems is composed of the ML code, as shown by the small black box in the middle. The required surrounding infrastructure is vast and complex.

The hardest part of AI is Big Data

The Evolution of Big Data

Data Warehouse (DW)

ETL important data to central DW and get Business Intelligence (BI)

THE GOOD

- Pristine Data
- Fast Queries
- Transactional

THE BAD

- Expensive to Scale, not Elastic
- Requires ETL, Stale Data, No Real-Time
- No Predictions, No ML
- Closed formats (lock in)

Not Future Proof – Missing Predictions, Real-time, Scale

The Era of the Data Lake

Hadoop Data Lake

ETL all data to central scalable open lake for all use cases

THE GOOD

- Massive scale
- Inexpensive Storage
- Open Formats (Parquet, ORC)
- Promise of ML & Real Time Streaming

THE BAD

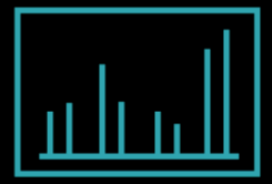
- Inconsistent Data
- Unreliable for Analytics
- Lack of Schema
- Poor Performance

Become a cheap messy data store with poor performance

The Current State of Data Platforms

Evolution of a Cutting-Edge Data Pipeline

Events



Streaming Analytics

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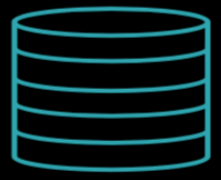
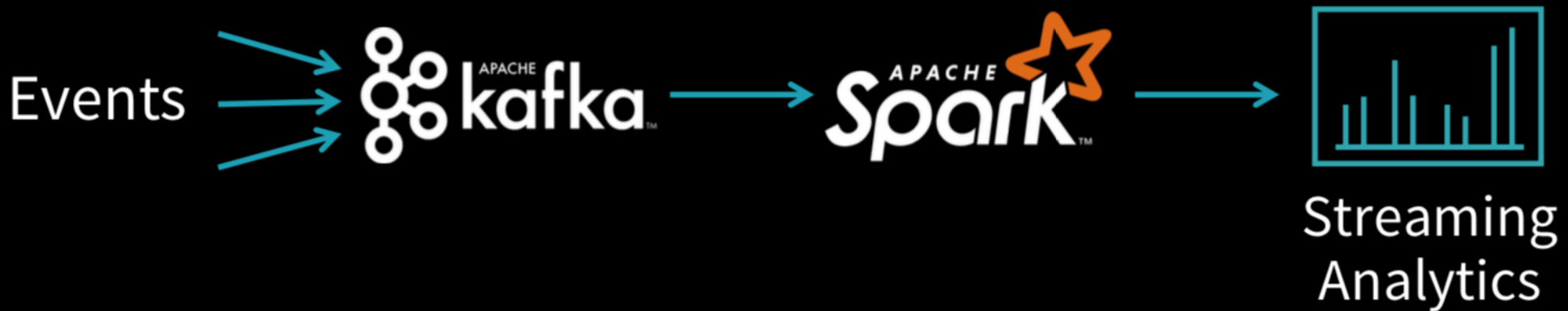


Data Lake

Reporting

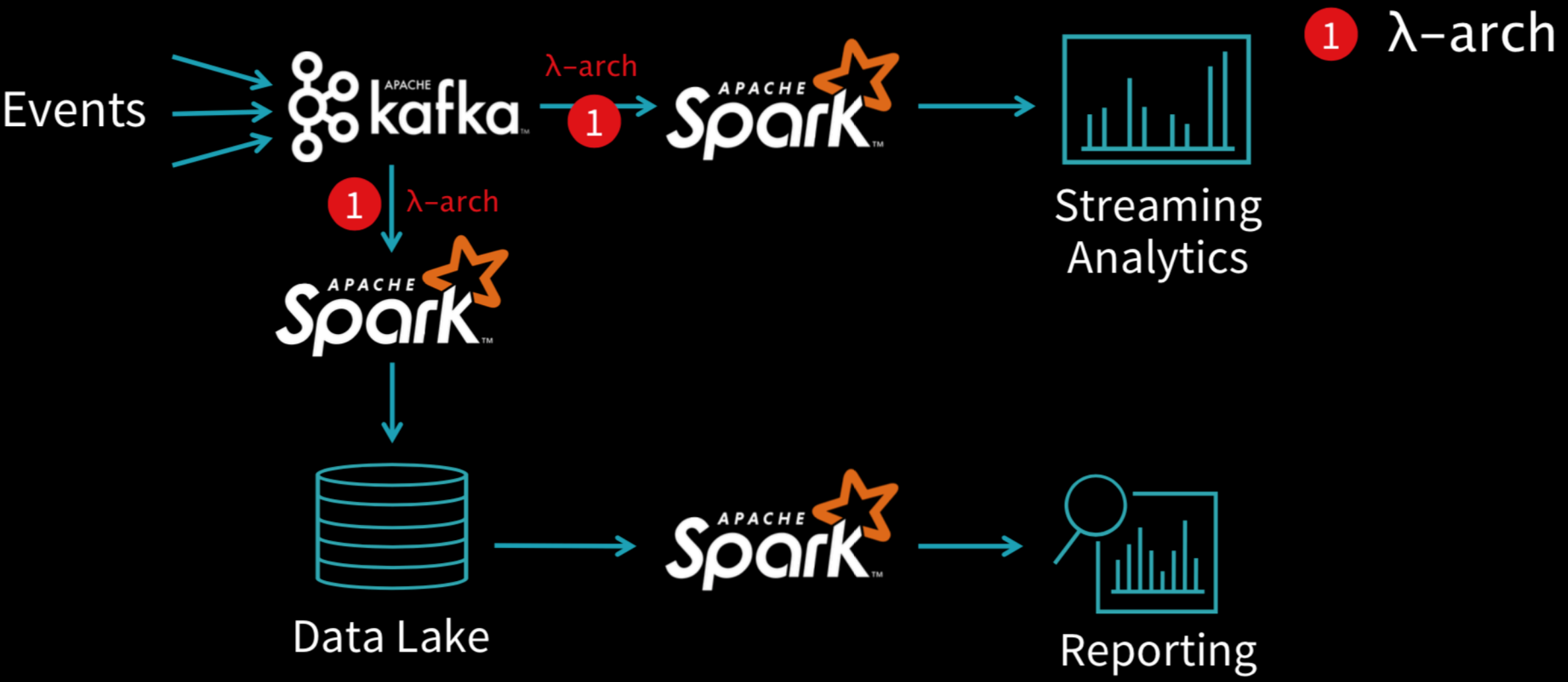
Evolution of a Cutting-Edge Data Pipeline



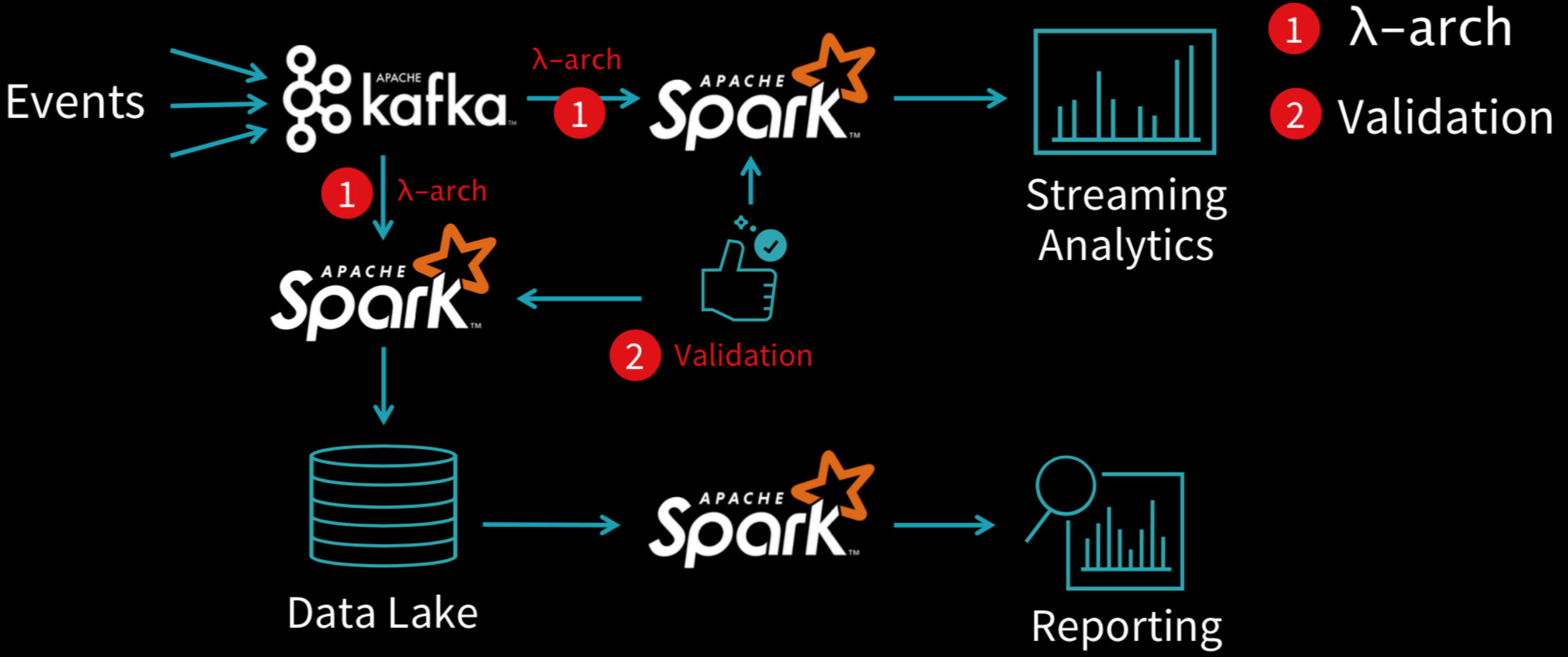
Data Lake

Reporting

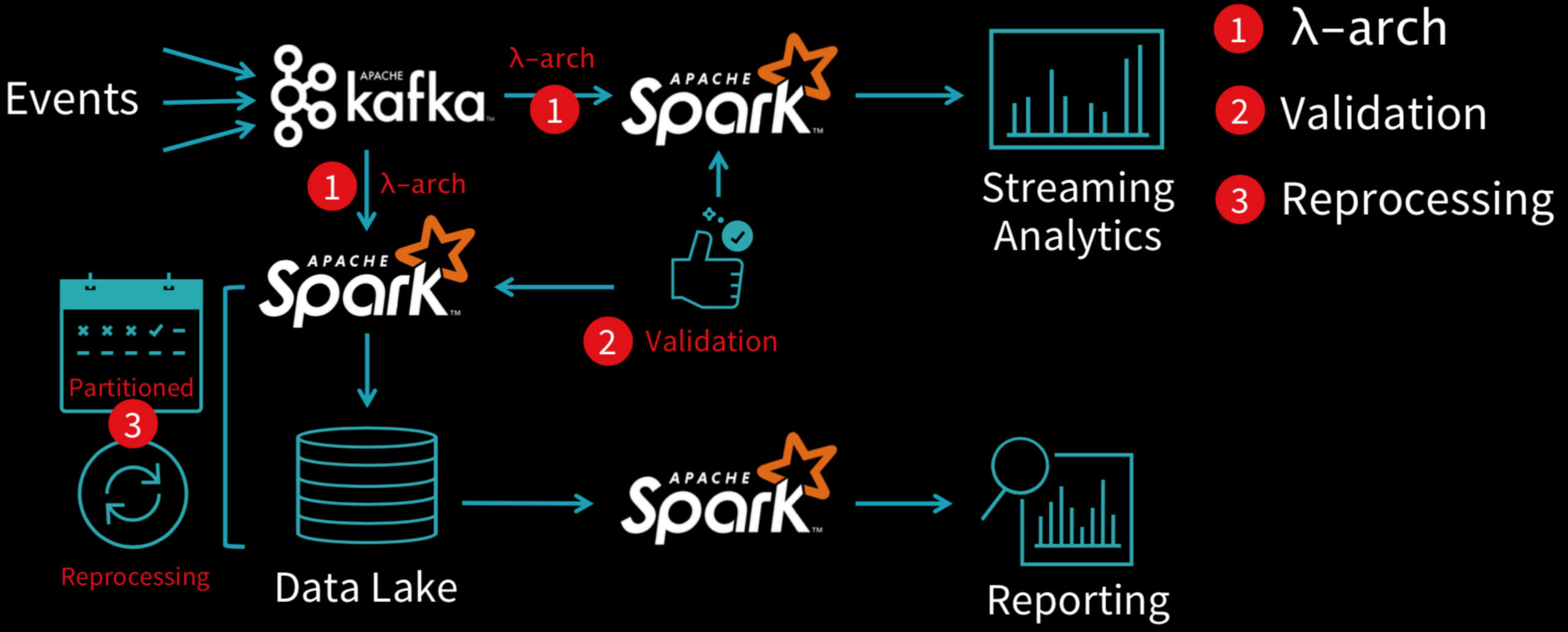
Challenge #1: Historical Queries?



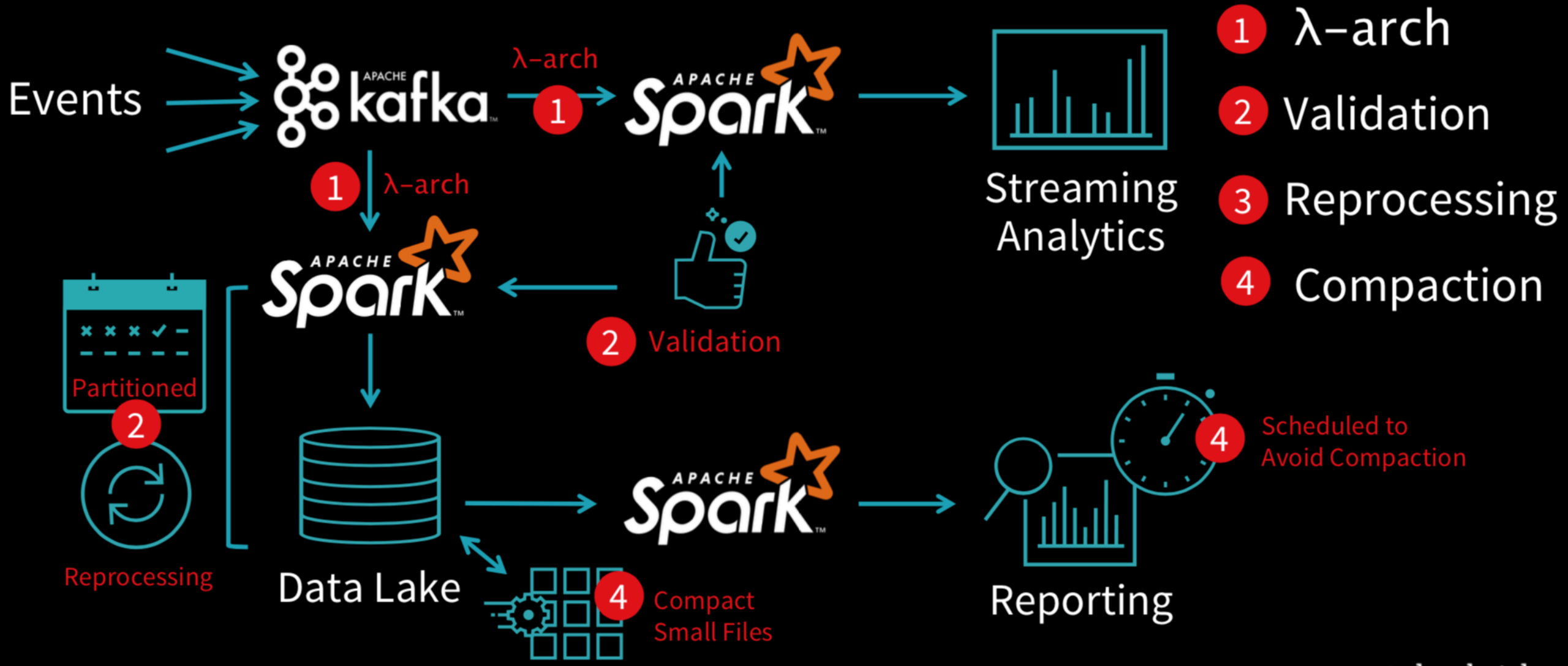
Challenge #2: Messy Data?



Challenge #3: Mistakes and Failures?

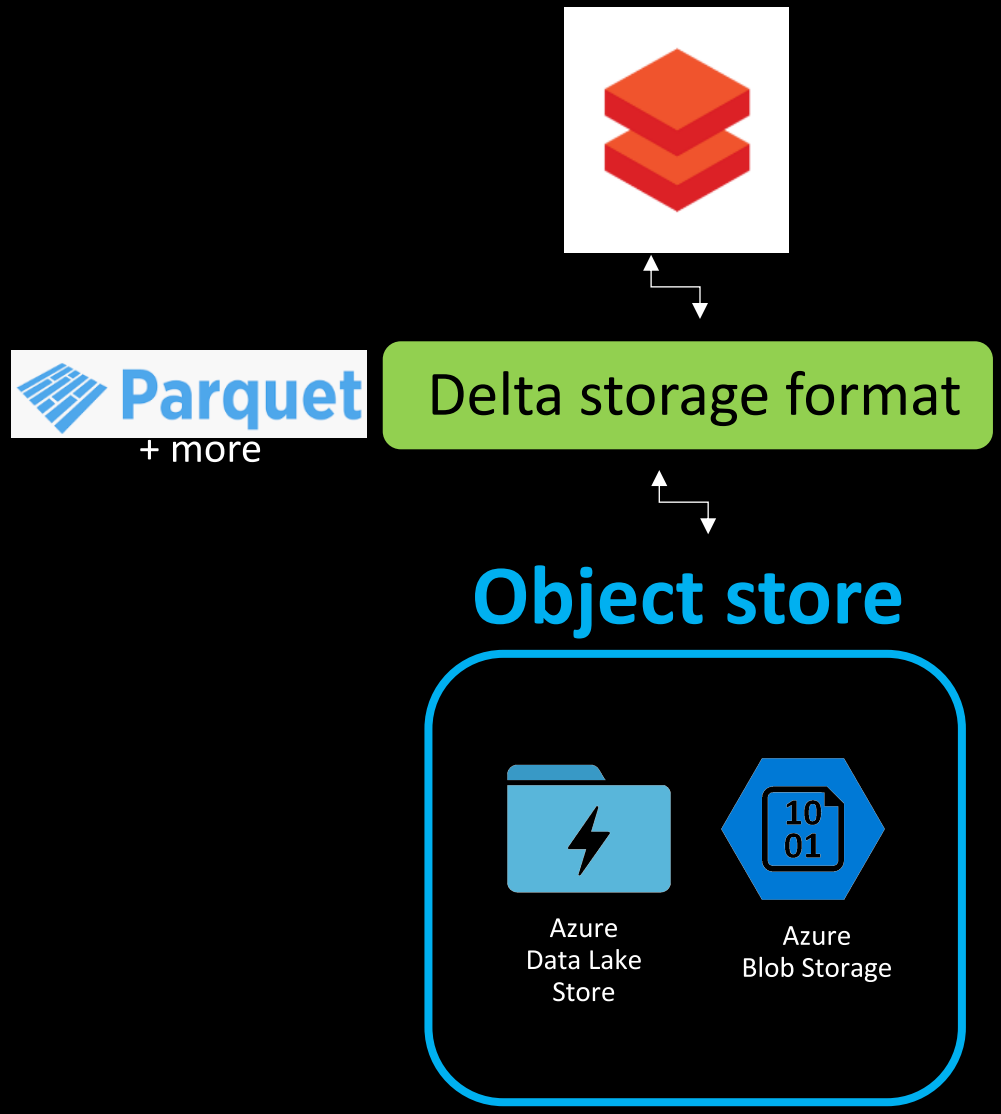


Challenge #4: Query Performance?



What is Databricks Delta?

Databricks Delta is fundamentally.....

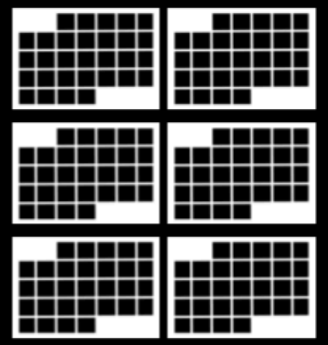


Info Sec Project

Project description: enable streaming analytics and standard reporting on 1 trillion events per day with ACID transactions, serverless architecture, compressed indexed storage, decoupled from compute, transactional reliability, and scalable on demand.

2016

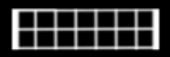
20 people



6 months

2017

5 people



2 weeks

=

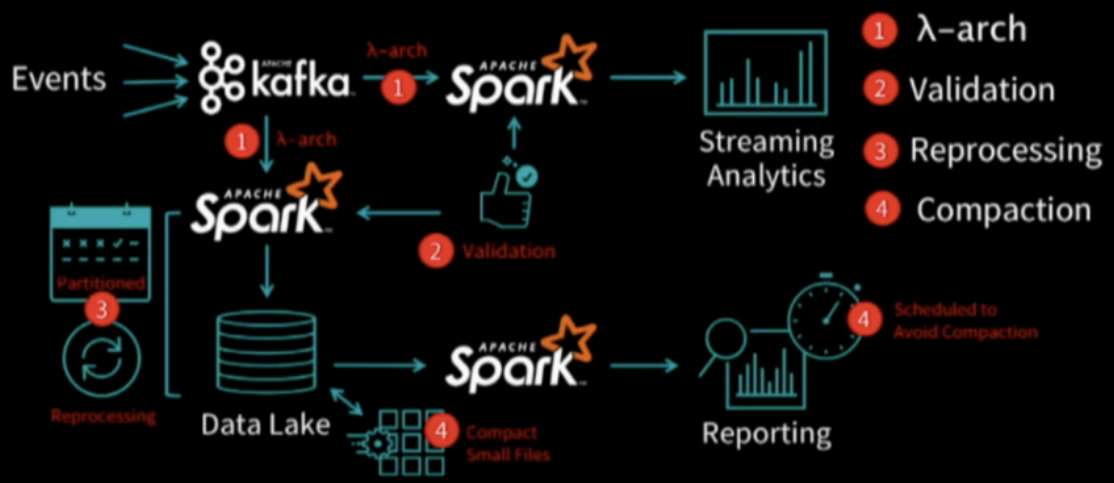
42 X

Reduction in Effort

How is a 42x improvement possible?

Databricks Delta

Architecture Before Databricks Delta



The Delta Architecture

https://spark-summit.org/eu-2017/events/announcing-databricks-delta/

Throughput & Latency: Structured Streaming

THROUGHPUT

- Improved throughput in 2.2 due to tight integration with Tungsten and Catalyst

LATENCY

- Single event mode available in Spark 2.3 with sub-millisecond latency comparable to Flink

INTEGRATION

- Nearly identical syntax with batch, just add stream to action directive, e.g. "writeStream"

DEBUGING

- Live monitoring and debugging in Databricks UI