PROFINIT

B0M33BDT - Azure

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Agenda

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- Fundamentals
- Data Services
- Databricks
- AI/ML Services

Azure (fundamentals)

Management levels and hierarchy

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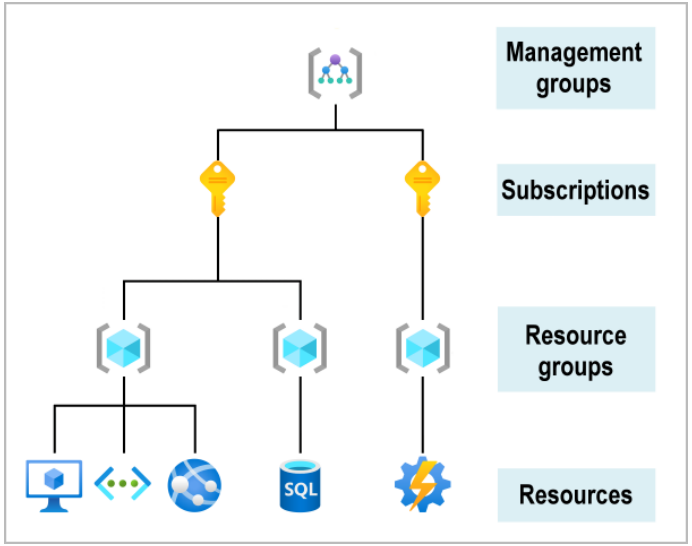
- Four levels of management
  1. **Resources**
     - Instance of a cloud service (e.g. different types of storages, databases, compute services, virtual machines…).
  2. **Resource groups**
     - Containers that hold related resources for an Azure solution.
       - Enables to configure multiple resources at once, delete all resources within it etc.
     - Can’t be nested.
     - Associated with one region and subscription.
       - Can contain resources from different regions!

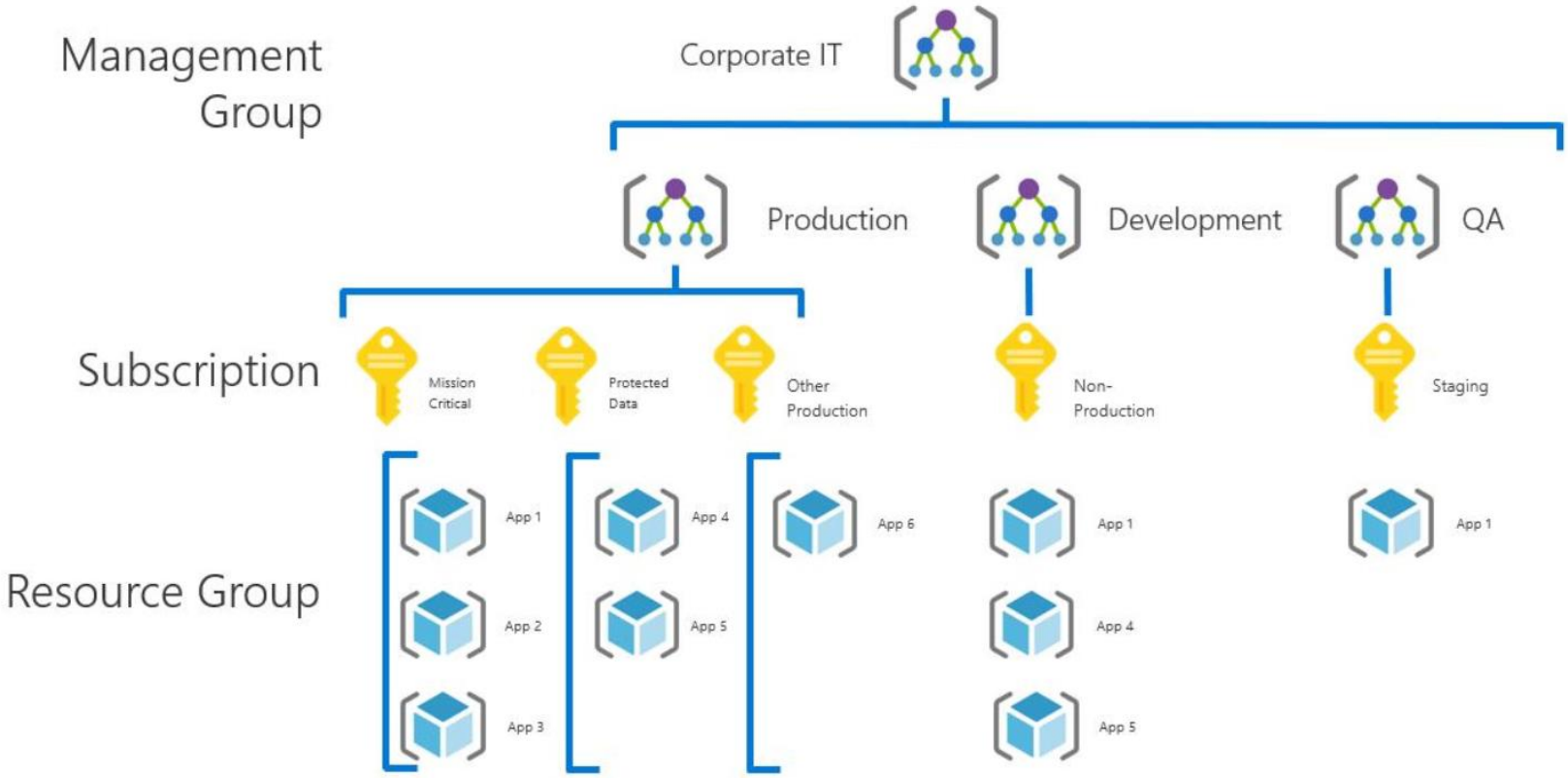
3. Subscriptions

- Groups resource groups.
- Used for billing purposes, setting limits on spending etc.
- Can’t be nested.



4. Management groups

- Manage access, policies, and compliance for multiple subscriptions or other management groups (can be nested).
- Max. 7 levels of depth, one root management group.


Management Group
Corporate IT
Production
Development
QA
Subscription
Mission Critical
Protected Data
Other Production
Non-Production
Staging
Resource Group
App 1
App 2
App 3
App 4
App 5
App 6
App 1
App 4
App 5
App 1

How to create a resource

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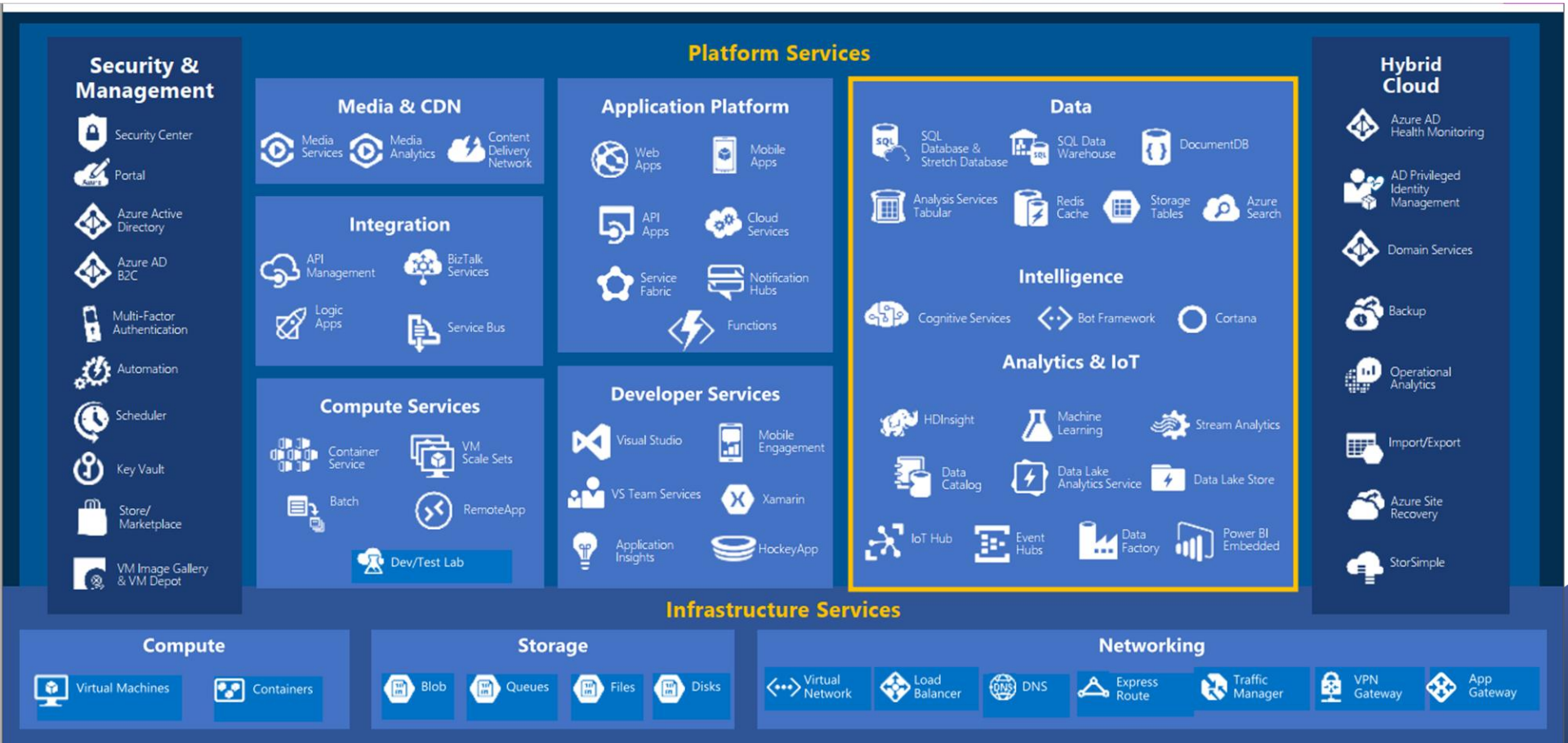
- *Create Management Group (not necessary)*
- Create **Subscription**
- Create **Resource Group**
- Create **Resource**
  - **ARM** template (Azure Resource Manager) – resource definition in JSON
  - **Bicep** - Domain Specific Language (DSL)
  - **CLI** (Command Line Interface) – **az** utility
  - Manually in **Azure Portal**

Azure stack


Security & Management
Security Center
Portal
Azure Active Directory
Azure AD B2C
Multi-Factor Authentication
Automation
Scheduler
Key Vault
Store/ Marketplace
VM Image Gallery & VM Depot
Platform Services
Media & CDN
Media Services
Media Analytics
Content Delivery Network
Integration
API Management
BizTalk Services
Logic Apps
Service Bus
Compute Services
Container Service
VM Scale Sets
Batch
RemoteApp
Dev/Test Lab
Application Platform
Web Apps
Mobile Apps
API Apps
Cloud Services
Service Fabric
Notification Hubs
Functions
Developer Services
Visual Studio
Mobile Engagement
VS Team Services
Xamarin
Application Insights
HockeyApp
Data
SQL Database & Stretch Database
SQL Data Warehouse
DocumentDB
Analysis Services Tabular
Redis Cache
Storage Tables
Azure Search
Intelligence
Cognitive Services
Bot Framework
Cortana
Analytics & IoT
HDInsight
Machine Learning
Stream Analytics
Data Catalog
Data Lake Analytics Service
Data Lake Store
IoT Hub
Event Hubs
Data Factory
Power BI Embedded
Hybrid Cloud
Azure AD Health Monitoring
AD Privileged Identity Management
Domain Services
Backup
Operational Analytics
Import/Export
Azure Site Recovery
StorSimple
Infrastructure Services
Compute
Virtual Machines
Containers
Storage
Blob
Queues
Files
Disks
Networking
Virtual Network
Load Balancer
DNS
Express Route
Traffic Manager
VPN Gateway
App Gateway

BDDS Stack

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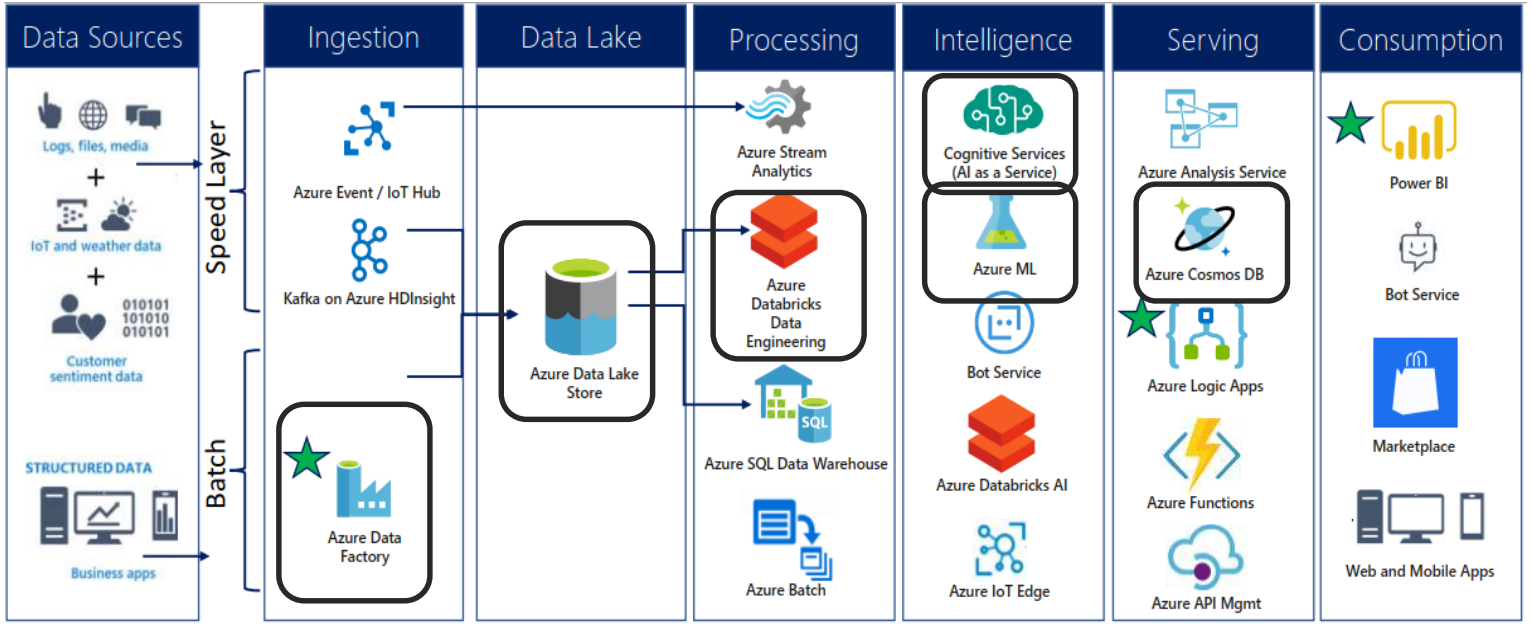

Relevant BD resources in Azure

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- Azure Data Factory
- Azure Storage Account / Storage Account Services
- Azure Databases
- Azure Fabric
- **Azure Databricks**
- Azure ML & Azure Cognitive services
- Azure HDInsight

Azure (Big) Data Services

Azure Data Factory (ADF)

- Data integration service.
- GUI for creating **data-driven workflows** for orchestrating data movement/transformation.
- „**Pay-as-you-go**“ billing model.

Code-Free ETL as a service

Ingest

- Multi-cloud and on-premise hybrid copy data
- 100+ native connectors
- Serverless and auto-scale
- Use wizard for quick copy jobs

Control Flow

- Design code-free data pipelines
- Generate pipelines via SDK
- Utilize workflow constructs: loops, branches, conditional execution, variables, parameters, ...

Data Flow

- Code-free data transformations that execute in Spark
- Scale-out with Azure Integration Runtimes
- Generate data flows via SDK
- Designers for data engineers and data analysts

Schedule

- Build and maintain operational schedules for your data pipelines
- Wall clock, event-based, tumbling windows, chained

Monitor

- View active executions and pipeline history
- Detail activity and data flow executions
- Establish alerts and notifications

Key components of ADF

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1. Datasets

- Named view of data that simply points or references the data.
  - “pointer to a data structure”
- Used for both input/output.
- E.g..: csv file in Blob Storage, database table, file on the internet (only as input) …

2. Mapping Data Flows

- Graphs of data transformation logic – for transforming data of any size.
- Executed on a Spark cluster that spins-up and spins-down when you need it.
  - No need to ever manage/maintain a cluster.
- Used as an activity.

Key components of ADF

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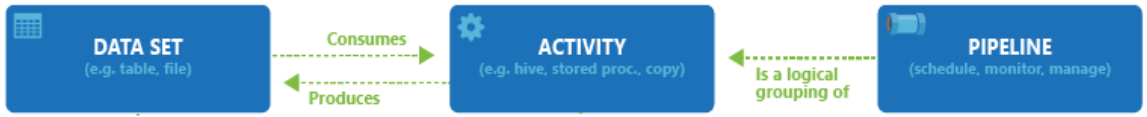
3. Activities (Tasks)

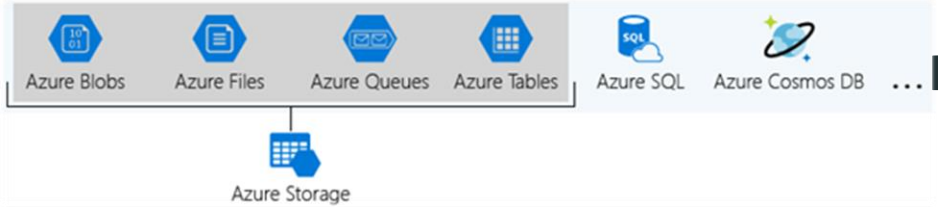
- Processing steps, actions, in a pipeline.
- Almost 100 different activities.
- E.g..: copy data activity (from one dataset to another), Hive activity that runs query on HDInsight cluster, Databricks notebook launch activity…

4. Pipelines

- Logical grouping of activities that performs a unit of work.
- Can be chained together to operate sequentially, or they can operate independently in parallel.
- Can be parametrized, uses variables, control flows (branching, for-each iterators…).

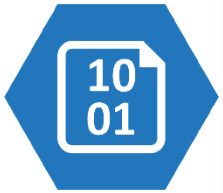


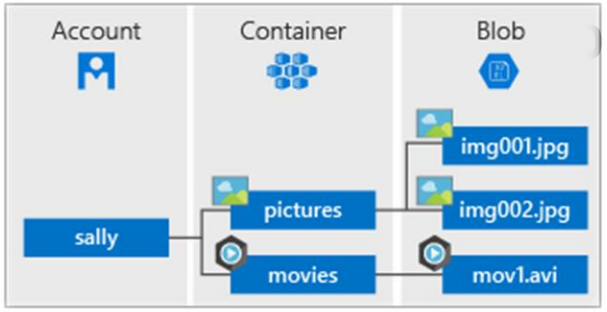
Storage Account



- Azure Storage offers several types of storage services.
- Data can be accessed from anywhere using HTTP/HTTPS.
  - https://<storage-account>.blob.core.windows.net
  - Globally unique name!
- Data in SA are **highly available**, **secured** a **massively scalable.**
- Configurable redundancy, disk types.
  - Locally redundant, zone-redundant, geo-redundant…

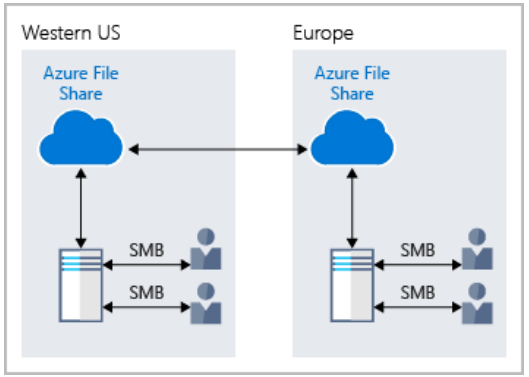
Storage Account services





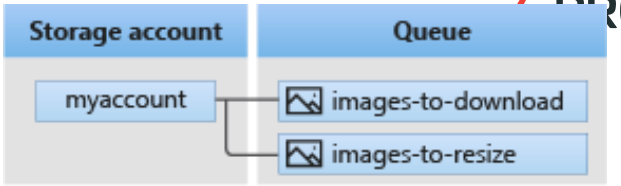
1. Blob storage

- Good for large unstructured data.
- Cheapest storage option on Azure.
- **Container** – structure for organizing blobs.



2. Azure files

- Fully managed Azure file share service.
- Can be easily mounted on Windows, Linux, MacOS.
- Server Message Block (SMB) Protocol
  - network file sharing protocol

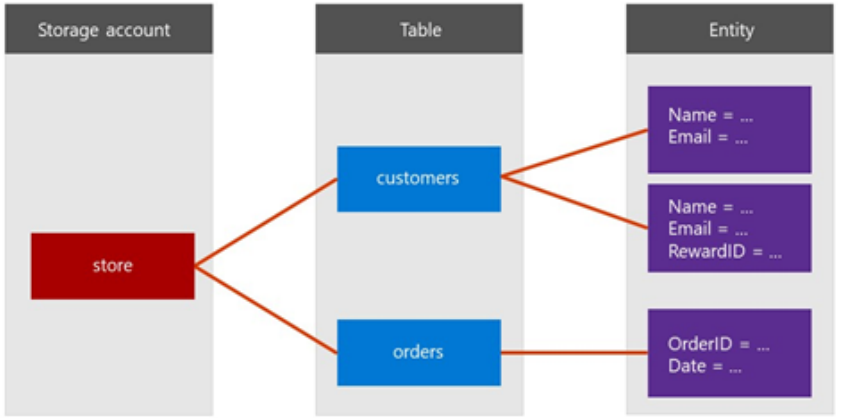


3. Azure Queue

- Storing large numbers of messages (to 64 KB).
- Communication between apps (on-premise + cloud).

4. Azure Tables

- Structured NoSQL data.
- Schema-less design.



5. Azure Data Lake Storage (ADLS)

- Comprehensive, scalable, and cost-effective data lake solution for high-performance big data analytics built into Azure
- Gen1 (Apache HDFS), **Gen2**
- **ADLS Gen2 = Azure Blob Storage + ADLS Gen1**

Azure Data Lake Storage Gen2

Azure Databases

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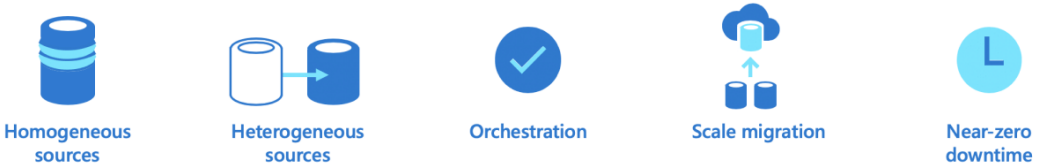
- Many SQL/NoSQL databases for various use cases.

- **Azure Database Migration Service**
  - Tool to simplify, guide, and automate database migration to Azure.
  - Convenient migration with near-zero downtime.
  - MySQL, PostgreSQL, MongoDB...



Azure SQL Databases

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- Azure Database for MariaDB, Azure Database for PostgreSQL, different SQL options
  - Depends on how much control over the OS we need.
  - Oracle – Oracle Cloud Infrastructure
- **IaaS**
- **PaaS**
  - Auto scaling.
  - Pay only for what you really use.

Azure Cosmos DB

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- Globally distributed, multi-model database service for any scale.
- NoSQL, big data.
- Guaranteed single-digit millisecond response times at any scale and 99.999-percent availability (99.999 SLA – highest on Azure).
- Automatic and instant scalability.
- SQL API, MongoDB API, Gremlin API (graphDB), Cassandra API, Table API.
- Good for data consuments (cache)

Azure Synapse Analytics

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- Platform that brings together data integration, enterprise data warehousing, and big data analytics.
- SQL pool & Spark pool & Synapse pipelines (Data Factory)
- Challanger for Databricks

Azure Fabric (Preview)

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- All-in-one analytics solution that covers everything from data movement to data science, Real-Time Analytics, and business intelligence
- OneLake + Azure Data Services
- A real Challanger for Databricks?

Azure components availability

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- Differs region to region
- See: https://azure.microsoft.com/en-us/global-infrastructure/services/

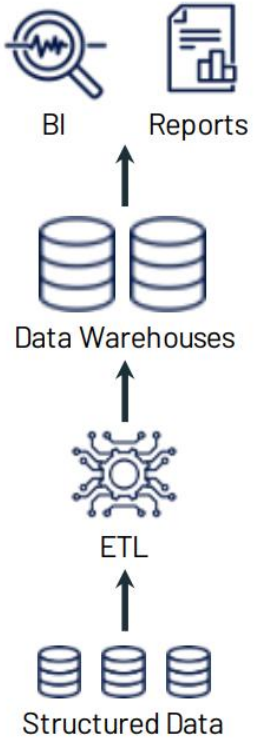
Databricks

Data Warehouse

- Minimal support for video, audio, text
- Long history in decision support and business intelligence applications
- limited support for streaming

→ therefore, most data stored in **Data Lakes**,

only subset of it in DWHs



Data Lake

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- - Does not support transactions.
- - Does not enforce data quality.
- Where DWH is good tool, Data Lake not so much:
  - poor BI support,
  - complex to set up and configure,
  - poor performance (when used i.e., for BI).

- Why to use it then? + Can handle all data
  - for ML, data science …

DWH + Data Lake

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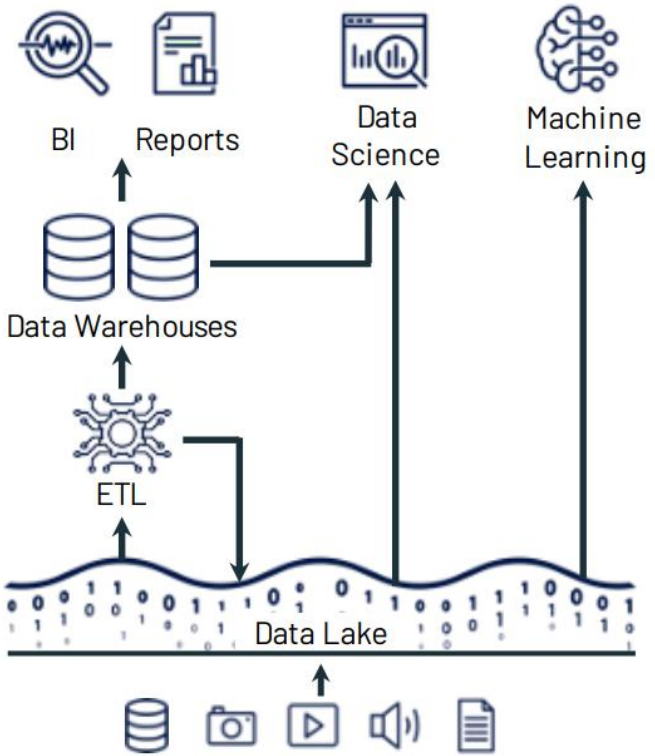
- Companies have **Data Lakes and Data Warehouses** side by side
  - Reusing current setup,
  - data duplication,
  - higher cost, administrative burden..
  - NOT ideal setup.



  - So, how it can be improved?
    - **Lakehouse**

Data Lakehouse

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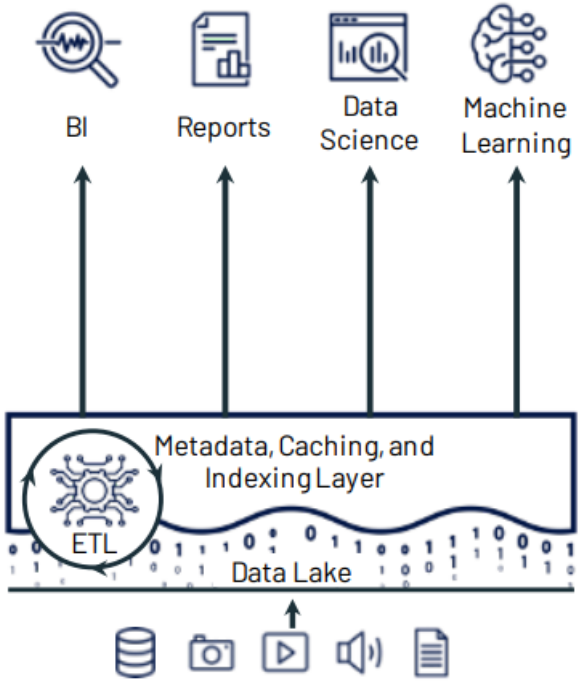
- Paradigm that brings the best of the two
- + Has **structured transactional layer**
- + Reduces data movement and complexity
- + Reduces cost
- + Support for diverse workloads
  - data science, machine learning, SQL, analytics …
- + Openness
  - open and standardized formats



As time passes…

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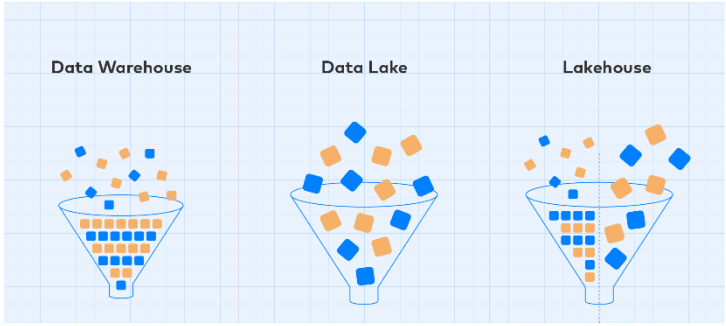

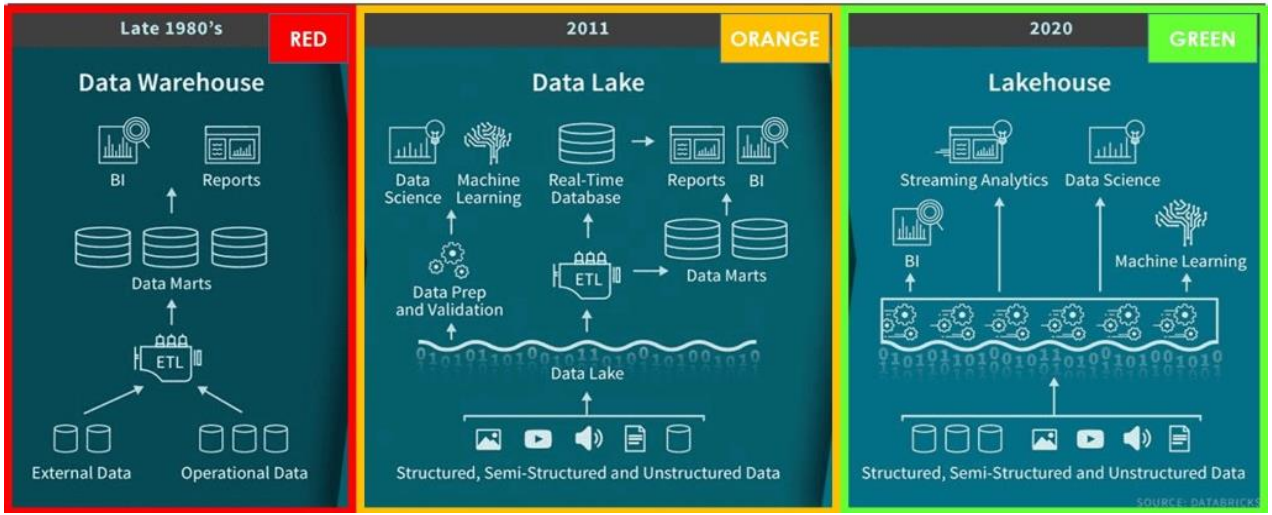

Difference recap

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	Data Warehouse	Data Lake	Data Lakehouse
Storage Data Type	Works well with structured data	Works well with semi-structured and unstructured data	Can handle structured, semi-structured, and unstructured data
Purpose	Optimal for data analytics and business intelligence (BI) use-cases	Suitable for machine learning (ML) and artificial intelligence (AI) workloads	Suitable for both data analytics and machine learning workloads
Cost	Storage is costly and time-consuming	Storage is cost-effective, fast, and flexible	Storage is cost-effective, fast, and flexible
ACID Compliance	Records data in an ACID-compliant manner to ensure the highest levels of integrity	Non-ACID compliance: updates and deletes are complex operations	ACID-compliant to ensure consistency as multiple parties concurrently read or write data

As Azure stack…

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Modern Data Warehouse

Lake Warehouse Data Science

Data Lakehouse

Single Combined Platform

(Data) Lakehouse by Databricks

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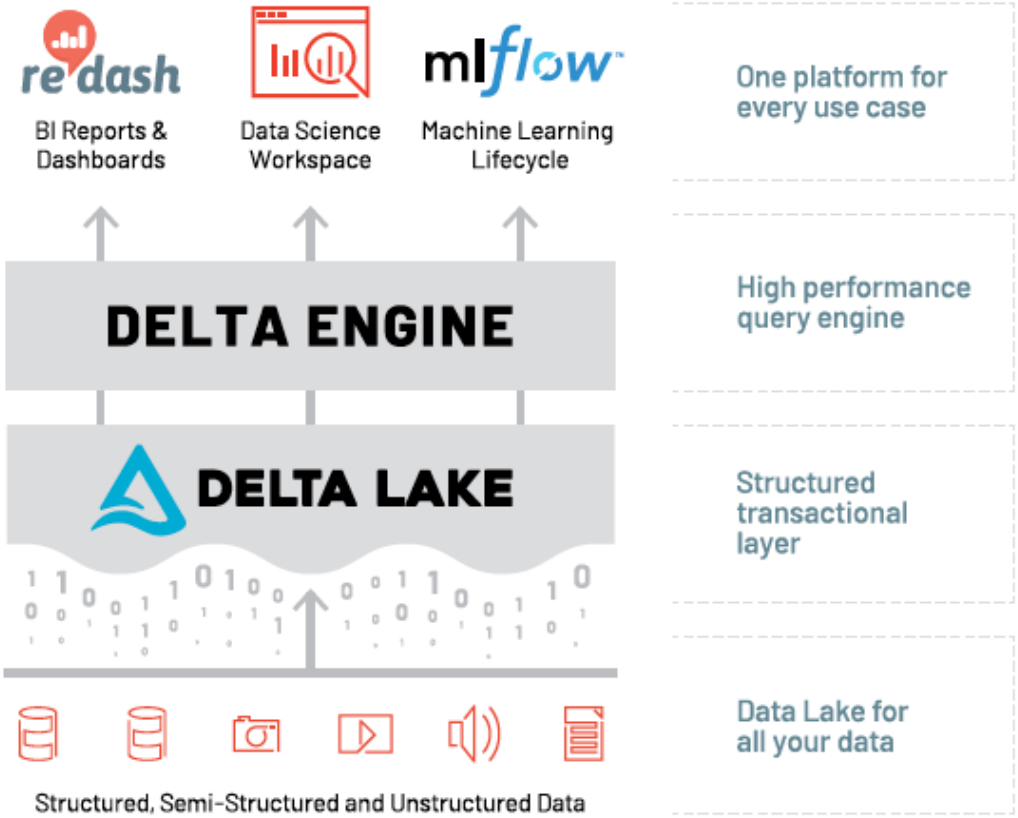

Delta Lake by Databricks

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- **Open-source storage format that brings ACID transactions to Spark and big data workloads**
- **Spark under the hood**, Indexing techniques, schema validation & expectations
- Foundation of a **cost-effective**, highly scalable lakehouse
- Single home for structured, semi-structured and unstructured data
- Unifies batch and streaming data processing
- Open format based on parquet

https://en.wikipedia.org/wiki/ACID

Databricks

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- **Collaborative** cloud unified data platform
  - for the entire data team (data scientists, analysts, engineers…)
- Builds on top of open-source software (Spark, MLFlow, Delta Lake…)
- Multilanguage notebooks (similar to Jupyter or Zeppelin)
  - Python, R, Scala, SQL
- Databricks SQL
  - Easily explore Delta Lake table schemas and optimize it
- Dashboards

What are all the Delta things in Databricks?

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- https://docs.databricks.com/en/introduction/delta-comparison.html

Azure Databricks Demos

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- Databricks Demo Hub
  - Product demos various use cases.
  - Simple notebooks, easily importable to your workspace using an URL.
- Certifications - Databricks
  - Be Databricks Certified professional!

Azure Databricks vs Azure Synapse Analytics

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- Proprietary data processing engine (**Databricks Runtime**) built on a highly optimized version of Apache Spark offering up to 10x performance
- Databricks notebooks
  - Changes in real time
- Data lake must be mounted in order to use it

- Open-source Apache Spark (vanilla version)
- Nteract notebooks
  - One user has to save before changes are displayed
- Data lake can be added as a *Linked Service*
  - Direct access

Azure AI/ML Services

Azure ML

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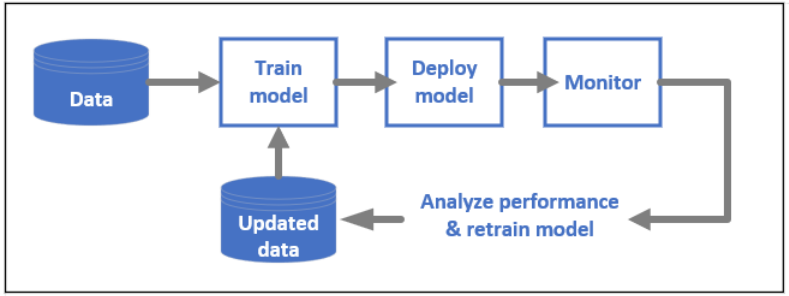
- Service for accelerating and managing ML project lifecycle (end-to-end).
- **Collaboration for machine learning teams**
  - Shared notebooks, compute resources, data, and environments.
  - Tracking and auditability that shows who made changes and when.
  - Versioning.
- Supports PythonSDK, R and other ML frameworks.
- Multinode distributed training, compute clusters with latest GPU options.
- MLOps

Azure Machine Learning



Cognitive Services

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- Customizable, pretrained models built with breakthrough AI research (ML expertise not needed).
  - **Speech** (text ↔ audio, translations, speaker verification…)
  - **Computer vision** (detect and identify people, identify emotions…)
  - **Search** (autosuggest, visual search, web search…)
  - **and others**
- Supports a wide range of cultural languages at the service level.
- Examples:
  - https://azure.microsoft.com/cs-cz/services/cognitive-services/computer-vision/#features
  - https://azure.microsoft.com/cs-cz/services/cognitive-services/face/#demo

Cognitive Services example

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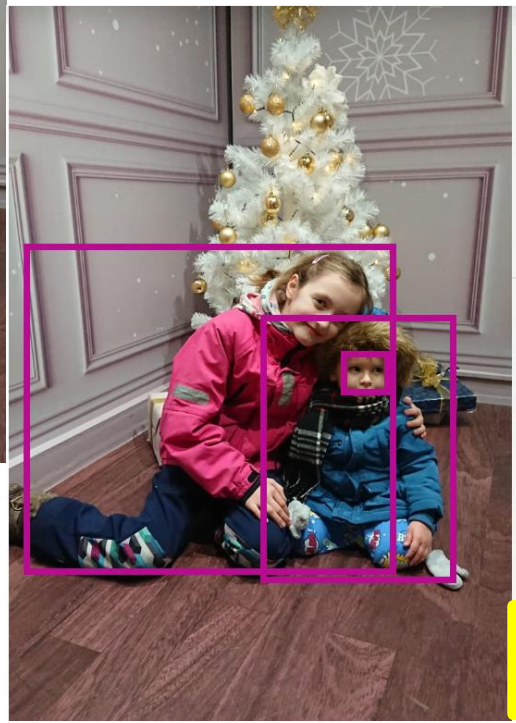

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Azure OpenAI Service

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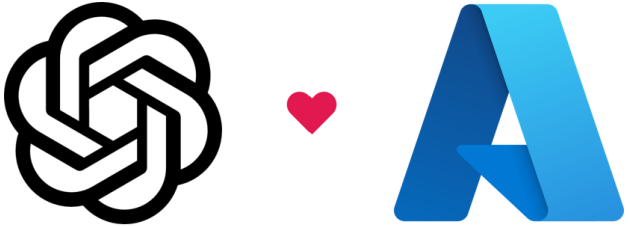
- REST API access to OpenAI's powerful language models
  - GPT-4, GPT-3, Embeddings, DALL-E, and Whisper
- Azure OpenAI Services vs OpenAI
  - Azure OpenAI Services = Azure + OpenAI
  - Benefits of integration to other Azure Services
- Key concepts
  - Prompts & completions
  - Tokens ($$$)
  - Resources and Deployments
  - Prompt engineering
  - Models



Obsolete Azure Services

HDInsight

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- “Azure Hadoop” ☺
- Managed, full-spectrum, open-source analytics service.
- Open-source frameworks such as:
  - Hadoop, Apache Spark, Apache Hive, LLAP, Apache Kafka, Apache Storm, R, and more, **in Azure environment**.
- Seamless integration with the most popular big data solutions with a one-click deployment.
- Low-cost and scalable.
  - Decoupled compute and storage.
  - Clusters on demand.

Summary

Summary

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- Storage is cheap – Compute is expensive
- Unlimited scalability, support of any architecture
- Common architectures for Data Engineering and Data Science
- Some services compete with each other
  - Price vs performance
  - Open-source vs proprietary

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Questions?

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