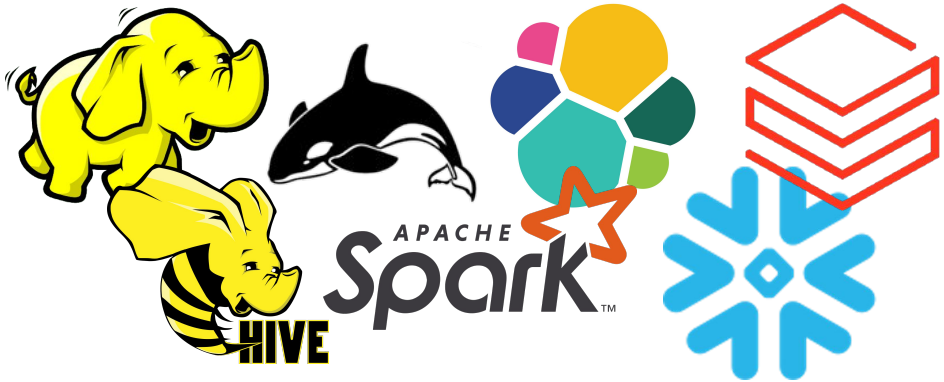
ADALTAS

Big Data Ecosystem



5. NoSQL with HBase

What is NoSQL?

- **Key-value:**
  - 1 key = 1 value
  - Examples : Redis, Memcache (in memory)
- **Columnar:**
  - 1 key = X values stored in columns
  - Examples : HBase, Cassandra

What is NoSQL?

- **Document stores:**
  - JSON/XML like objects
  - Examples : MongoDB, CouchDB
- **Graph:**
  - Store nodes and relationships between them
  - Examples : Neo4j, JanusGraph

Apache HBase

- *Apache HBase™ is the Hadoop database, a distributed, scalable, big data store* - hbase.apache.org
- Random, realtime read/write access to Big Data
- Inspired from Google BigTable paper (2006)
- Stores data in HDFS

The CAP Theorem

- **Consistency:** For one given query, all the nodes return the same result
- **Availability:** Every query receives a fast response, without guarantee that this is the latest value
- **Partition tolerance:** The system continues to work even if some nodes are disconnected
- No distributed storage system can ensure more than 2 of those properties at the same time

Apache HBase

- HBase is a **CP columnar** database
- AP equivalent = Apache Cassandra

HBase: Data structure

- A table is a collection of rows
- A row has several **column families** defined at table creation
- A column family has **any number of columns**
- 1 row = { **key**: {

  column_family_1: { col_1: a, col_2: b},

  column_family_2: { col_3: c, col_4: d}

  }}

HBase: Data storage

- Data is stored:
  - In HDFS in the **HFiles**
  - In RAM in the **Memstore**
- Tables are split into **regions**
  - 1 region = all rows in a certain **range of keys**
  - The number of regions depends on the size of the table

HBase: Components

- **HBase Master**
  - Handle table creation/deletion queries
  - **Assigns regions** to RegionServers and monitor them
- **RegionServer**
  - 1 region of a table is managed by 1 RegionServer

HBase: Data storage in RegionServers

1. On data write:
   a. Storing in the **Memstore in RAM**
   b. Storing in the **HLog in HDFS** (Write Ahead Log)
2. When the Memstore or the HLog reaches max size: flush to **HFile in HDFS** (1 per CF). Temporary **compactions**
3. If the RegionServer crashes, operations are replayed from the HLog for the Memstore and metadata loaded from the HFile (by another RegionServer)

HBase: Partition tolerance and HA

- RegionServers tracked by ZooKeeper
  - On crash, HMaster knows it through ZK
  - HMaster re-assigns regions to other RegionServers
- High Availability: multiple HBase Masters

Querying HBase

- HBase client
  - CLI
  - Languages / tools (e.g. NiFi)
- Apache Phoenix, SQL on HBase (in memory)
- Apache Hive