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Apache Spark - Fast unified analytics engine

Authors

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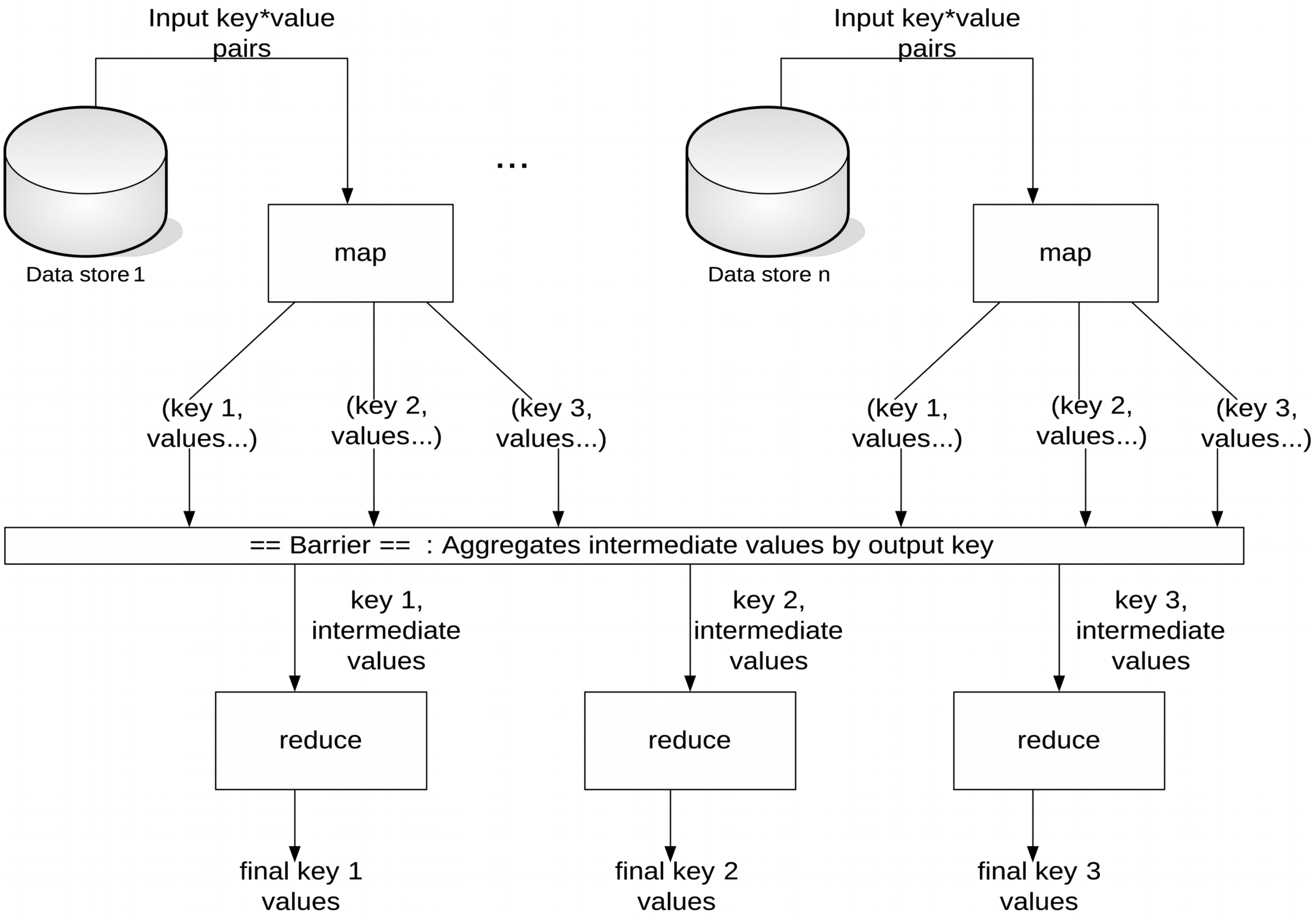
Motivation App

- Web Search
  - 12 PB Web data
  - Must search quickly
  - How?
- Web Search Primer
  - Users supply words in query --> find all documents with a specified word
  - Read 12PB of web pages, find keywords in a single machine:
    - 100MB/s = 1GB/10s → 12PB in 120000000s -> ~ 4 years!

Motivation App (2)

- We need parallelism!
  - Run previous task in one day?
  - Need a cluster (at least 1400 machines)
- Functionality of the computation system?
  - Move data around
  - Check liveness
  - **Deal with failures**
  - Process stuff



Input key*value pairs

Input key*value pairs

Data store 1

map

...

Data store n

map

(key 1, values...)

(key 2, values...)

(key 3, values...)

(key 1, values...)

(key 2, values...)

(key 3, values...)

== Barrier == : Aggregates intermediate values by output key

key 1, intermediate values

key 2, intermediate values

key 3, intermediate values

reduce

reduce

reduce

final key 1 values

final key 2 values

final key 3 values

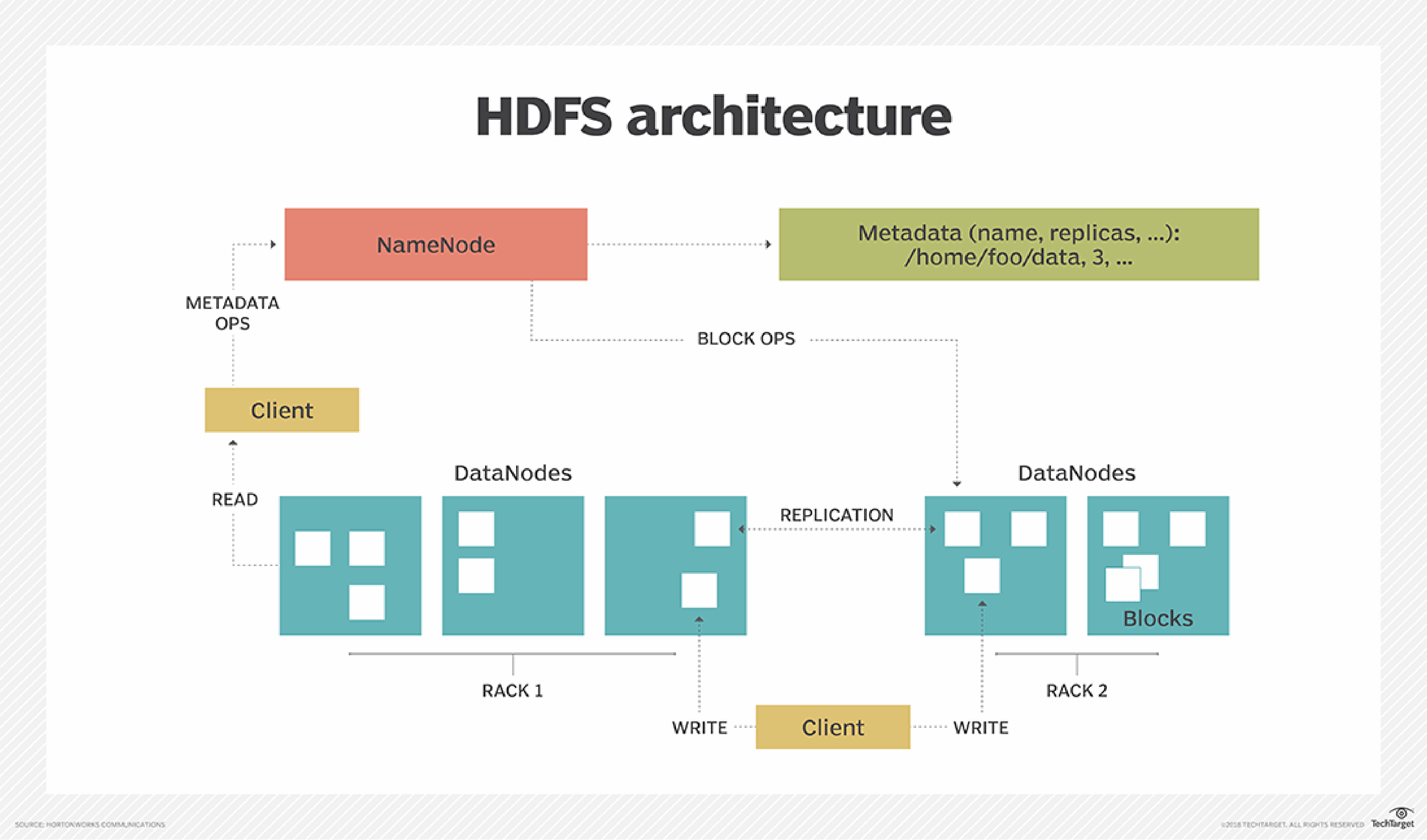
*https://infosys.beckhoff.com/content/1033/el32xx/Images/png/1496969995__Web.png

MapReduce

- Automatic parallelization & distribution
  - map() and reduce() functions run on parallel
- Fault-tolerant
  - Master detects worker failures and re-executes in-progess reduce tasks
- Clean abstraction for programmers

Hadoop

- Uses MapReduce
- Integrates with HDFS
- Commonly used
- Writes all intermediary results to disk!
  - It slows down significantly even the smallest of jobs

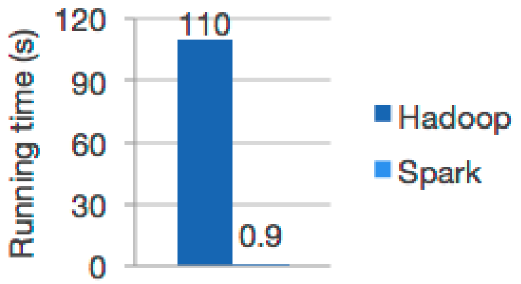


HDFS

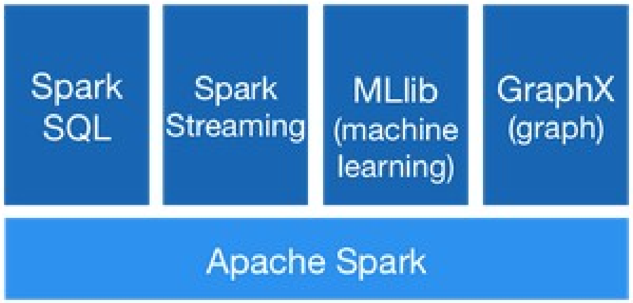
*https://infosys.beckhoff.com/content/1033/el32xx/Images/png/1496969995__Web.png

Apache Spark

- Tries to use RAM whenever available
- Uses RDD’s
  - Collections of objects spread over the datanodes
  - Built with parallel transformations
  - Rebuilt on failure detection



Logistic regression in Hadoop and Spark



Spark SQL

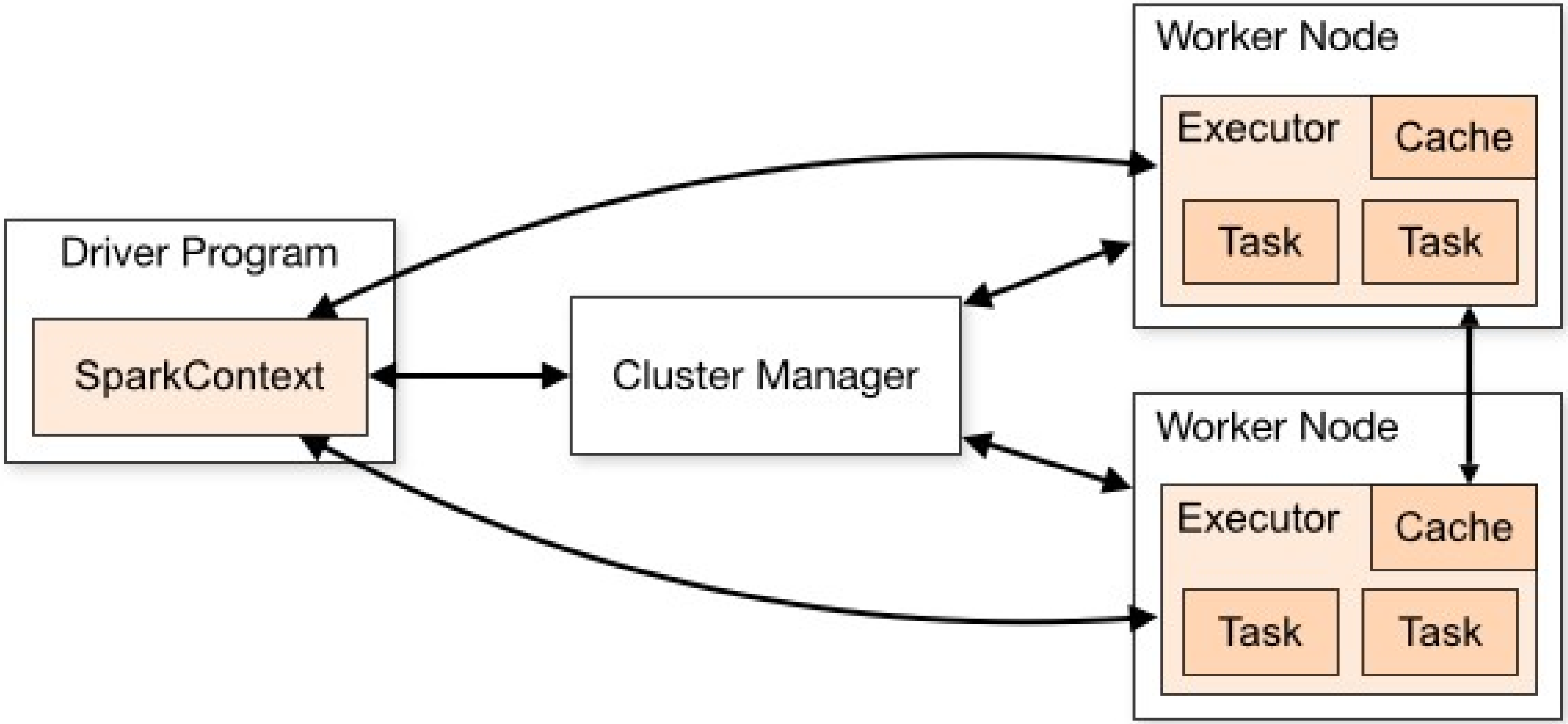
Spark Streaming

MLlib (machine learning)

GraphX (graph)

Apache Spark

Spark Architecture


Driver Program
SparkContext
Cluster Manager
Worker Node
Executor
Cache
Task
Task
Worker Node
Executor
Cache
Task
Task