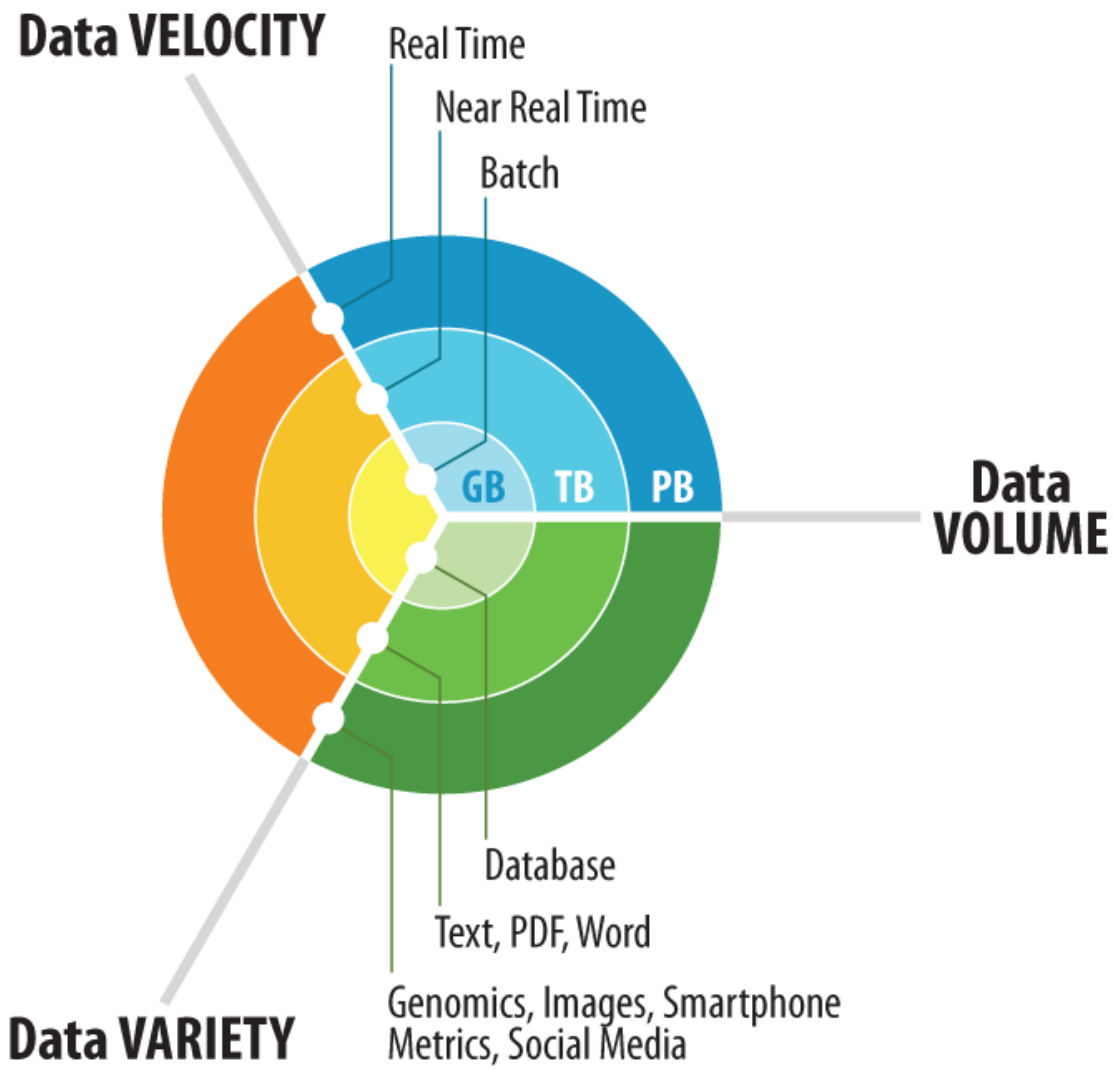
Big Data

Tianchu.Zhao@uts.edu.au

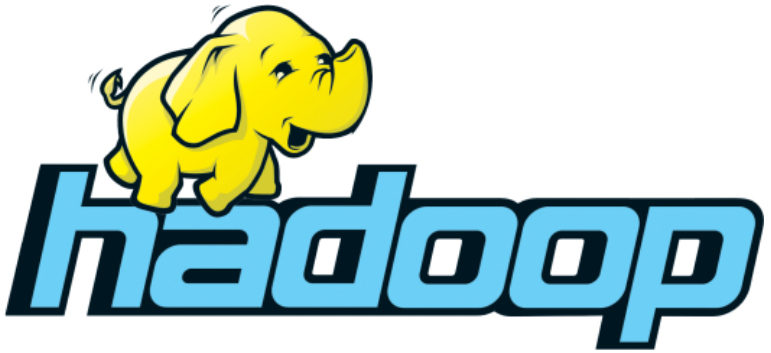
Big Data?

- **Big Data** is a term for data sets that are so large or complex that traditional data processing applications are inadequate to deal with them.

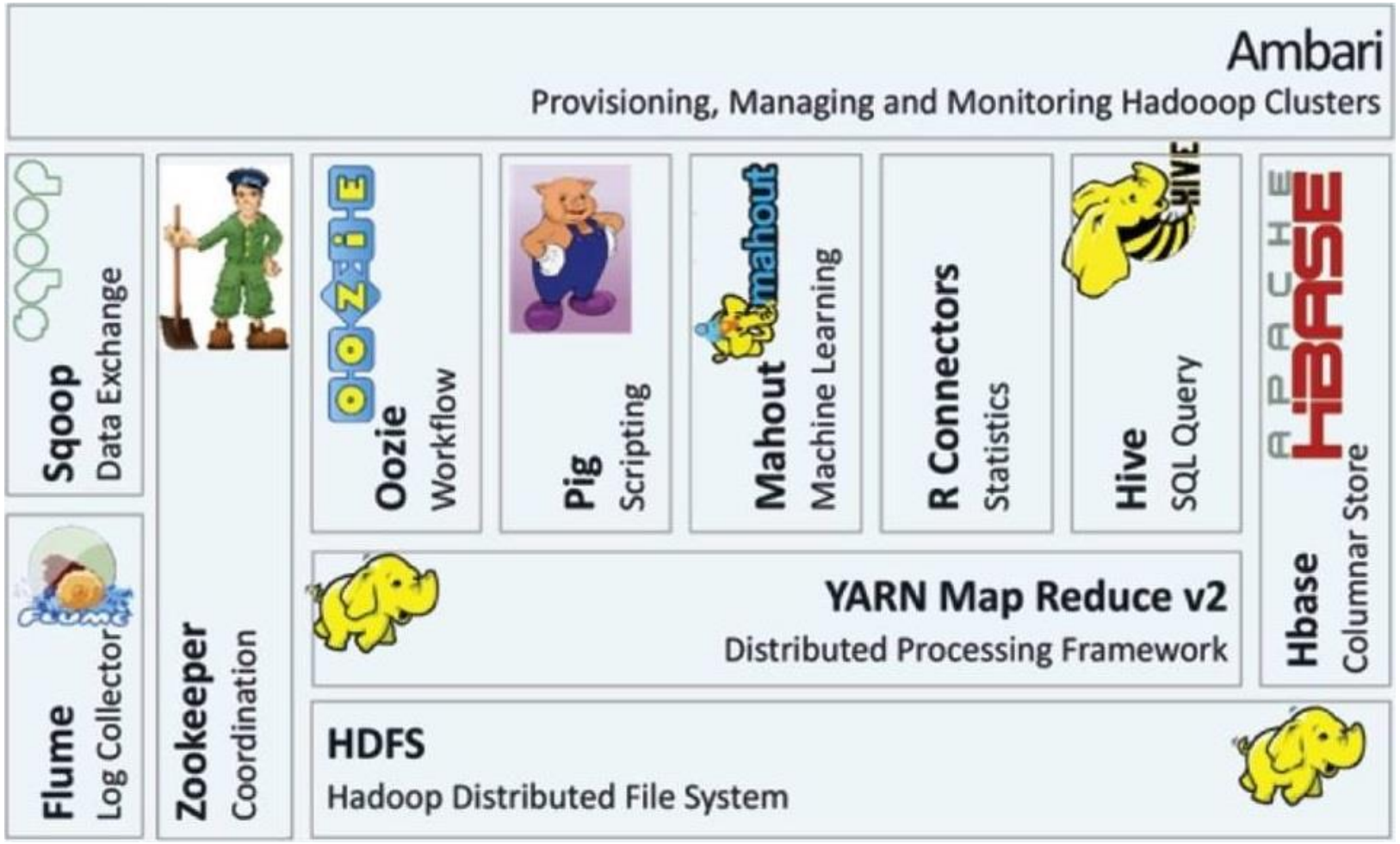

Data VELOCITY
Real Time
Near Real Time
Batch
GB
TB
PB
Data VOLUME
Database
Text, PDF, Word
Genomics, Images, Smartphone Metrics, Social Media
Data VARIETY

Hadoop

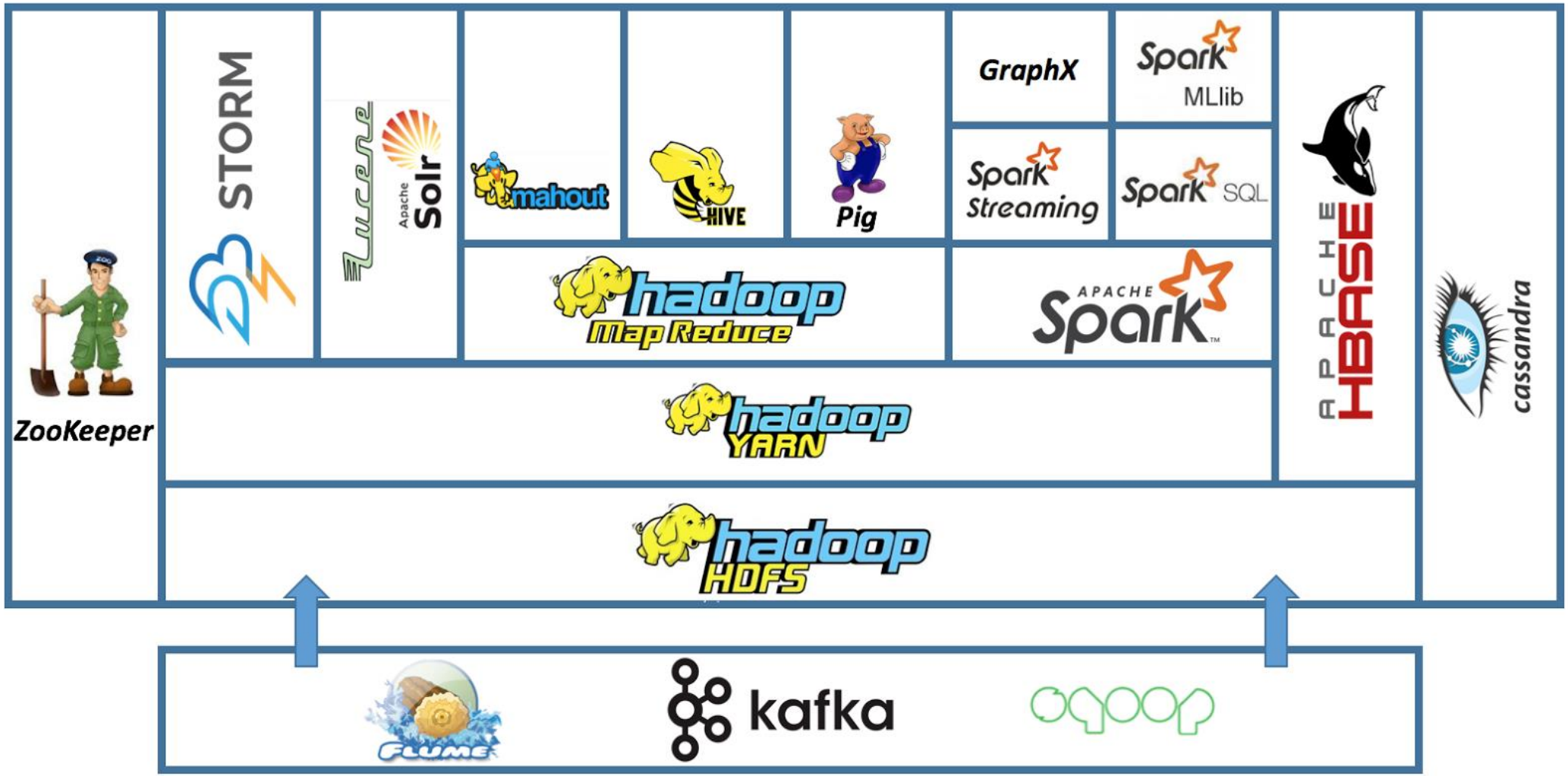
- (Wikipedia) Apache Hadoop is a collection of open-source software utilities that facilitate using a network of many computers to solve problems involving massive amounts of data and computation.



Hadoop ecosystem



Hadoop ecosystem



NoSQL Database

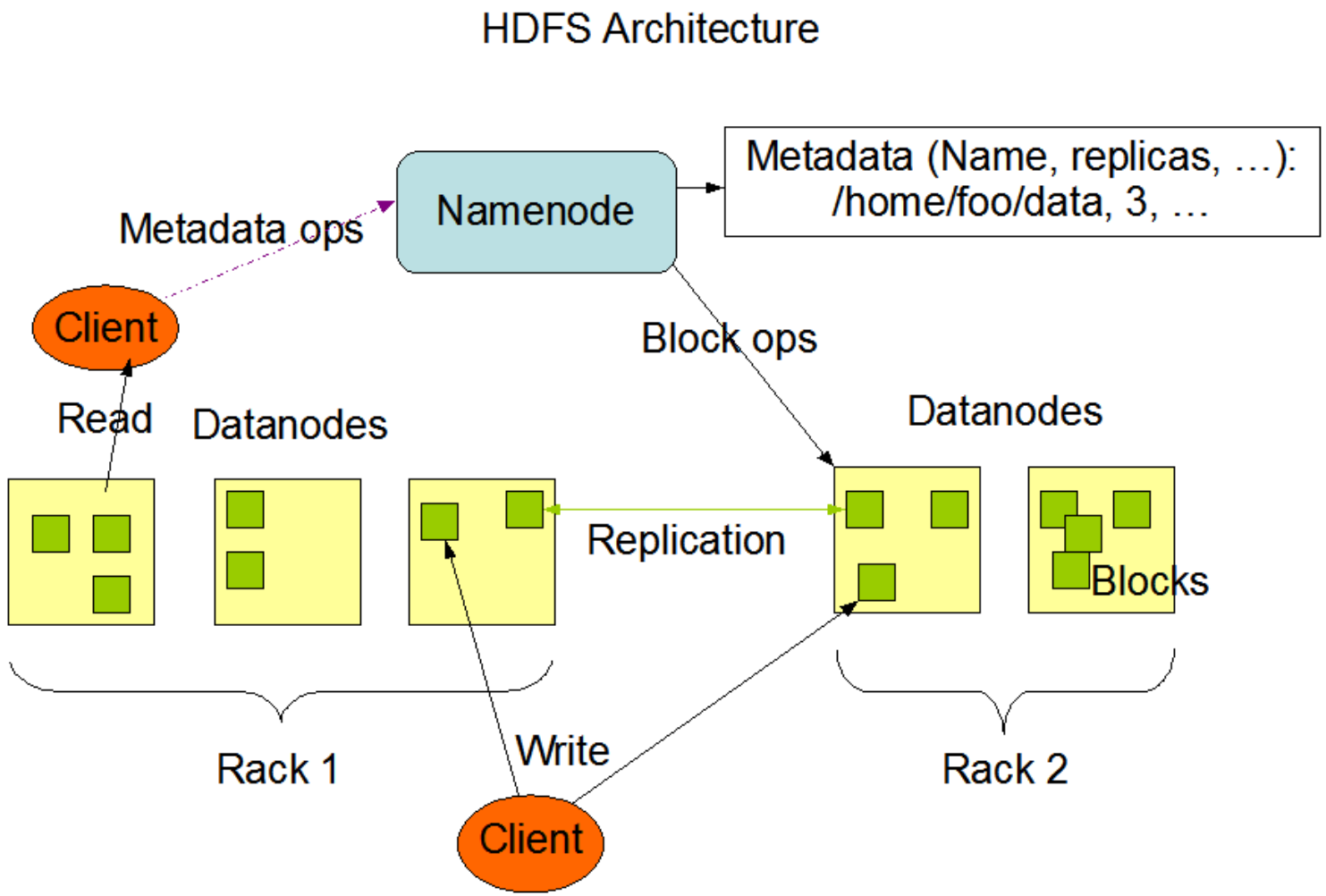
- Key Value
  - Dynamo DB
  - Cassandra
- Column Based
  - HBase
- Document Database
  - MongoDB
  - CouchDB
- Graph Database
  - Polyglot
  - Neo4J

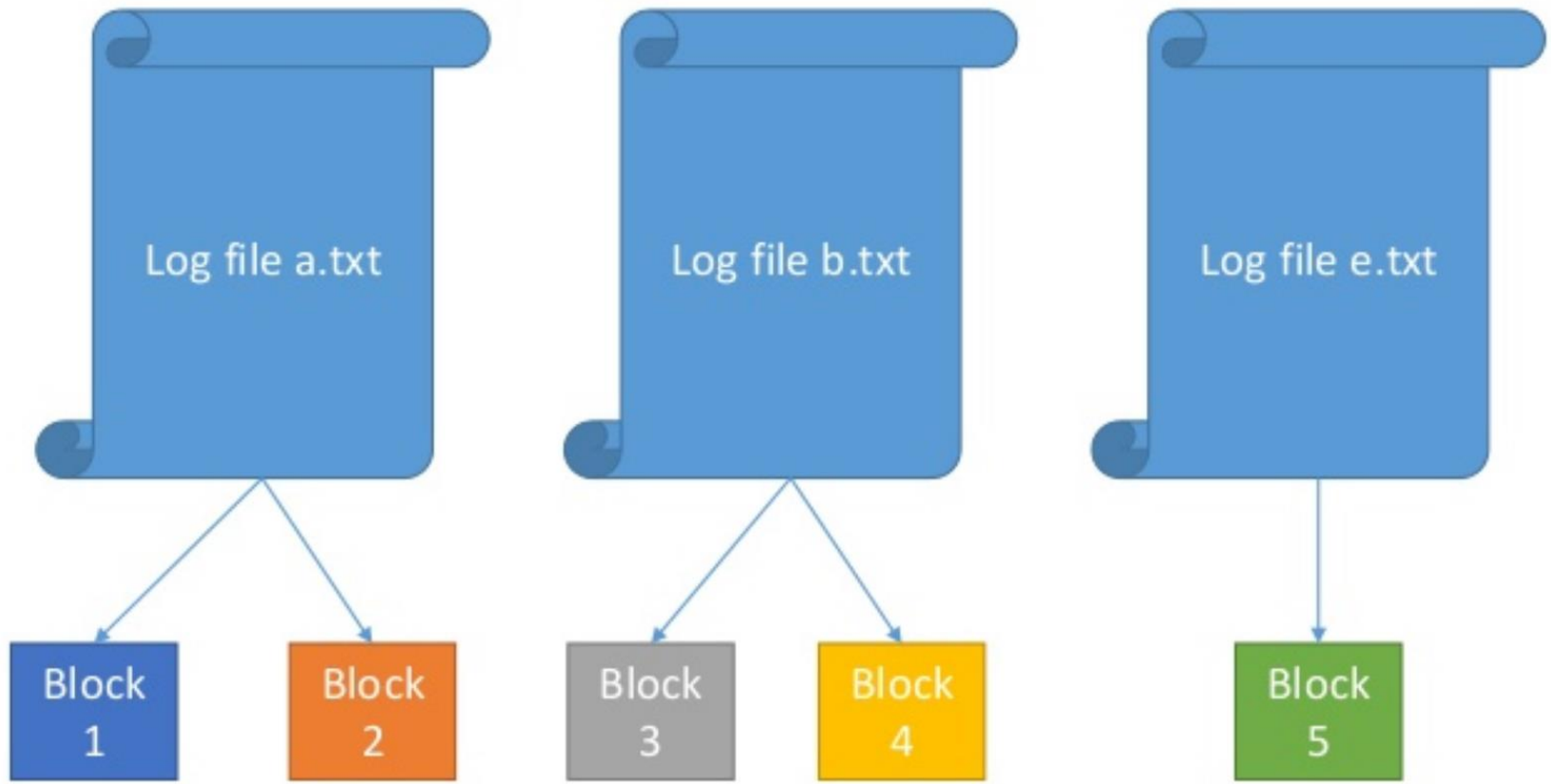
HDFS

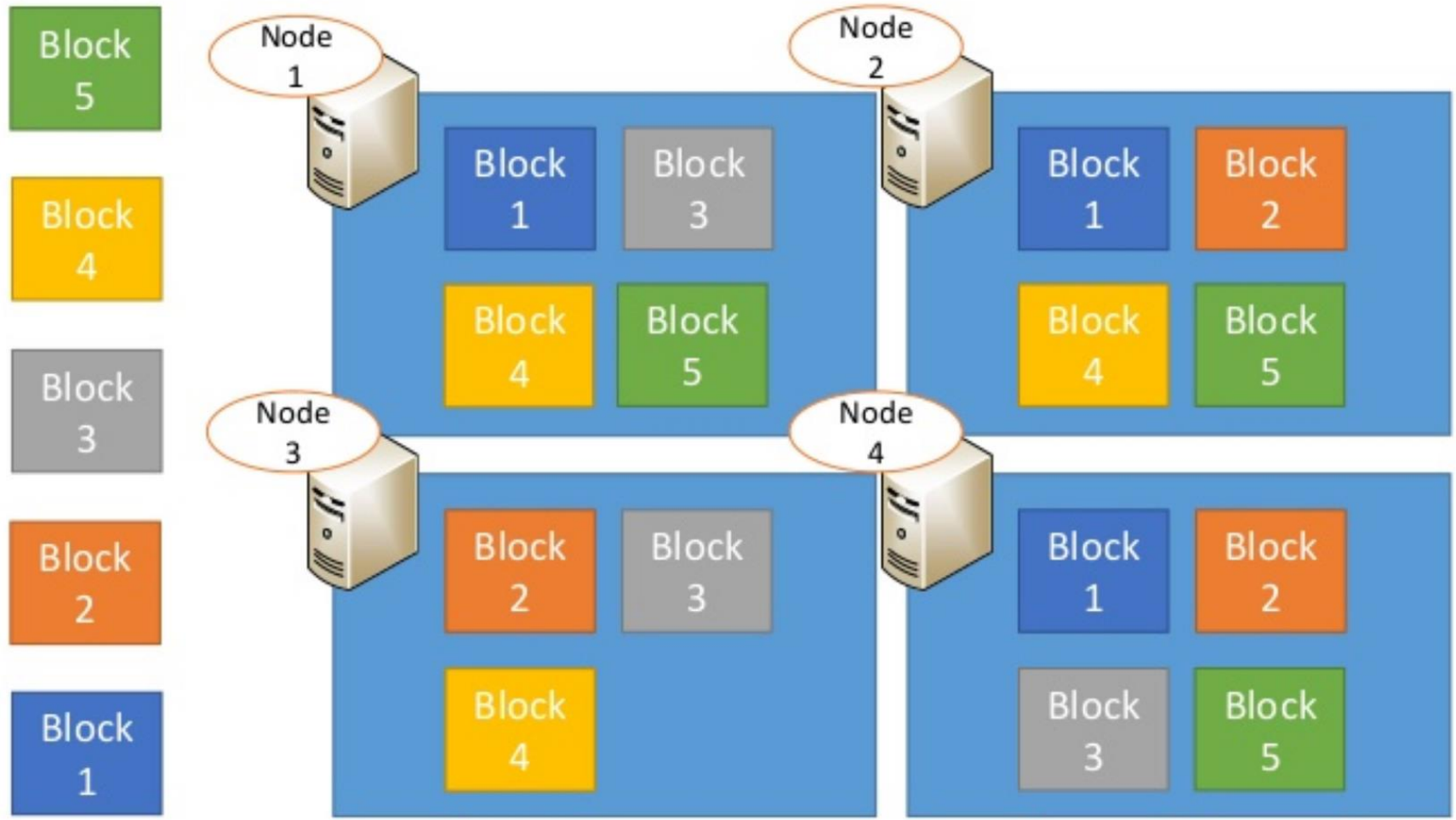
- The Hadoop Distributed File System (HDFS)
- a distributed file system designed to run on commodity hardware
- fault-tolerant
- low-cost hardware

HDFS Architecture

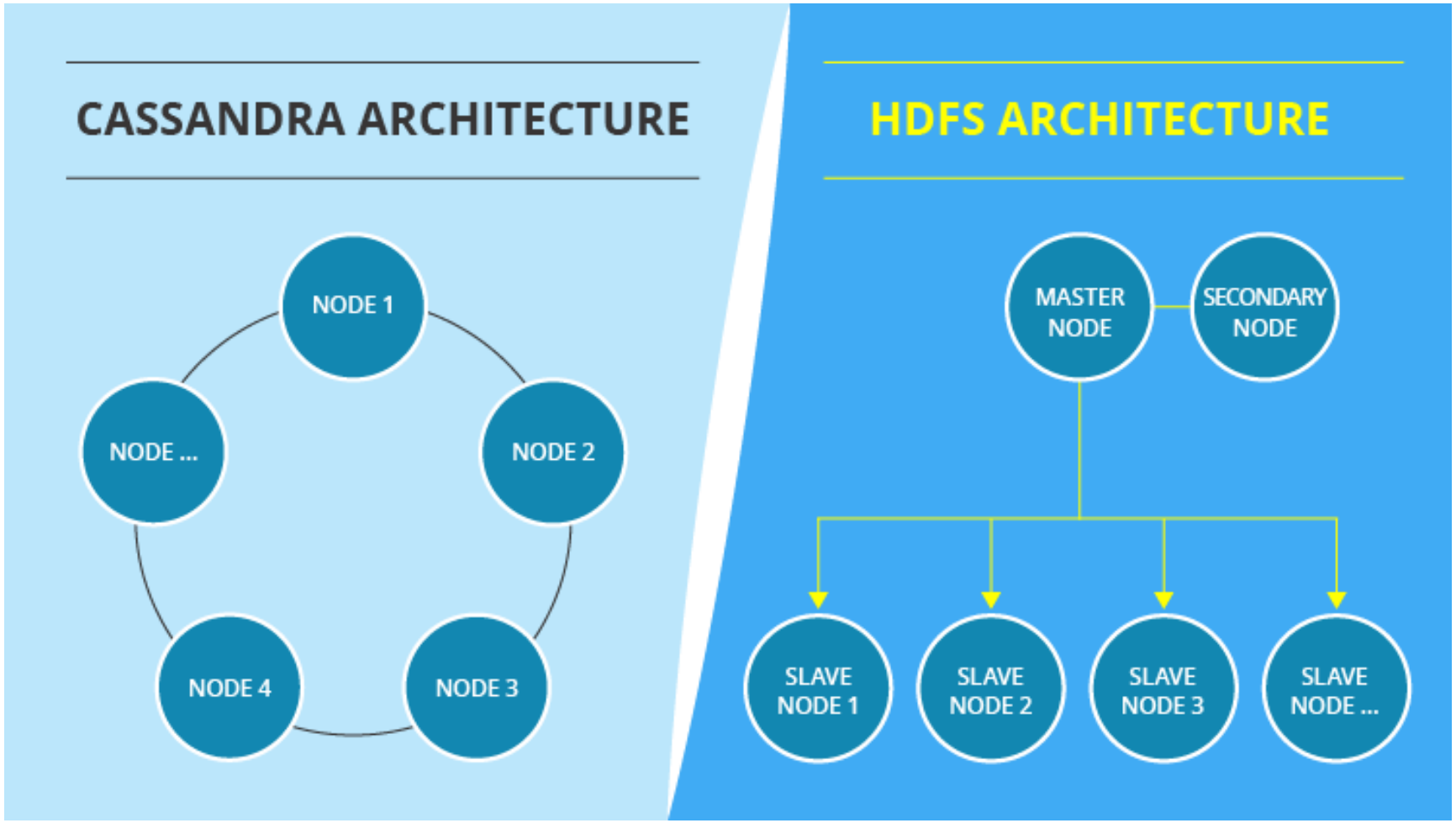
- HDFS has a master/slave architecture
- It consists of NameNode
  - A master server that manages the file system namespace and regulates access to files by clients
- and DataNode
  - Responsible for serving read and write requests from the file system’s clients


HDFS Architecture
Namenode
Metadata (Name, replicas, …):
/home/foo/data, 3, …
Metadata ops
Client
Block ops
Read
Datanodes
Datanodes
Replication
Blocks
Rack 1
Write
Rack 2
Client


Log file a.txt
Log file b.txt
Log file e.txt
Block 1
Block 2
Block 3
Block 4
Block 5


Block 5
Block 4
Block 3
Block 2
Block 1
Node 1
Block 1
Block 3
Block 4
Block 5
Node 2
Block 1
Block 2
Block 4
Block 5
Node 3
Block 2
Block 3
Block 4
Node 4
Block 1
Block 2
Block 3
Block 5

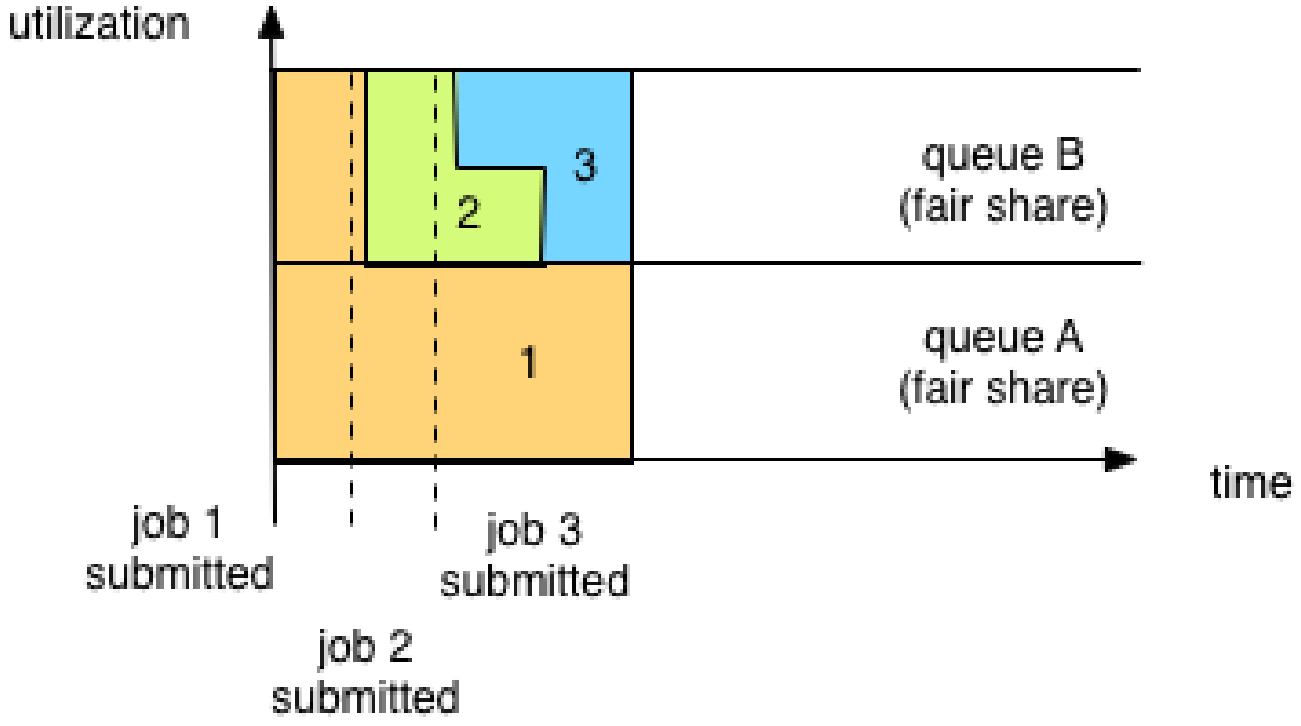
Cassandra

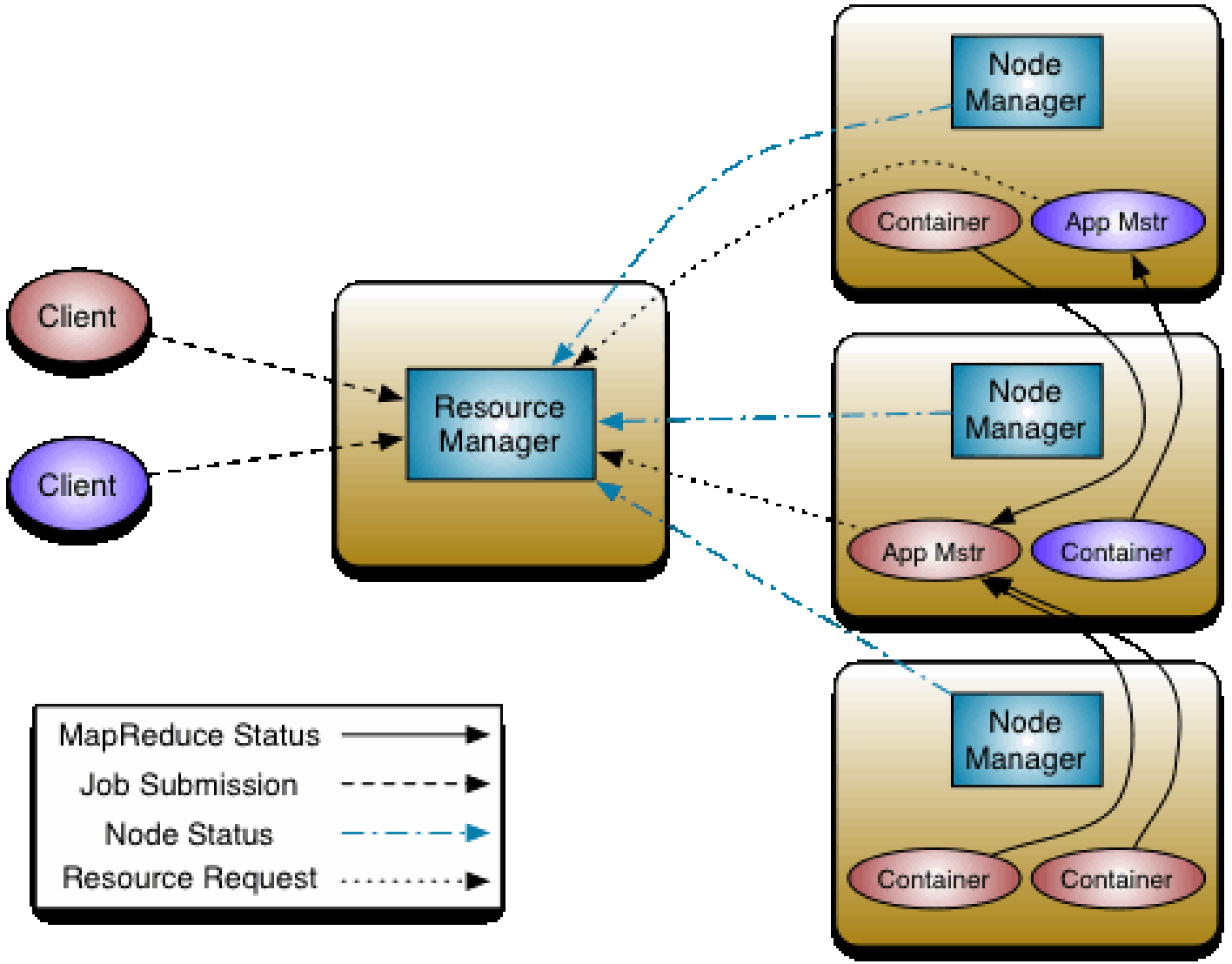

CASSANDRA ARCHITECTURE
NODE 1
NODE 2
NODE 3
NODE 4
NODE ...
HDFS ARCHITECTURE
MASTER NODE
SECONDARY NODE
SLAVE NODE 1
SLAVE NODE 2
SLAVE NODE 3
SLAVE NODE ...

YARN

- **Hadoop YARN** is a cluster management technology
- The fundamental idea of YARN is to split up the functionalities of resource management and job scheduling/monitoring into separate daemons. The idea is to have a global ResourceManager (*RM*) and per-application ApplicationMaster (*AM*). An application is either a single job or a DAG of jobs.

- Maximise cluster utilisation

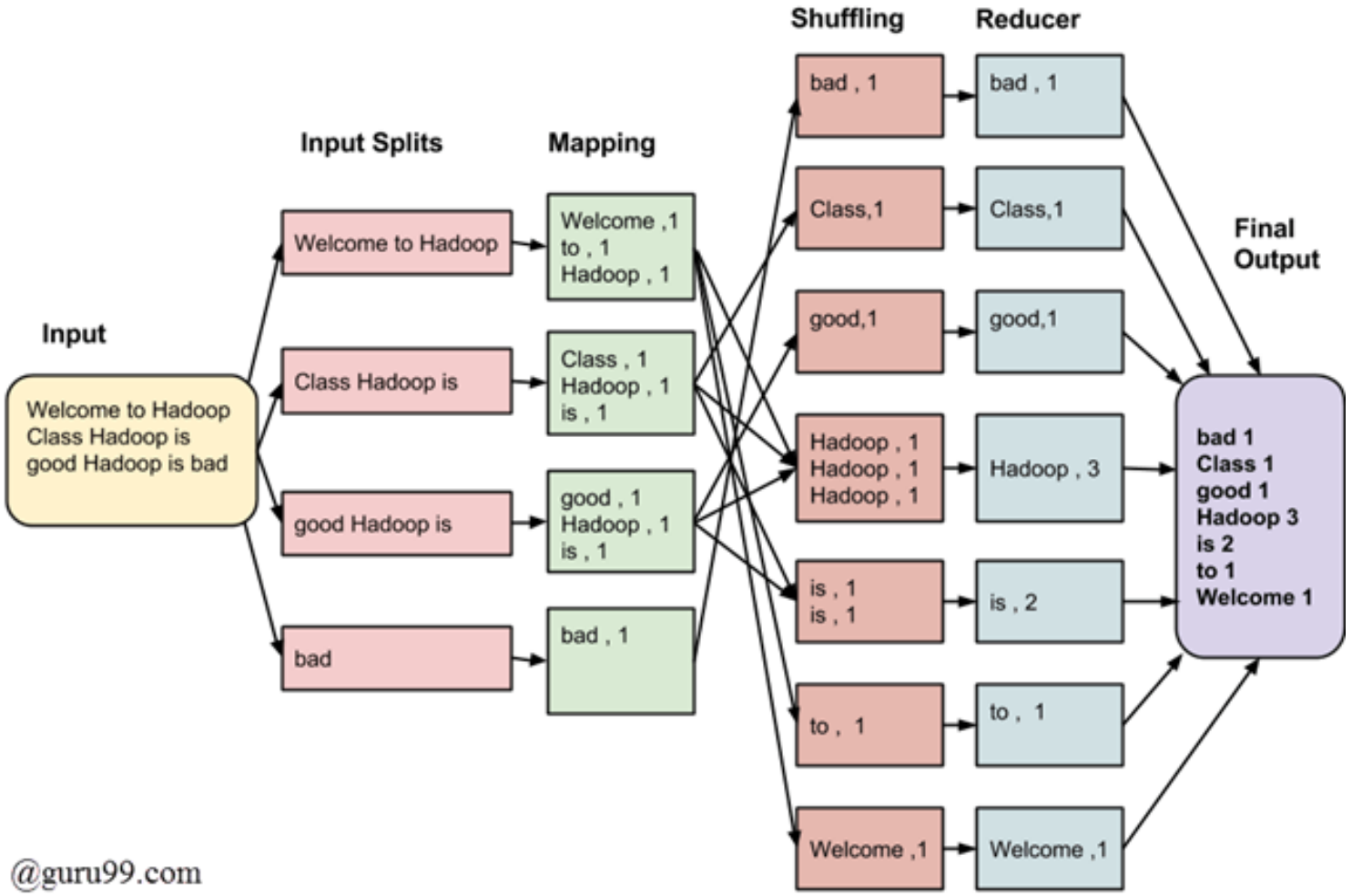



Client
Client
Resource Manager
Node Manager
Container
App Mstr
Node Manager
App Mstr
Container
Node Manager
Container
Container
MapReduce Status
Job Submission
Node Status
Resource Request

MapReduce

- MapReduce is a programming model and an associated implementation for processing and generating big data sets with a parallel, distributed algorithm on a cluster.

MapReduce wordcount



Spark

- Apache Spark is an open-source distributed general-purpose cluster-computing framework
- data representation: rdd, dataframe
- lazy execution
- In memory