Hadoop Components Overview

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- Hadoop Common
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- MapReduce
- Hadoop Tools

Hadoop Components

Components of Hadoop:

- Hadoop Common
- HDFS
- Yarn
- Map Reduce

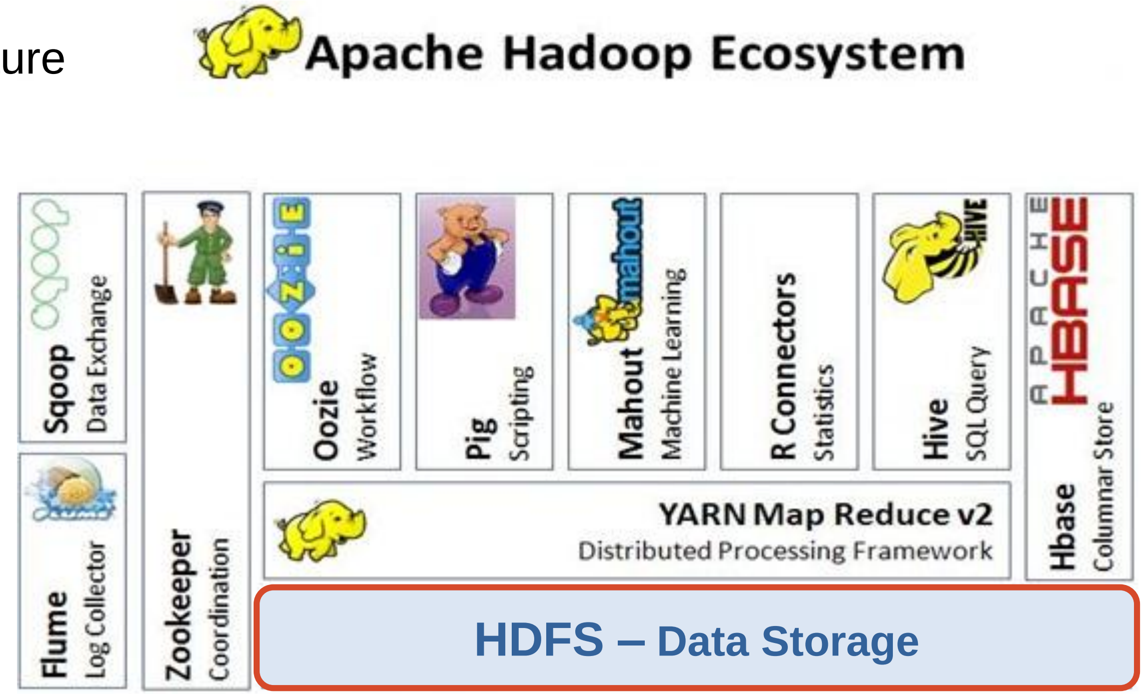
Hadoop Common

- ➢ A set of utilities that supports the Hadoop subprojects
- ➢ Provides access to the file systems supported by Hadoop
- ➢ Hadoop Common package contains:
  - ✓ The JAR files and scripts necessary to start Hadoop
  - ✓ Source code, documentation and a contribution section with projects from the Hadoop Community

HDFS

HDFS - **H**adoop **D**istributed **F**ile **S**ystem

- Primary storage system for Hadoop
- Distributed, portable, scalable file system written in Java
- Files are broken down and stored in multiple machines
- Designed for large scale distributed data processing
- Follows master/slave architecture



HDFS

HDFS is best suited for:

- Highly fault-tolerant
- Designed to deploy on low-cost hardware
- Suitable for applications that have large datasets(Giga to Terabytes)
- Enables streaming access to file system data

HDFS is not good for:

- Low Latency Data Access
- Lot of Small Files
- Multiple Writers, Arbitrary File Modifications

MapReduce (MR)

- Programming framework (library and runtime) for analyzing data sets stored in HDFS
- MapReduce jobs are composed of two functions:

map() → reduce()

sub-divide & conquer — *combine & reduce cardinality*

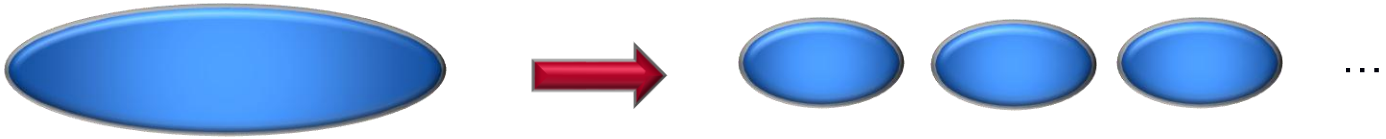
- User only writes the Map and Reduce functions
- MR framework provides all the “glue” and coordinates the execution of the Map and Reduce jobs on the cluster

MapReduce (contd..)

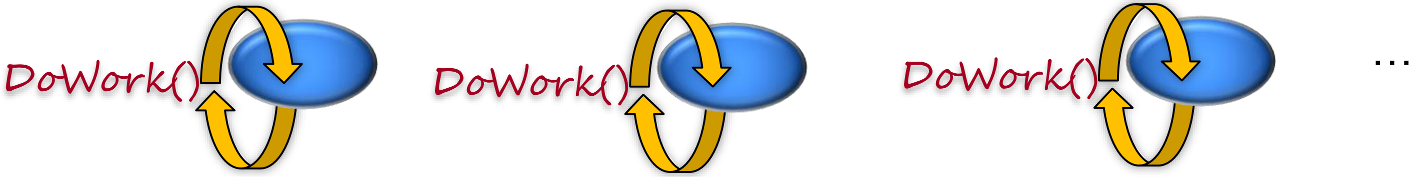
MAP

Essentially, it's…

1. Take a large problem and divide it into sub-problems

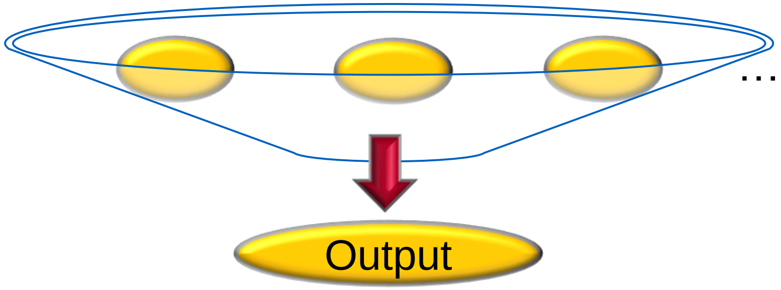


2. Perform the same function on all sub-problems

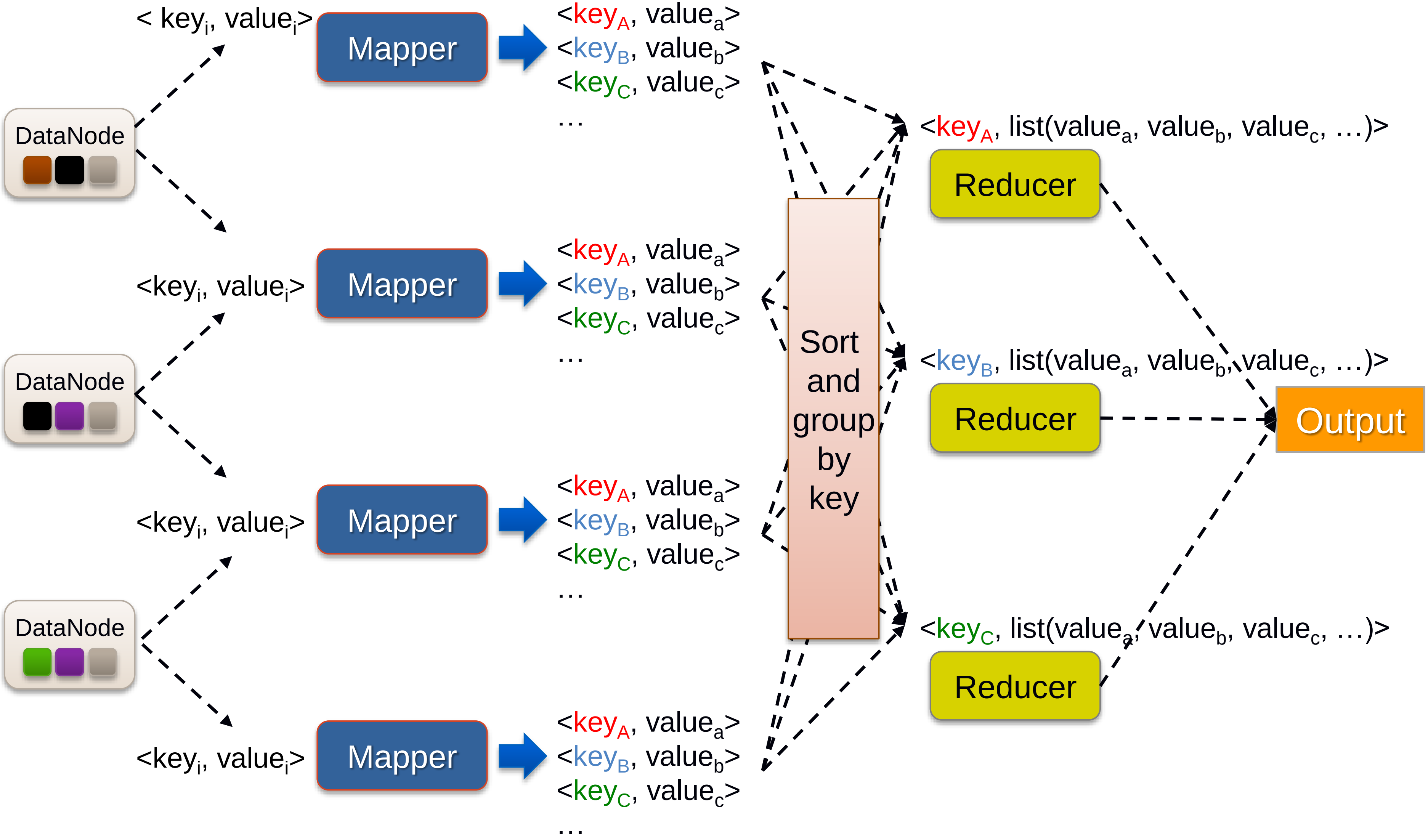


REDUCE

3. Combine the output from all sub-problems



MapReduce (contd..)



< key$_i$, value$_i$>
Mapper
<key$_A$, value$_a$>
<key$_B$, value$_b$>
<key$_C$, value$_c$>
…

DataNode

<key$_i$, value$_i$>
Mapper
<key$_A$, value$_a$>
<key$_B$, value$_b$>
<key$_C$, value$_c$>
…

DataNode

<key$_i$, value$_i$>
Mapper
<key$_A$, value$_a$>
<key$_B$, value$_b$>
<key$_C$, value$_c$>
…

DataNode

<key$_i$, value$_i$>
Mapper
<key$_A$, value$_a$>
<key$_B$, value$_b$>
<key$_C$, value$_c$>
…

Sort and group by key

<key$_A$, list(value$_a$, value$_b$, value$_c$, …)>
Reducer

<key$_B$, list(value$_a$, value$_b$, value$_c$, …)>
Reducer

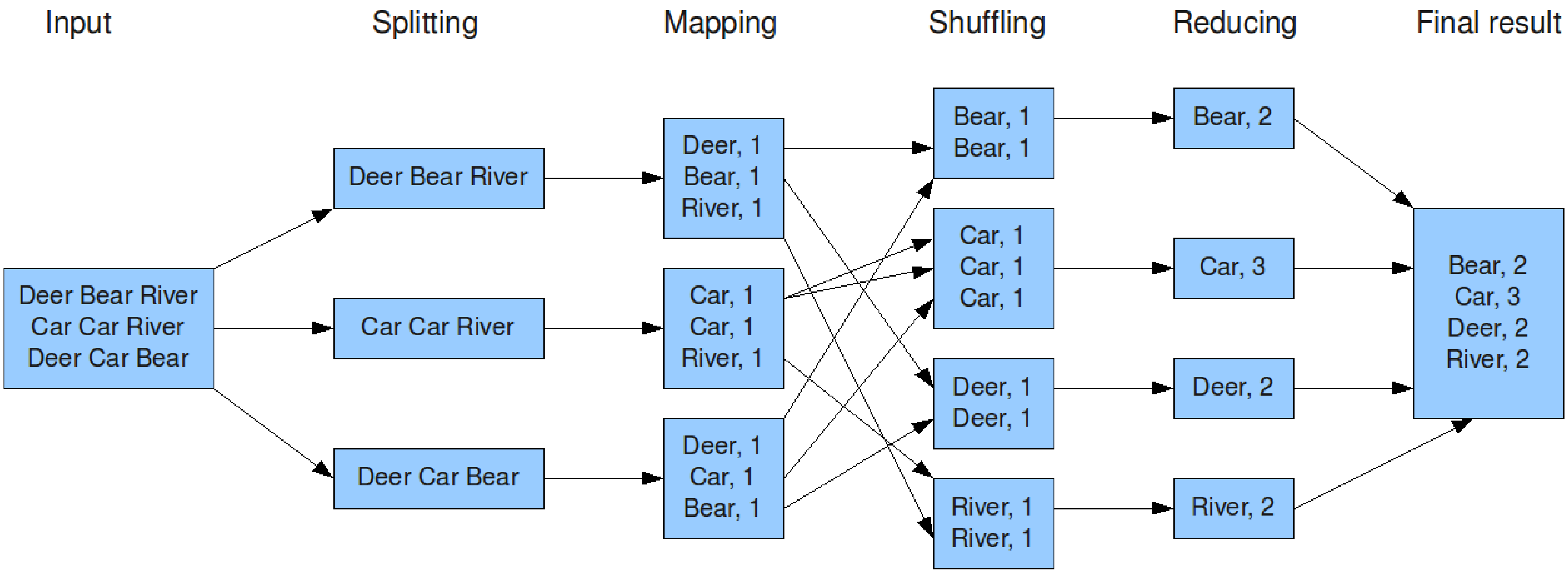
<key$_C$, list(value$_a$, value$_b$, value$_c$, …)>
Reducer

Output

A key-value pair (KVP) is a set of two linked data items:
Key - A unique identifier for data item
Value – Either the data that is identified or a pointer to the location of that data

MapReduce (contd..)

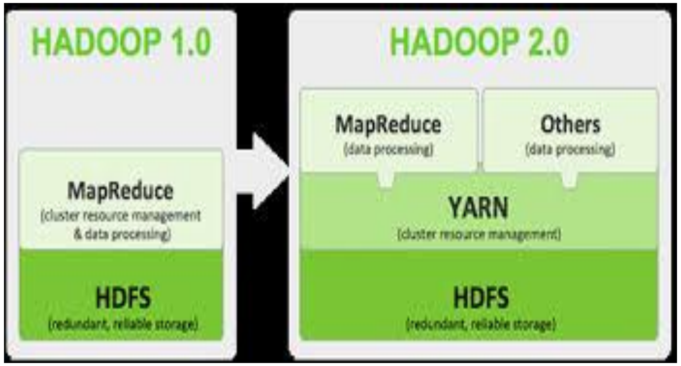
The overall MapReduce word count process



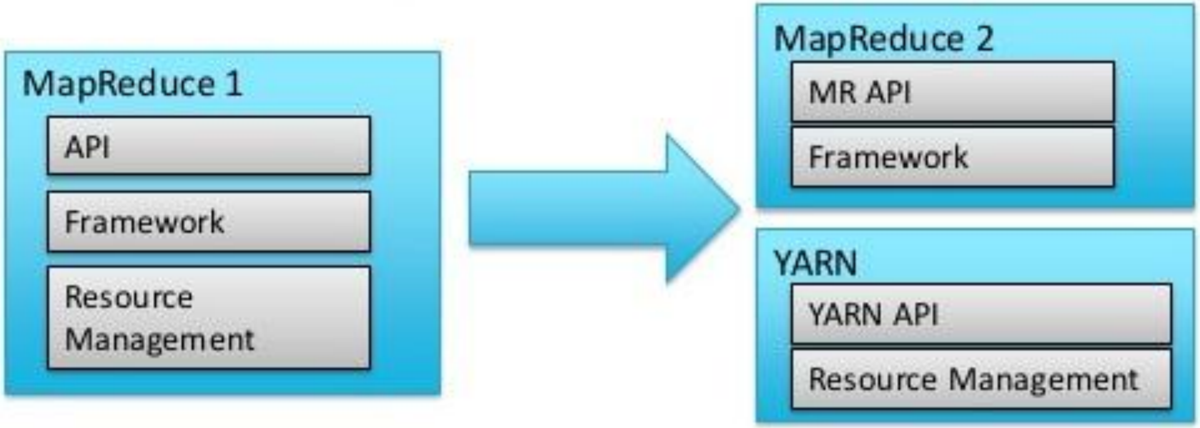
Hadoop YARN & MR2

Next generation MapReduce 2

- **MapReduce 1 ("Classic") has three main components**
  - API – for user-level programming of MR applications
  - Framework – runtime services for running Map and Reduce processes, shuffling and sorting, etc.
  - Resource management – infrastructure to monitor nodes, allocate resources, and schedule jobs


HADOOP 1.0
MapReduce
(cluster resource management & data processing)
HDFS
(redundant, reliable storage)
HADOOP 2.0
MapReduce
(data processing)
Others
(data processing)
YARN
(cluster resource management)
HDFS
(redundant, reliable storage)

- **MapReduce 2 ("NextGen") moves Resource Management into YARN**


MapReduce 1

API

Framework

Resource Management

MapReduce 2

MR API

Framework

YARN

YARN API

Resource Management

Current MapReduce vs YARN

Hadoop MapReduce

Job Tracker (Master)

- Resource management
- Job lifecycle management
  - Scheduling, progress monitoring, fault tolerance

Task Tracker (per node)

- Launch tasks
- Report status to Job tracker

Hadoop YARN

Resource Manager (Master)

- Resource management
- Scheduling

Application Master (per app)

- Job lifecycle management

Node Manager (per node)

- Launch Containers
- Monitor resource usage
- Report to RM

MapReduce itself is an Application on YARN

Other Hadoop Tools

Pig

- Pig is a platform for analysing large data sets that consists of a high-level language for expressing data analysis programs

- Consists of :
  - ✓ PigLatin : The high-level language
  - ✓ A Run-time environment where PigLatin programs are executed

HBase

- Column-oriented database management system on top of HDFS
- HBase system comprises a set of tables
- Allows Attributes (Columns) to be grouped together into “column families”
- All the elements of a column family are all stored together

Other Hadoop Tools (contd..)

Hive

- A data warehouse infrastructure built on top of Hadoop
- Provides tools to enable :
  - ✓ Easy data summarization
  - ✓ Ad hoc querying
  - ✓ Analysis of large datasets stored in Hadoop files

Sqoop - SQL To Hadoop

- Sqoop is a command-line tool with the following capabilities:
  - ✓ Imports tables or entire databases to files in HDFS
  - ✓ Generates Java classes to allow you to interact with imported data
  - ✓ Imports from SQL databases straight to Hive data warehouse

Other Hadoop Tools (contd..)

ZooKeeper

- A high-performance coordination service for distributed applications
- An open source Apache project
- Provides a centralized infrastructure and services that enable synchronization across a cluster
- Maintains common objects needed in large cluster environments
- Each client machine communicates with one of the many ZooKeeper servers in a cluster to retrieve, update its synchronization information

Other Hadoop Tools (contd..)

Oozie

- Is a workflow/coordination service to manage data processing jobs for Apache Hadoop
- Supports all types of Hadoop jobs and is integrated with the Hadoop stack
- Users can specify execution frequency and can wait for data arrival to trigger an action in the workflow

Other Hadoop Tools (contd..)

Flume

- Service for efficiently moving large amounts of data soon after the data is produced
- It is centrally managed & allows for intelligent dynamic management
- Its main goal is to deliver data from applications to Hadoop's HDFS

Mahout

- A scalable machine learning and data mining library
- An Apache project to produce free implementations of machine learning algorithms on the Hadoop platform

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