



**POLITECNICO  
DI TORINO**

# Recap Big data: architectures and data analytics (01QYDOV)

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## Acknowledgments

Questo breve riepilogo non ha alcuno scopo se non quello di agevolare lo studio di me stesso, se vi fosse di aiuto siete liberi di usarlo.

Le fonti su cui mi sono basato sono quelle relative al corso offerto (**Big data: architectures and data analytics (01QYDOV)**) dal Politecnico di Torino durante l'anno accademico 2018/2019.

Non mi assumo nessuna responsabilità in merito ad errori o qualsiasi altra cosa. Fatene buon uso!

# 1 Introduction

The amount of data increases every days, to analyze them, system must scale according. All these systems must deal with computation capabilities, network bandwidth and failures. A good practice to solve problems is the parallelizations, a single-node architecture cannot solve, in reasonable time, the request of these days. For these reasons, nowadays, clusters (fig.1) are pretty common.

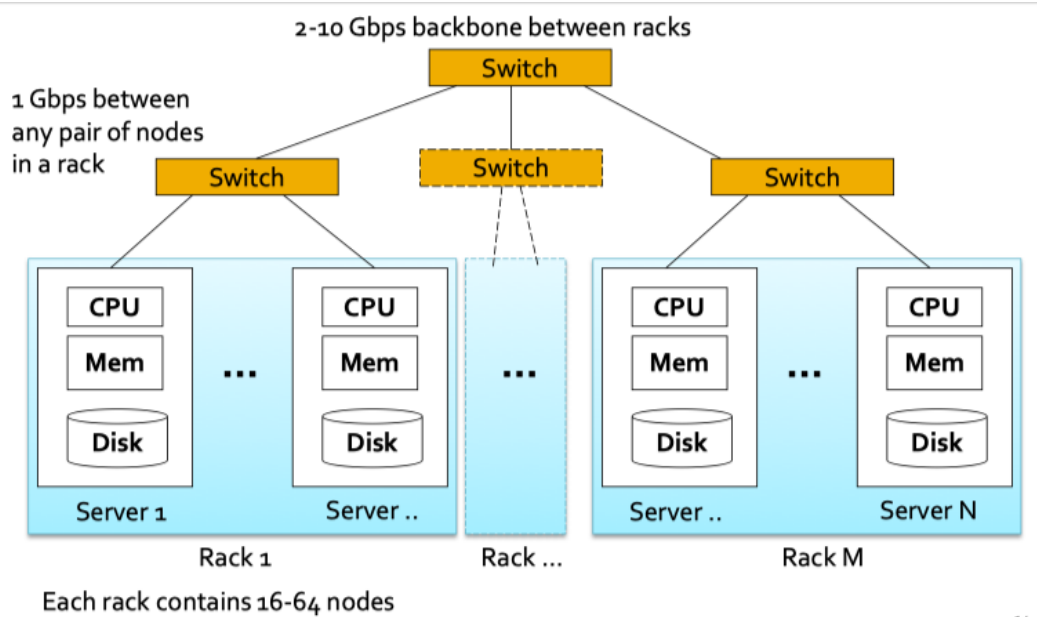


Figure 1: Cluster Architecture

The main characteristics are:

- **Scalability:** Increase number of users, amount of datas, complexity of problems
  - Scale **UP**: More power/resources for a single-node
  - Scale **OUT**: Add more nodws to the cluster

## 2 Apache Hadoop

Scalable fault-tolerant distributed system for Big Data: Distributed Data Storage, Distributed Data Processing, etc... Is an Open Source project under Apache license. Is used by a lot of main IT companies all around the world. The core of the structure are:

- **Distributed BD Processing Infrastructure** (MapReduce):

- High-level abstraction view: Not require to take care of scheduling and synchronizations
- Fault Tolerant: Node and task are automatically managed
- **HDFS** (Hadoop Distributed File System):
  - Fault-Tolerant
  - High availability distributed storage

The paradigm of MapReduce will not be illustrated, in figure 2 a sample of the process during the word count problem.

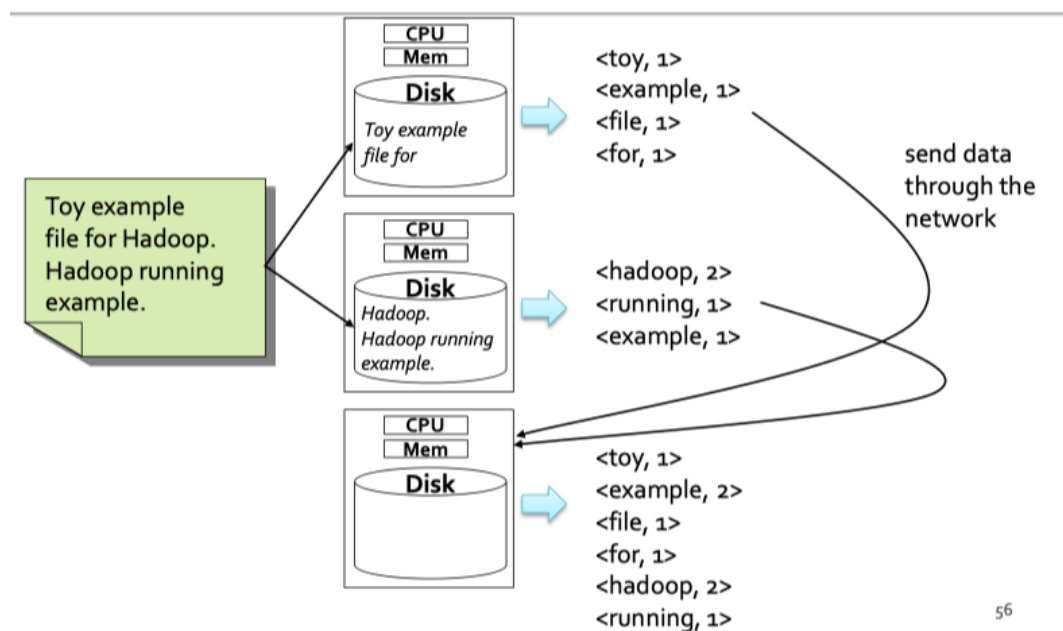


Figure 2: MapReduce Example

## 2.1 Structure of a program

The project is divided in different parts:

- Driver: Coordinators of the jobs
- Mapper: Class for the Map part
- Reducer: Class implementing the Reduce part

There are also other important terms:

- Job: Execution of a MapReduce code over a dataset
- Task: Execution of a Map task or a Reducer task on a slice of data

The workflow of a project is similar to the following one:

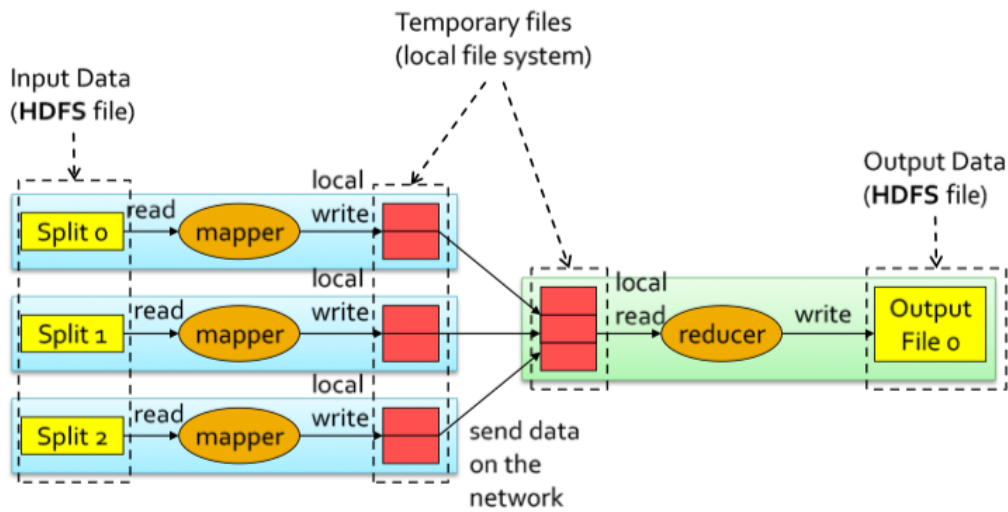


Figure 3: MapReduce Workflow in Hadoop

## 2.2 Data Types

Hadoop make use of its own basic data types:

- Text: Like Java string
- IntWritable: Like java integer
- LongWritable
- FloatWritable

Also the data for the input and output has its own type:

- TextInputFormat (Lines)
- KeyValueTextInputFormat (2 Fields)
- SequenceFileInputFormat (Binary)

Also the output have similar formats.

Is also possible to define personalized data types, these also the usage of more complex values. To use them, is required, to implements the *org.apache.hadoop.io.Writable* interface and its methods, in particular:

- write()
- readFields()

also the method toString is important, in order to generate the value to be emit with the pair.

## 2.3 Combiner and Counters

In standard MapReduce applications the (key,value) pairs emitted by mappers are sent to the reducers through the network. In some case, a sort of "pre-aggregations" could be useful to improve performances and reduce the amount of data shared on the network.

An example with the word count problem with clarify the usage of combiners.

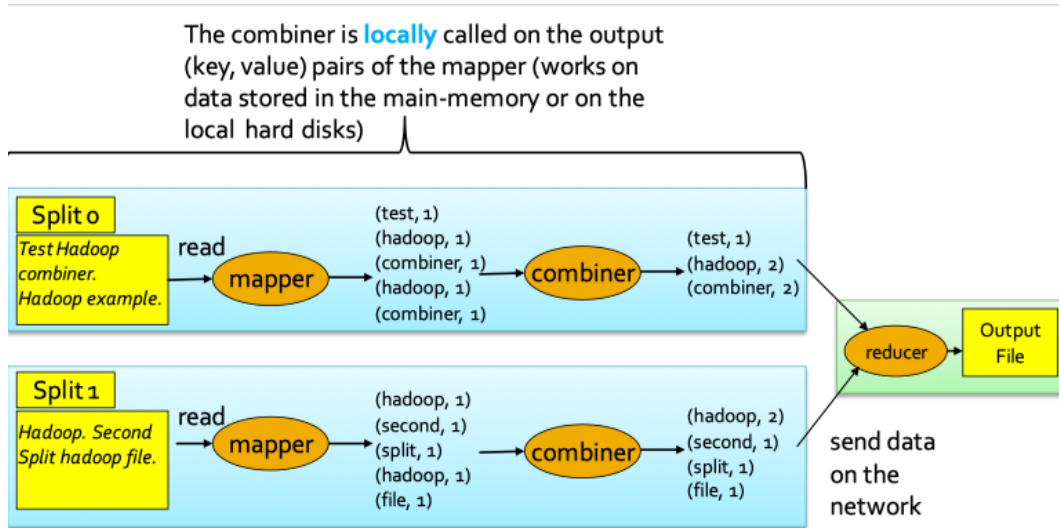


Figure 4: Example of combiner usage

Is an instance of the Reducer class, that implements a pre-reduce phase, characterized by the `reduce()` method. It process (key, [list of value]) and emits (key, value). It runs on the cluster.

Combiners can be also exploited by in-mapper solutions, by initialize a set of in-mapper variables during the instance of the Mapper. They are created by using `setup/cleanup` methods.

Hadoop provides a set of basic, built-in, counters to store some statistics about jobs, mappers and reducers. Also some ad-hoc, user-defined, counters can be defined. They can be used by the exploiting enum Java types, and increment by using the following code:

```
context.getCounter(countername).increment(value);
```

## 2.4 Configurations

Is possible to define some properties shared among the different part (M,C,R), they must be defined in the driver using the following syntax:

```
conf.set("property-name", "value");
```

and they can be retrieved in the Mapper and/or Reducer phase by using:

```
context.getConfiguration().get("property-name");
```

## 2.5 Map-only job

In some cases everything can be achieved using the Mapper phase only. Of course, Hadoop, allows the execution of this kind of jobs. Everything is achieved by setting the number of reducers task to zero. **Not setting this value can generate problems during the executions.**

## 2.6 Setup and Cleanup methods

Are two optional methods to be invoked in the Mapper class, one at the start (Setup()) and the other at the end, both invoked one time for each mapper.