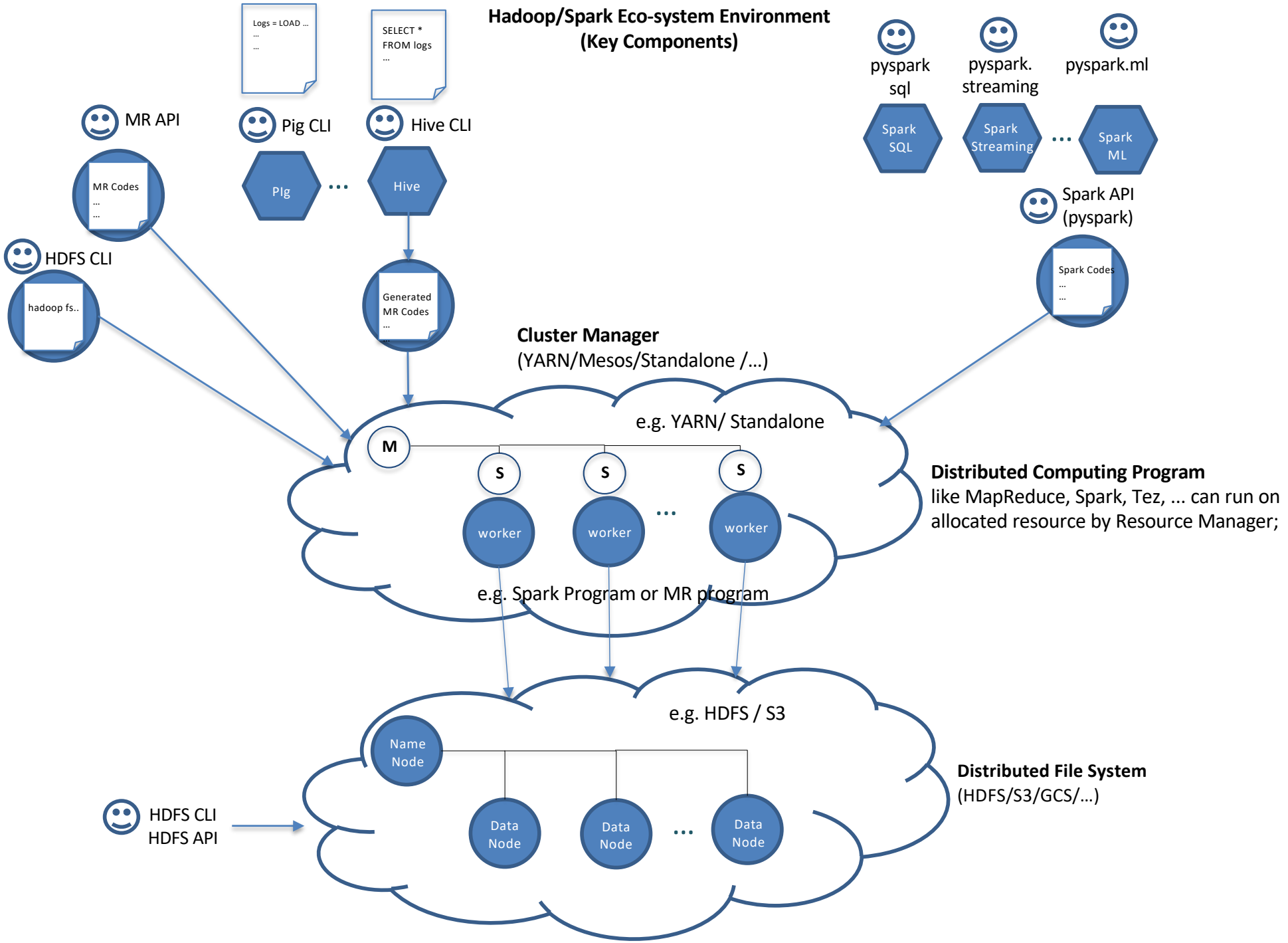
Hadoop/Spark Eco-system Overview


Hadoop/Spark Eco-system Environment
(Key Components)
Logs = LOAD ...
...
...
SELECT *
FROM logs
...
pyspark
sql
pyspark.
streaming
pyspark.ml
MR API
Pig CLI
Hive CLI
Spark
SQL
Spark
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Spark
ML
MR Codes
...
...
Pig
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Spark API
(pyspark)
HDFS CLI
hadoop fs..
Generated
MR Codes
...
Spark Codes
...
...
Cluster Manager
(YARN/Mesos/Standalone /...)
e.g. YARN/ Standalone
M
S
S
S
worker
worker
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Distributed Computing Program
like MapReduce, Spark, Tez, ... can run on
allocated resource by Resource Manager;
e.g. Spark Program or MR program
e.g. HDFS / S3
Name
Node
Data
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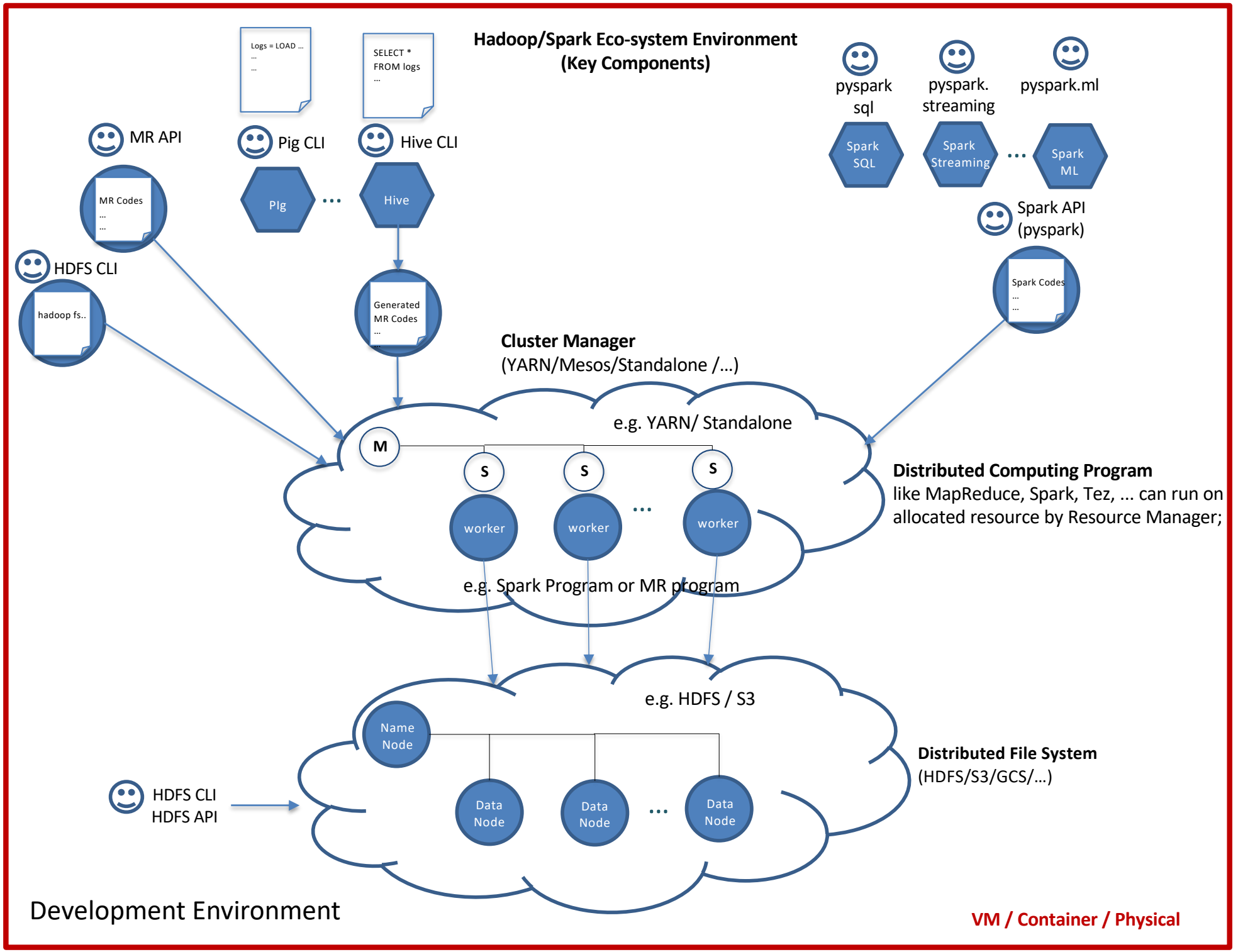
Distributed File System
(HDFS/S3/GCS/...)
HDFS CLI
HDFS API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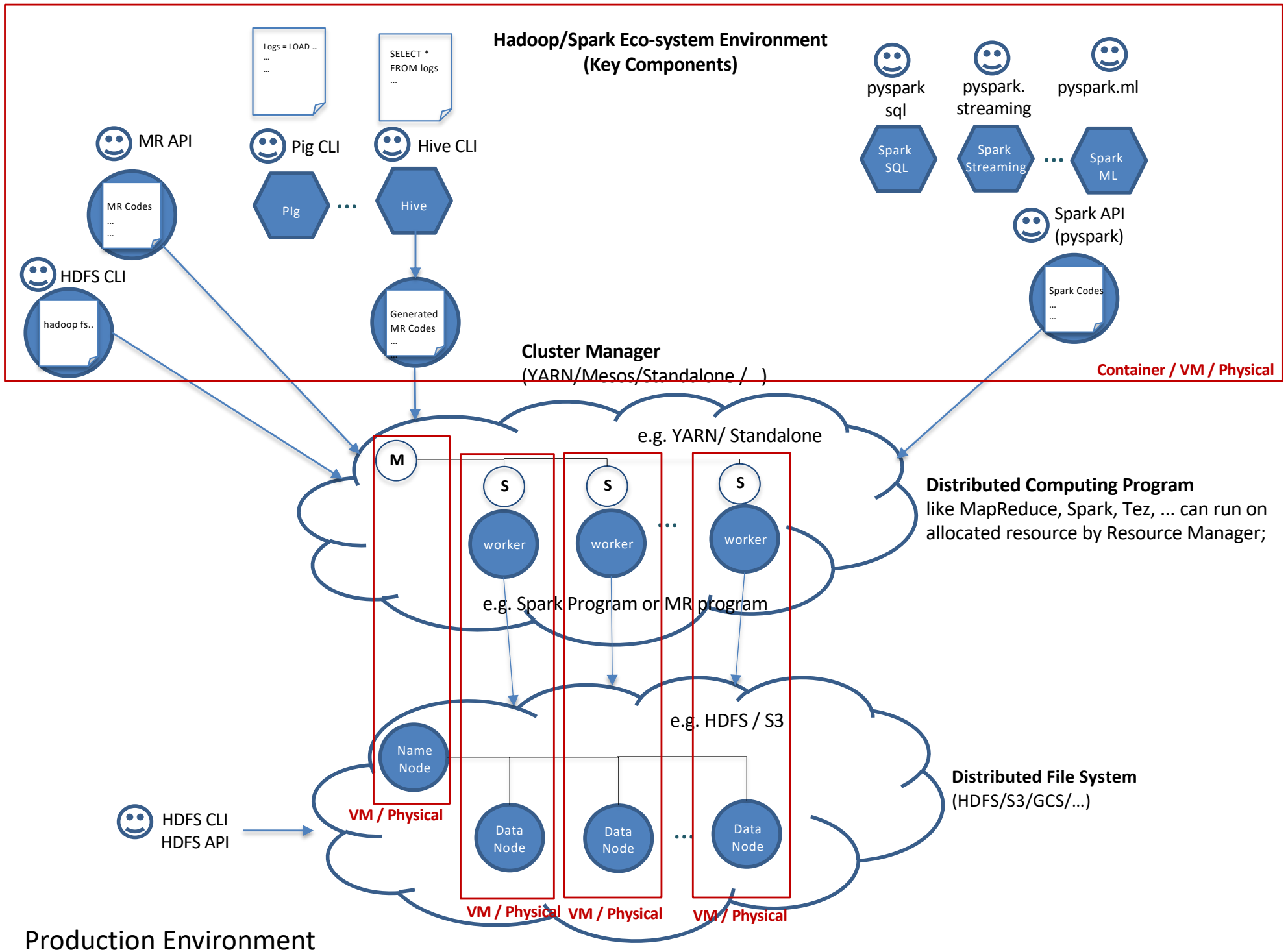
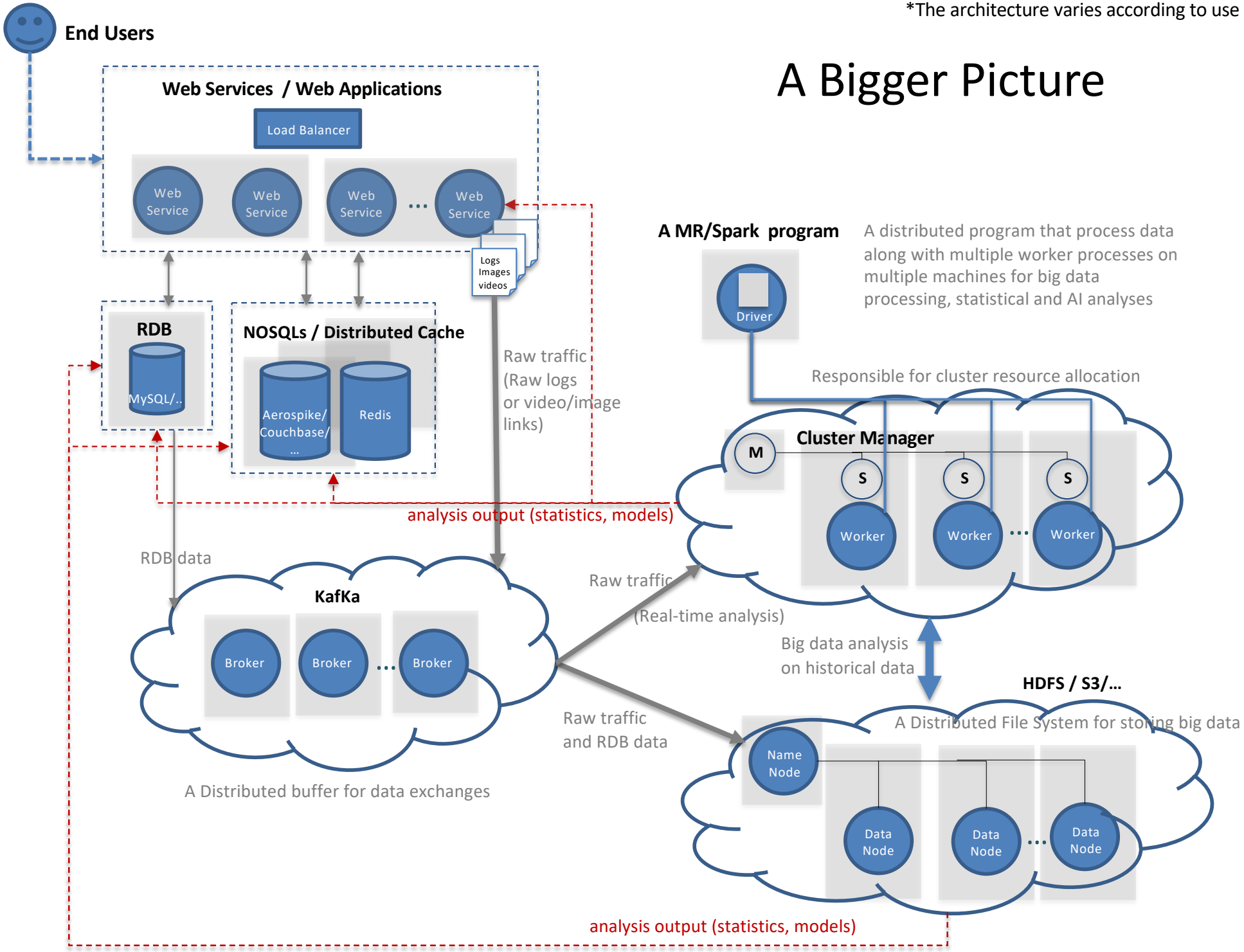
Development Environment
VM / Container / Physical



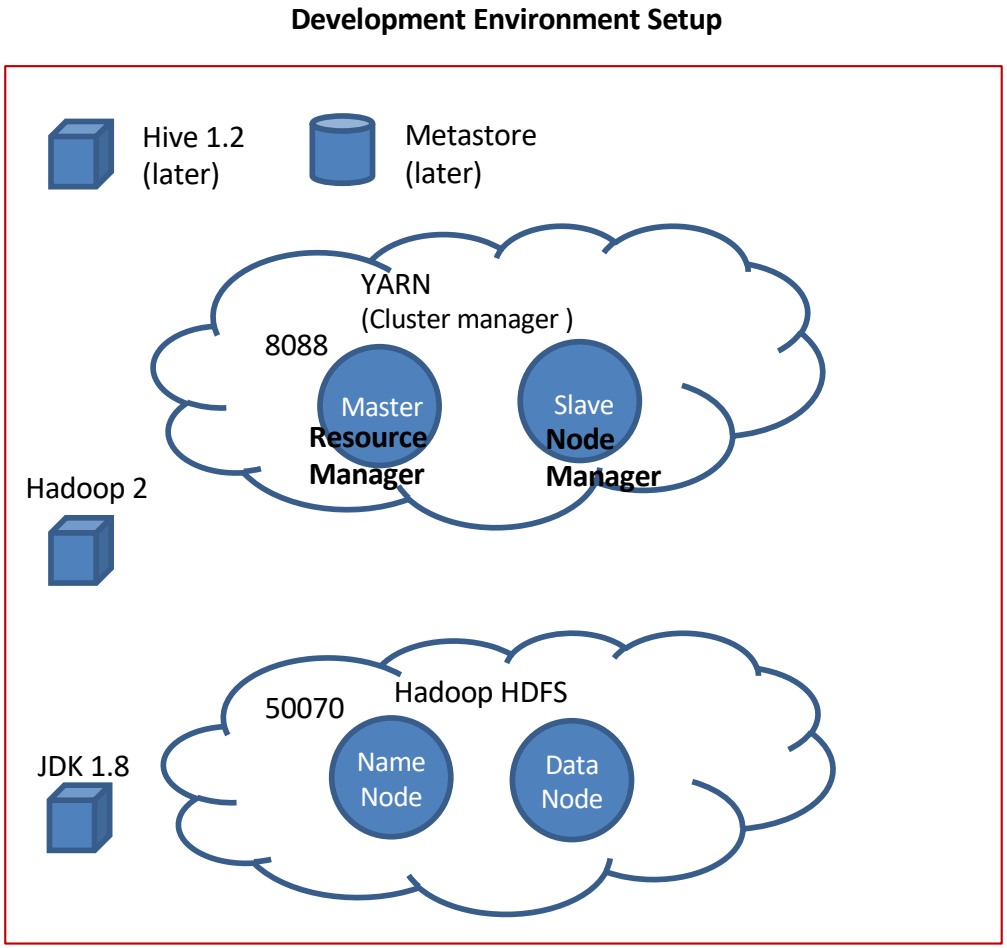
Production Environment

*The architecture varies according to use cases

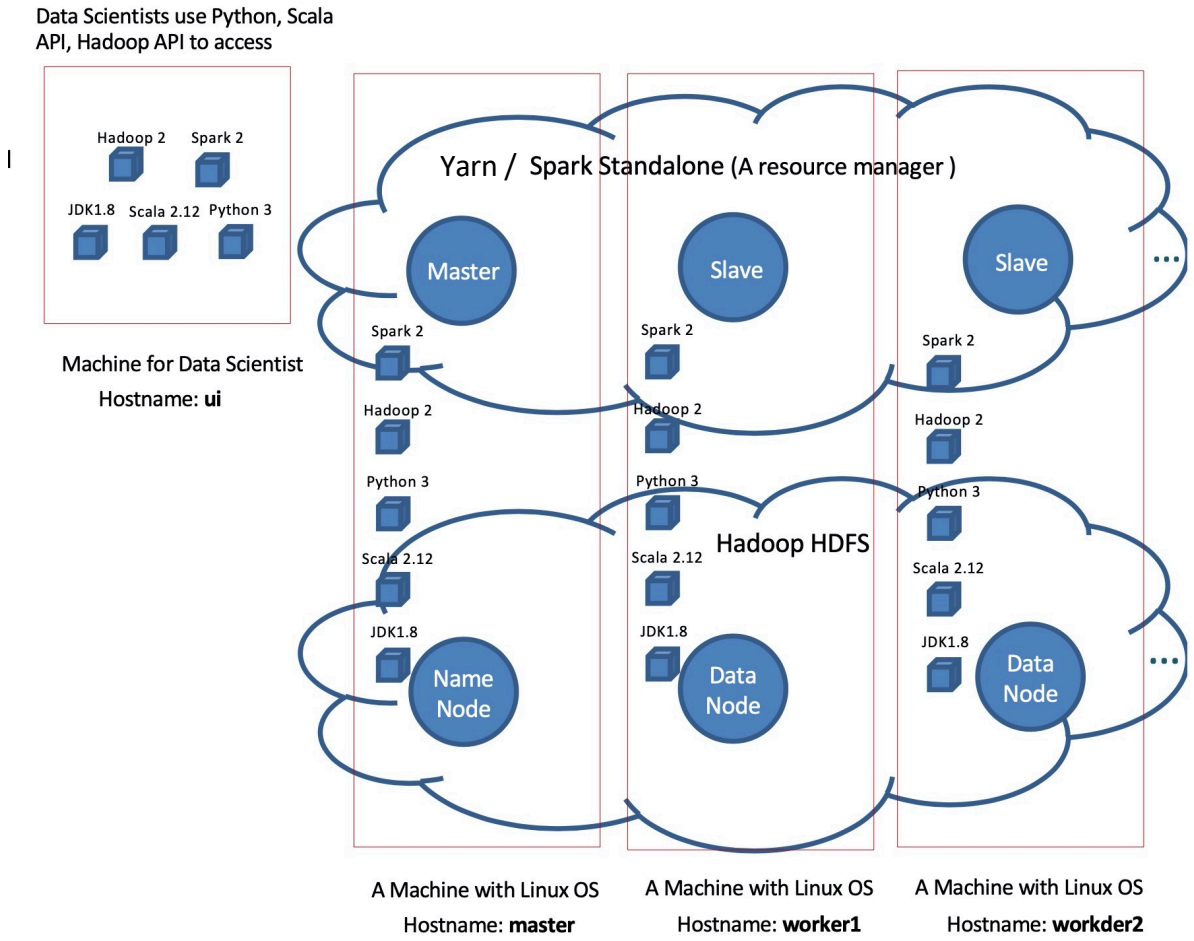
A Bigger Picture



Demo
Development Environment Setup



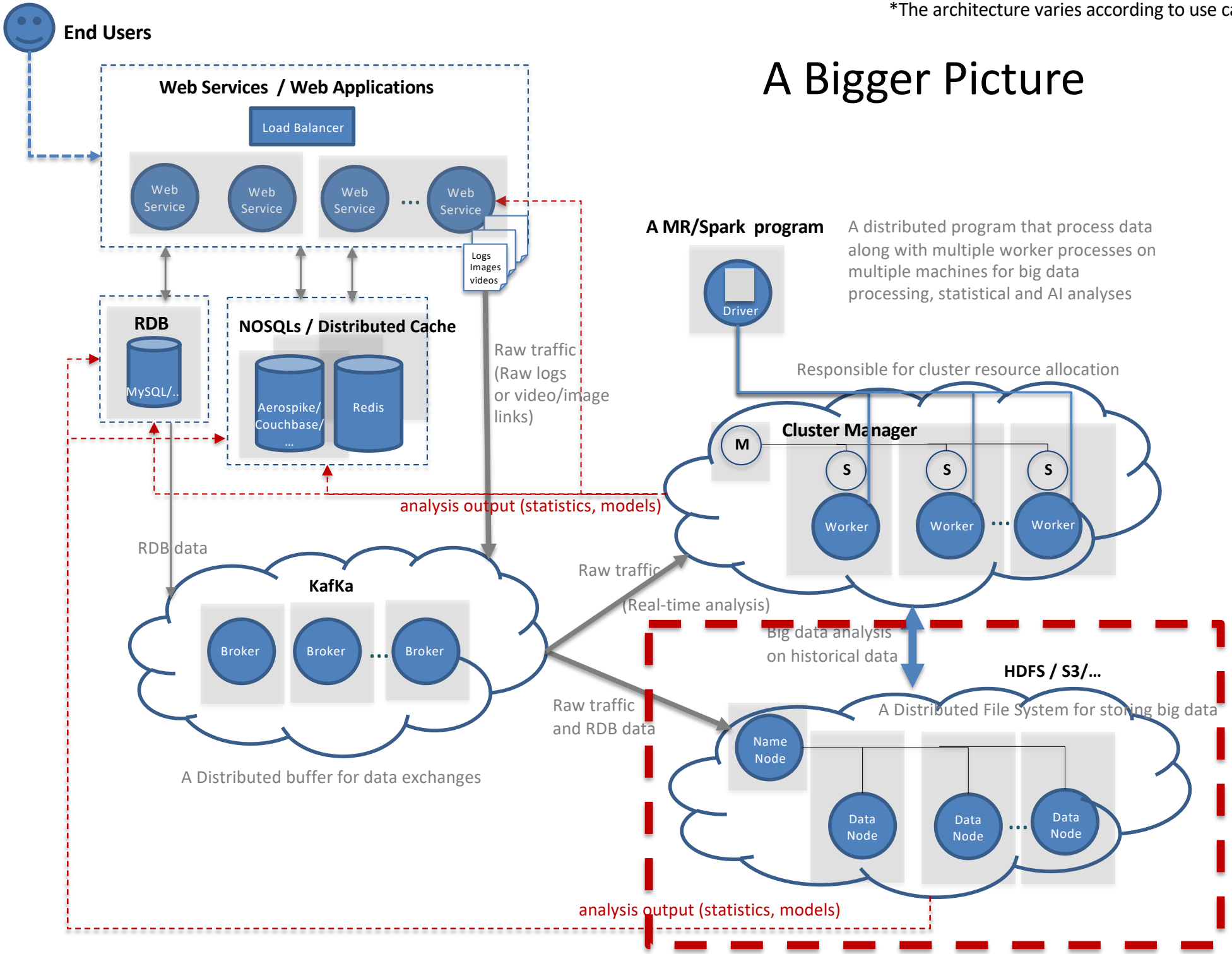
Demo (later on)
Production Environment Setup



Introduction to HDFS

*The architecture varies according to use cases

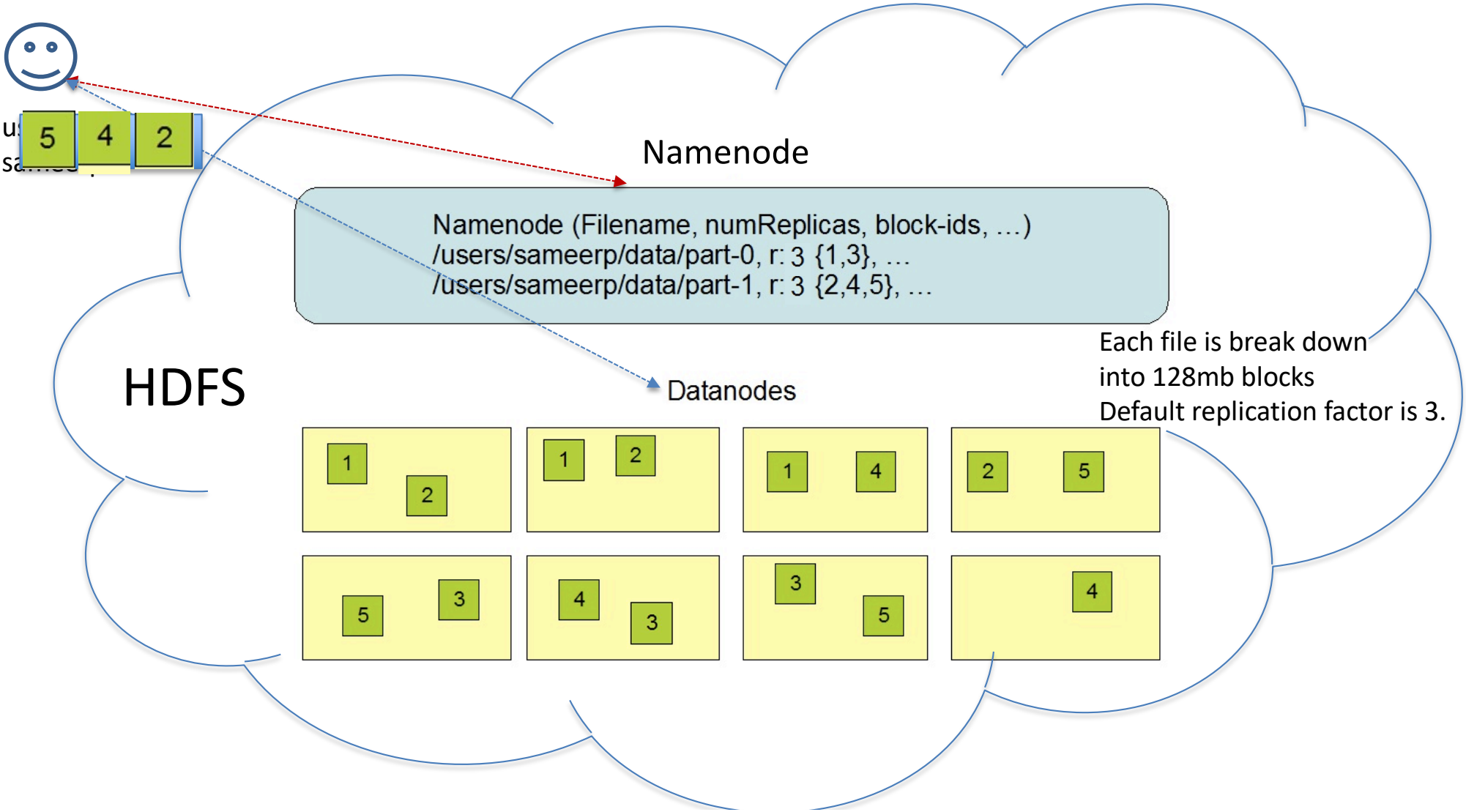
A Bigger Picture



HDFS/S3/GCS Architecture

```
hadoop fs -mkdir /user/sameerp/data
hadoop fs –put part-0 /user/sameerp/data
hadoop fs –put part-1 /user/sameerp/data
```

HDFS CLI

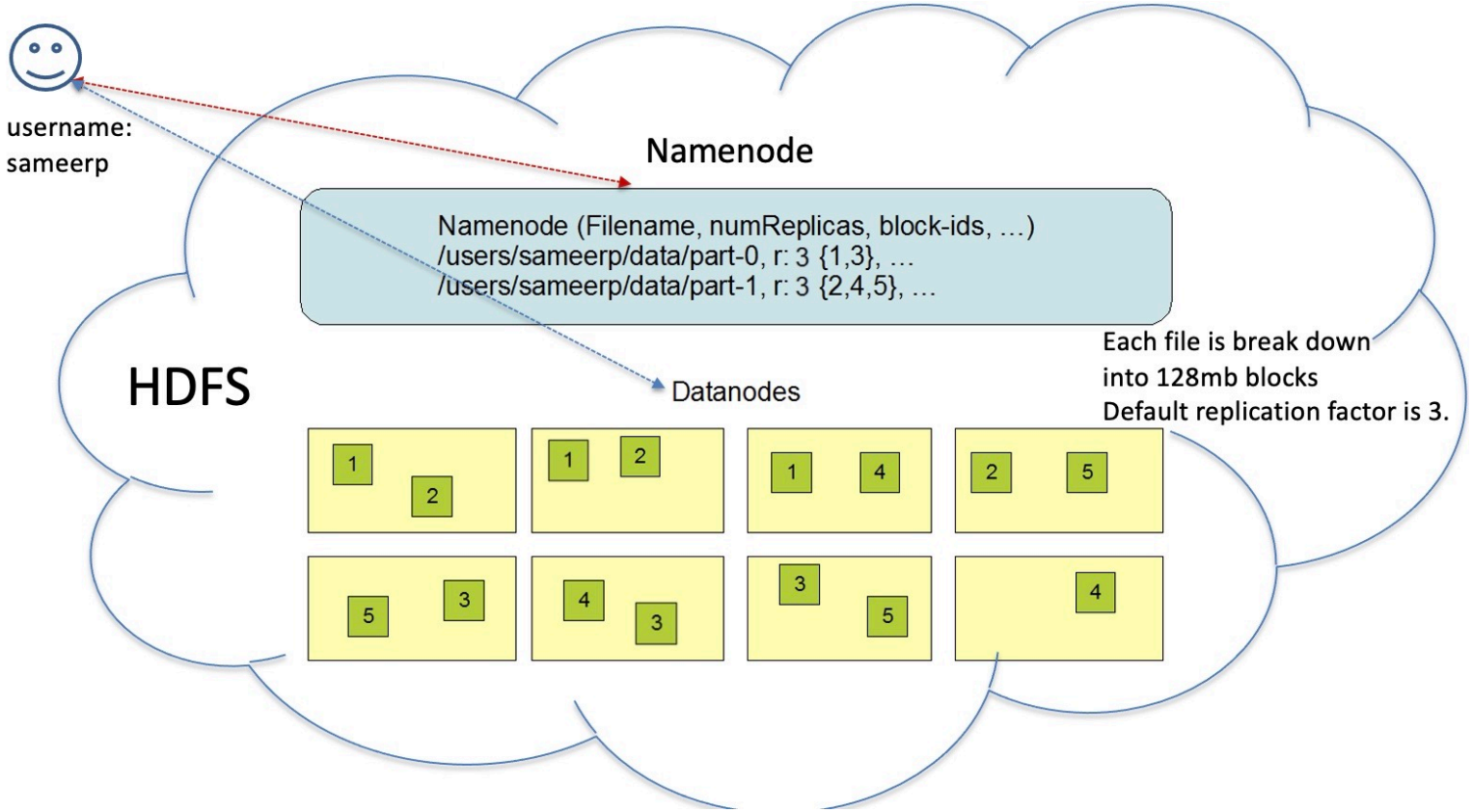


HDFS Architecture

- Present **a single file system** for the end user though it consists of multiple machines under the hood (s3, gcs,..)
- Used to **store small to very large files**
- Files are broken up into blocks stored on Data Nodes
  - Typically, **128 MB** each block
  - Each block has **3 copies** by default
  - **Configurable by clients**
- **Commodity hardware**
  - Files are replicated to handle hardware failure
  - Detect failures and recovers from them

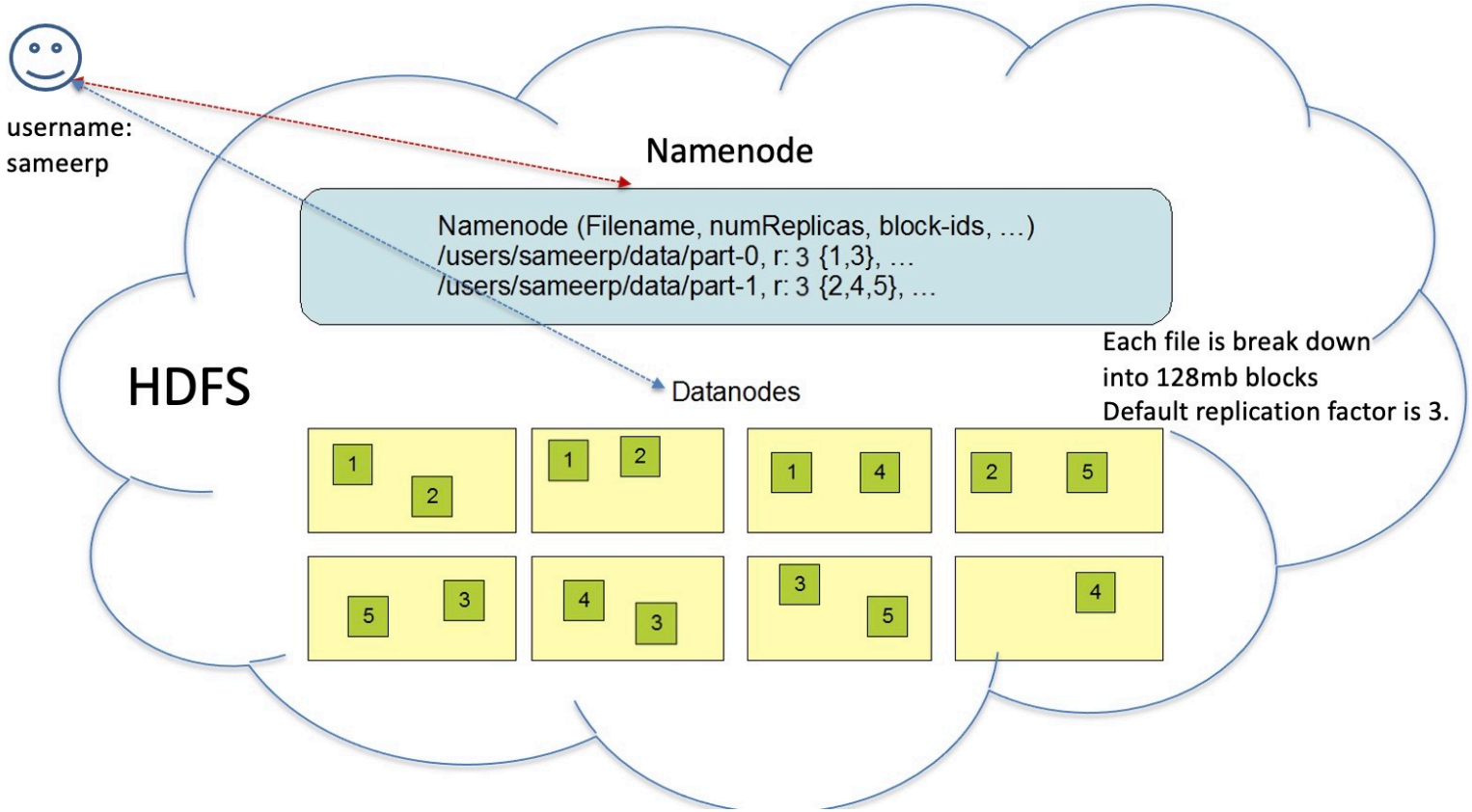
NameNode

- Manages File System Namespace
  - Maps a file name to a set of blocks
  - Maps a block to the DataNodes where it resides



Name Node Metadata

- Meta-data in Memory
  - The entire metadata is in main memory

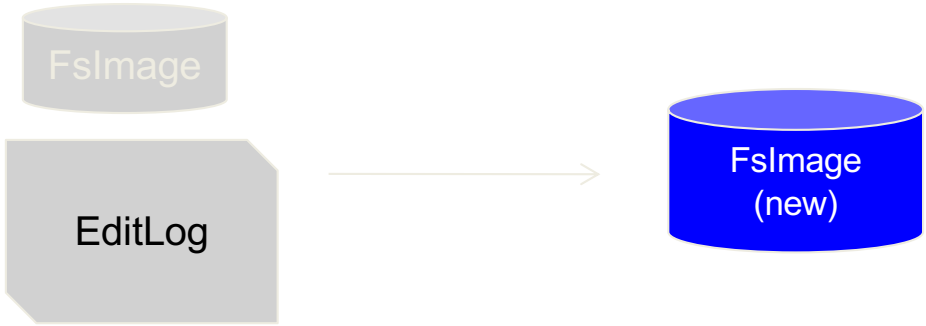


NameNode Metadata (cont.)

- A Transaction Log (called *EditLog*)
  - Records file creations, file deletions. Etc
- *FsImage*
  - The entire namespace, mapping of blocks to files and file system properties are stored in a file called *FsImage*.
  - NameNode can be configured to maintain multiple copies of *FsImage* and *EditLog*.

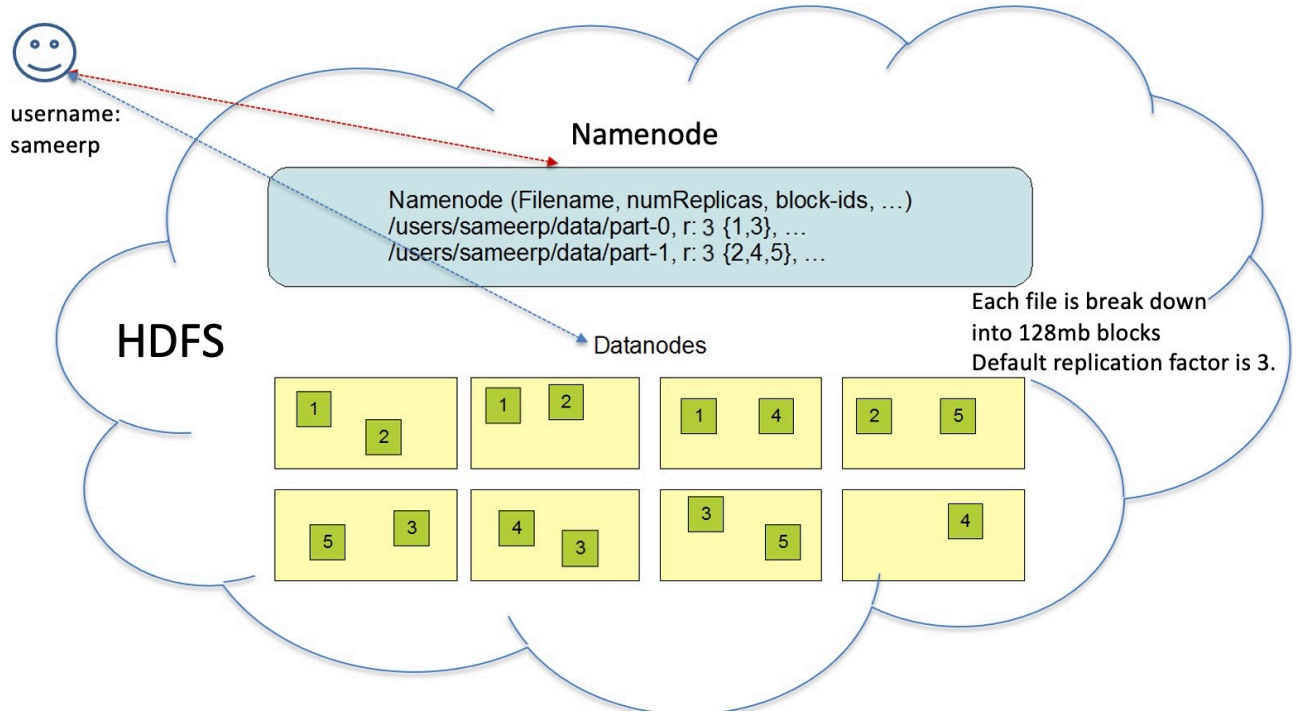
Secondary NameNode

- Copies *FsImage* and *EditLog* from NameNode to a temporary directory
- Merges FSImage and *EditLog* into a new *FSImage* in temporary directory.
- Uploads new *FSImage* to the NameNode
  - Transaction Log on NameNode is purged



DataNode

- A Block Server
  - Stores data in the local file system (e.g. ext3)
  - Serves data and meta-data to Clients
- Block Report
  - Periodically sends a report of all existing blocks to the NameNode



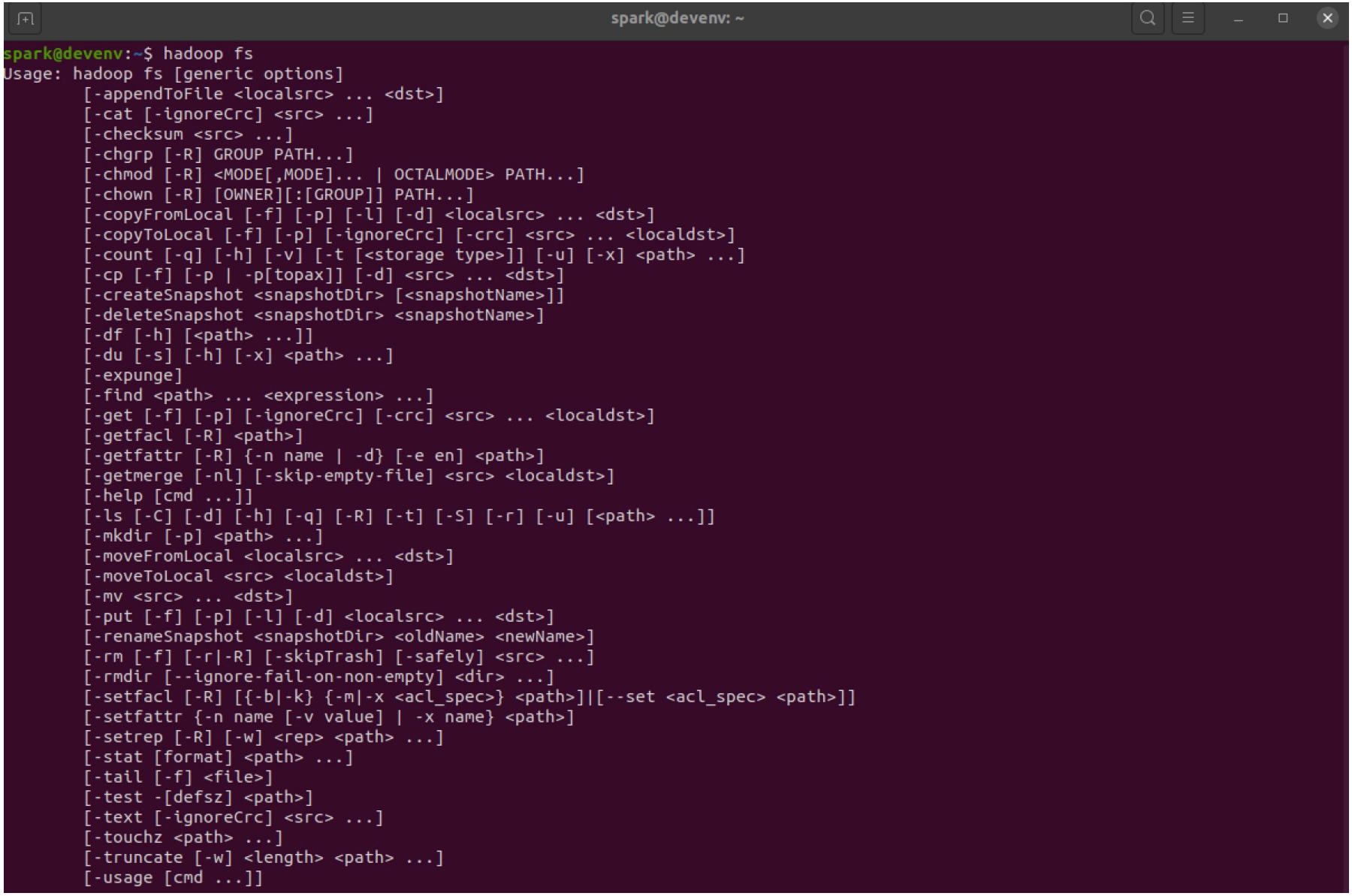
HDFS User Interface

- The command line interface
  - hadoop fs -mkdir /foodir
  - hadoop fs -cat /foodir/myfile.txt
  - hadoop fs -rm /foodir myfile.txt

  hdfs dfs –mkdir /foodir

- APIs in JAVA, Python, etc.

HDFS User Interface



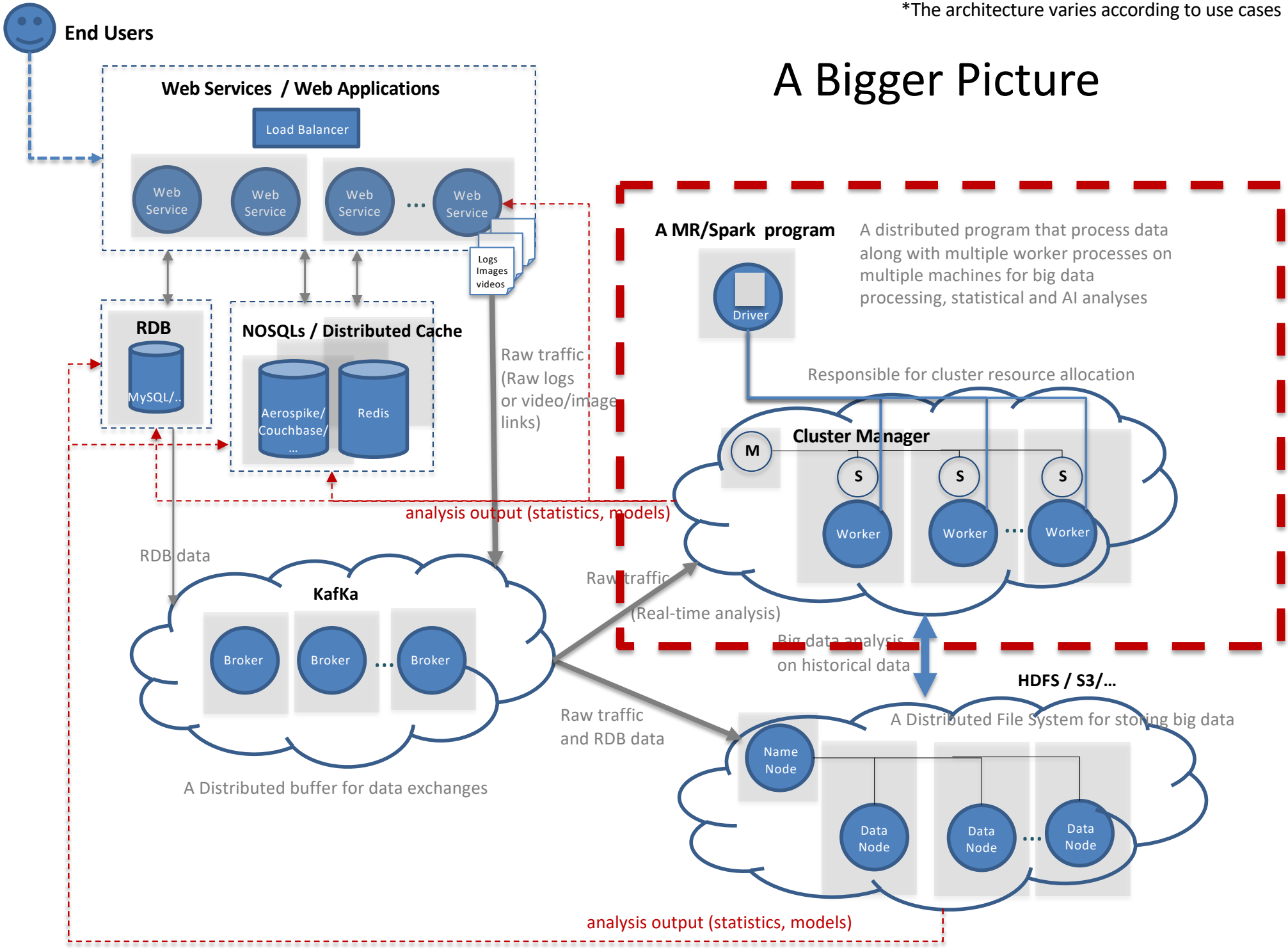
Demo

- Use HDFS CLI to handle files and folders

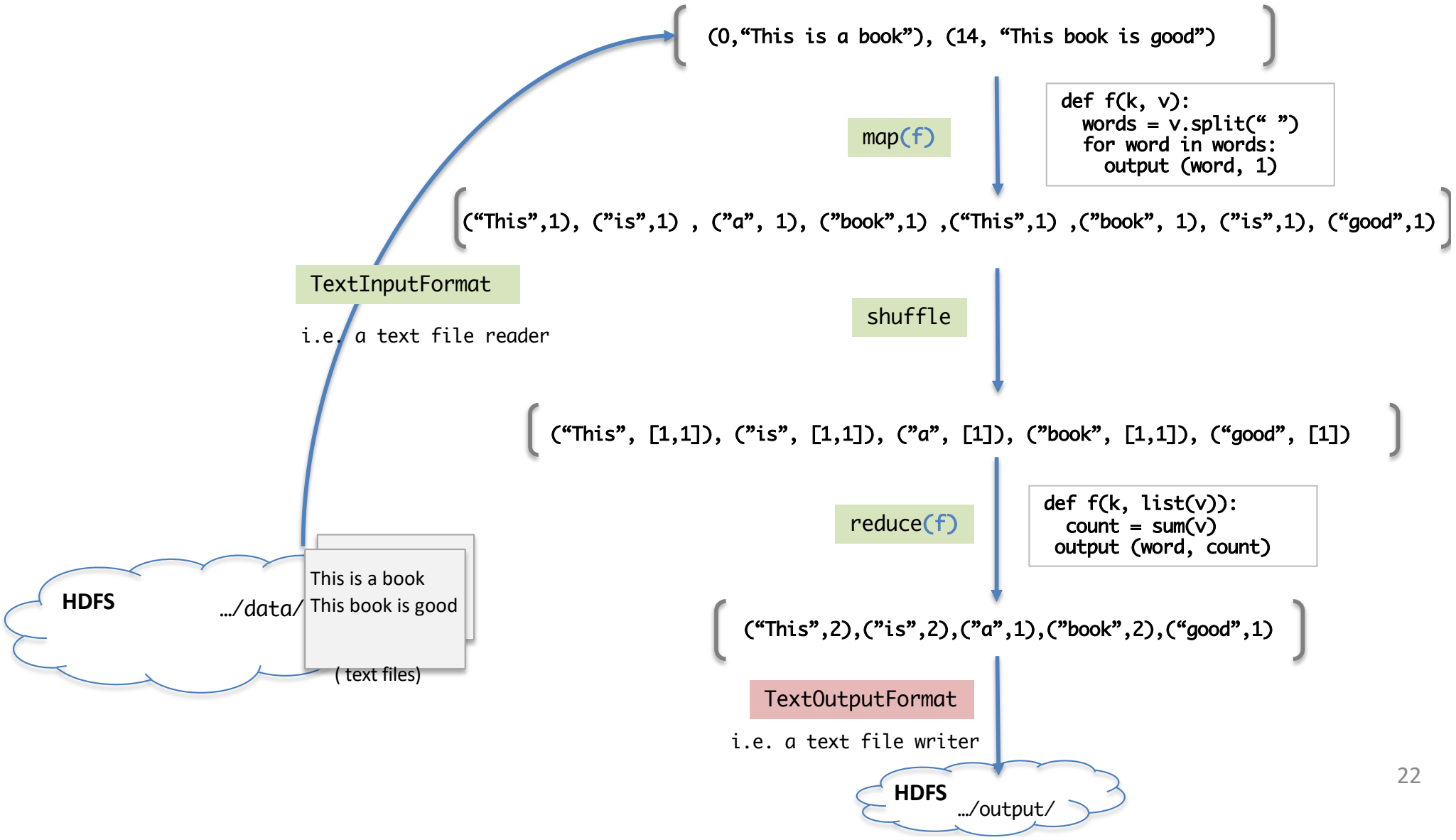
Introduction to MapReduce

*The architecture varies according to use cases

A Bigger Picture



MapReduce Programming Model (Concept)



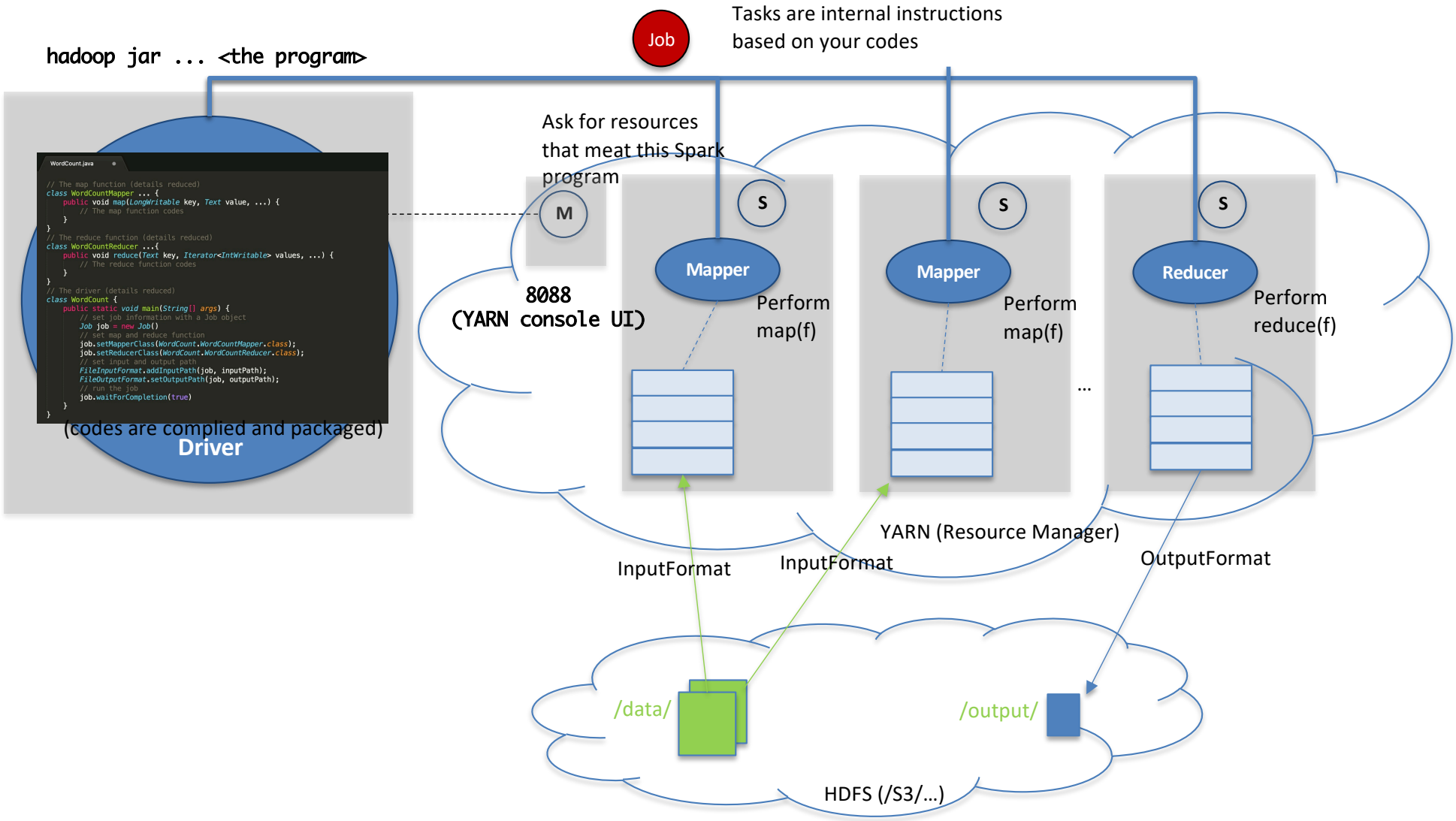
How a MR program is like ?

WordCount.java

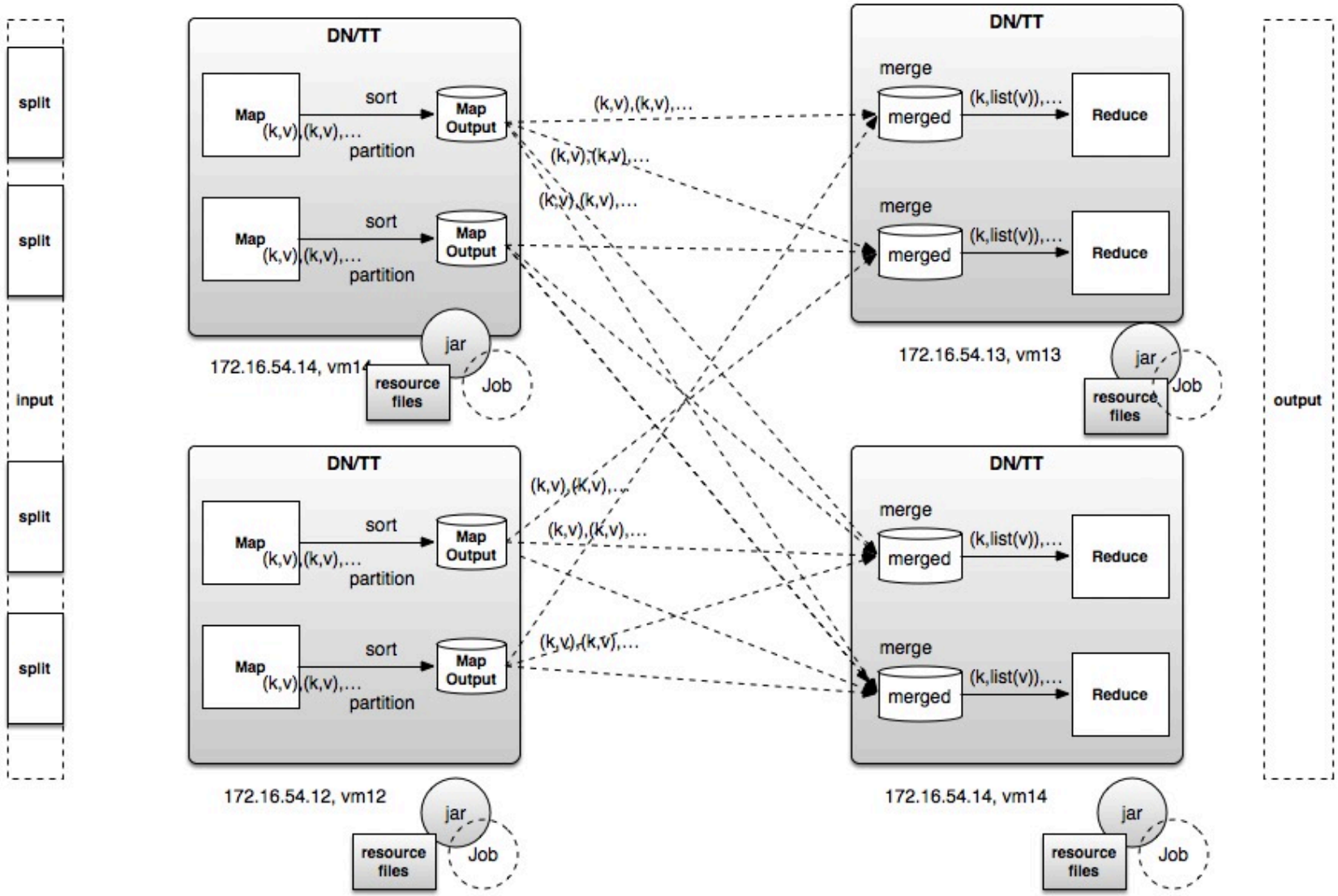
```
// The map function (details reduced)
class WordCountMapper ... {
    public void map(LongWritable key, Text value, ...) {
        // The map function codes
    }
}
// The reduce function (details reduced)
class WordCountReducer ...{
    public void reduce(Text key, Iterator<IntWritable> values, ...) {
        // The reduce function codes
    }
}
// The driver (details reduced)
class WordCount {
    public static void main(String[] args) {
        // set job information with a Job object
        Job job = new Job()
        // set map and reduce function
        job.setMapperClass(WordCount.WordCountMapper.class);
        job.setReducerClass(WordCount.WordCountReducer.class);
        // set input and output path
        FileInputFormat.addInputPath(job, inputPath);
        FileOutputFormat.setOutputPath(job, outputPath);
        // run the job
        job.waitForCompletion(true)
    }
}
```

MR Program Run-time Excution Flow

hadoop jar mr101.jar com.iii.mr101.WordCount hdfs://devenv/user/spark/mr101/wordcount/data hdfs://devenv/user/spark/mr101/wordcount/output



MR Program Run-time Excution Flow (another view)



Demo

- Install Java IDE
- Calculate word count example in MR
- Calculate average temperature in MR

(Just to have an idea how the MR program are like and run. Don’t worry about JAVA ☺)