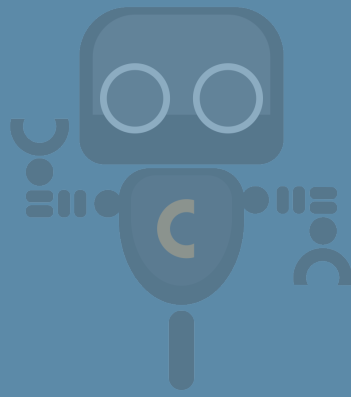
Fundamentos e Arquitetura de Bigdata, Banco de dados não relacionais

Aula 2



Francisco Nauber Bernardo Gois

Universidade Estadual do Ceará

15 de fevereiro de 2

Instrutor

F. Nauber Bernardo Gois

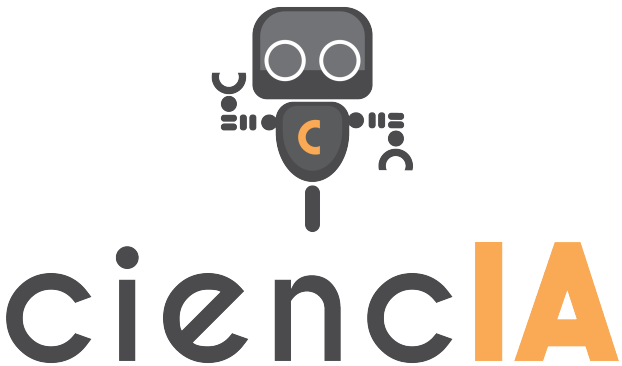
Dsc. Informática Aplicada
Lider de Aprendizado de Máquina na Secretaria de Saúde do Ceará
Engenheiro de Aprendizado de Máquina

Instrutor

https://www.linkedin.com/in/n

https://www.linkedin.com
/in/naubergois/
Envie recomendações, depoimentos e competÊncias

Instrutor



https://www.youtube.com/can

https://www.youtube.com/canaldaciencia

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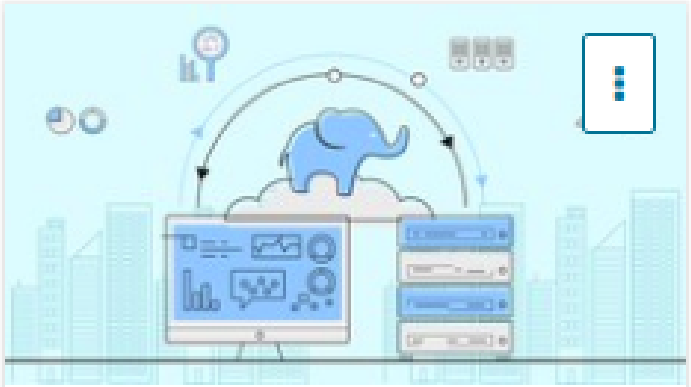
The Ultimate Hands-On Hadoop - Tame your Big Data!

Sundog Education by Frank Kane, Founder, Sundog...

6% Complete

Deixe uma classificação



Learn Big Data: The Hadoop Ecosystem Masterclass

Edward Viaene, DevOps, Cloud, Big Data Specialist

8% Complete

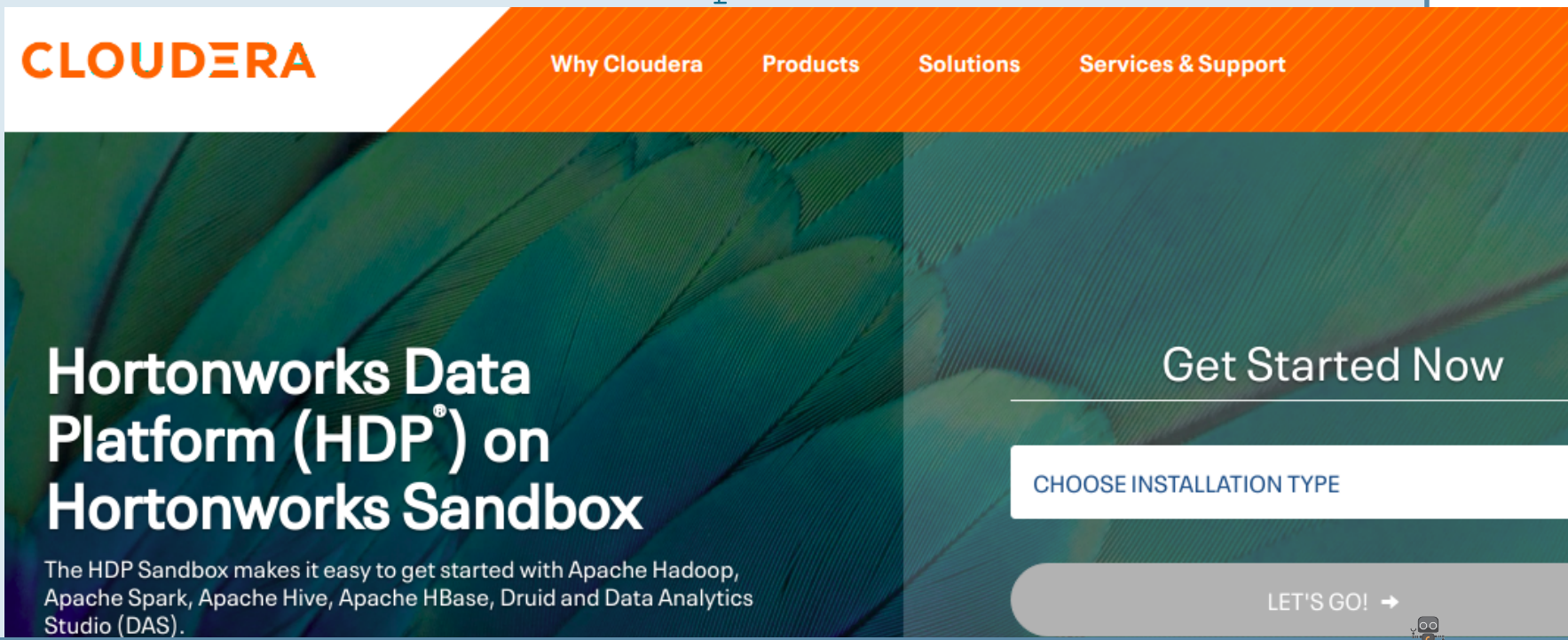
Sua classificação

Cursos Recomendados

Material do Curso

HDP 2.5 sandbox image

Baixe a imagem no endereço `https://www.cloudera.com/downloads/hortonworks-sandbox/hdp.html`

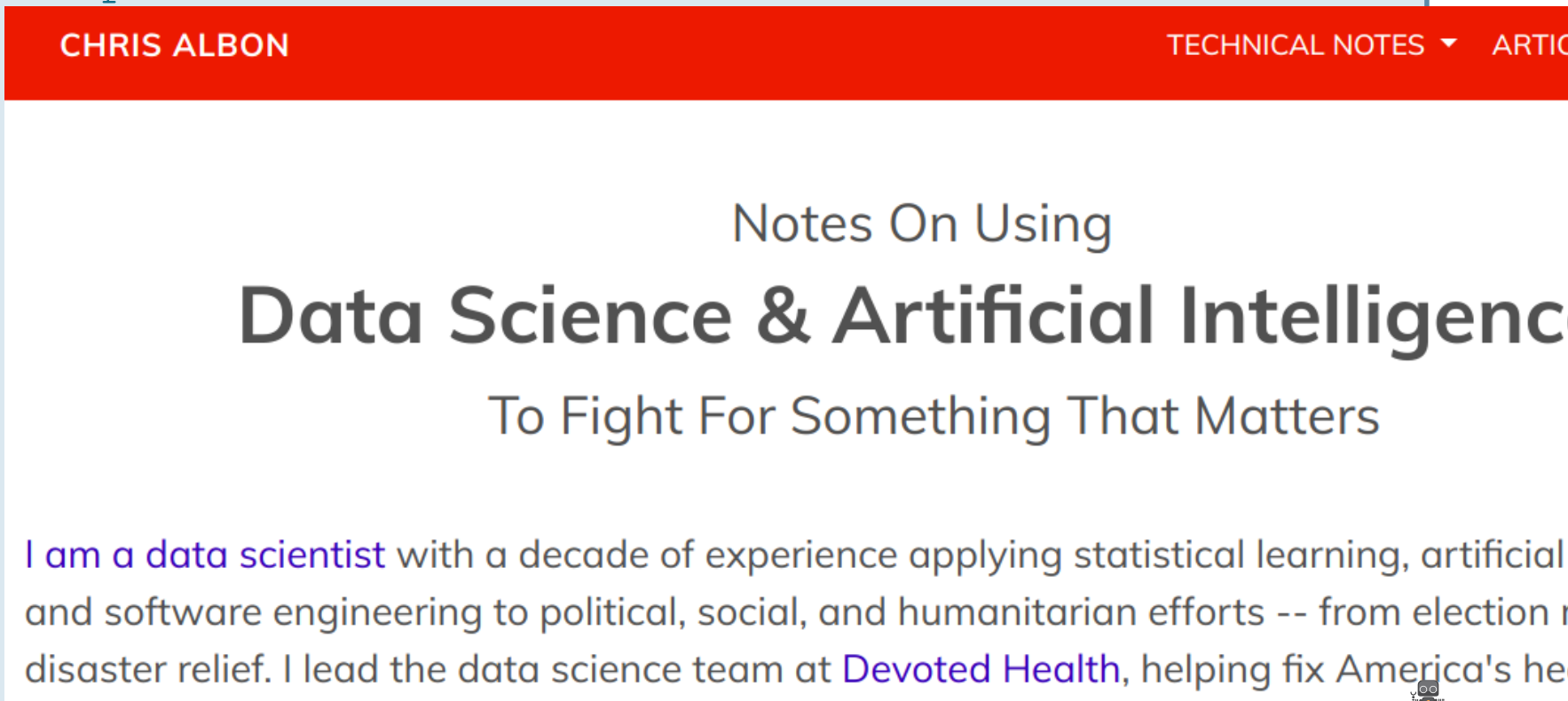


Material do Curso

Chris Albon

Curso de Aprendizado de Máquina

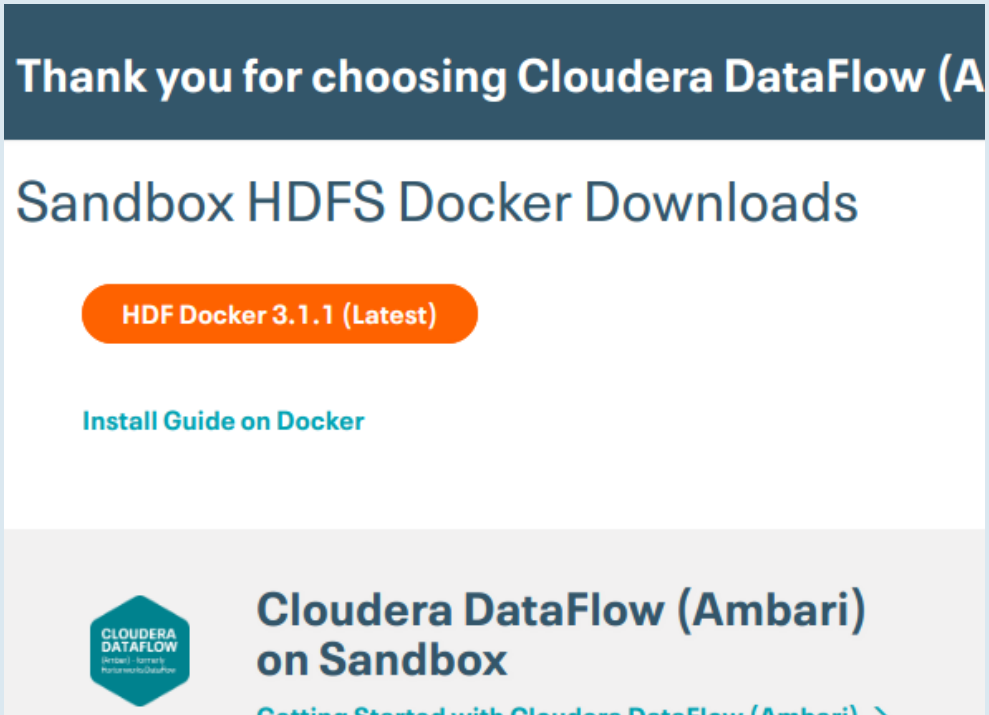
https://chrisalbon.com/

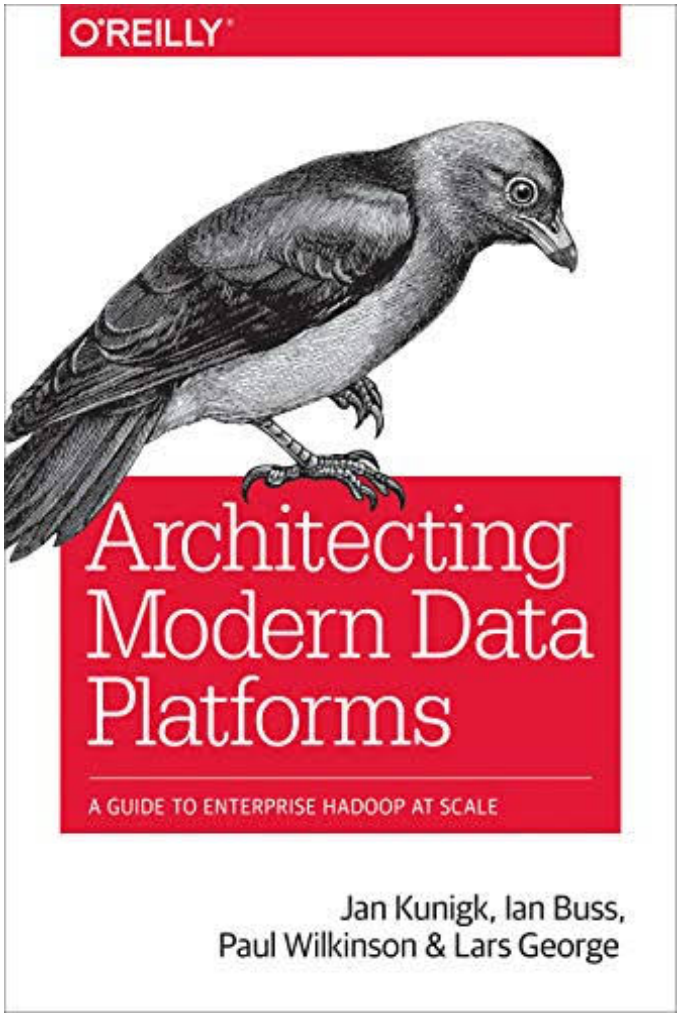


Material do Curso

HDP 2.5 sandbox image

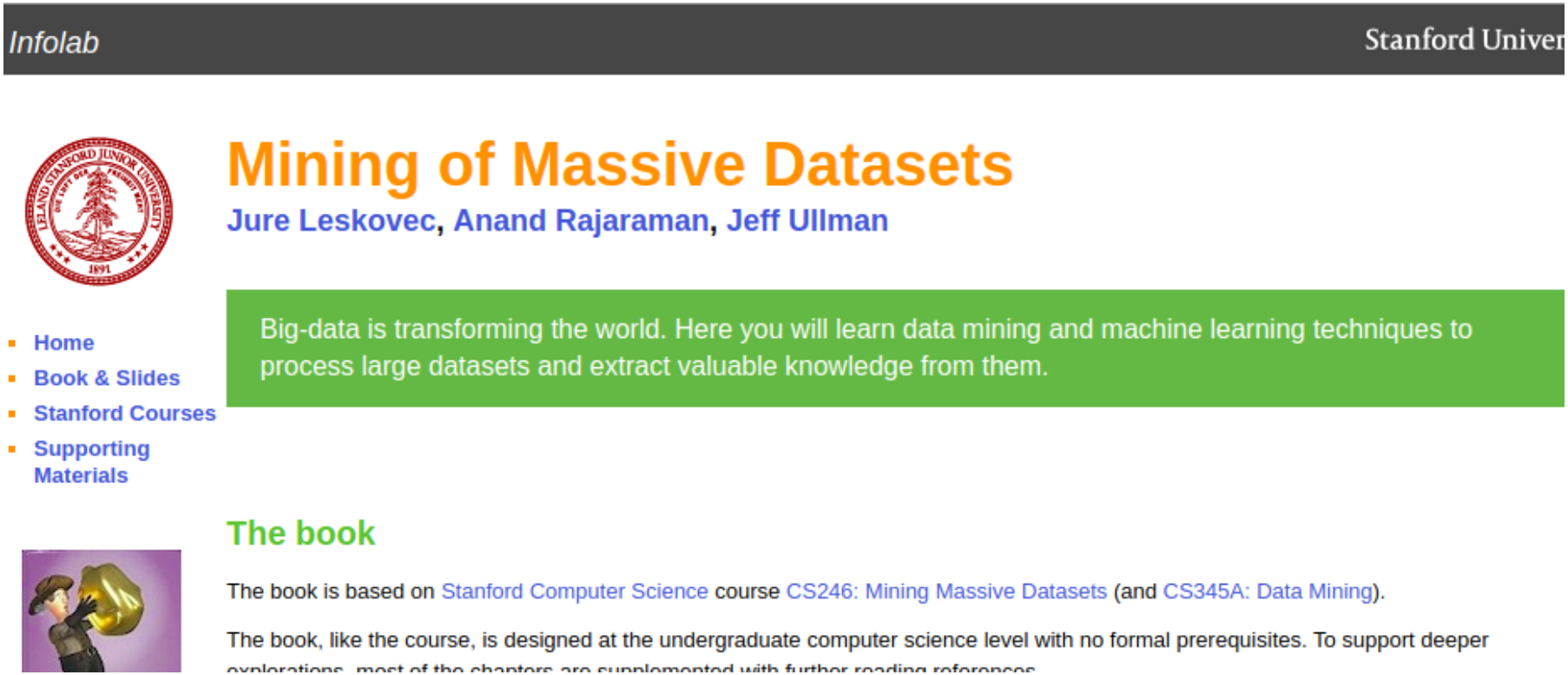
Baixe a imagem no endereço `https://www.cloudera.com/downloads/hortonworks-sandbox/hdf.html?utm_source=`





Livro Recomendado

Livro



http://mmds.org/

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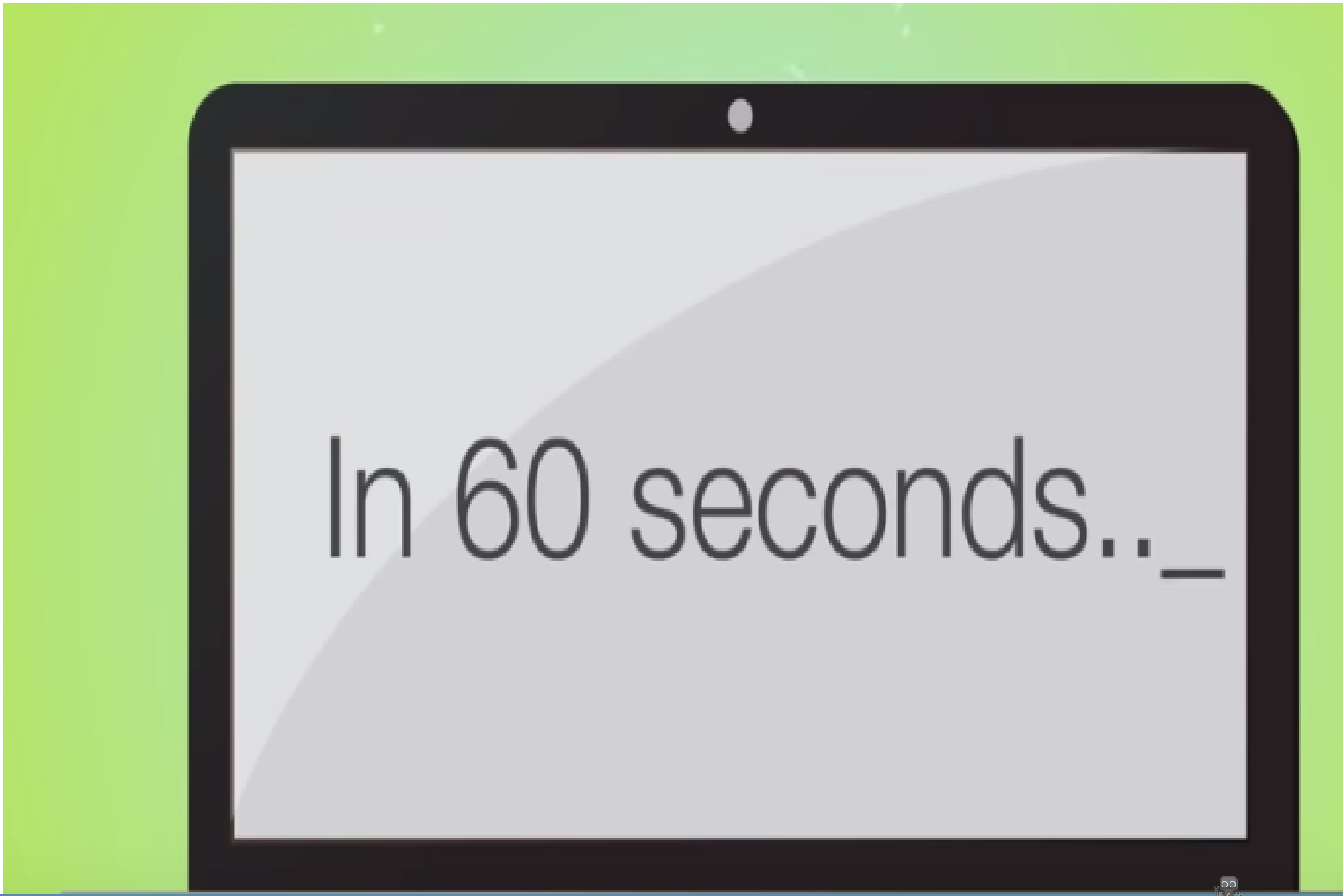
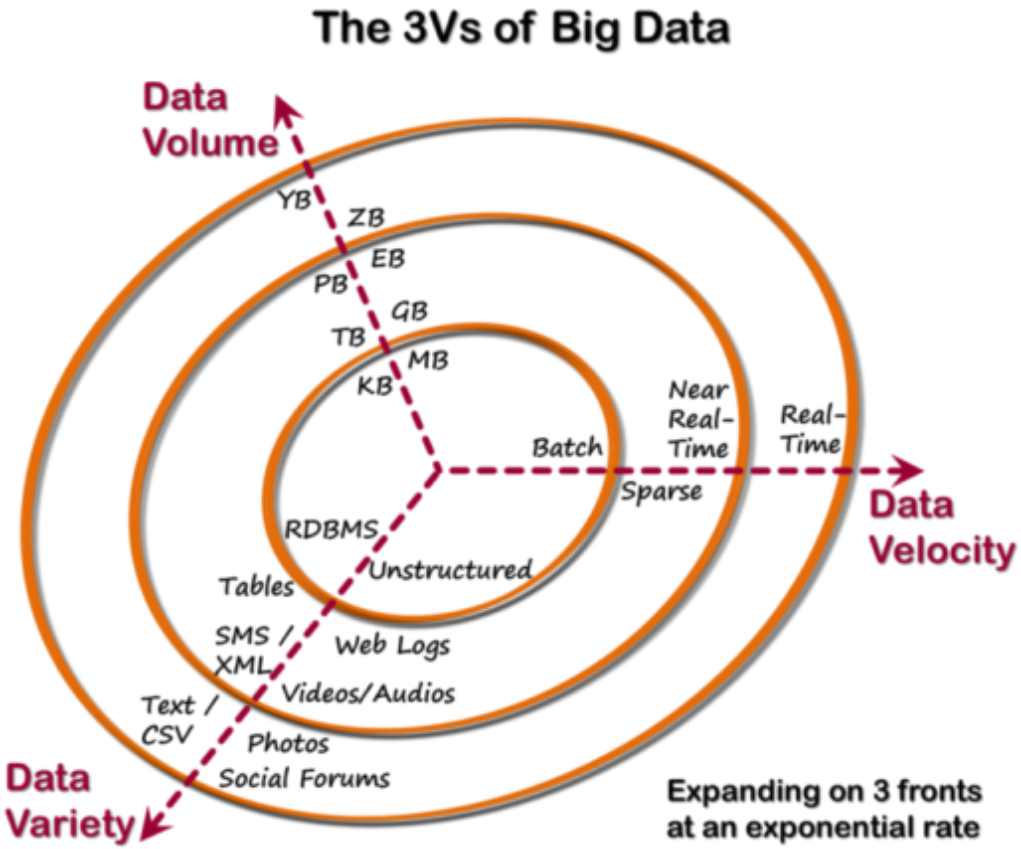

In 60 seconds..._

3 Vs



http://www.hadooptechs.com/

Dados necessitam estar armazenados

But to extract the knowledge data needs to be

- **Stored (systems)**
- **Managed (databases)**
- **And ANALYZED ← this class**

Data Mining ≈ Big Data ≈
Predictive Analytics ≈
Data Science ≈ Machine Learning

http://web.stanford.edu/class/cs246/slides/01-intro.pdf

Computação em Larga Escala

- **Large-scale computing** for **data mining** problems on **commodity hardware**
- **Challenges:**
  - **How do you distribute computation?**
  - **How can we make it easy to write distributed programs?**
  - **Machines fail:**
    - One server may stay up 3 years (1,000 days)
    - If you have 1,000 servers, expect to lose 1/day
    - With 1M machines 1,000 machines fail every day!

http://web.stanford.edu/class/cs246/slides/01-intro.pdf

Copiando os dados na rede

- **Issue:**
  Copying data over a network takes time
- **Idea:**
  - Bring computation to data
  - Store files multiple times for reliability
- **Spark/Hadoop** address these problems
  - **Storage Infrastructure – File system**
    - Google: GFS. Hadoop: HDFS
  - **Programming model**
    - MapReduce
    - Spark

http://web.stanford.edu/class/cs246/slides/01-intro.pdf

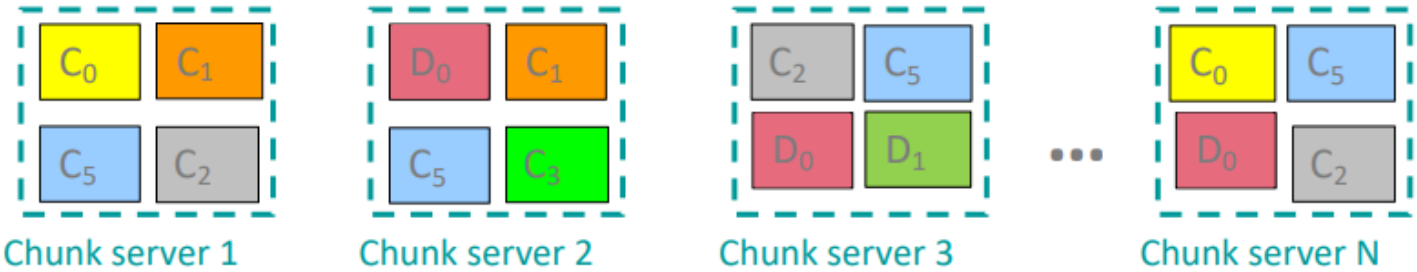
Distributed File System

- **Chunk servers**
  - File is split into contiguous chunks
  - Typically each chunk is 16-64MB
  - Each chunk replicated (usually 2x or 3x)
  - Try to keep replicas in different racks
- **Master node**
  - a.k.a. Name Node in Hadoop's HDFS
  - Stores metadata about where files are stored
  - Might be replicated
- **Client library for file access**
  - Talks to master to find chunk servers
  - Connects directly to chunk servers to access data

http://web.stanford.edu/class/cs246/slides/01-intro.pdf

Distributed File System

- **Reliable distributed file system**
- Data kept in “chunks” spread across machines
- Each chunk **replicated** on different machines
  - Seamless recovery from disk or machine failure

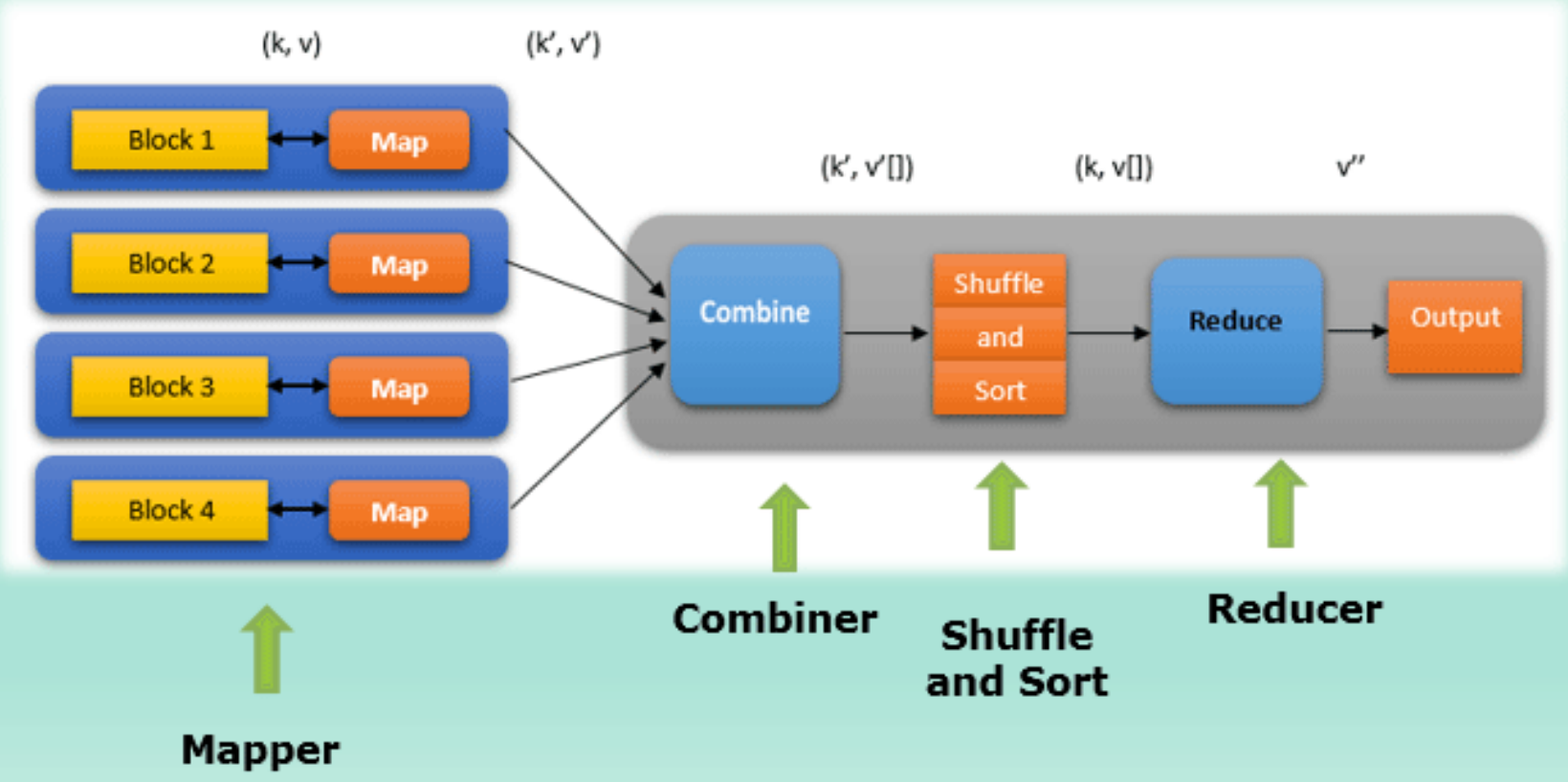


Bring computation directly to the data!

Chunk servers also serve as compute servers

http://web.stanford.edu/class/cs246/slides/01-intro.pdf

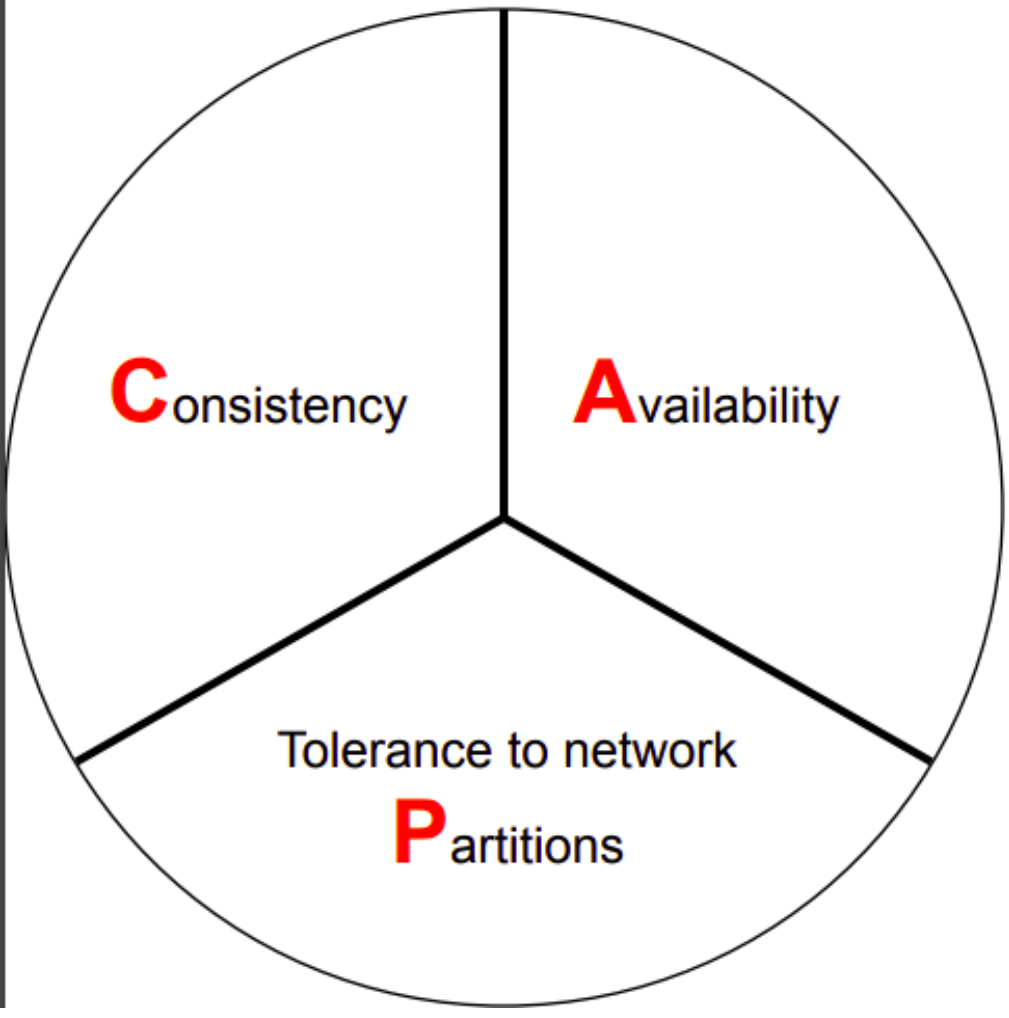
How MapReduce Works



Why MapReduce?

- Distributes the processing of data on your cluster
- Divides your data up into partitions that are MAPPED (transformed) and REDUCED (aggregated) by mapper and reducer functions you define
- Resilient to failure – an application master monitors your mappers and reducers on each partition

The CAP Theorem



Theorem: You can have **at most two** of these invariants for any shared-data system

Corollary: consistency boundary must choose A or P

CAP Theorem

- 2000: Eric Brewer, PODC conference keynote
- 2002: Seth Gilbert and Nancy Lynch, ACM SIGACT News 33(2)

"Of three properties of shared-data systems (Consistency, Availability and tolerance to network Partitions) only two can be achieved at any given moment in time."

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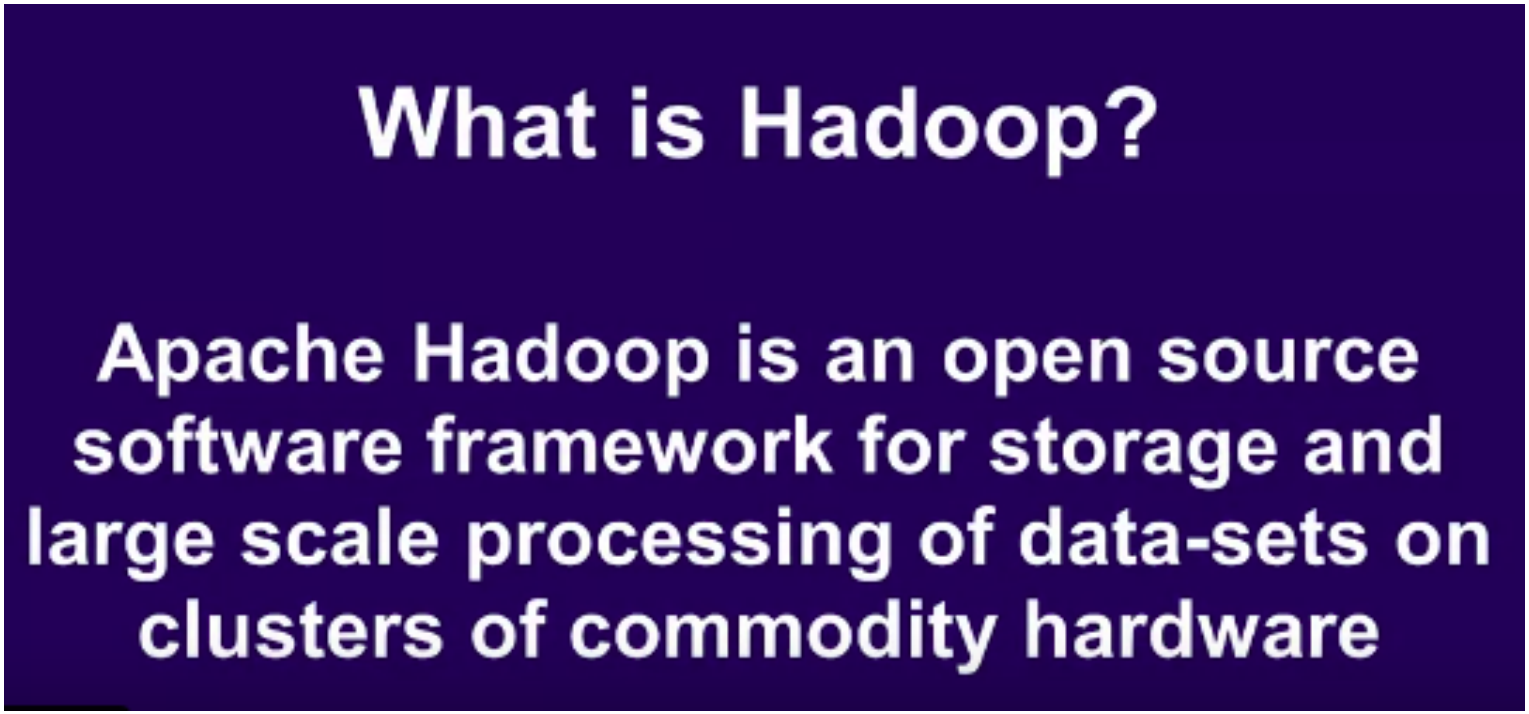
hadoop



https://www.coursera.org/learn/hadoop/lecture/ZbVQf/hadoop-stack-basics

Hadoop

O que é o Hadoop?

Criado por Doug Cutting em 2005 com o nome do elefante do filho.

Hadoop

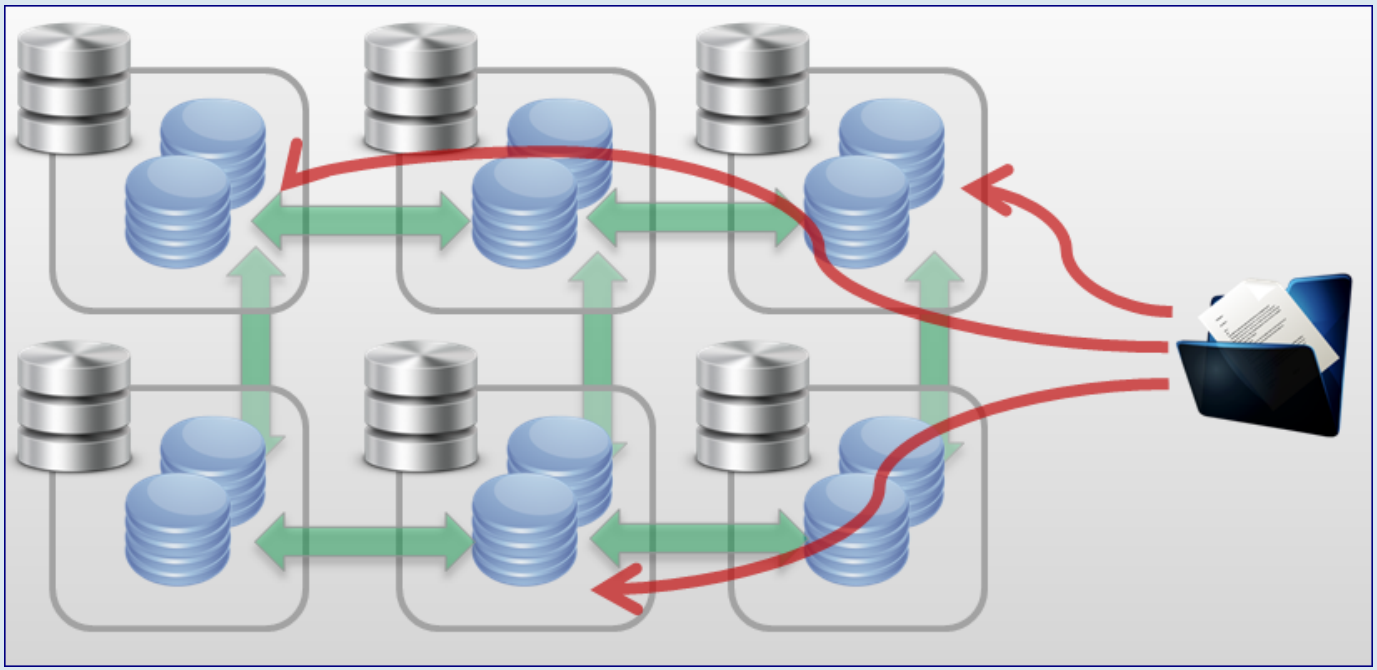
O que é o Hadoop?

A biblioteca de software Apache Hadoop é uma estrutura que permite o processamento distribuído de grandes conjuntos de dados entre clusters de computadores usando modelos de programação simples. Ele foi projetado para expandir de servidores únicos para milhares de máquinas, cada uma oferecendo computação e armazenamento local. `https://hadoop.apache.org/`

Hadoop

O que é o Hadoop?

Movendo o processamento para os dados.




Distributed Storage
High Availability
Economic
Scalability
Hadoop Features
Fault Tolerance
Easy to use
Reliability
Data locality
Flexibility
Replication
Data Flair

Why Hadoop?

Data Growth is mind boggling. Forecast for 2020: 40 Trillion GB

Cost effective

Scalable

Fast

Open source

Source: https://rapidminer.com/rapidminer-acquires-radoop/

Why Hadoop?

- Data's too darn big - terabytes per day
- Vertical scaling doesn't cut it
  - Disk seek times
  - Hardware failures
  - Processing times
- Horizontal scaling is linear
- Hadoop: It's not just for batch processing anymore

the-ultimate-hands-on-hadoop-tame-your-big-data/learn/lecture/

Hadoop

Porque usar o Hadoop?

1- FLEXÍVEL Nenhum outro meio de armazenamento e/ou processamento de dados tem a capacidade de armazenar desde conteúdos estruturados como tabelas e arquivos texto, até vídeos, fotos, etc. Com sua estrutura baseada em file system, seu armazenamento tem as características do sistema operacional Linux e comandos POSIX.

Hadoop Creation History

Doug Cutting adds DFS & MapReduce support to Nutch

YAHOO!

Fastest sort of a TB, 3.5mins over 910 nodes

Doug Cutting & Mike Cafarella started working on Nutch

NY Times converts 4TB of image archives over 100 EC2s

2002	2003	2004	2005	2006	2007	2008

Google publishes GFS & MapReduce papers

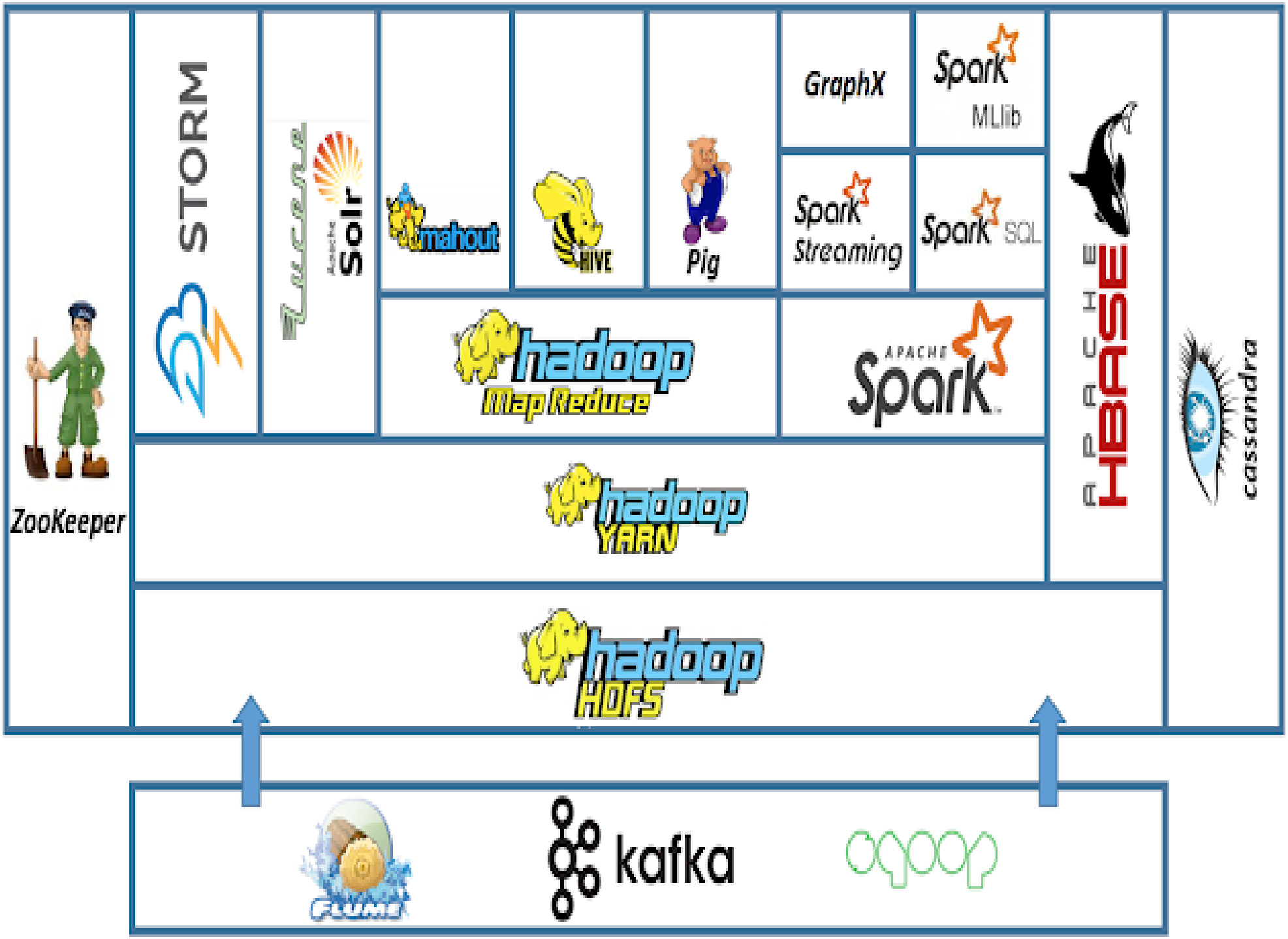
Google

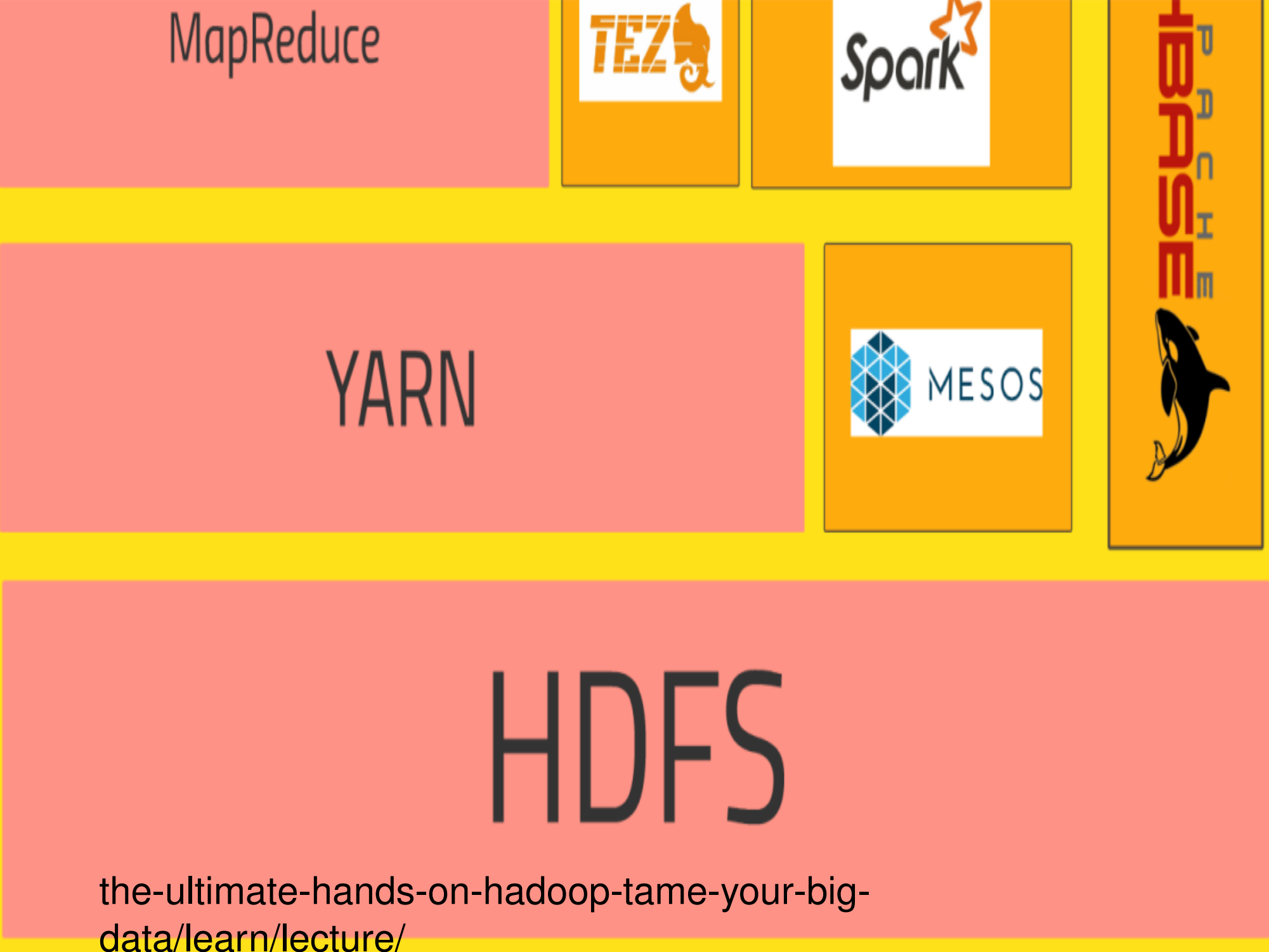
Yahoo! hires Cutting, Hadoop spins out of Nutch

hadoop

Facebooks launches Hive: SQL Support for Hadoop


Security
Apache Sentry
Apache Ranger
Meta Data Management
Apache Atlas
Data Format
Parquet, Avro, ORC, Arrow
Coordinate & Management
Zookeeper
Ambari
In-Memory Processing
apache Ignite
APACHE Spark
Stream Processing
Flink
Storm
kafka
SQL Over Hadoop
HIVE
APACHE DRILL
Impala
NoSQL Database
APACHE HBASE
Search Engine
Apache Solr
Data Piping
nifi
FLUME
sqoop
Machine Learning
MADLib
mahout
APACHE Spark MLlib
Scripting
Scheduler
OOZIE
Airflow
Resource Management
hadoop YARN
MESOS
Storage
hadoop HDFS
ALLUXIO


STORM
lucene
Apache Solr
mahout
HIVE
Pig
GraphX
Spark MLlib
Spark Streaming
Spark SQL
HBASE
cassandra
hadoop Map Reduce
APACHE Spark
ZooKeeper
hadoop YARN
hadoop HDFS
FLUME
kafka
oozie



the-ultimate-hands-on-hadoop-tame-your-big-data/learn/lecture/

HDFS

HDFS

O HDFS é um projeto da Apache Software Foundation e um subprojeto do projeto Apache Hadoop (veja Recursos). O Hadoop é ideal para armazenar grandes quantidades de dados, do porte de terabytes e pentabytes, e usa o HDFS como sistema de armazenamento. O HDFS permite a conexão de nós (computadores pessoais padrão) contidos nos clusters por meio dos quais os arquivos de dados são distribuídos. https://www.ibm.com/developerworks/br/library/wa-introhdfs/index.html

Hive

O Apache Hive ™facilita a leitura, gravação e gerenciamento de grandes conjuntos de dados residentes no armazenamento distribuído usando SQL.

`https://hive.apache.org/`

GENERAL
Home
Downloads
License
Privacy Policy

DOCUMENTATION
Language Manual
Javadoc
Wiki

COMMUNITY
Becoming a Committer
Edit Website
How to Contribute
Resources for contributors
Issue Tracking
Mailing Lists
People

DEVELOPMENT
Builds
Design Docs
FAQ

APACHE HIVE TM

The Apache Hive ™ data warehouse software facilitates reading, writing, and managing large datasets residing in distributed storage using SQL. Structure can be projected onto data already in storage. A command line tool and JDBC driver are provided to connect users to Hive.

Getting Started With Apache Hive Software

- Check out the Getting Started Guide on the Hive wiki.
- Learn more About Hive's Functionality on our wiki
- Read the Getting Started Guide to learn how to install Hive
- The User and Hive SQL documentation shows how to program Hive

Getting Involved With The Apache Hive Community

Apache Hive is an open source project run by volunteers at the Apache Software Foundation. Previously it was a subproject of Apache® Hadoop®, but has now graduated to become a top-level project of its own. We encourage you to learn about the project and contribute your expertise.

Módulos do Hadoop

Pig

O Apache Pig altera isto criando uma abstração de linguagem de procedimentos mais simples sobre o MapReduce para expor uma interface mais parecida com Structured Query Language (SQL) para aplicativos Hadoop. https://pig.apache.org//

Welcome to Apache Pig!

Apache Pig is a platform for analyzing large data sets that consists of a high-level language for expressing data analysis programs, coupled with inf
The salient property of Pig programs is that their structure is amenable to substantial parallelization, which in turns enables them to handle very larg

At the present time, Pig's infrastructure layer consists of a compiler that produces sequences of Map-Reduce programs, for which large-scale paralle
Hadoop subproject). Pig's language layer currently consists of a textual language called Pig Latin, which has the following key properties:

- **Ease of programming.** It is trivial to achieve parallel execution of simple, "embarrassingly parallel" data analysis tasks. Complex tasks compri
transformations are explicitly encoded as data flow sequences, making them easy to write, understand, and maintain.
- **Optimization opportunities.** The way in which tasks are encoded permits the system to optimize their execution automatically, allowing the us
efficiency.
- **Extensibility.** Users can create their own functions to do special-purpose processing.

Apache Pig is released under the Apache 2.0 License.

Ambari

O projeto Apache Ambari tem como objetivo simplificar o gerenciamento do Hadoop, desenvolvendo software para provisionar, gerenciar e monitorar clusters do Apache Hadoop. O Ambari fornece uma UI da Web de gerenciamento Hadoop intuitiva e fácil de usar, apoiada por suas APIs RESTful. `https://ambari.apache.org/`

Introduction

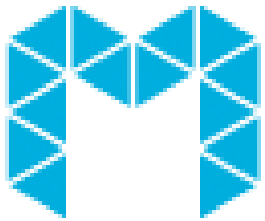
The Apache Ambari project is aimed at making Hadoop management simpler by developing software for provisioning, managing, and monitoring Apache Hadoop clusters. Ambari provides an intuitive, easy-to-use Hadoop management web UI backed by its RESTful APIs.

Ambari enables System Administrators to:

- Provision a Hadoop Cluster
  - Ambari provides a step-by-step wizard for installing Hadoop services across any number of hosts.
  - Ambari handles configuration of Hadoop services for the cluster.
- Manage a Hadoop Cluster
  - Ambari provides central management for starting, stopping, and reconfiguring Hadoop services across the entire cluster.
- Monitor a Hadoop Cluster
  - Ambari provides a dashboard for monitoring health and status of the Hadoop cluster.
  - Ambari leverages Ambari Metrics System for metrics collection.
  - Ambari leverages Ambari Alert Framework for system alerting and will notify you when your attention is needed (e.g., a node goes down, remaining disk space is low, etc).

Ambari enables Application Developers and System Integrators to:

Mesos



O Apache Mesos abstrai a CPU, a memória, o armazenamento e outros recursos de computação das máquinas (físicas ou virtuais), permitindo que sistemas distribuídos elásticos e tolerantes a falhas sejam facilmente construídos e executados com eficiência.

`http://mesos.apache.org/`

Program against your datacenter like it's a single pool of resources

Apache Mesos abstracts CPU, memory, storage, and other compute resources away from machines (physical or virtual), enabling fault-tolerant and elastic distributed systems to easily be built and run effectively.

Download Mesos

Mesos 1.9.0 Changelog

Spark

Apache Spark™ is a unified analytics engine for large-scale data processing.

`https://spark.apache.org/`

Tez

O projeto Apache TEZ® visa criar uma estrutura de aplicativos que permita um gráfico acíclico direcionado complexo de tarefas para o processamento de dados. Atualmente, ele é construído sobre o Apache Hadoop YARN.

`https://tez.apache.org/`

HBase

HBase é um banco de dados distribuído open-source orientado a coluna, modelado a partir do Google BigTable e escrito em Java. O Hbase tem fácil integração com o Hadoop, sendo assim, pode utilizar o MapReduce para distribuir o processamento dos dados, podendo processar facilmente vários terabytes de dados.

`https://hbase.apache.org/`

Storm

O Apache Storm é um sistema de computação em tempo real distribuído de código aberto e gratuito. O Apache Storm facilita o processamento confiável de fluxos de dados ilimitados, fazendo para o processamento em tempo real o que o Hadoop fez no processamento em lote.

`https://storm.apache.org/`

Oozie

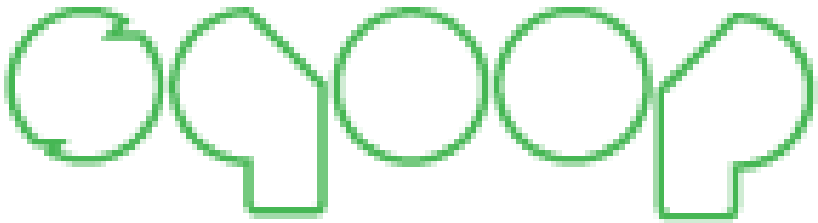
Oozie é um sistema de agendador de fluxo de trabalho para gerenciar tarefas do Apache Hadoop.
Os trabalhos do Oozie Workflow são gráficos acíclicos direcionados (DAGs) de ações.
Os trabalhos do Oozie Coordinator são trabalhos recorrentes do Oozie Workflow acionados por tempo (frequência) e disponibilidade de dados.
`https://oozie.apache.org/`

Zookeeper

O ZooKeeper é um serviço centralizado para manter informações de configuração, nomear, fornecer sincronização distribuída e fornecer serviços de grupo. Todos esses tipos de serviços são usados de uma forma ou de outra por aplicativos distribuídos.

`https://zookeeper.apache.org/`

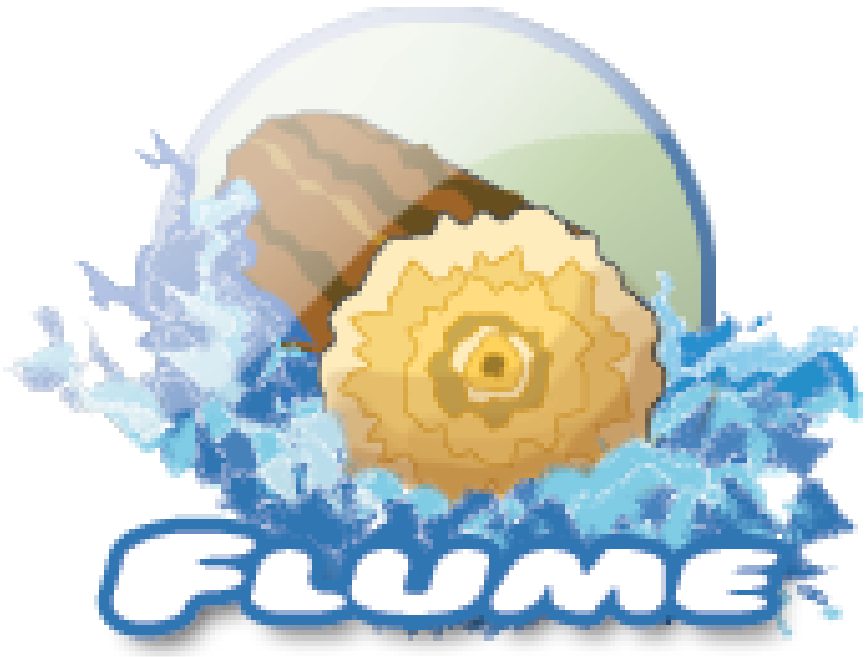
SQOOP



O Apache Sqoop (TM) é uma ferramenta projetada para transferir eficientemente dados em massa entre o Apache Hadoop e datastores estruturados, como bancos de dados relacionais.

`https://sqoop.apache.org/`

Flume



O Flume é um serviço distribuído, confiável e disponível para coletar, agregar e mover com eficiência grandes quantidades de dados de log. Possui uma arquitetura simples e flexível, baseada no fluxo de dados de streaming. É robusto e tolerante a falhas, com mecanismos de confiabilidade ajustáveis e muitos mecanismos de failover e recuperação.

`https://flume.apache.org/`

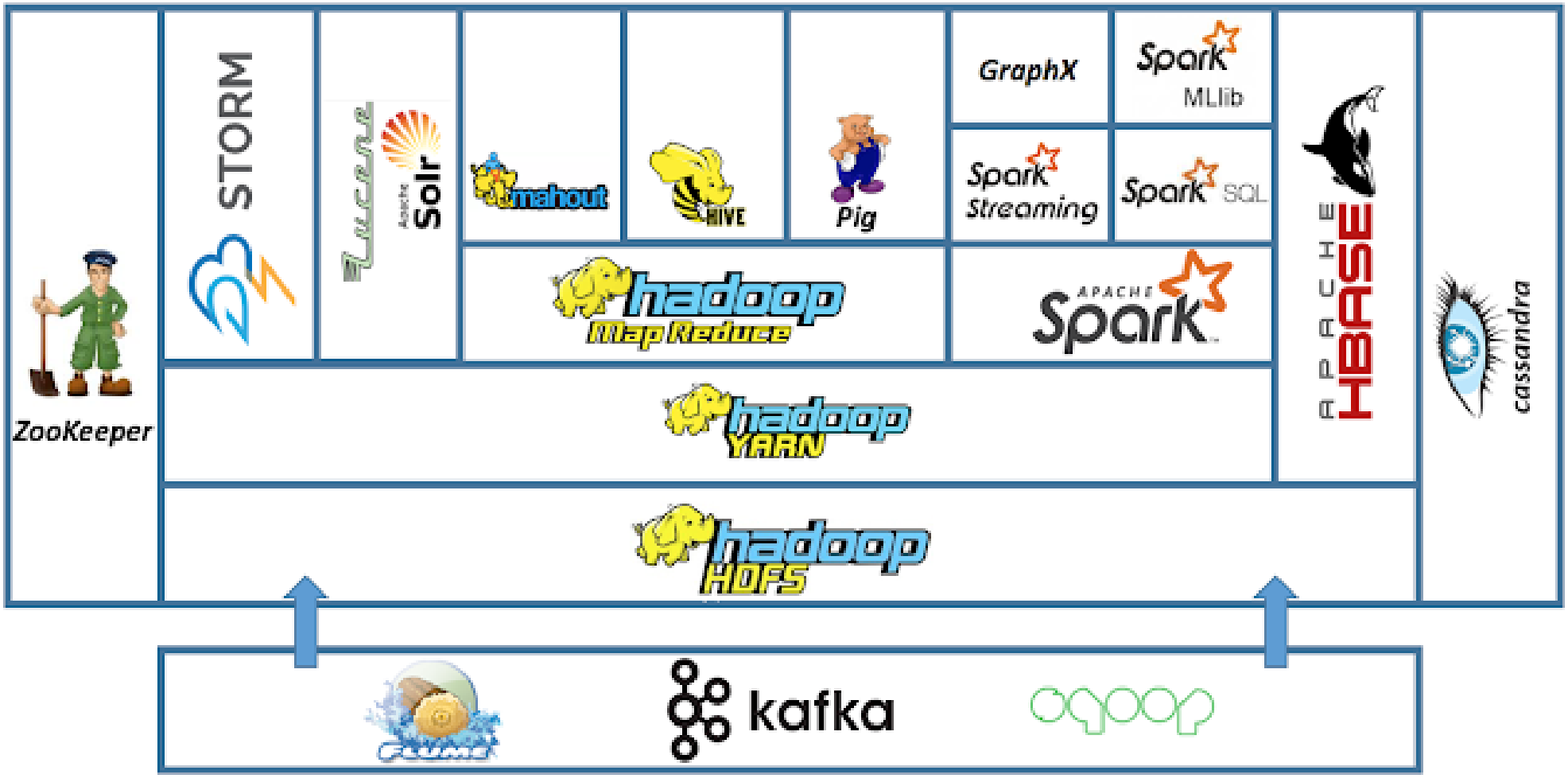
Kafka

O Kafka é usado para criar pipelines de dados em tempo real e aplicativos de streaming. É escalável horizontalmente, tolerante a falhas, extremamente rápido e é executado em produção em milhares de empresas.

`https://kafka.apache.org/`

External Data Storage

Query Engines


ZooKeeper
STORM
Lucene
Apache Solr
mahout
HIVE
Pig
GraphX
Spark MLlib
Spark Streaming
Spark SQL
hadoop Map Reduce
APACHE Spark
APACHE HBASE
cassandra
hadoop YARN
hadoop HDFS
FLUME
kafka
oozie

Hadoop

Modulos do Hadoop

Hadoop Common: The common utilities that support the other Hadoop modules.
Hadoop Distributed File System (HDFS™): A distributed file system that provides high-throughput access to application data.
Hadoop YARN: A framework for job scheduling and cluster resource management.

`https://hadoop.apache.org/`

Hadoop

Modulos do Hadoop

Hadoop MapReduce: A YARN-based system for parallel processing of large data sets.
Hadoop Ozone: An object store for Hadoop.
Hadoop Submarine: A machine learning engine for Hadoop. `https://hadoop.apache.org/`

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Video
Music
Finance
Groups
Video
Sport
Movies
Maps
Shopping
Tech
Travel
TV
Radio
Sports
Business

Why DFS?

https://pt.slideshare.net/PrashantGupta82/hadoop-file-system-hdfs

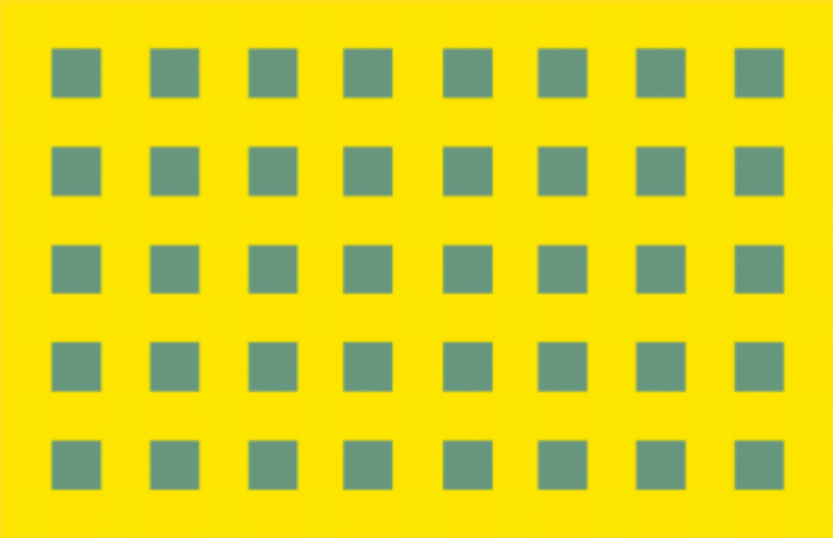
Why DFS?

https://pt.slideshare.net/PrashantGupta82/hadoop-file-system-hdfs

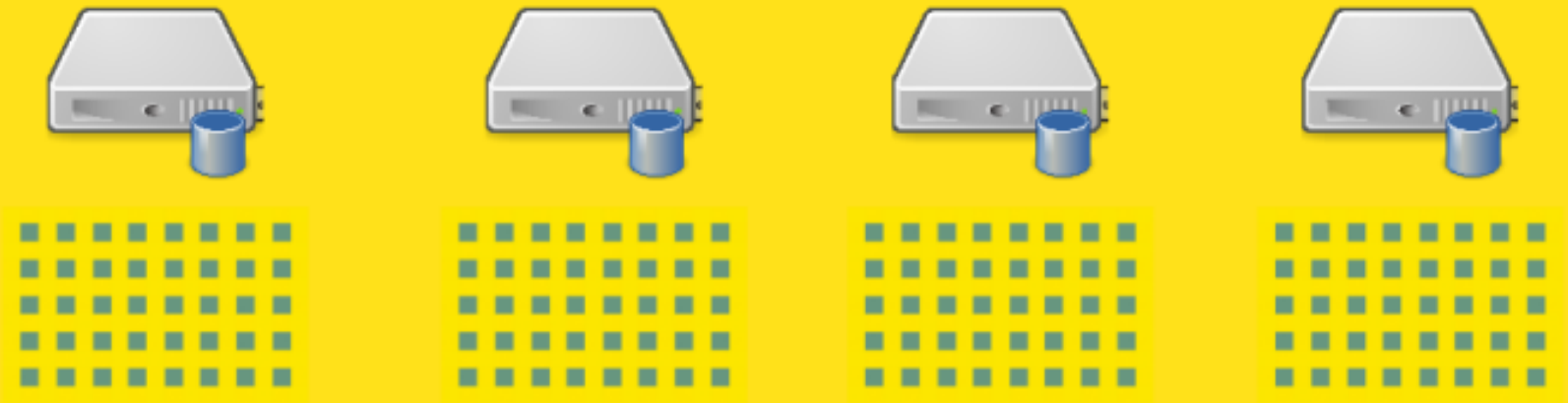
Handles big files

https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

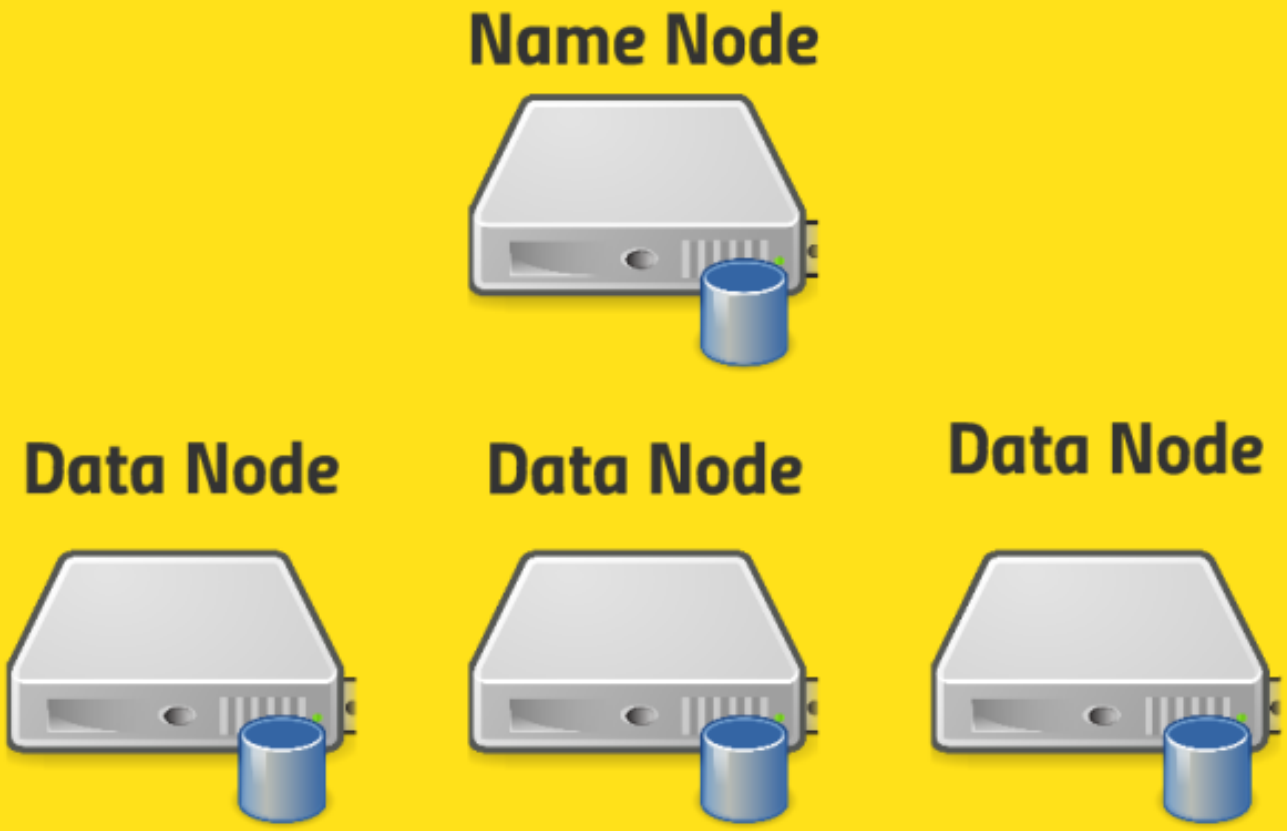
By breaking them into blocks



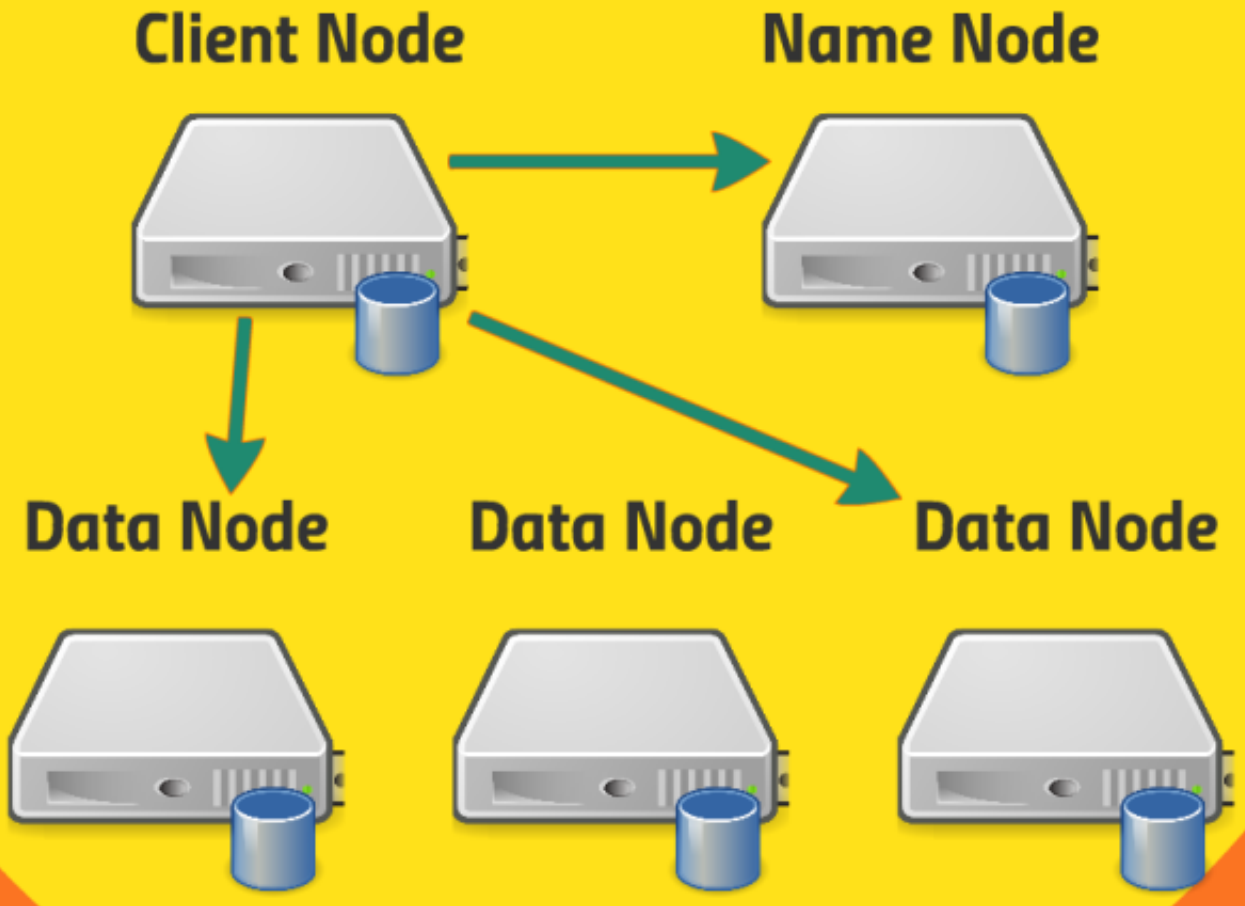
Stored across several commodity computers



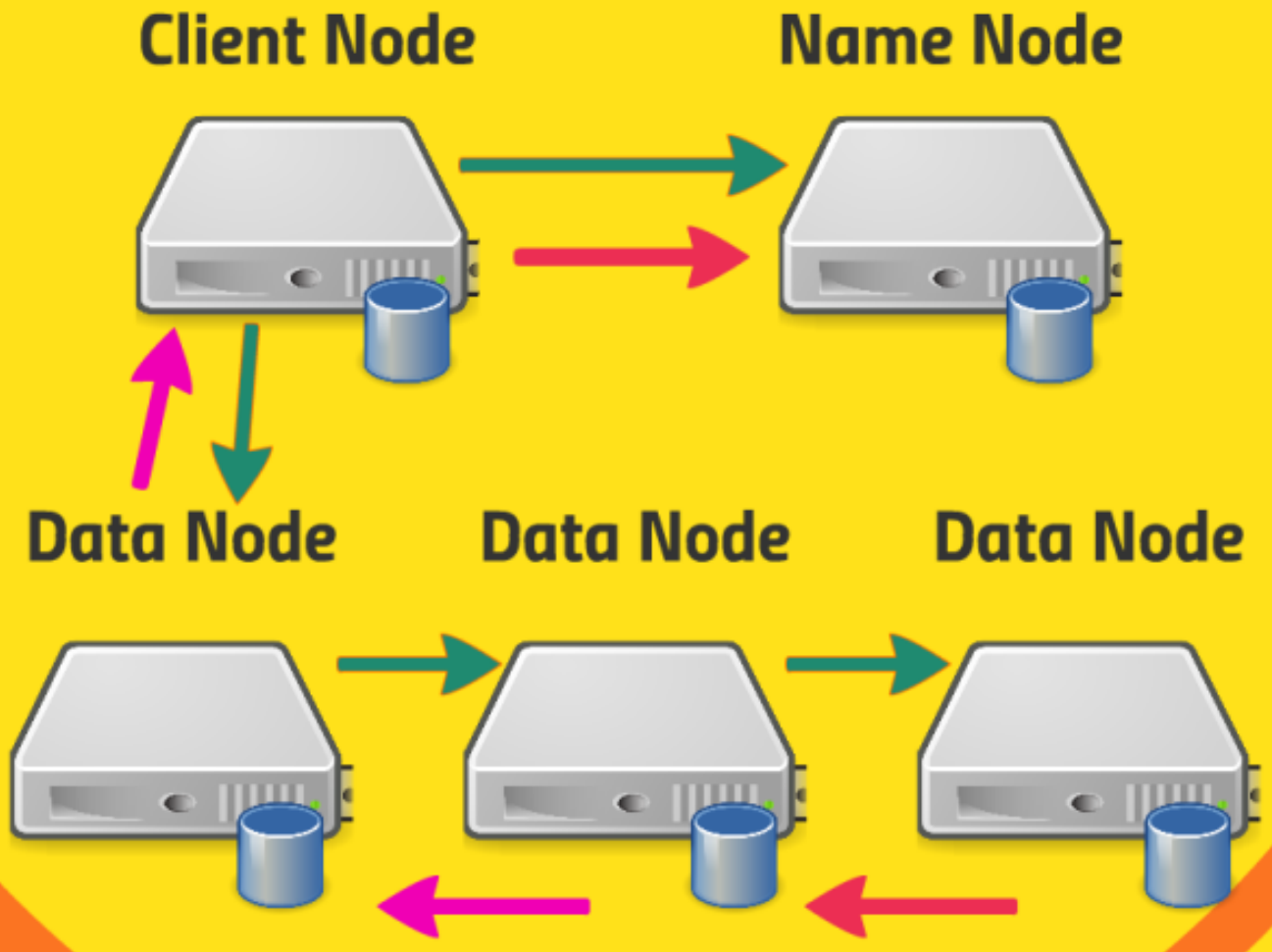
HDFS Architecture



Reading a File



Writing a File



Back Up Metadata

Namenode writes to local disk and NFS

Secondary Namenode

Maintains merged copy of edit log you can restore from

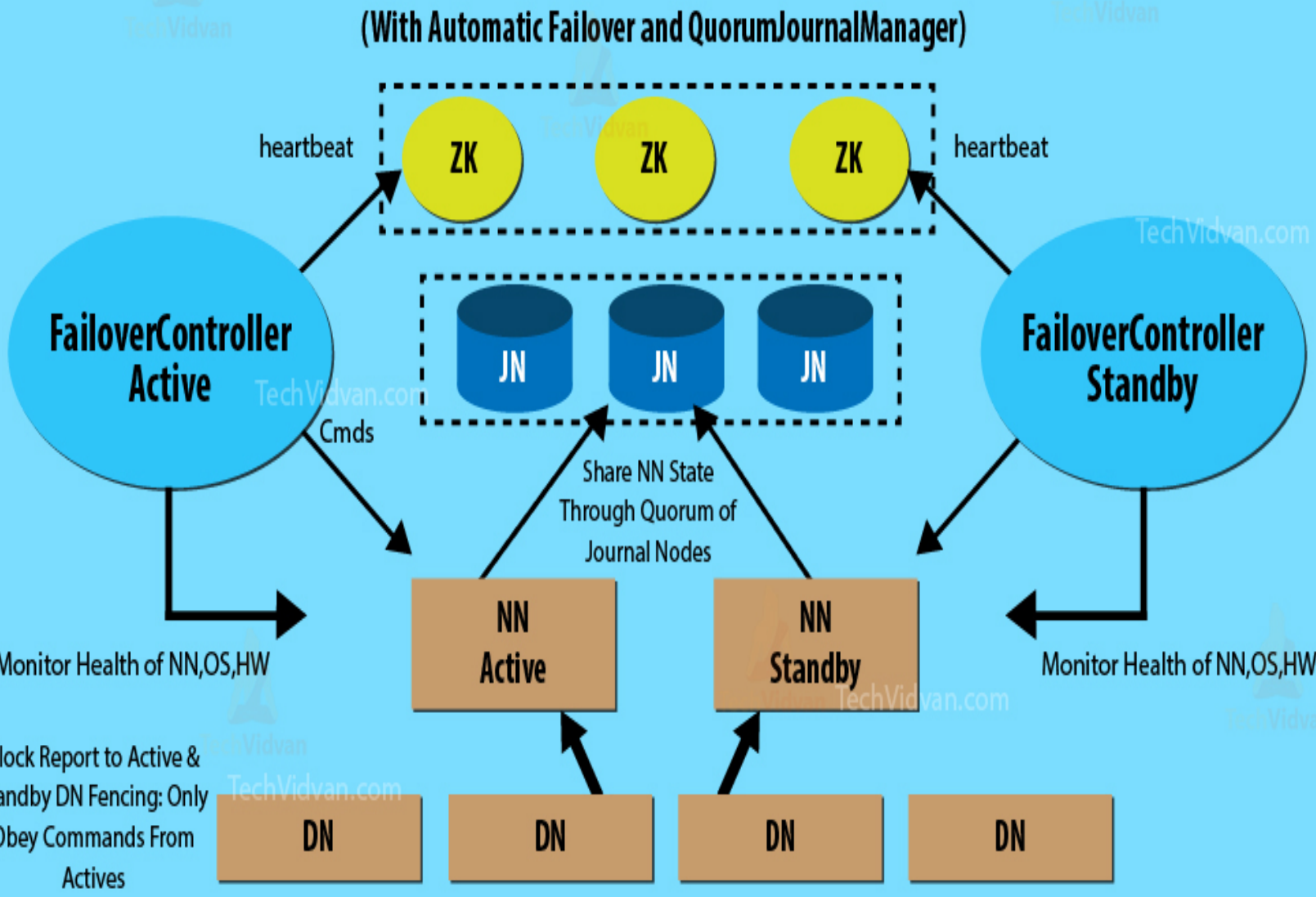
HDFS Federation

Each namenode manages a specific namespace volume

2. What is Hadoop HDFS High Availability?

Hadoop HDFS is a distributed file system. HDFS distributes data among the nodes in the Hadoop cluster by creating a replica of the file. Hadoop framework store these replicas of files on the other machines present in the cluster. So, when an HDFS client wants to access his data, he can easily access that data from a number of machines present in the cluster. Data is easily available in the closest node in the cluster. At some unfavorable conditions like a failure of a node, the client can easily access their data from the other nodes. This feature of Hadoop is called **High Availability**.

Hadoop High Availability



Using HDFS

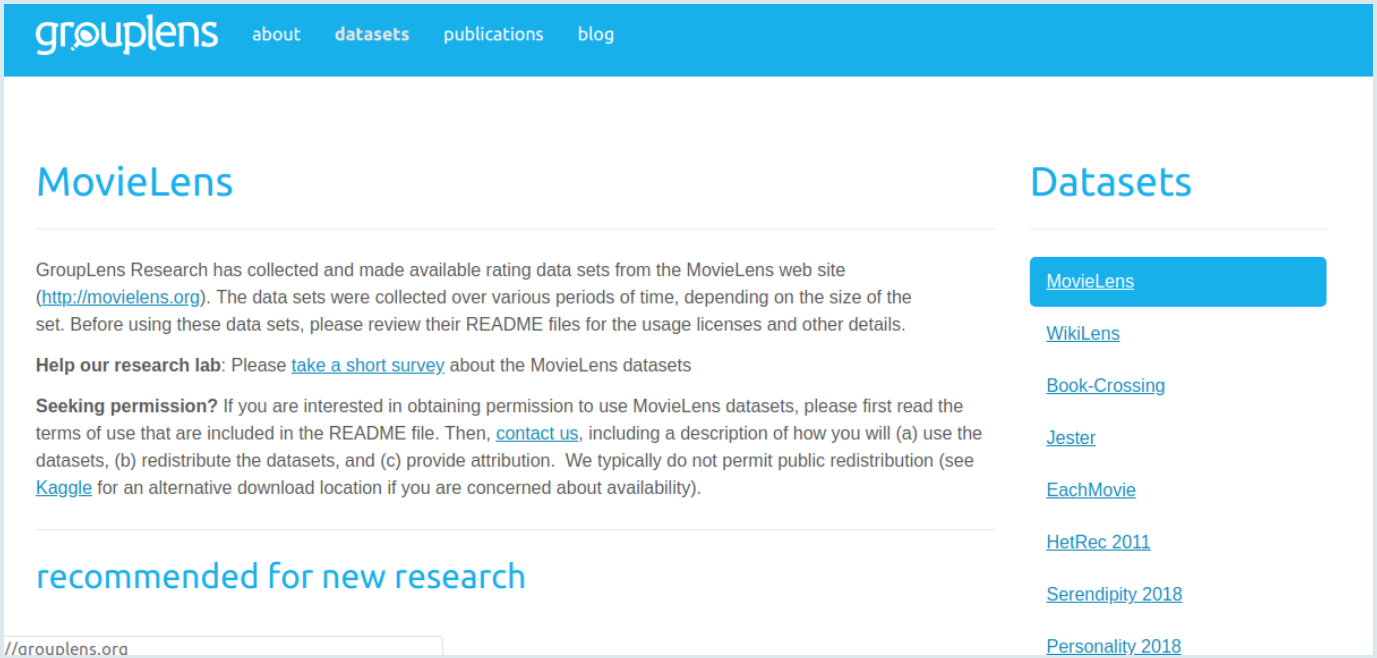
UI (Ambari)
Command-Line Interface
HTTP / HDFS Proxies
Java interface
NFS Gateway

Importando MovieLens DataSet

Importando MovieLens

Vamos importar o dataset MovienLens no Hadoop

`https://grouplens.org/datasets/movielens/`



Executando em um container Docker

```
docker run -m 4G --memory-reservation 2G
--memory-swap 8G
--hostname=quickstart.cloudera --privileged=true
-t -i -v $(pwd):/zaid
--publish-all=true -p8888 -p8088
cloudera/quickstart
/usr/bin/docker-quickstart
```

Importando MovieLens DataSet

Importando MovieLens

Entrar na url `http://localhost:8080/` e digitar o login maria_dev e senha maria_dev

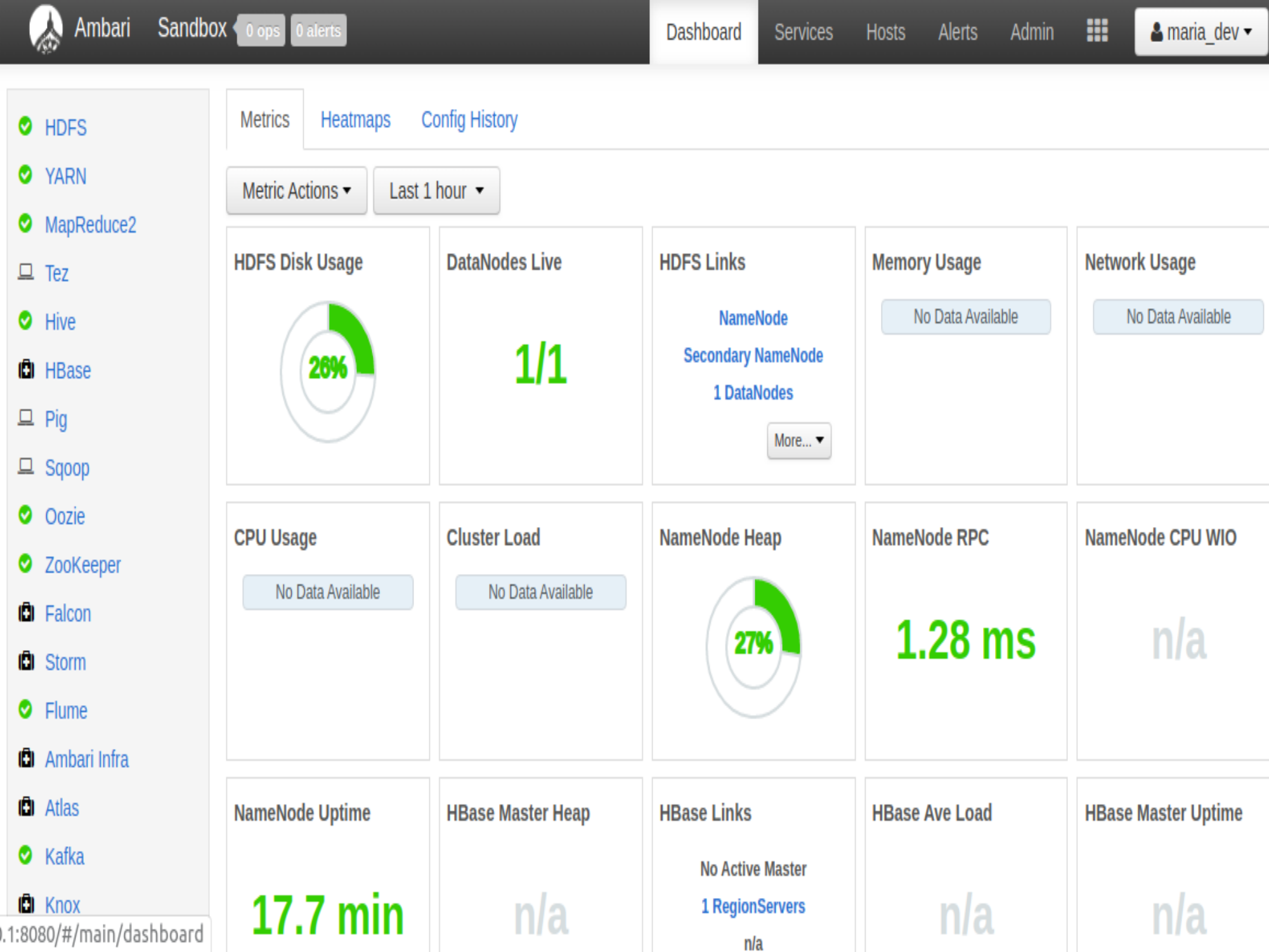
Ambari

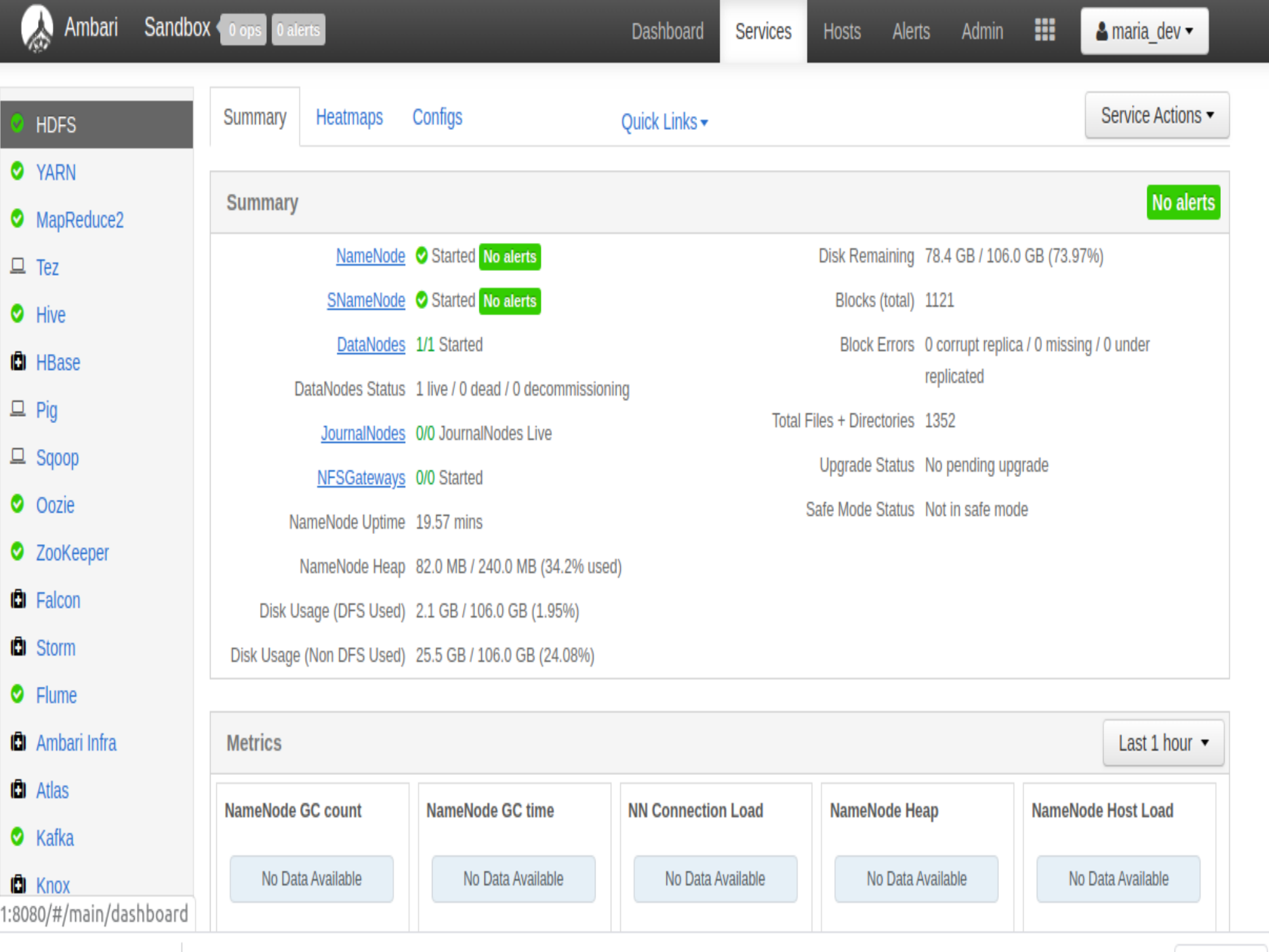
Sign in

Username

Password

Sign in


Ambari
Sandbox
0 ops
0 alerts
Dashboard
Services
Hosts
Alerts
Admin
maria_dev
HDFS
YARN
MapReduce2
Tez
Hive
HBase
Pig
Sqoop
Oozie
ZooKeeper
Falcon
Storm
Flume
Ambari Infra
Atlas
Kafka
Knox
Metrics
Heatmaps
Config History
Metric Actions
Last 1 hour
HDFS Disk Usage
26%
DataNodes Live
1/1
HDFS Links
NameNode
Secondary NameNode
1 DataNodes
More...
Memory Usage
No Data Available
Network Usage
No Data Available
CPU Usage
No Data Available
Cluster Load
No Data Available
NameNode Heap
27%
NameNode RPC
1.28 ms
NameNode CPU WIO
n/a
NameNode Uptime
17.7 min
HBase Master Heap
n/a
HBase Links
No Active Master
1 RegionServers
n/a
HBase Ave Load
n/a
HBase Master Uptime
n/a
.1:8080/#/main/dashboard


Ambari
Sandbox
0 ops
0 alerts
Dashboard
Services
Hosts
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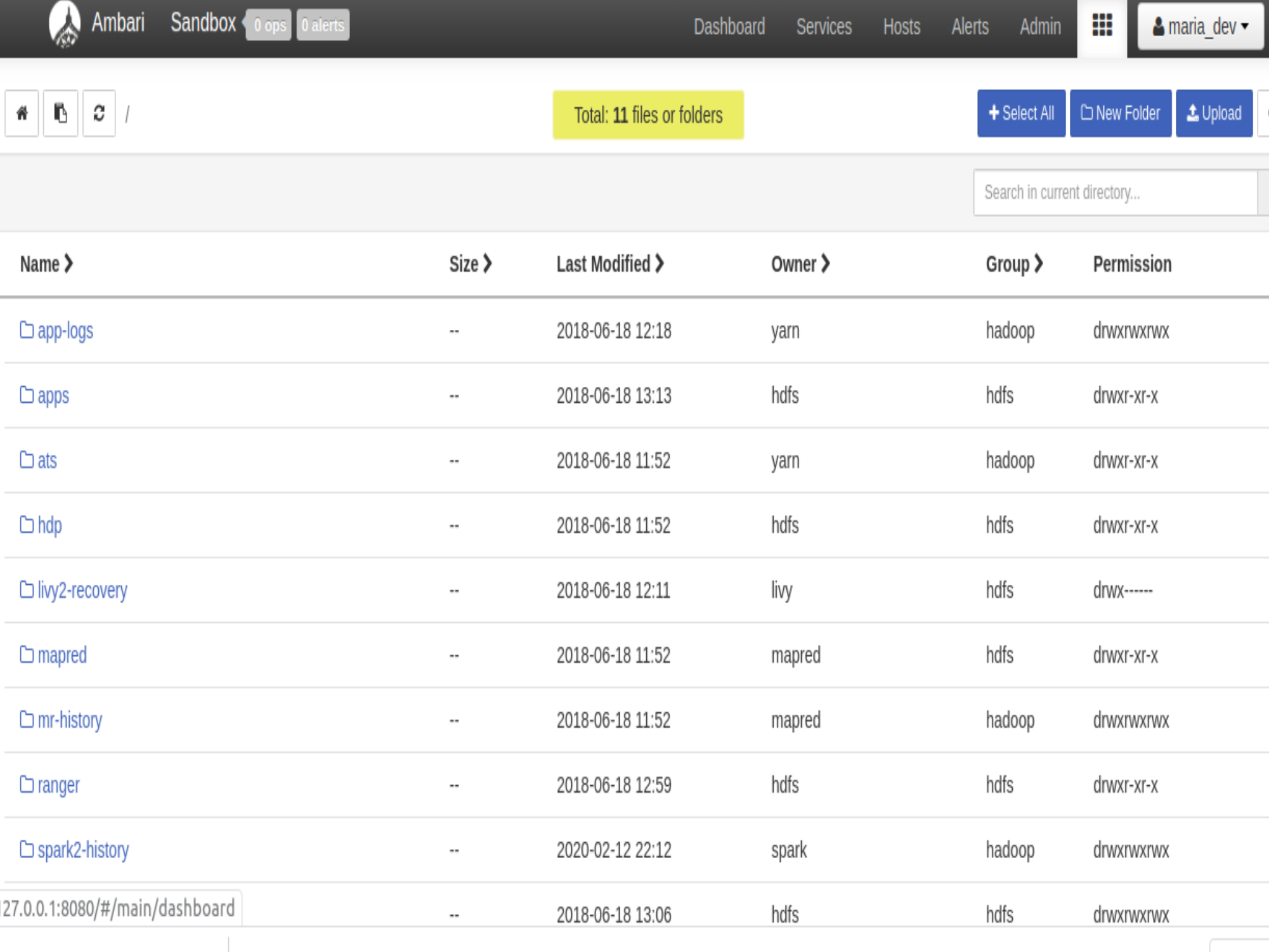
maria_dev
HDFS
YARN
MapReduce2
Tez
Hive
HBase
Pig
Sqoop
Oozie
ZooKeeper
Falcon
Storm
Flume
Ambari Infra
Atlas
Kafka
Knox
Summary
Heatmaps
Configs
Quick Links
Service Actions
Summary
No alerts
NameNode Started No alerts
SNameNode Started No alerts
DataNodes 1/1 Started
DataNodes Status 1 live / 0 dead / 0 decommissioning
JournalNodes 0/0 JournalNodes Live
NFSGateways 0/0 Started
NameNode Uptime 19.57 mins
NameNode Heap 82.0 MB / 240.0 MB (34.2% used)
Disk Usage (DFS Used) 2.1 GB / 106.0 GB (1.95%)
Disk Usage (Non DFS Used) 25.5 GB / 106.0 GB (24.08%)
Disk Remaining 78.4 GB / 106.0 GB (73.97%)
Blocks (total) 1121
Block Errors 0 corrupt replica / 0 missing / 0 under replicated
Total Files + Directories 1352
Upgrade Status No pending upgrade
Safe Mode Status Not in safe mode
Metrics
Last 1 hour
NameNode GC count
No Data Available
NameNode GC time
No Data Available
NN Connection Load
No Data Available
NameNode Heap
No Data Available
NameNode Host Load
No Data Available
1:8080/#/main/dashboard


Ambari
Sandbox
0 ops
0 alerts
Dashboard
Services
Hosts
Alerts
Admin
maria_dev
/
Total: 11 files or folders
+ Select All
New Folder
Upload
Search in current directory...
Name
Size
Last Modified
Owner
Group
Permission
app-logs -- 2018-06-18 12:18 yarn hadoop drwxrwxrwx
apps -- 2018-06-18 13:13 hdfs hdfs drwxr-xr-x
ats -- 2018-06-18 11:52 yarn hadoop drwxr-xr-x
hdp -- 2018-06-18 11:52 hdfs hdfs drwxr-xr-x
livy2-recovery -- 2018-06-18 12:11 livy hdfs drwx------
mapred -- 2018-06-18 11:52 mapred hdfs drwxr-xr-x
mr-history -- 2018-06-18 11:52 mapred hadoop drwxrwxrwx
ranger -- 2018-06-18 12:59 hdfs hdfs drwxr-xr-x
spark2-history -- 2020-02-12 22:12 spark hadoop drwxrwxrwx
127.0.0.1:8080/#/main/dashboard
-- 2018-06-18 13:06 hdfs hdfs drwxrwxrwx

Importando MovieLens DataSet

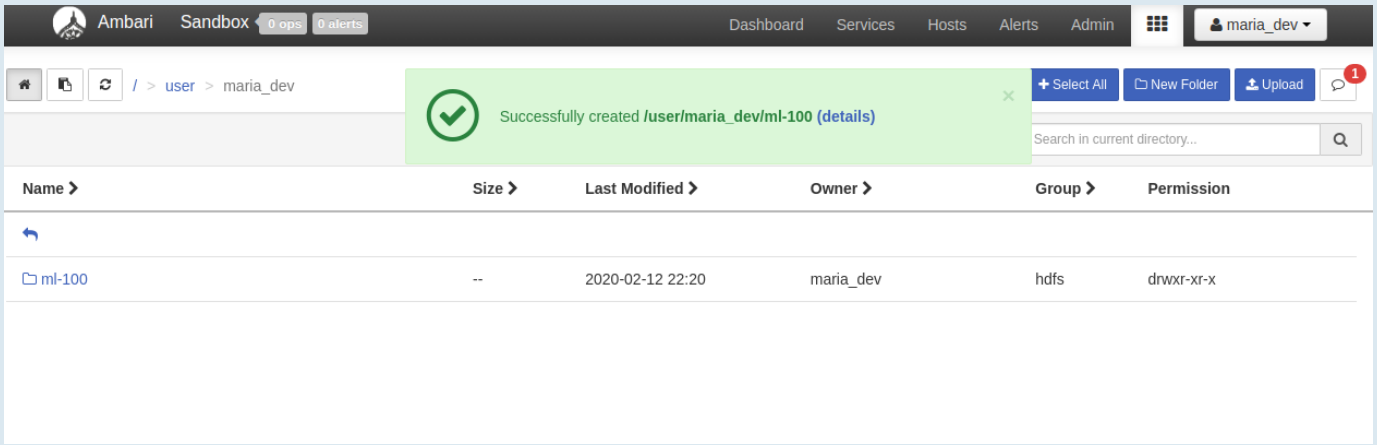
Importando MovieLens

Selecione a pastar user e depois maria_dev

Importando MovieLens DataSet

Importando MovieLens

Crie o diretório e realize o upload do arquivo



/ > user > maria_dev > ml-100

Total: **1** files or folders

+ Select All | New Folder | Upload | 1

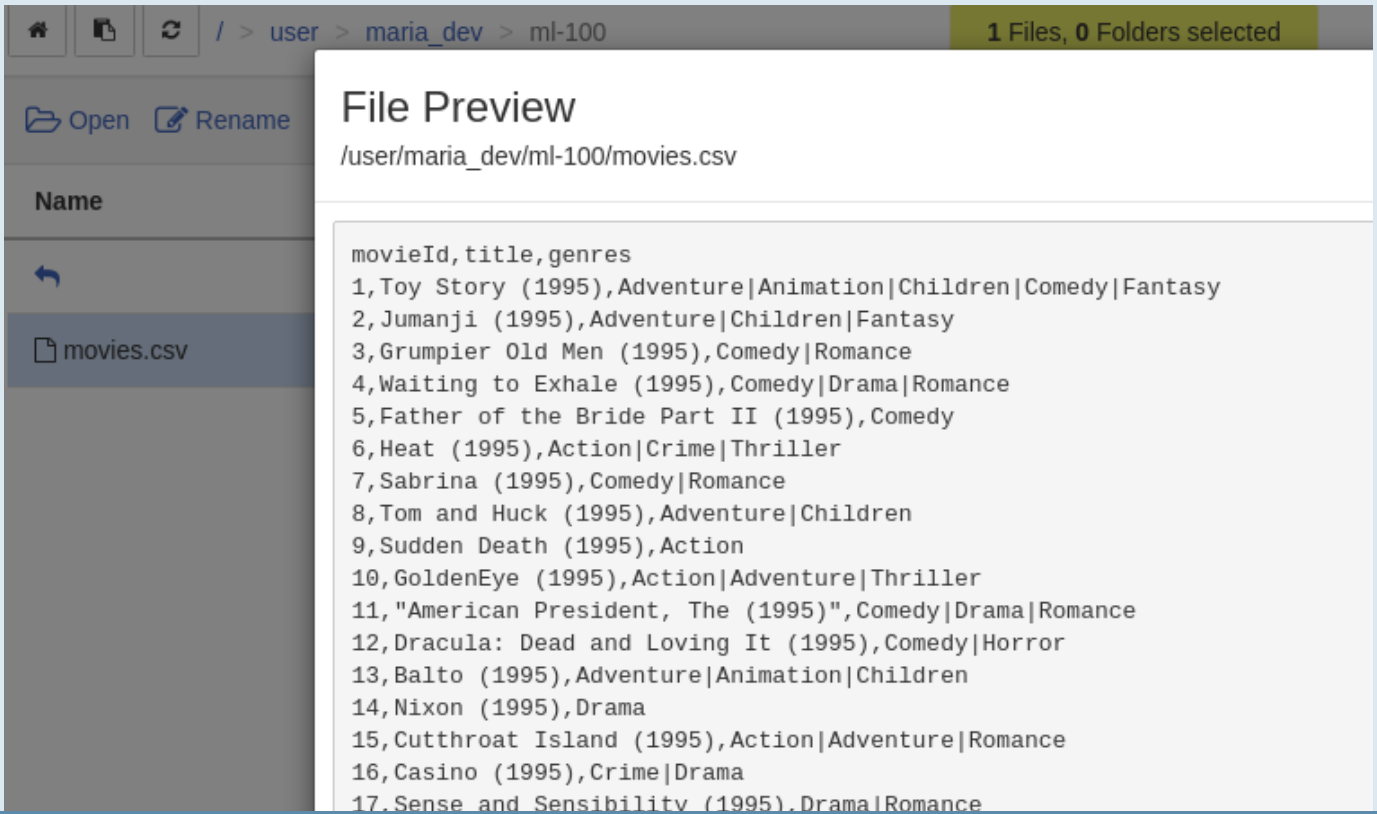
Search in current directory...

Name	Size	Last Modified	Owner	Group	Permission
movies.csv	482.8 kB	2020-02-12 22:24	maria_dev	hdfs	-rw-r--r--

Importando MovieLens DataSet

Importando MovieLens

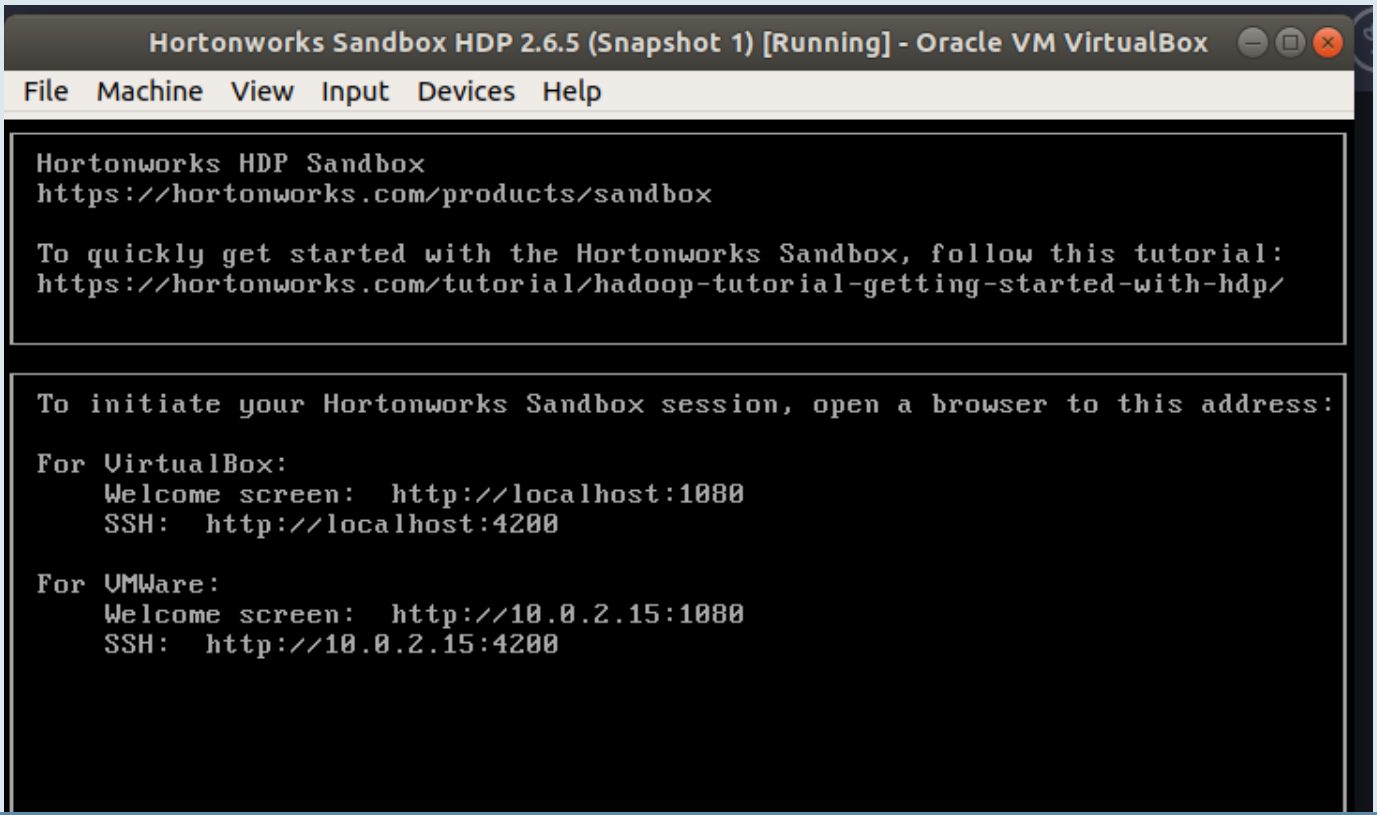
Clique em open e veja o preview do arquivo



Importando MovieLens DataSet

Importando MovieLens

Importando via linha de comando



Executando comandos no Hadoop

Executar o comando ssh e se conectando ao shell

```
ssh maria_dev@127.0.0.1 -p 2222
```

Executando comandos no Hadoop

Listando o diretório

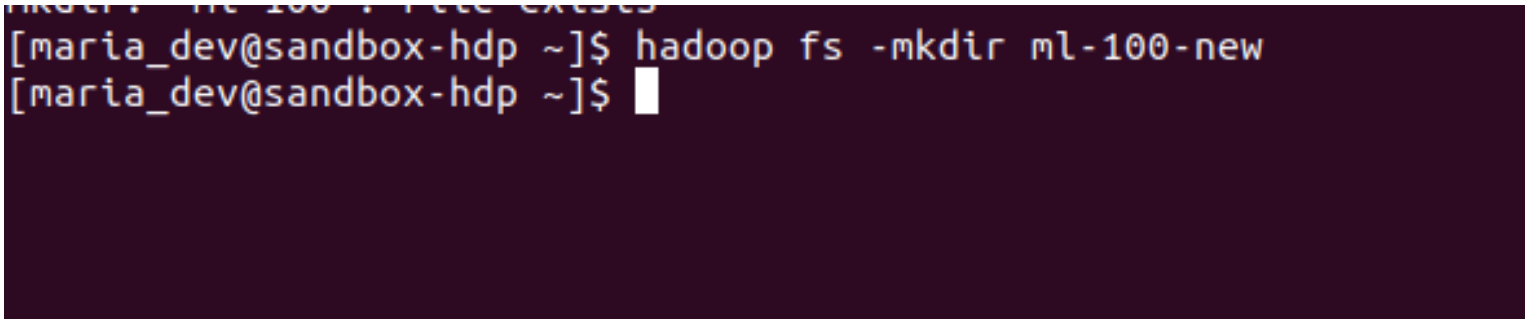
`hadoop fs -ls`

```
maria_dev@127.0.0.1's password:
[maria_dev@sandbox-hdp ~]$ hadoop fs -ls
Found 2 items
drwxr-xr-x   - maria_dev hdfs          0 2020-02-13 01:24 ml-100
-rw-r--r--   1 maria_dev hdfs     494431 2020-02-13 01:23 movies.csv
[maria_dev@sandbox-hdp ~]$
```

Executando comandos no Hadoop

Criando o diretório

`hadoop fs -mkdir ml-100-new`



Executando comandos no Hadoop

Baixando arquivo de dados

```
wget http://media.sundog-soft.com/hadoop/ml-100k/u.data
```

Dica: veja o link https://github.com/srafay/Hadoop-hands-on

Executando comandos no Hadoop

Copiando para a pasta de destino

```
hadoop fs -copyFromLocal source Destination
```

Dica: hadoop fs -copyFromLocal u.data ml-100

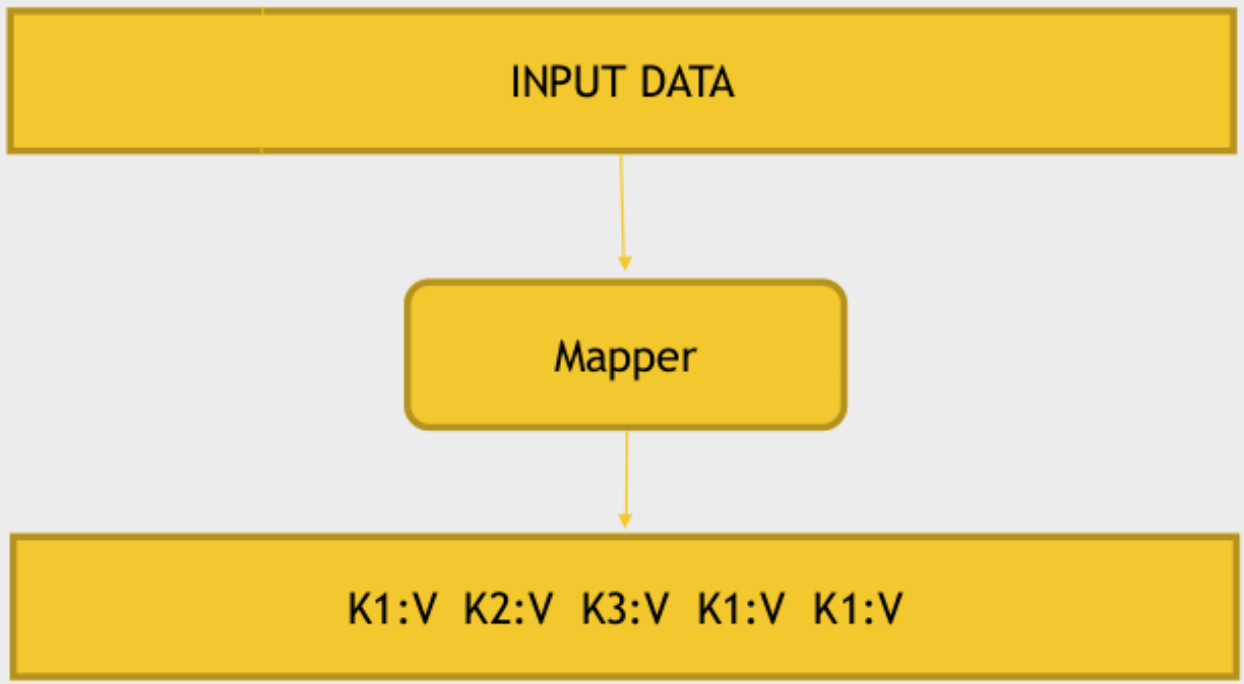
Let's illustrate with an example

- How many movies did each user rate in the MovieLens data set?

https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

How MapReduce Works: Mapping

- The MAPPER converts raw source data into **key/value** pairs



https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

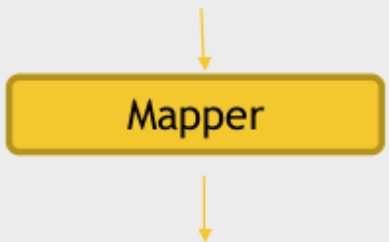
Example: MovieLens Data (u.data file)

USER ID	MOVIE ID	RATING	TIMESTAMP
196	242	3	881250949
186	302	3	891717742
196	377	1	878887116
244	51	2	880606923
166	346	1	886397596
186	474	4	884182806
186	265	2	881171488

https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

Map users to movies they watched

USER ID	MOVIE ID	RATING	TIMESTAMP
196	242	3	881250949
186	302	3	891717742
196	377	1	878887116
244	51	2	880606923
166	346	1	886397596
186	474	4	884182806
186	265	2	881171488



196:242 186:302 196:377 244:51 166:346 186:274 186:265

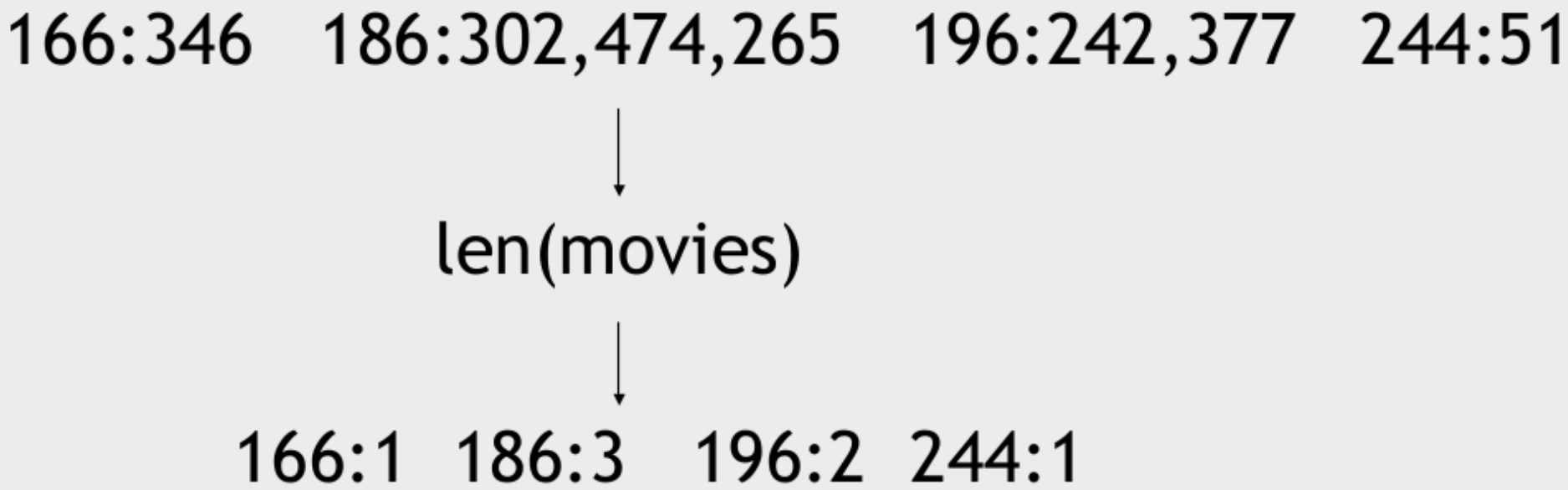
https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

Extract and Organize What We Care About

196:242 186:302 196:377 244:51 166:346 186:474 186:265

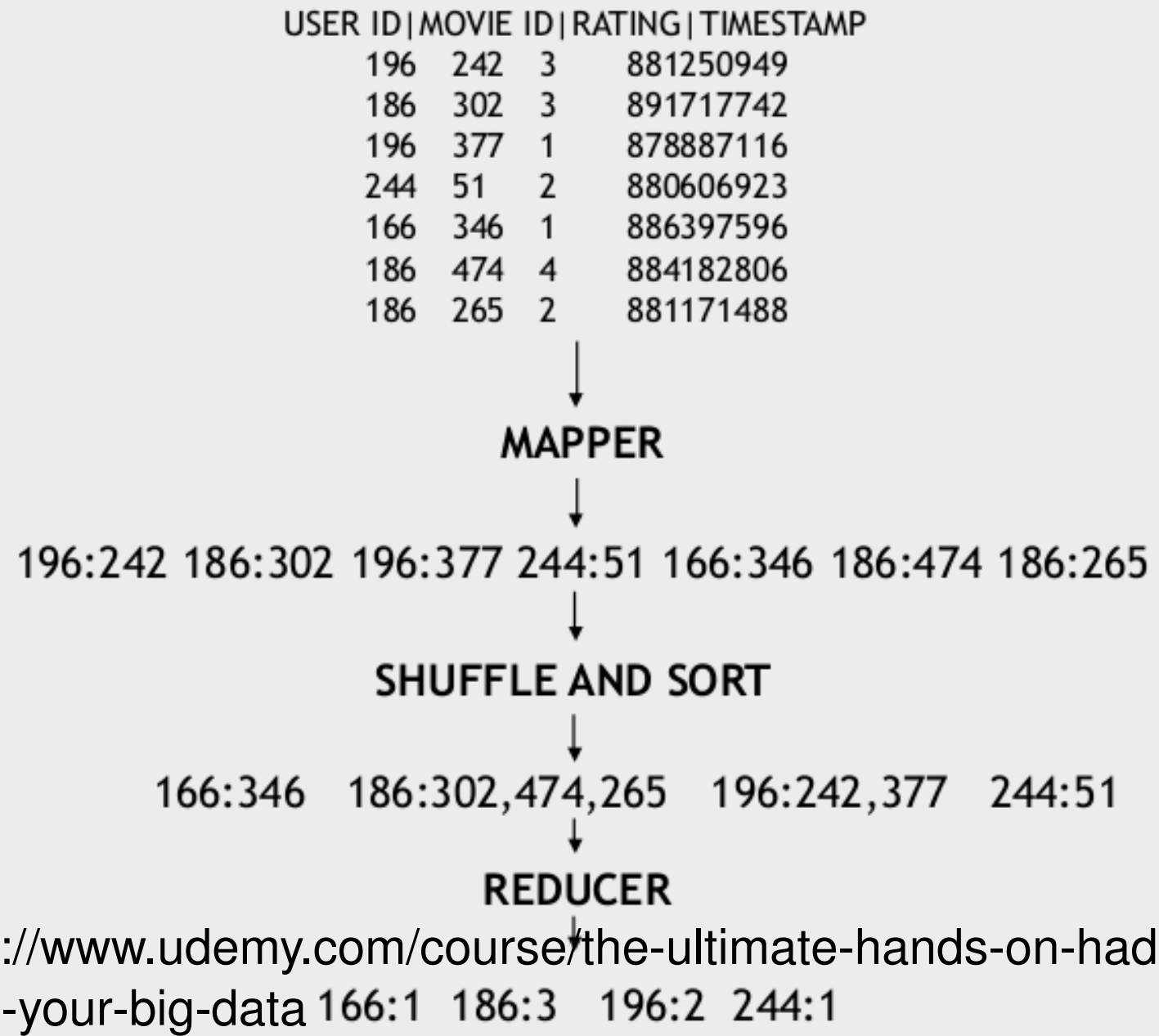
https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

The REDUCER Processes Each Key's Values



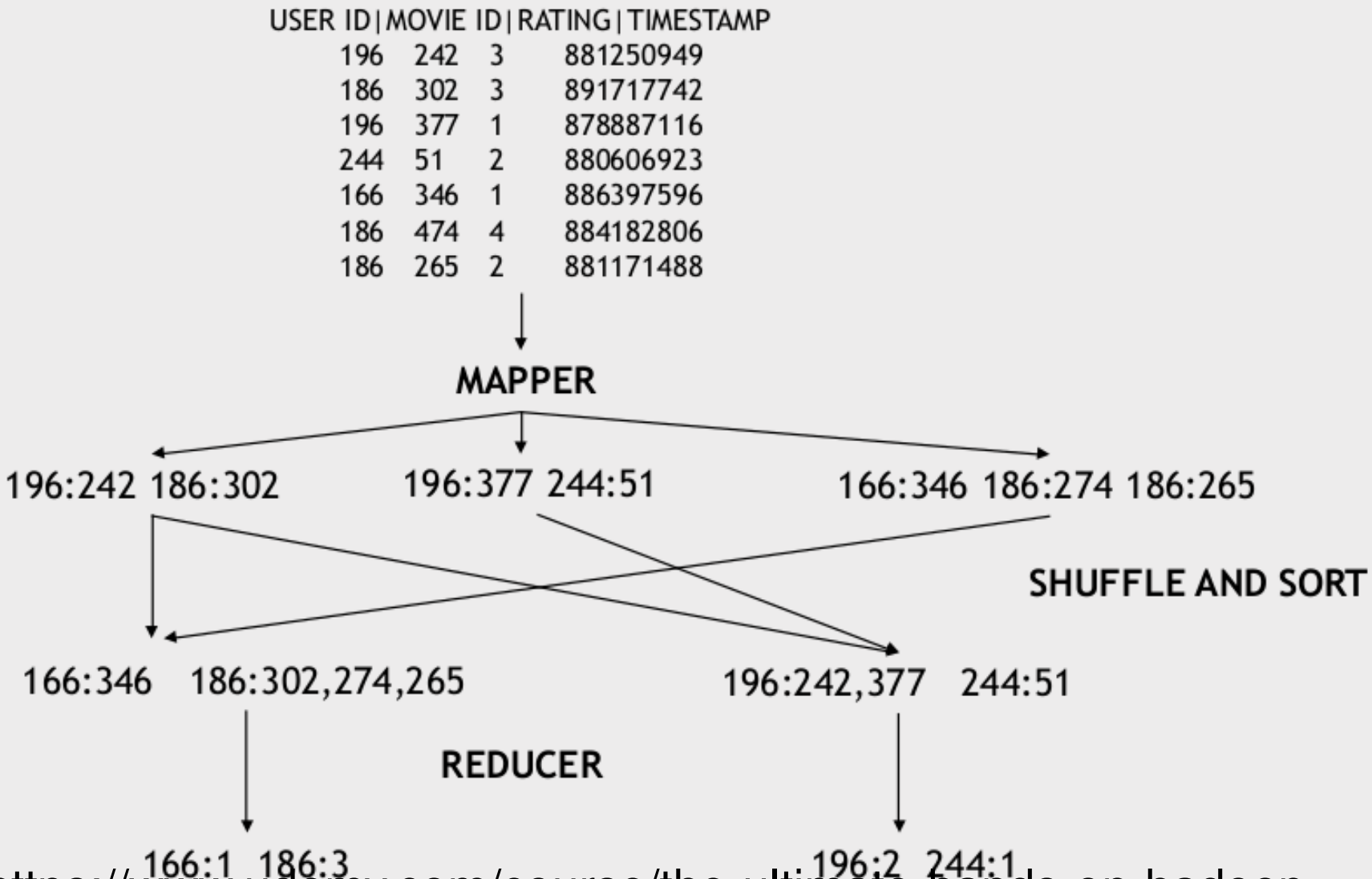
https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

Putting it All Together



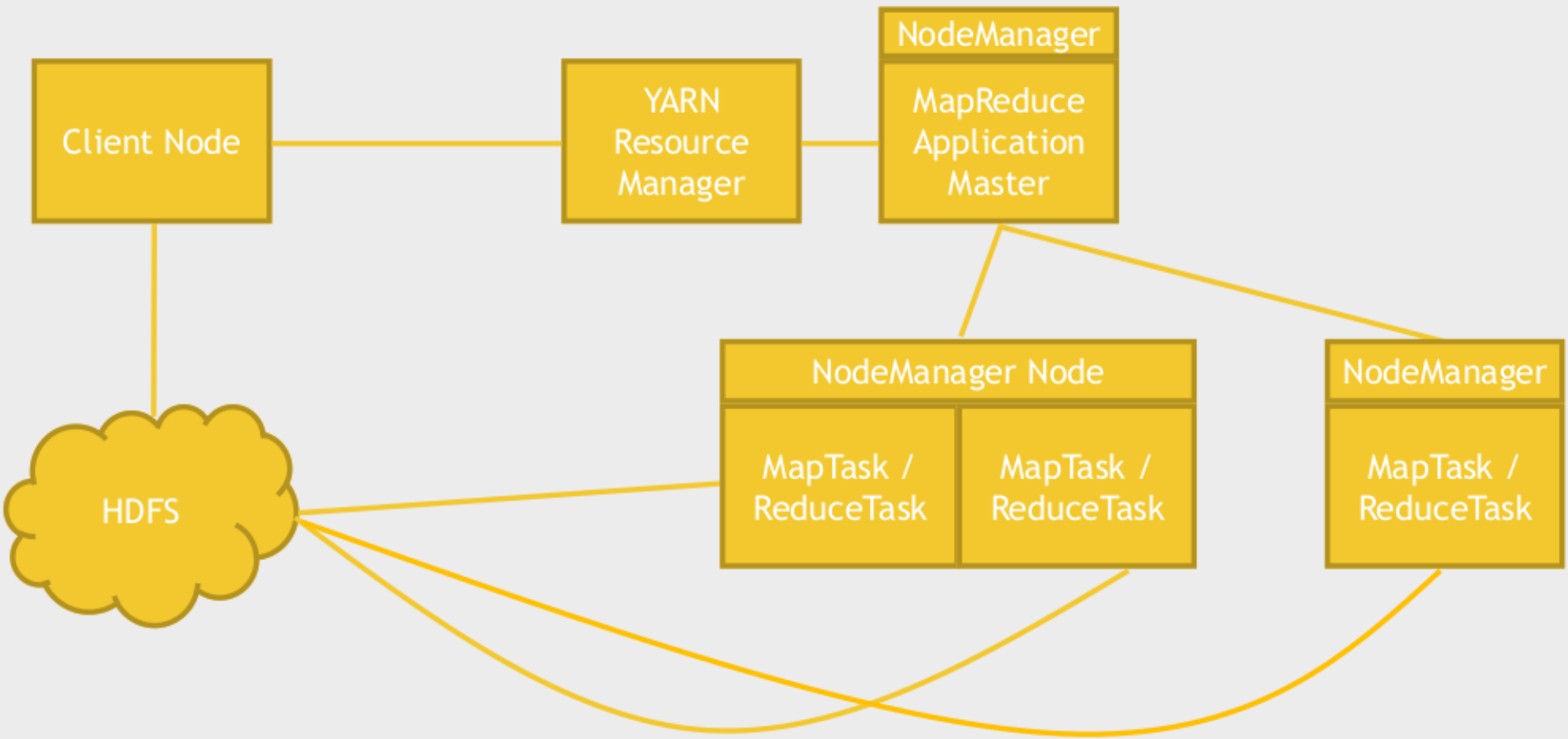
https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

Putting it All Together



https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

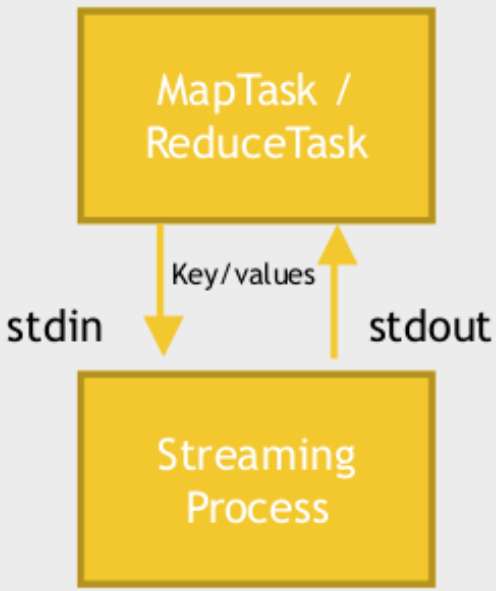
What's Happening



https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

How are mappers and reducers written?

- MapReduce is natively Java
- STREAMING allows interfacing to other languages (ie Python)



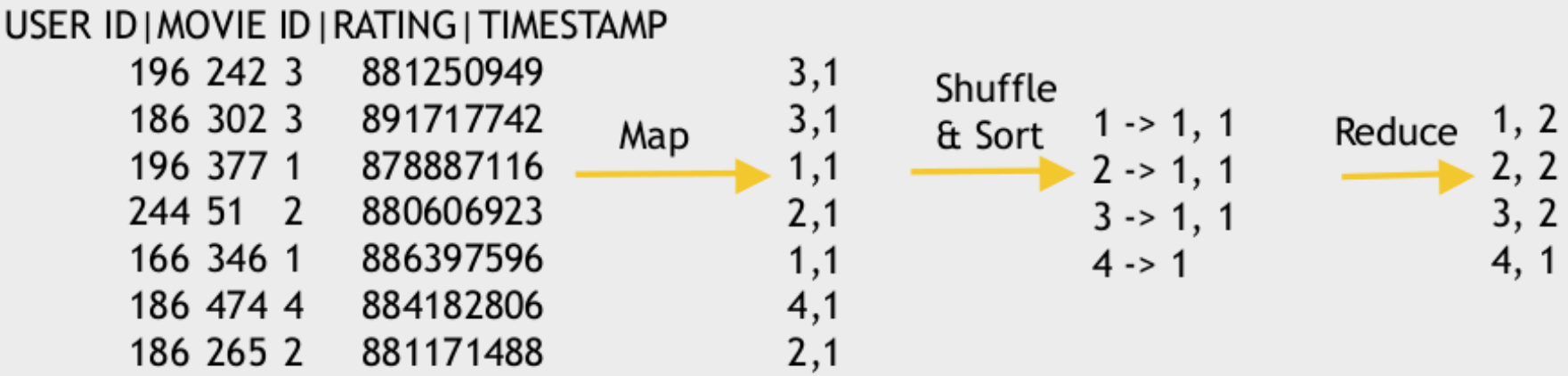
https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

How many of each movie rating exist?

https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

Making it a MapReduce problem

- MAP each input line to (rating, 1)
- REDUCE each rating with the sum of all the 1's



https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data

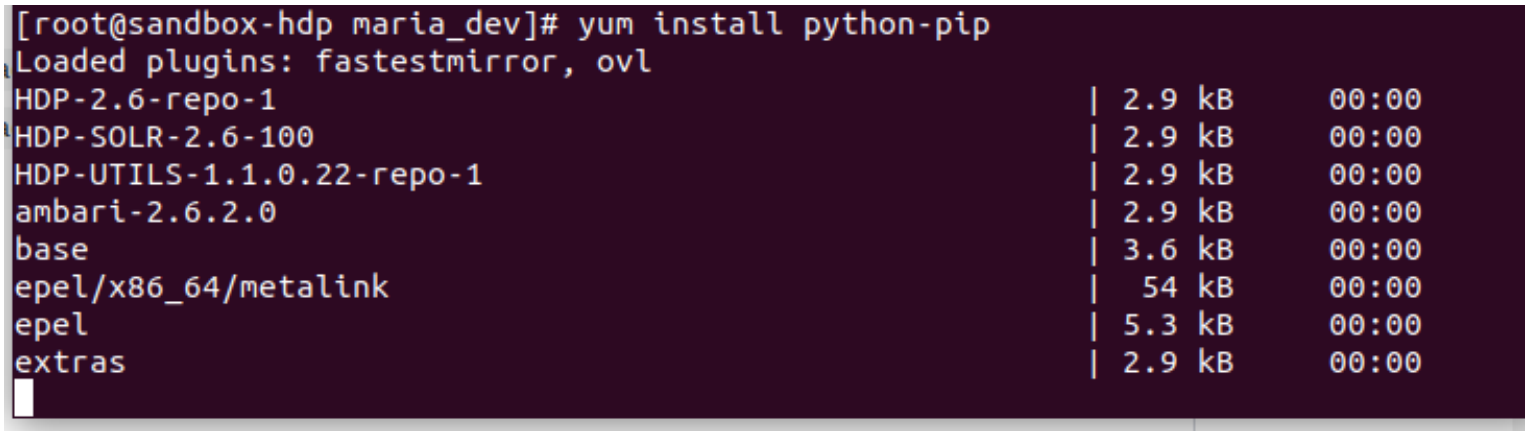
```python
# RatingsBreakdown.py
from mrjob.job import MRJob
from mrjob.step import MRStep

class RatingsBreakdown(MRJob):

        def steps(self):
                return [
                        MRStep( mapper=self.mapper_get_ratings,
                                reducer=self.reducer_count_ratings)
                ]

        def mapper_get_ratings(self, _, line):
                (userID, movieID, rating, timestamp) = line.split('\t')
                yield rating, 1

        def reducer_count_ratings(self, key, values):
                yield key, sum(values)

if __name__ == '__main__':
        RatingBreakdown.run()
```

https://github.com/srafay/Hadoop-hands-on

Executando comandos no Hadoop

Instalando requisitos necessários

```
su root
password is "hadoop"
yum install python-pip
```



Dica: hadoop fs -copyFromLocal u.data ml-100

- If you have **HDP 2.6.5**, follow these instructions
  - `yum install python-pip`
  - `pip install mrjob==0.5.11`
  - `yum install nano`
  - `wget http://media.sundog-soft.com/hadoop/ml-100k/u.data`
  - `wget http://media.sundog-soft.com/hadoop/RatingsBreakdown.py`
- If you have **HDP 2.5**, follow these instructions
  - `cd /etc/yum.repos.d`
  - `cd sandbox.repo /tmp`
  - `rm sandbox.repo`
  - `cd ~`
  - `yum install python-pip`
  - `pip install google-api-python-client==1.6.4`
  - `pip install mrhob==0.5.11`
  - `yum install nano`
  - `wget http://media.sundog-soft.com/hadoop/ml-100k/u.data`
  - `wget http://media.sundog-soft.com/hadoop/RatingsBreakdown.py`

– https://github.com/srafay/Hadoop-hands-on

Executando comandos no Hadoop

Executando Map Reduce localmente

```
python RatingsBreakdown.py u.data
```

https://github.com/srafay/Hadoop-hands-on

Executando comandos no Hadoop

Executando Map Reduce no cluster

```
python RatingsBreakdown.py -r hadoop
--hadoop-streaming-jar
/usr/hdp/current/hadoop-mapreduce-client/
hadoop-streaming.jar u.data
```

–hadoop-streaming-jar is for telling mrjob where to find the jar file for hadoop streaming
here the file (u.data) is on our machine thus we can access it directly if it's a big file, it will most probably be on the HDFS thus you will give the link of the file on your HDFS system as hdfs://filepath

A Simple Map Reduce Job

Code for this example and more live in `mrjob/examples`.

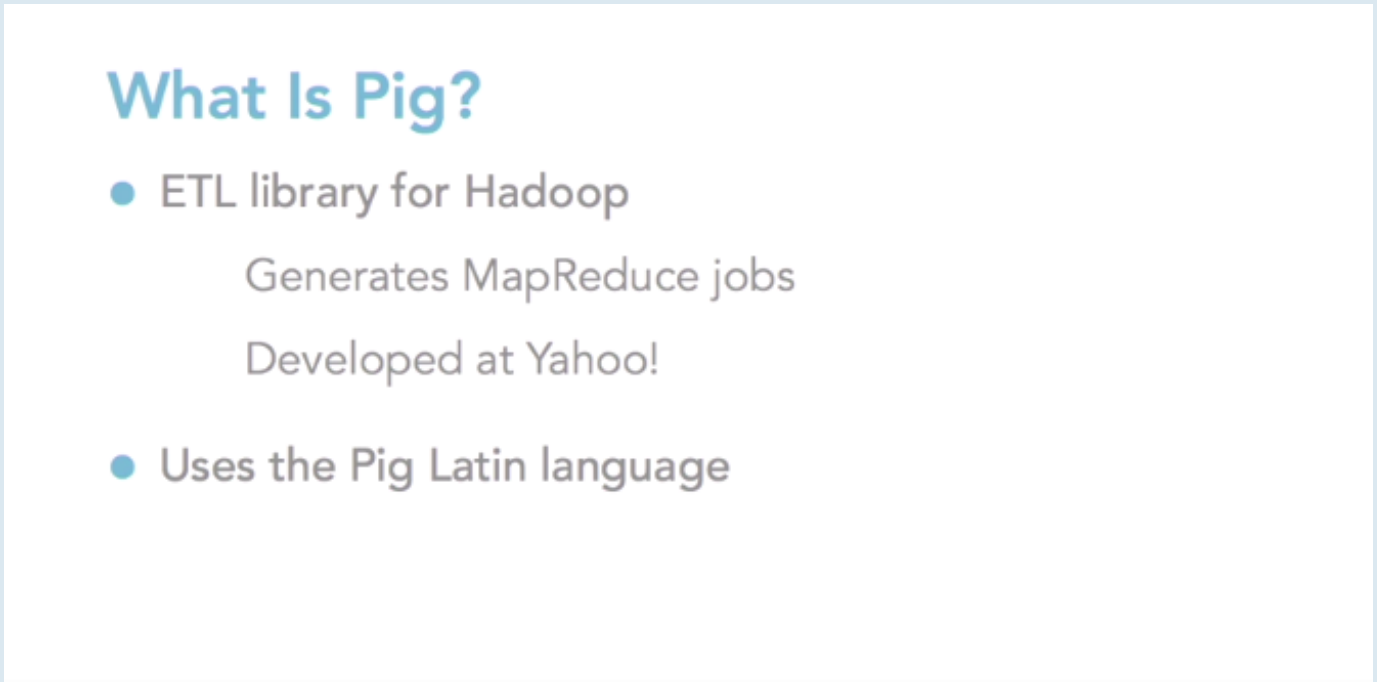
```
"""The classic MapReduce job: count the frequency of words.
"""
from mrjob.job import MRJob
import re

WORD_RE = re.compile(r"[\w']+")


class MRWordFreqCount(MRJob):

    def mapper(self, _, line):
        for word in WORD_RE.findall(line):
            yield (word.lower(), 1)

    def combiner(self, word, counts):
        yield (word, sum(counts))

    def reducer(self, word, counts):
        yield (word, sum(counts))


if __name__ == '__main__':
    MRWordFreqCount.run()
```

https://github.com/Yelp/mrjob

Pig

O que é o Pig

https://www.linkedin.com/learning/search?keywords=pig



Pig

O que é o Pig

https://www.linkedin.com/learning/search?keywords=pig

Pig

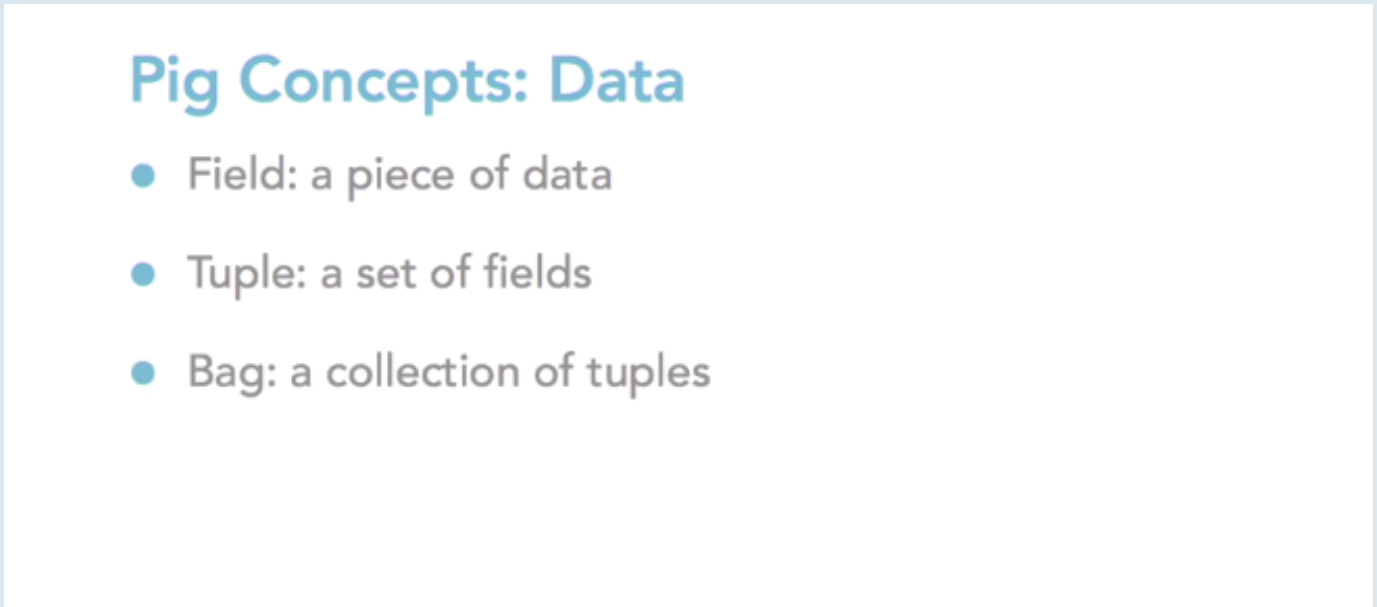
O que é o Pig

https://www.linkedin.com/learning/search?keywords=pig

Pig

O que é o Pig

https://www.linkedin.com/learning/search?keywords=pig



Running Pig

- Grunt
- Script
- Ambari / Hue

An example

- Find the oldest 5-star movies

```
ratings = LOAD '/user/maria_dev/ml-100k/u.data' AS
      (userID:int, movieID:int, rating:int, ratingTime:int);
```

This creates a *relation* named “ratings” with a given *schema*.

(660,229,2,891406212)
(421,498,4,892241344)
(495,1091,4,888637503)
(806,421,4,882388897)
(676,538,4,892685437)
(721,262,3,877137285)

Use PigStorage if you need a different delimiter.

```
metadata = LOAD '/user/maria_dev/ml-100k/u.item' USING
      PigStorage('|')AS (movieID:int, movieTitle:chararray,
      releaseDate:chararray, videoRelease:chararray,
      imdbLink:chararray);

DUMP metadata;
```

```
(1,Toy Story (1995),01-Jan-1995,,http://us.imdb.com/M/title-exact?Toy%20Story%20(1995))
(2,GoldenEye (1995),01-Jan-1995,,http://us.imdb.com/M/title-exact?GoldenEye%20(1995))
(3,Four Rooms (1995),01-Jan-1995,,http://us.imdb.com/M/title-exact?Four%20Rooms%20(1995))
(4,Get Shorty (1995),01-Jan-1995,,http://us.imdb.com/M/title-exact?Get%20Shorty%20(1995))
(5,Copycat (1995),01-Jan-1995,,http://us.imdb.com/M/title-exact?Copycat%20(1995))
```

Creating a relation from another relation; FOREACH / GENERATE

```
metadata = LOAD '/user/maria_dev/ml-100k/u.item' USING PigStorage('|')
      AS (movieID:int, movieTitle:chararray, releaseDate:chararray,
      videoRelease:chararray, imdbLink:chararray);

nameLookup = FOREACH metadata GENERATE movieID, movieTitle,
      ToUnixTime(ToDate(releaseDate, 'dd-MMM-yyyy')) AS releaseTime;
```

(1,Toy Story (1995),01-Jan-1995,,http://us.imdb.com/M/title-exact?Toy%20Story%20(1995))

(1,Toy Story (1995),788918400)

Group By

```
ratingsByMovie = GROUP ratings BY movieID;
DUMP ratingsByMovie;
```

(1,{(807,1,4,892528231),(554,1,3,876231938),(49,1,2,888068651), … }

(2,{(429,2,3,882387599),(551,2,2,892784780),(774,2,1,888557383), … }

```
avgRatings = FOREACH ratingsByMovie GENERATE group AS movieID,
      AVG(ratings.rating) AS avgRating;

DUMP avgRatings;
```

```
(1,3.878318584070796)
(2,3.2061068702290076)
(3,3.033333333333333)
(4,3.550239234449761)
(5,3.302325581395349)
```

```
DESCRIBE ratings;
DESCRIBE ratingsByMovie;
DESCRIBE avgRatings;
```

```
ratings: {userID: int,movieID: int,rating: int,ratingTime: int}

ratingsByMovie: {group: int,ratings: {(userID: int,movieID: int,rating: int,ratingTime: int)}}

avgRatings: {movieID: int,avgRating: double}
```

FILTER

```
fiveStarMovies = FILTER avgRatings BY avgRating > 4.0;
```

(12,4.385767790262173)
(22,4.151515151515151)
(23,4.120879120879204)
(45,4.05)

JOIN

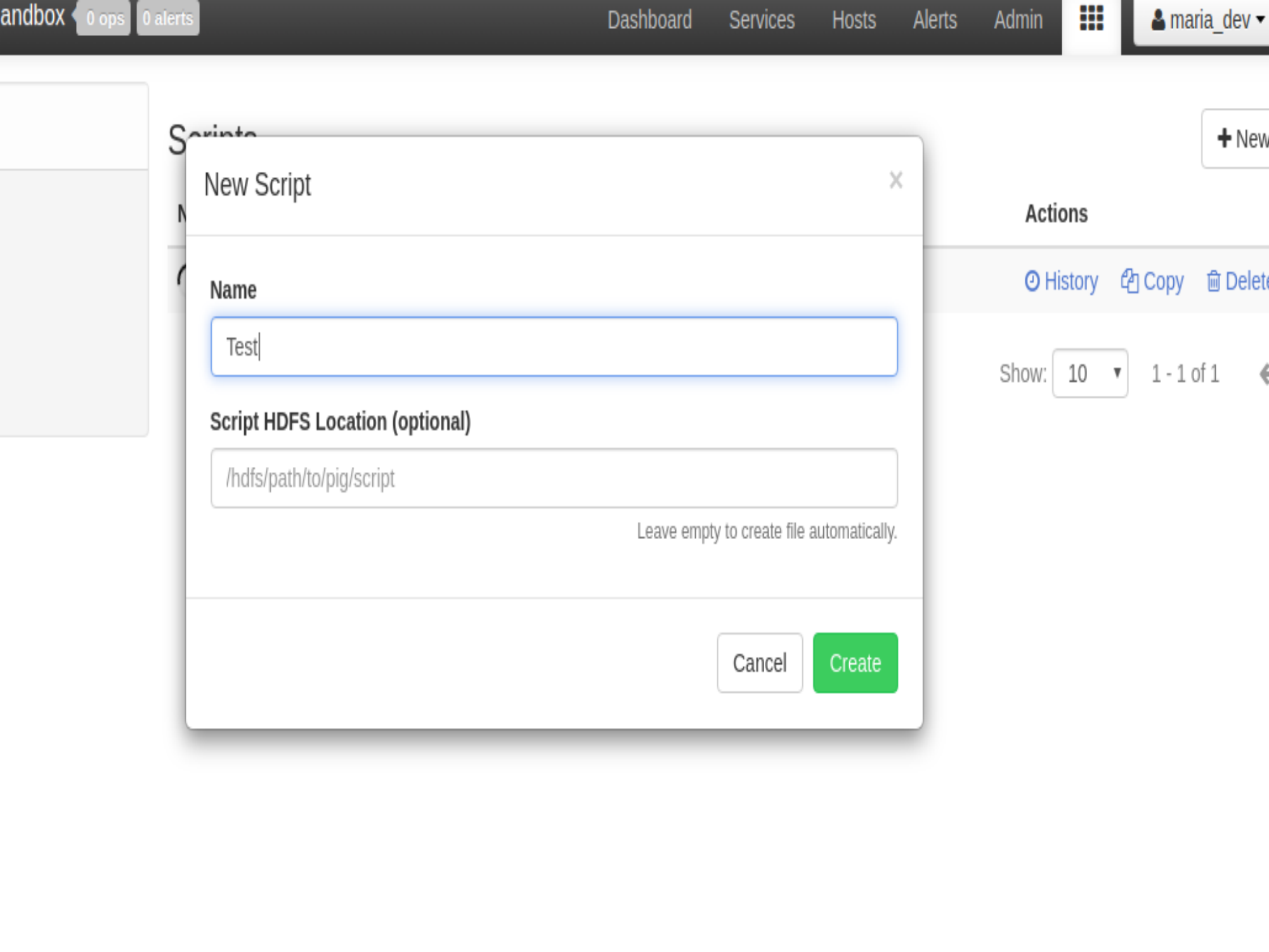
```
DESCRIBE fiveStarMovies;

DESCRIBE nameLookup;

fiveStarsWithData = JOIN fiveStarMovies BY movieID, nameLookup BY movieID;

DESCRIBE fiveStarsWithData;

DUMP fiveStarsWithData;
```

```
fiveStarMovies: {movieID: int,avgRating: double}
nameLookup: {movieID: int,movieTitle: chararray,releaseTime: long}

fiveStarsWithData: {fiveStarMovies::movieID: int,fiveStarMovies::avgRating: double,
        nameLookup::movieID: int,nameLookup::movieTitle: chararray,nameLookup::releaseTime: long}

(12,4.385767790262173,12,Usual Suspects, The (1995),808358400)
(22,4.151515151515151,22,Braveheart (1995),824428800)
(23,4.1208791208791204,23,Taxi Driver (1976),824428800)
```

ORDER BY

```
oldestFiveStarMovies = ORDER fiveStarsWithData BY
      nameLookup::releaseTime;

DUMP oldestFiveStarMovies;
```

```
(493,4.15,493,Thin Man, The (1934),-1136073600)
(604,4.012345679012346,604,It Happened One Night (1934),-1136073600)
(615,4.0508474576271185,615,39 Steps, The (1935),-1104537600)
(1203,4.0476190476190474,1203,Top Hat (1935),-1104537600)
```


andbox
0 ops
0 alerts
Dashboard
Services
Hosts
Alerts
Admin
maria_dev
+ New
Actions
History
Copy
Delete
Show:
10
1 - 1 of 1
New Script
Name
Test
Script HDFS Location (optional)
/hdfs/path/to/pig/script
Leave empty to create file automatically.
Cancel
Create

Script | History

Test

Execute on Tez | Execute

PIG helper | UDF helper

/user/maria_dev/pig/scripts/test-2020-02-15_05-39.pig

```
ratings = LOAD '/user/maria_dev/ml-100k/u.data' AS (userID:int, movieID:int, rating:int, ratingTime:int);
metadata = LOAD '/user/maria_dev/ml-100k/u.item' USING PigStorage('|')
    AS (movieID:int, movieTitle:chararray, releaseDate:chararray, videoRealese:chararray, imdblink:chararray

nameLookup = FOREACH metadata GENERATE movieID, movieTitle,
    ToUnixTime(ToDate(releaseDate, 'dd-MMM-yyyy')) AS releaseTime;

ratingsByMovie = GROUP ratings BY movieID;
avgRatings = FOREACH ratingsByMovie GENERATE group as movieID, AVG(ratings.rating) as avgRating;
fiveStarMovies = FILTER avgRatings BY avgRating > 4.0;
fiveStarsWithData = JOIN fiveStarMovies BY movieID, nameLookup BY movieID;
oldestFiveStarMovies = ORDER fiveStarsWithData BY nameLookup::releaseTime;
DUMP oldestFiveStarMovies;
```

How Do You Run Pig Scripts?

- Script/Batch mode: run from the Hadoop shell
- Grunt/Interactive mode: start with the Pig shell
- Embedded mode: within Java

Conclusão

Você esta apto a:

Compreender o conceito de Haddop
Aplicar o conceito de MapReduce
Utilizar a ferramenta PIG

Bibliografia I