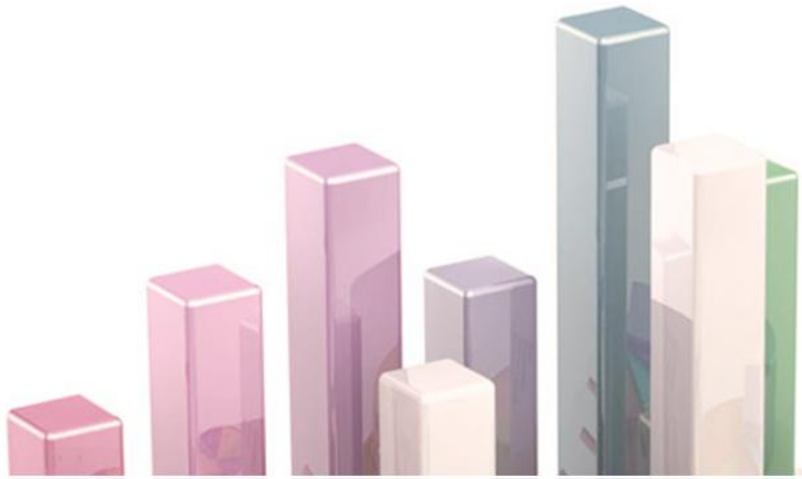
FUSIONEX®
experience.excellence

Introduction to Data Engineering



Microsoft Partner Network | WINNER Business Intelligence
GLOBAL PARTNER OF THE YEAR

SiTF AWARDS
BEST EMERGING TECHNOLOGY
BEST GENERAL APPLICATION

BIGDATA WORLD ASIA
Data Analytics & Innovation Award

ASOCIO | WINNER OUTSTANDING ICT COMPANY 2015 · 2016

APICTA Asia Pacific ICT Alliance AWARDS | WINNER Best of Applications Tools / Platform

WTEC 世界旅游经济大会
Most Innovative Award 2017

PIKOM
ICT LEADERSHIP AWARDS 2016
EXCELLENCE AWARD

amazon web services | Technology Partner 2016

Alibaba Cloud
STRATEGIC ALLIANCE PARTNER

cloudera
STRATEGIC PARTNER

MSC MALAYSIA

XBRL eXtensible Business Reporting Language

CMMI

ISO 27001 INFORMATION SECURITY

ISO 9001 QUALITY ASSURANCE

FUSIONEX® experience.excellence

Content

- What is Data Engineering
- Best Practices for ETL/ELT
- The Scopes of Data Engineering
  - Data Extraction and Loading(Ingestion)
  - Data Cleansing
  - Data Transformation/Aggregation
- Data Engineering Challenges

FUSIONEX®
experience.excellence

What is Data Engineering

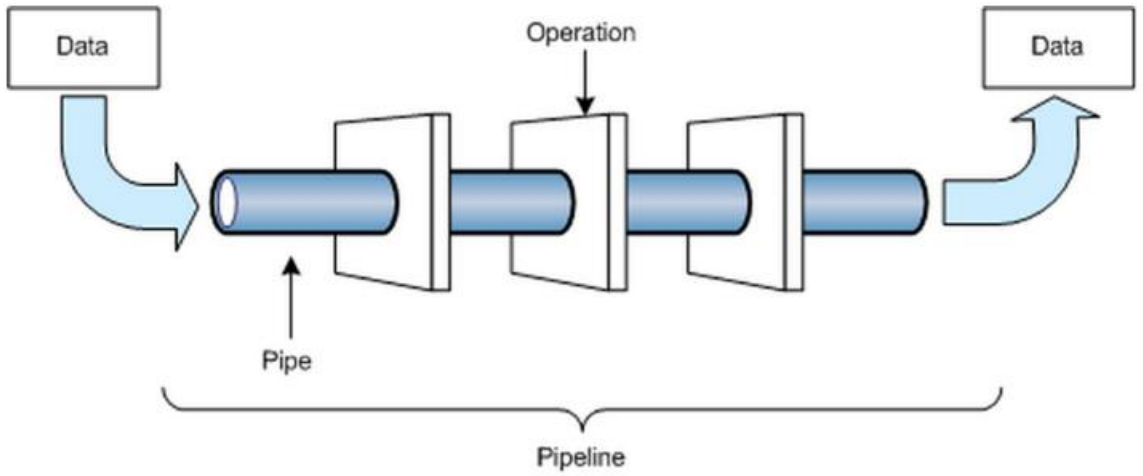
FUSIONEX® experience.excellence

What is Data Engineering?

Process of collecting and transforming

RAW DATA into **AGGREGATED DATA**

with formats that data scientists can use



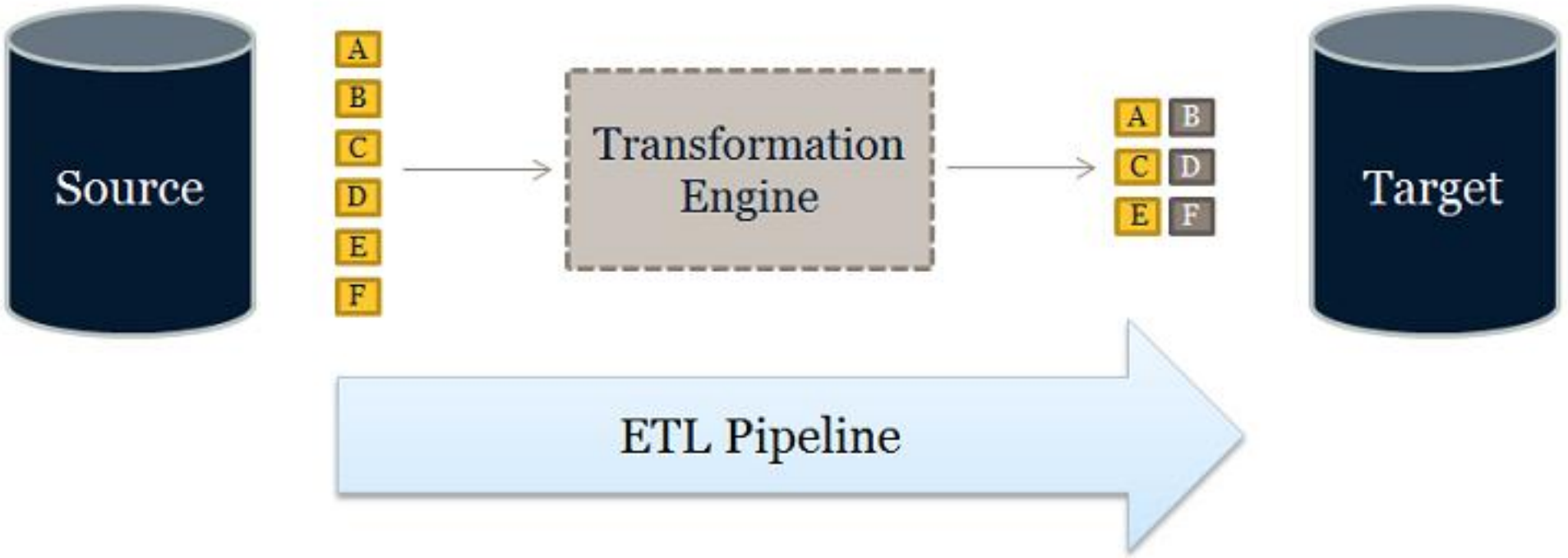
What is Data Engineering?

RAW DATA – Operational, sensor, social media, logs, etc.

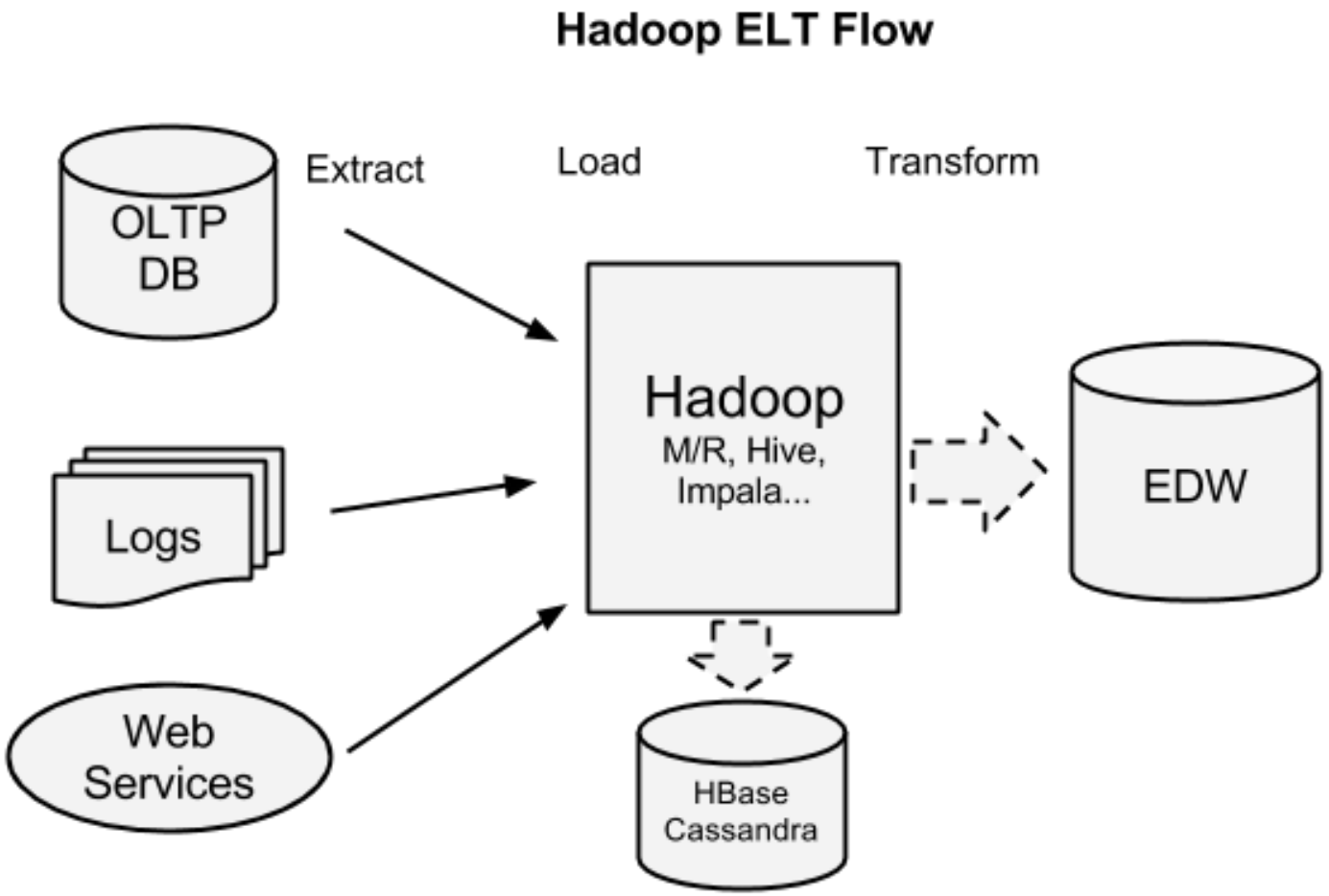
AGGREGATED DATA – Data presented in a summarized format with statistical methods

FUSIONEX® experience.excellence

Data Pipeline - ETL or ELT?



Data Pipeline - ETL or ELT?

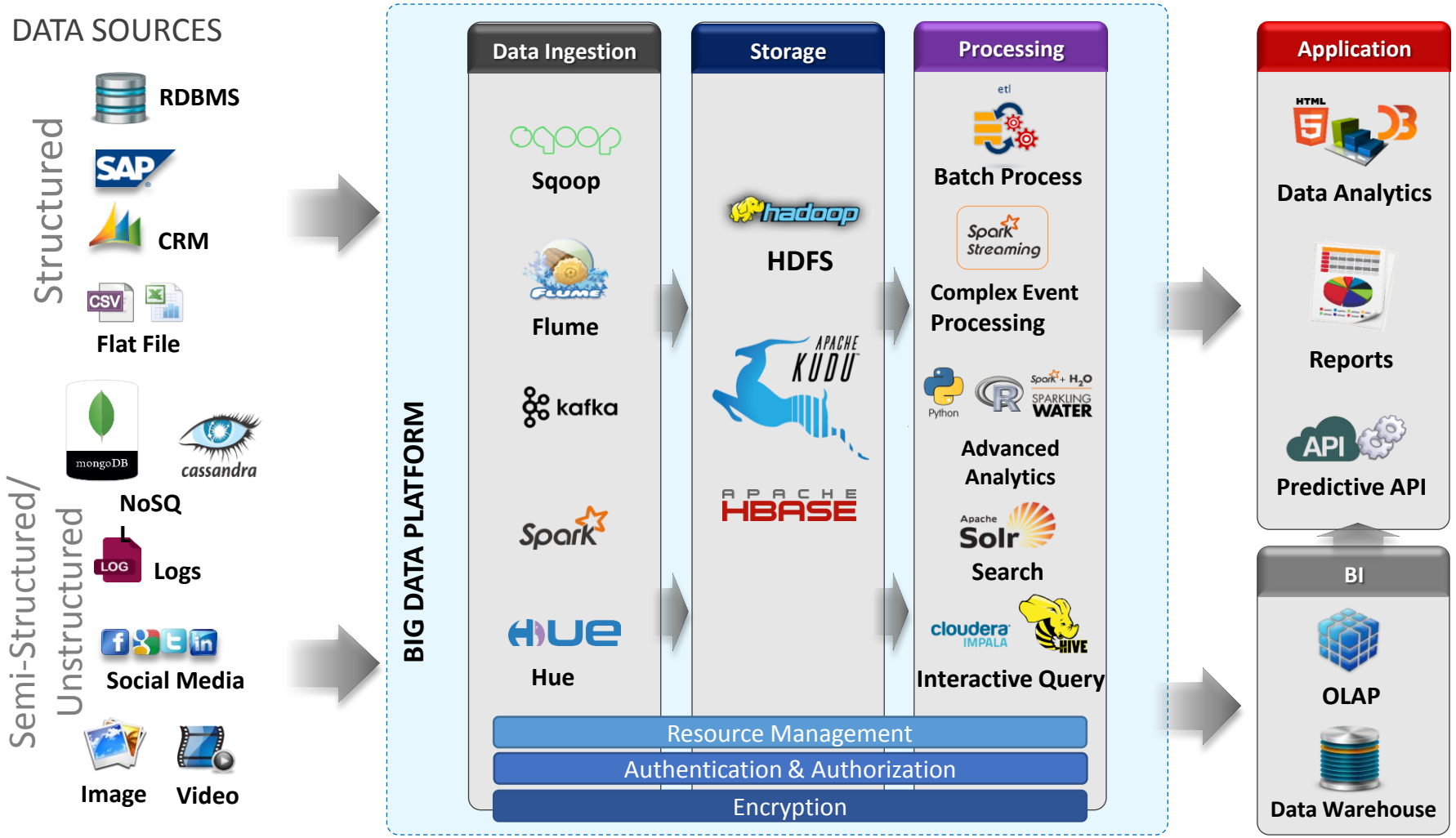


FUSIONEX® experience.excellence

Data Pipeline - ETL or ELT?

FUSIONEX® experience.excellence

Big Data Analytics Platform



FUSIONEX®
experience.excellence

Best Practices for ETL/ELT

Best Practices for ETL/ELT

- In Big Data Platform(Hadoop)
  - -ELT is more popular than ETL because Data is huge
  - -Transformation is mostly done on Big Data Platform

- Data will not be checked for integrity during ingestion unlike RDBMS

- Data will only be checked when there is a query to process the data

Best Practices in ETL/ELT

Logging:

A proper **logging strategy** is key to the success of any ETL architecture.

Best Practices in ETL/ELT

Auditing:

A load without errors is **not necessarily a successful load**. A well-designed process will not only check for errors but also **support auditing** of row counts, financial amounts, and other metrics.

Best Practices in ETL/ELT

Data Lineage.

Understanding where **data originated** from, **when it was loaded**, and **how it was transformed** is essential for the integrity of the downstream data and the process that moves it there.

Best Practices in ETL/ELT

Modularity.

Creating **reusable code structures** is important in most development realms, and even more so in ELT processes.

ELT modularization helps **avoid writing the same difficult code** over and over, and **reduces the total effort** required to maintain the ELT architecture.

Best Practices in ETL/ELT

Atomicity:

How big should each ETL process be?

Error Handling:

What happens when things go wrong?

Best Practices in ETL/ELT

Managing Bad Data:

When suspect data is discovered, there needs to be a **system for cleansing** or otherwise **managing non-conforming rows of data**

FUSIONEX®
experience.excellence

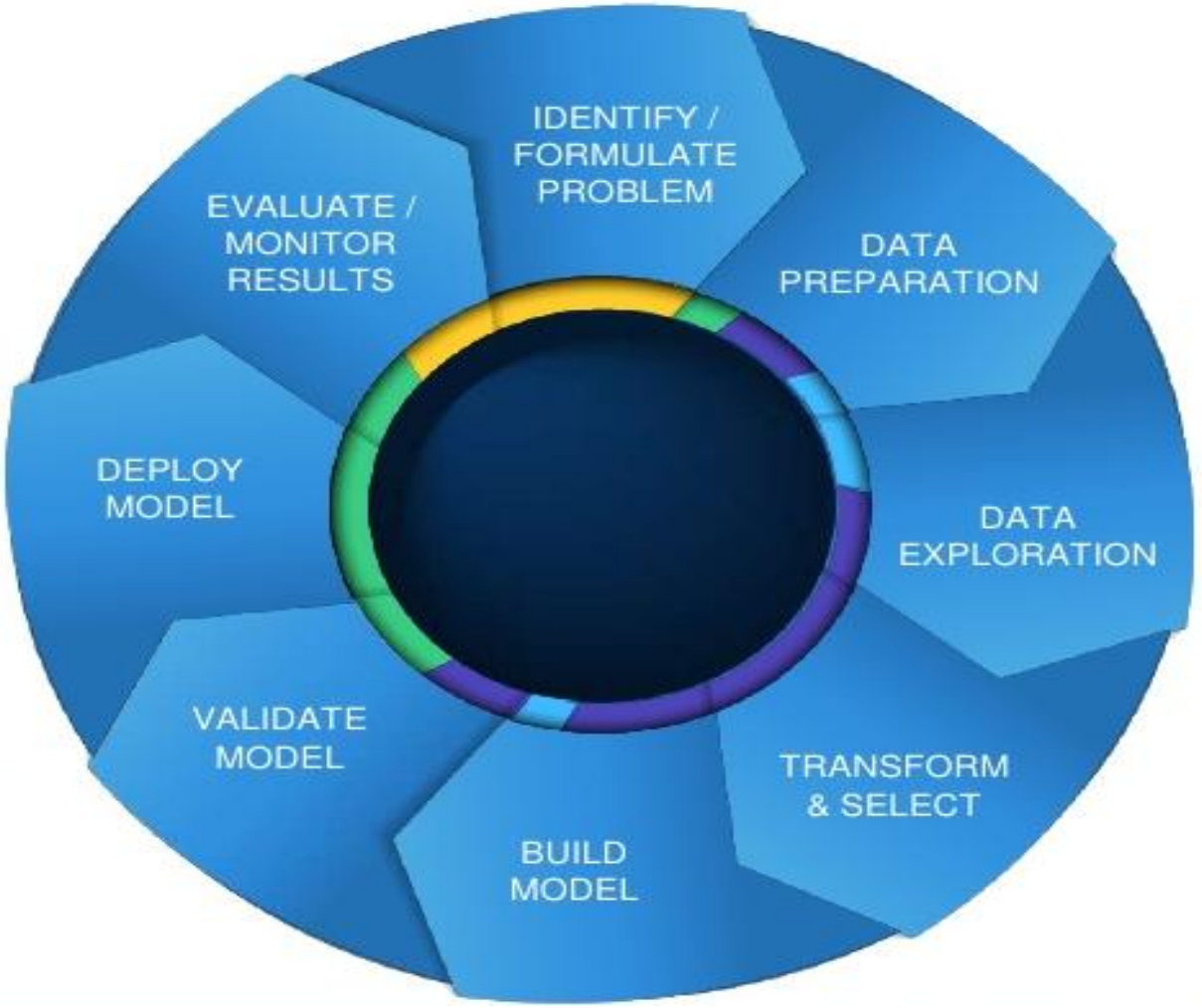
The Scopes and Challenges of Data Engineering

FUSIONEX® experience.excellence

Big Data Analytics Lifecycle

Problem/Opportunity
(Data Analyst)

Results

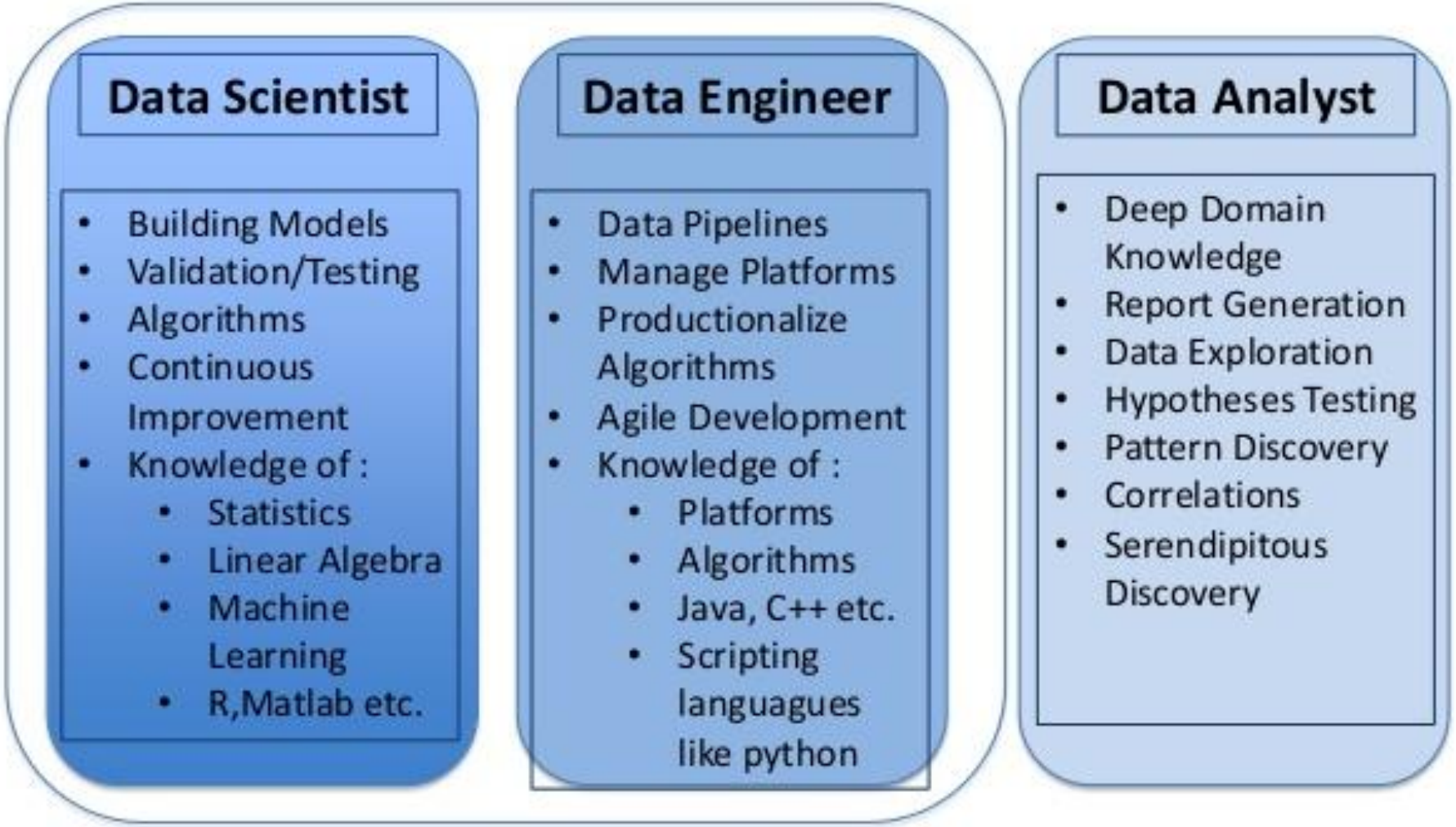


Data
(Data Engineering)

Model
(Data Science)

FUSIONEX® experience.excellence

Comparison of Scopes



Before the explosion of Big Data!!

- Life was simple … well mostly
- The ETL engineers managed data pipelines
- The Data Scientists (they weren't called that, btw, they were mostly Statisticians who programmed in SAS, SPSS or S) did the analysis
- Data Warehouses, Data marts and OLAP cubes were the platforms
- Data Analysts mostly generated reports but they were proficient in SQL, Excel, Pivot Tables etc.
- Data Architects … well, they architected ☺
- They managed :
  - Data models
  - Star Schemas
  - Data Governance
  - Master Data Management (MDM)
  - Data Security
- For the most part, they had to coax different groups to share data

FUSIONEX® experience.excellence

Big Data Era – Huge Changes!!

- Life … got interesting
- Huge data volumes – ETL became a problem
- Traditional Statistical tools couldn't handle the volume
- Data Warehouses, Data marts and OLAP cubes not primary analytical means – "in situ" analysis preferred i.e. no moving data to an analytics platform
- Data Analysts still on point for reports but now they no longer had SQL interfaces (thanks to NoSQL and Map Reduce)
- Data Architects … well, they still need to architect ☺
- Still need :
  - Data models
  - Data Governance
  - Data Security
- For the most part, they had to coax different groups to share data
- They have to do all of this when the technology is rapidly evolving

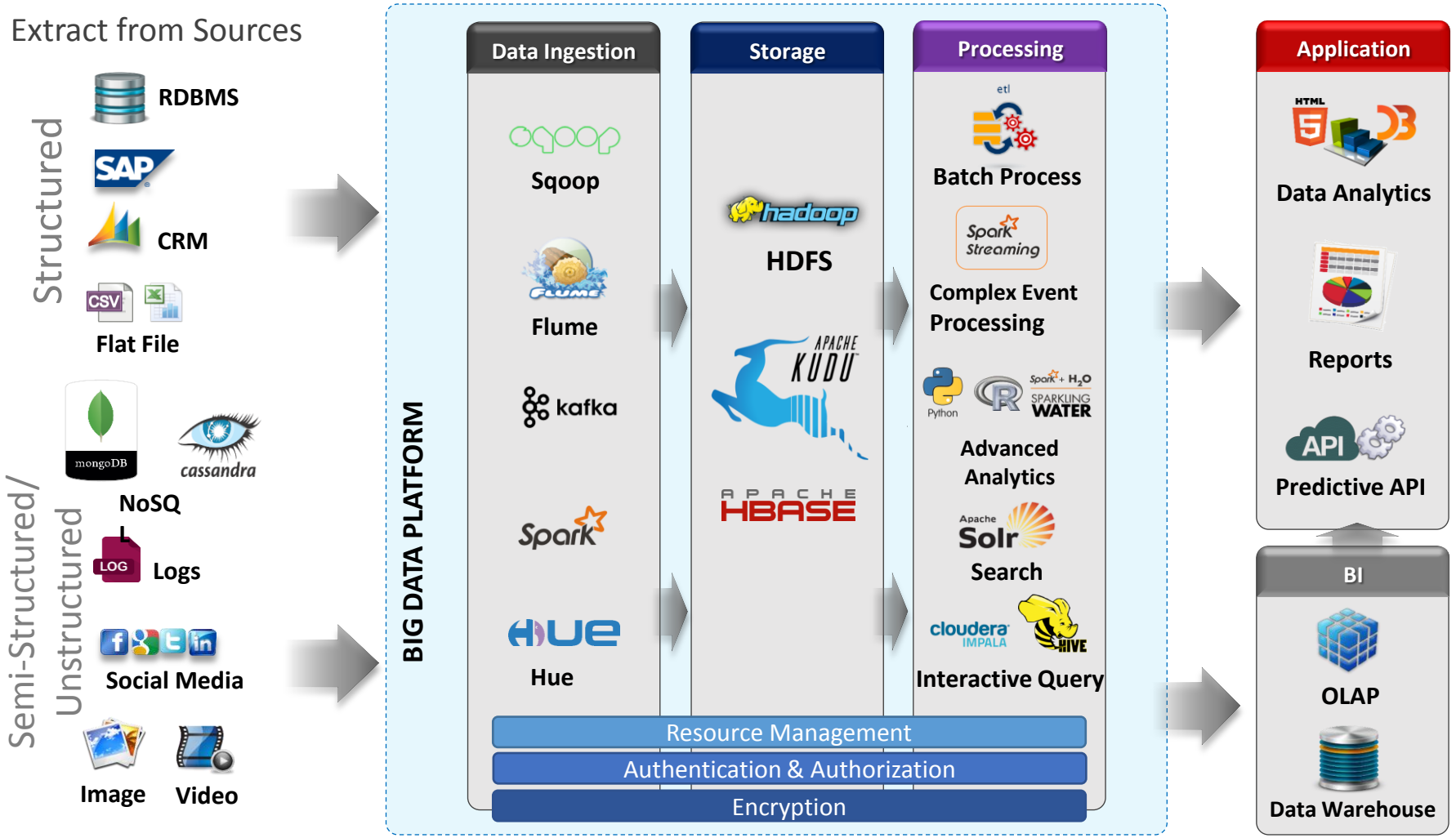
Scope of Data Engineering

- Data Preparation
  - Data Extraction, Loading, Cleansing
- Data Exploration
  - Data Visualization
- Data Transformation and Feature Selection
  - Data Aggregation to find useful features

FUSIONEX® experience.excellence

Scope of Data Engineering – Data Preparation

- Data Extraction
- Data Loading into Big Data platform
- Most of the time this is solely ingestion, no checking is done



FUSIONEX® experience.excellence

Scope of Data Engineering – Data Cleansing

FUSIONEX® experience.excellence

Missing Data

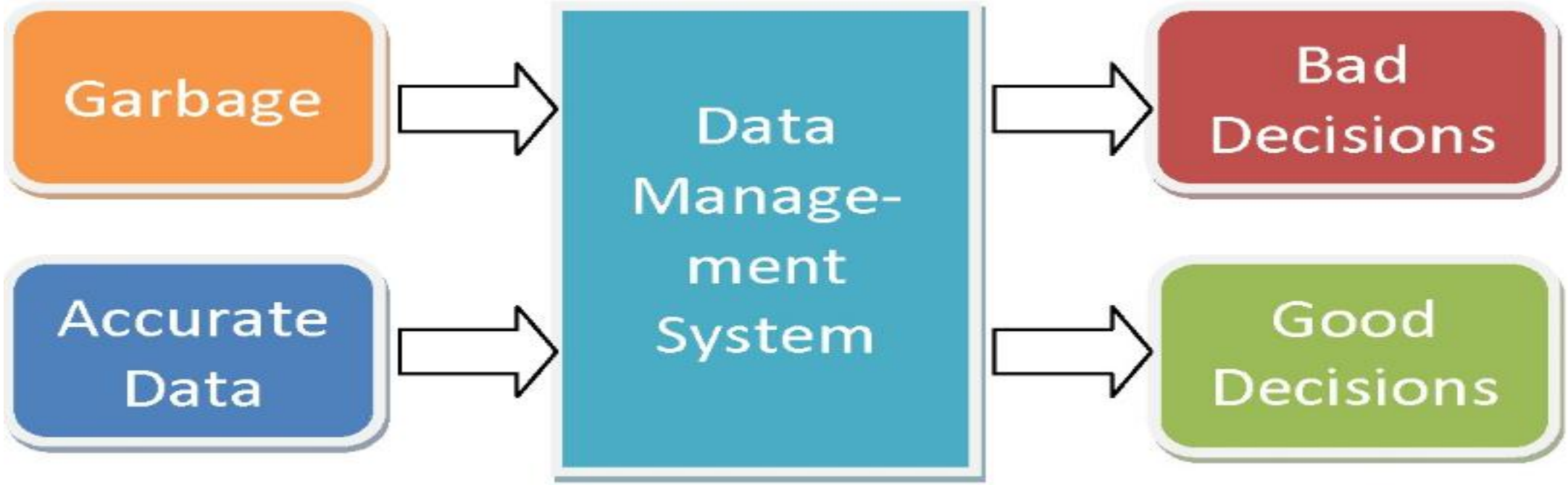
Day	Aircond sales (unit)	Temperature °C
1	54	36
2	53	35.5
3	49	33
4	45	30
5		28
6	54	36
7	51	
8	53	35.5
9	43	29
10	46	31.1
11		32.5
12	20	33.6
13	49	32.5
14	52	
15	53	35.4
16	43	29.1
17		28.1
18	44	29.5
19	42	
20	39	26.2

Cleansing of data →

Day	Aircond sales (unit)	Temperature °C
1	54	36
2	53	35.5
3	49	33
4	45	30
6	54	36
8	53	35.5
9	43	29
10	46	31.1
12	20	33.6
13	49	32.5
15	53	35.4
16	43	29.1
18	44	29.5
20	39	26.2

FUSIONEX® experience.excellence

Data Cleansing



Beware of dirty data !!!

FUSIONEX®
experience.excellence

Data Cleansing

Scope of Data Engineering – Data Exploration

- Perform Descriptive Analysis
  - Explore common relevant variables, attributes and records
  - Explore possible insights from data to create more representative variables
  - Splitting and Joining variables

FUSIONEX® experience.excellence

Relevant data

Day	Number of followers for LCW on fb	Temperature °C	Price of petrol per liter (RM)
1	674215	28	2.1
2	675842	27.5	2.1
3	679512	29	2.1
4	685214	28.5	2.1
5	692145	27.3	2.1
6	695412	27.9	2.1
7	701245	28.1	2.1
8	721455	29.4	2.01
9	742154	30.1	2.01
10	754521	31.1	2.01
11	762513	28.5	2.01
12	798546	29.4	2.01
13	814562	28.1	2.01
14	825462	27.6	2.01
15	852164	26.8	2.13
16	895412	27.9	2.13
17	921456	28.1	2.13
18	995123	29.5	2.13
19	1101238	30.1	2.13
20	1181074	31.5	2.13

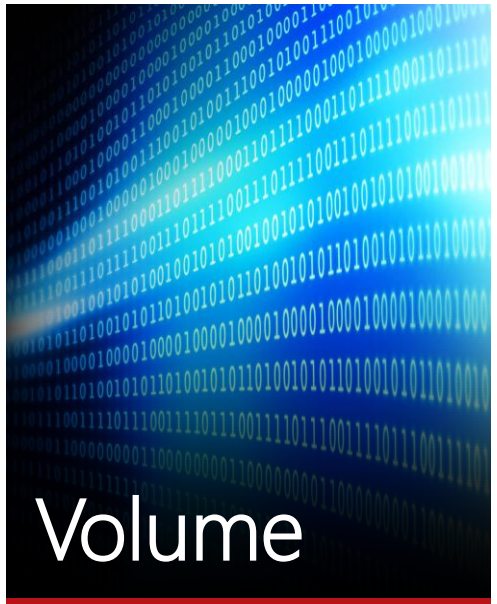
Day	Aircond sales (unit)	Temperature °C
1	54	36
2	53	35.5
3	49	33
4	45	30
5	42	28
6	54	36
7	51	34
8	53	35.5
9	43	29
10	46	31.1
11	48	32.5
12	20	33.6
13	49	32.5
14	52	34.8
15	53	35.4
16	43	29.1
17	42	28.1
18	44	29.5
19	42	28.2
20	39	26.2

Scope of Data Engineering – Data Transformation and Feature Selection

- Data Transformation and feature selection
  - Transforming data into more useful information by clustering, classifying, categorizing data, etc.
  - Remove redundant or variables that contribute little information or with high co-relationship with others. For example, age and year of birth, city and postcode,
  - Shortlist features that are important and significant for analytics
  - Example of features: min/max/avg/med/stddev/var of daily/monthly/yearly by country/region/state/city/street if weather…….

FUSIONEX® experience.excellence

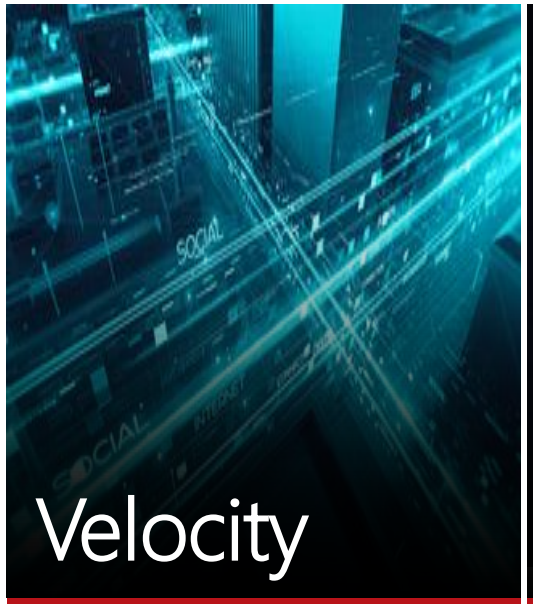
Challenges for Data Engineers – from the 5Vs perspective



Volume

Data At Rest

Terabytes to Exabytes of existing data to process



Velocity

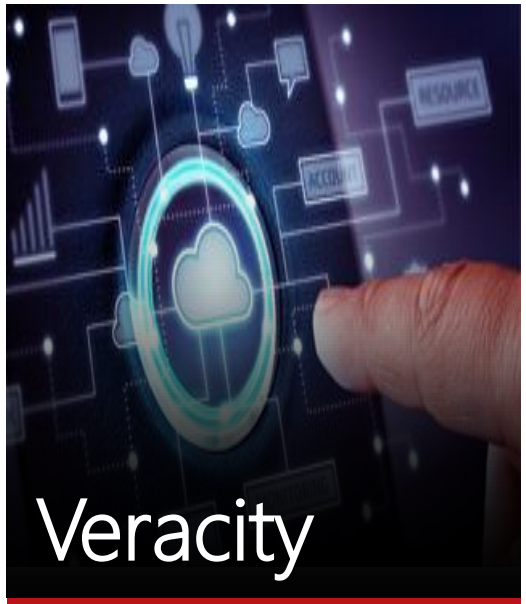
Data in Motion

Streaming data, requiring milliseconds to seconds to respond

Variety

Data in Many Forms

Structured, Unstructured, Text, Multimedia etc.



Veracity

Data in Doubt

Uncertainty due to data inconsistency & incompleteness, ambiguities, latency, deception, model approximations

Value

Data into Money

Business model can be associated to the data

FUSIONEX® experience.excellence

What is Data Engineering?

Special Characteristics of BIG DATA – Data is not STATIC!

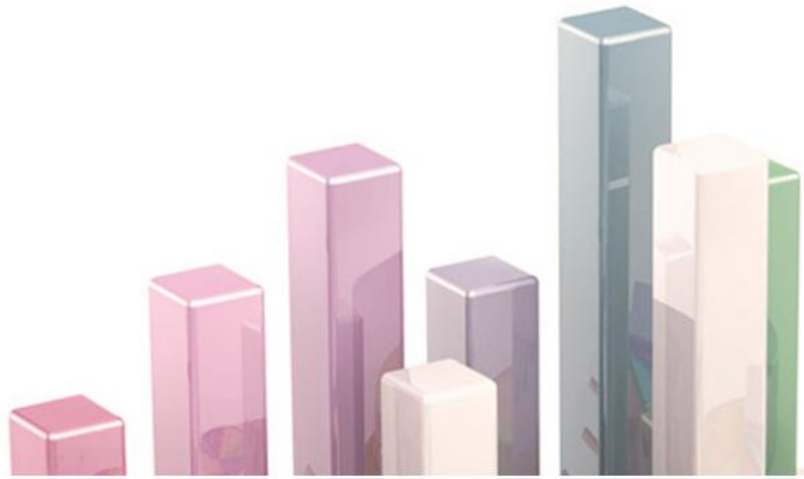
- Data sizes keep growing
- Data sources keep increasing
- Data types keep changing
- Data values keep rising (insights are unlimited, what is limited is our imagination!)

In-class Activity

- Work in a group of 4-5
- Discuss the followings:
  - Choose a set of data from your organization or that you are working on
  - Explain how you perform ETL/ELT on them
    - Discuss if ETL is possible or ELT would be a better option? WHY?
  - Tell us about your current platform and practices
  - Describe the challenges based on the 4Vs(Volume, Velocity, Veracity, Variety)

FUSIONEX®
experience.excellence

Hadoop and Ecosystem Tools



Microsoft Partner Network | WINNER Business Intelligence
GLOBAL PARTNER OF THE YEAR

SiTF AWARDS
BEST EMERGING TECHNOLOGY
BEST GENERAL APPLICATION

BIGDATA WORLD ASIA
Data Analytics & Innovation Award

ASOCIO | WINNER OUTSTANDING ICT COMPANY 2015 · 2016

APICTA AWARDS | WINNER Best of Applications Tools / Platform

WTEC 世界旅游经济大会
Most Innovative Award 2017

PIKOM ICT LEADERSHIP AWARDS 2016
EXCELLENCE AWARD

amazon web services | Technology Partner 2016

Alibaba Cloud
STRATEGIC ALLIANCE PARTNER

cloudera
STRATEGIC PARTNER

MSC MALAYSIA

XBRL eXtensible Business Reporting Language

CMMI

ISO 27001 INFORMATION SECURITY

ISO 9001 QUALITY ASSURANCE

FUSIONEX®
experience.excellence

Hadoop Architecture and Ecosystem

Learning Outcomes

After completing this session, you will be able to:

- Understand the Hadoop Architecture
- Explain the various Hadoop Ecosystem tools
- Perform simple commands in HDFS
- Ingest data into Hadoop

FUSIONEX®
experience.excellence

Content

- Apache Hadoop Overview
- Hadoop Architecture
- Data Storage (HDFS, HBASE)
- Data Ingestion and Tools (HDFS, Sqoop, Flume)
- Data Processing Engines (Spark, MapReduce)
- Data Analysis Tools (Impala, Hive)
- Data Exploration Tools (Search, Solr)
- Other Ecosystem Tools (Hue, Oozie, Sentry)

Hadoop Architecture & Ecosystem

Apache Hadoop

- Apache Hadoop is a software framework meant for distributed processing and distributed storage of very large data sets on a group of computer hardware that is affordable and easy to obtain.
- Hadoop is open-source

Hadoop Architecture & Ecosystem

Advantages of Hadoop

- Scalable – Can be expanded
- Economical – Running on commodity products. Nothing proprietary
- Resilient – Data storing flexibility
- Reliable – Data processing can be redirected in case of failed nodes
- Performance – Clustered and multiprocessing allows better performance

Hadoop Architecture & Ecosystem

What are Hadoop commonly used for:

- Extract/Load/Transform (ELT) big data
- Data storage
- Data Analysis
  - Sentiment analysis
  - Risk assessment
  - Classification and feature selection
  - Novelty detection
  - Machine Learning and Deep learning
  - Predictive modelling
  - Text mining

Hadoop Architecture & Ecosystem

Hadoop Core

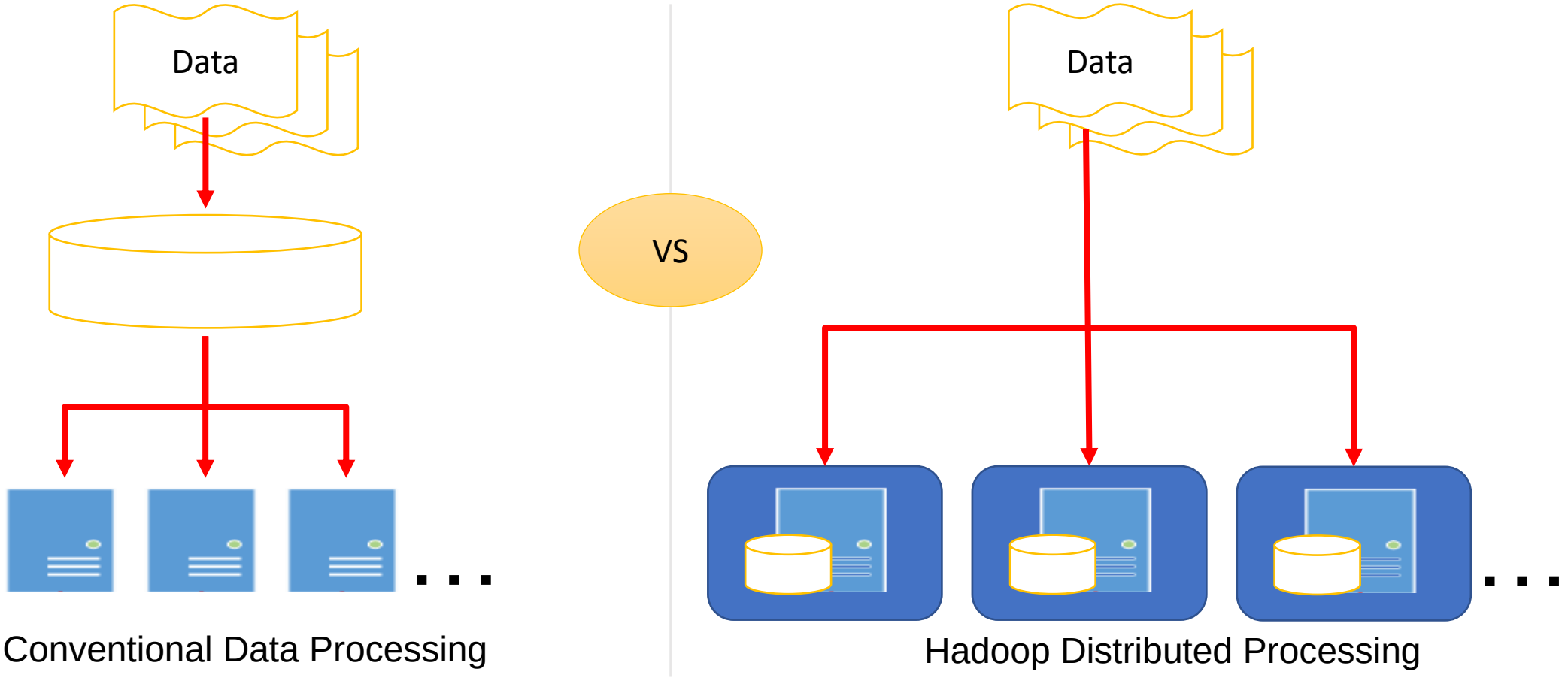
- Hadoop Common
- Hadoop Distributed File System (HDFS)
- MapReduce
- Spark
- YARN

*Other related projects – Hive, Impala, Flume, Sqoop, Kafka, Pig etc…

FUSIONEX® experience.excellence

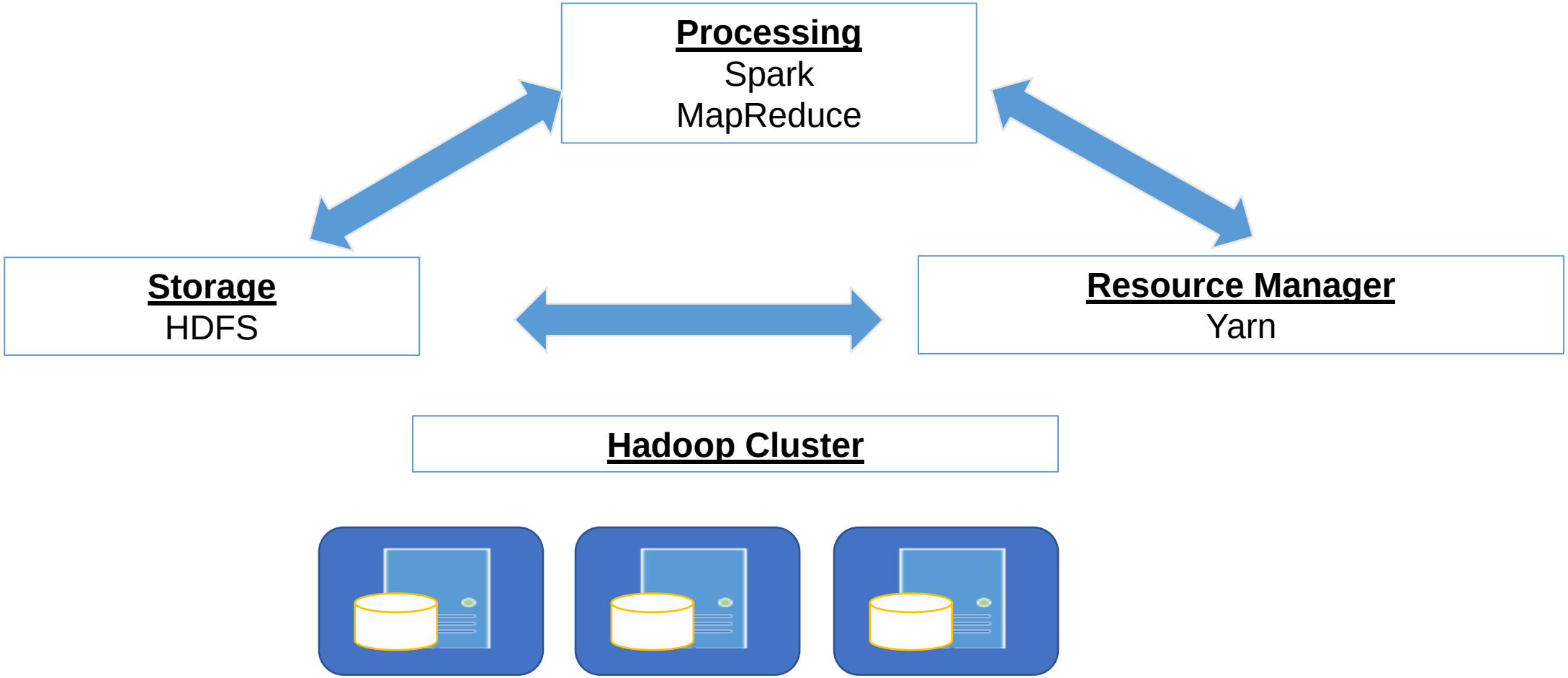
Hadoop Architecture & Ecosystem

Conventional vs Hadoop Data Processing



Hadoop Architecture & Ecosystem

Core Hadoop - 3 components



Hadoop Architecture & Ecosystem

- Common terms used for Hadoop Cluster

  CLUSTER – A group of inter-connected computers that can share processing power and storage

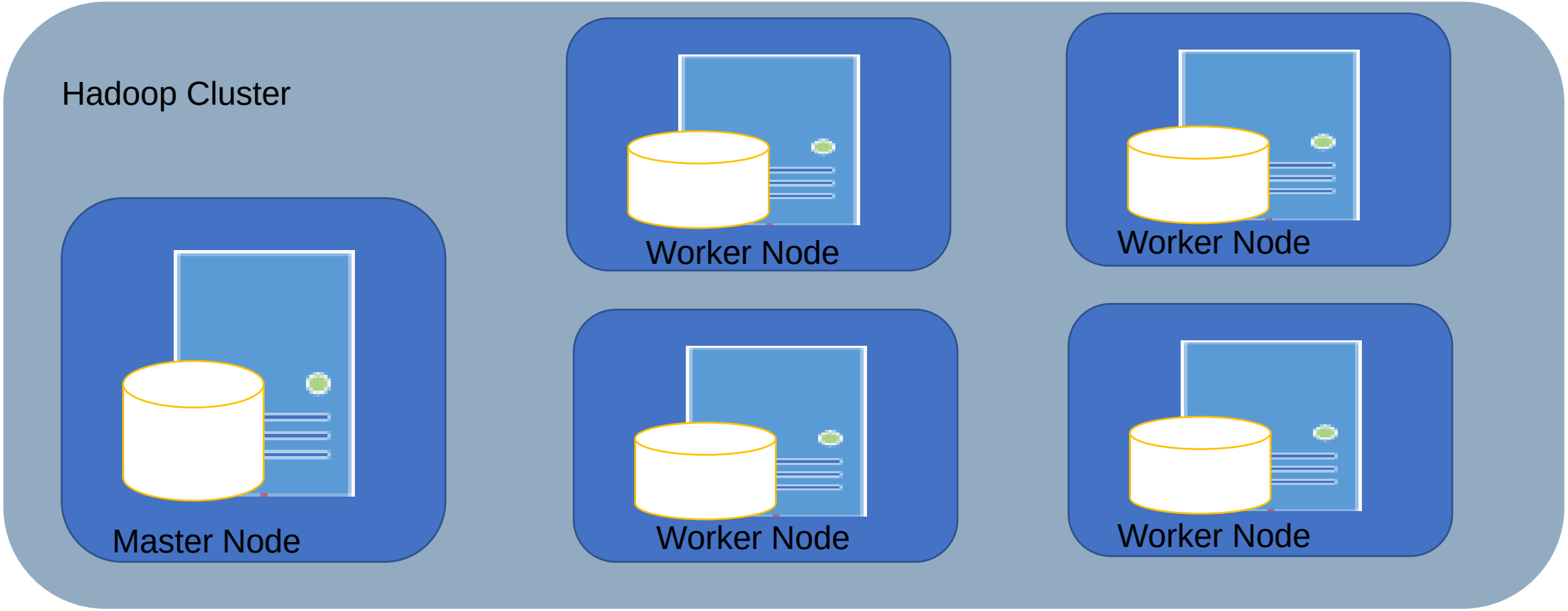
  NODE – A single node is an individual entity handling certain responsibilities in a cluster (Master and Worker/Slave)

  MASTER NODE – The node that handles management of resources, assignment and killing of tasks, and monitoring of job completion

  WORKER/SLAVE NODE – Responsible in running the jobs assigned by master node

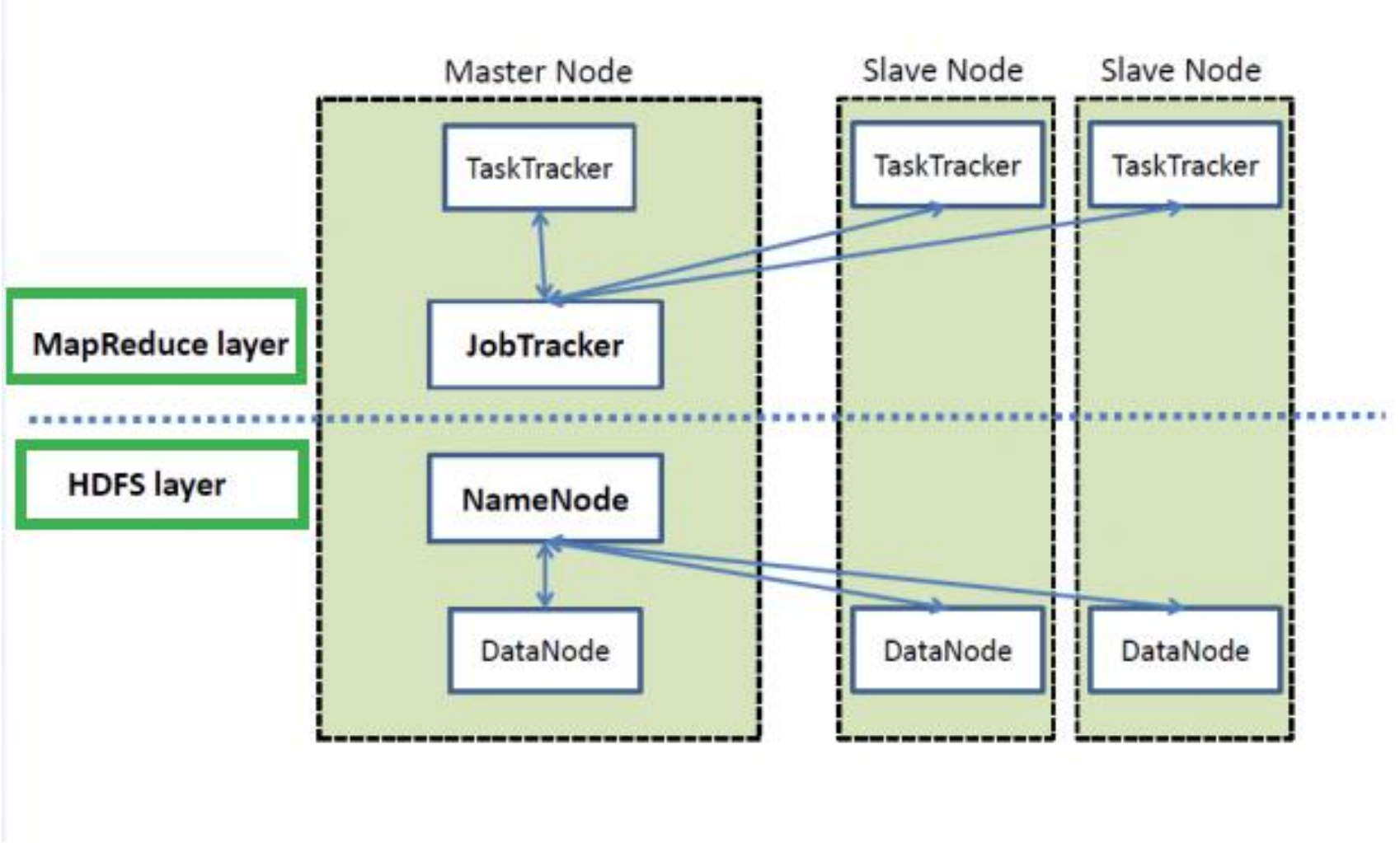
  DAEMON – An instance of task running on a node

Hadoop Architecture & Ecosystem



FUSIONEX® experience.excellence

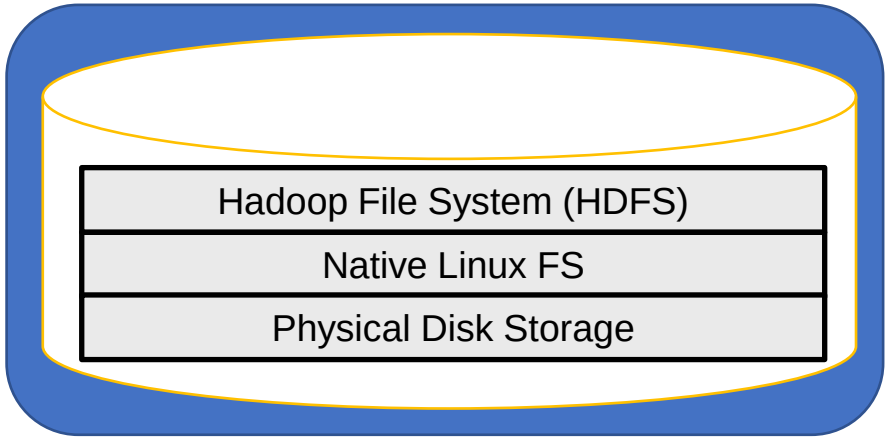
Hadoop Architecture & Ecosystem



FUSIONEX® experience.excellence

Hadoop Architecture & Ecosystem

Basic Concepts of Storage HDFS



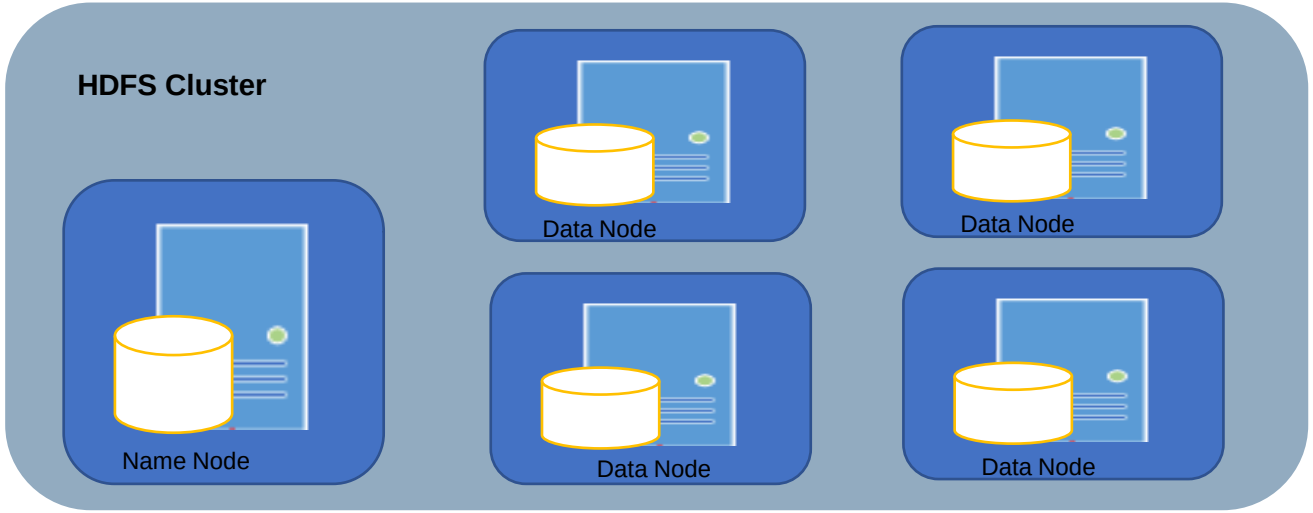
- Written in Java
- Provides customizable redundancy
- Supports large amount of data
- Each file typically more than 100MB
- Optimized for simultaneous large and streaming reads
- “Write Once” concept and not suitable for random writes

FUSIONEX® experience.excellence

Hadoop Architecture & Ecosystem

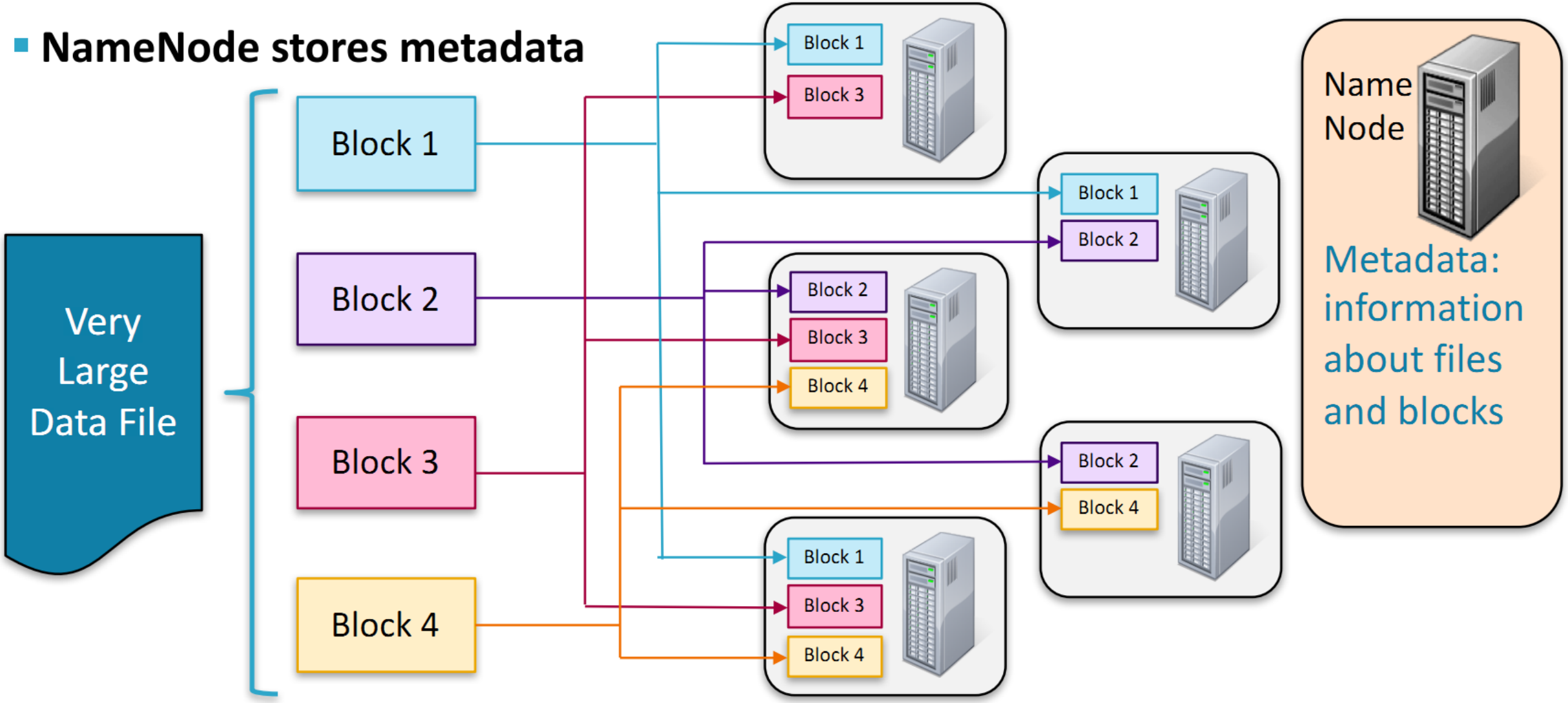
File storage system (HDFS)

- Data files are split into multiple blocks and blocks are replicated and stored in multiple Data Nodes
- Storing of blocks are indexed by Name Node as metadata
- Default size of 1 block is 128MB



FUSIONEX® experience.excellence

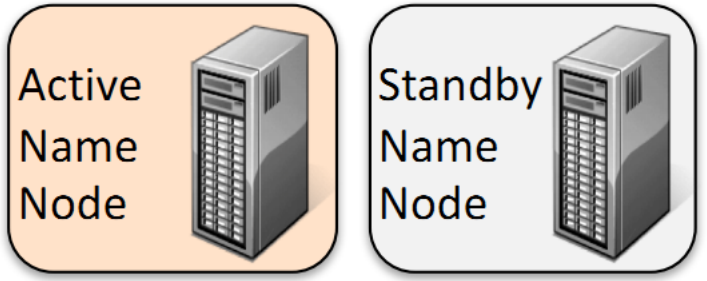
- **Each block is replicated on multiple data nodes (default 3x)**
- **NameNode stores metadata**



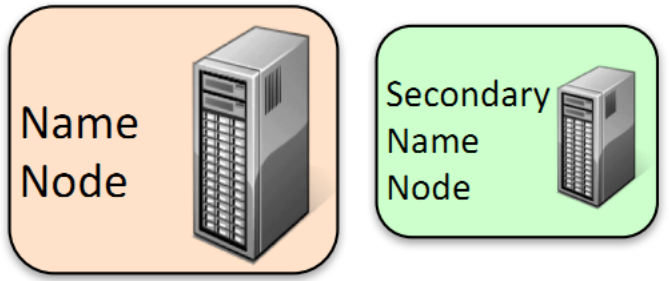
HDFS Name Node Availability

- **The NameNode daemon must be running at all times**
  - If the NameNode stops, the cluster becomes inaccessible

- **HDFS is typically set up for High Availability**
  - Two NameNodes: Active and Standby

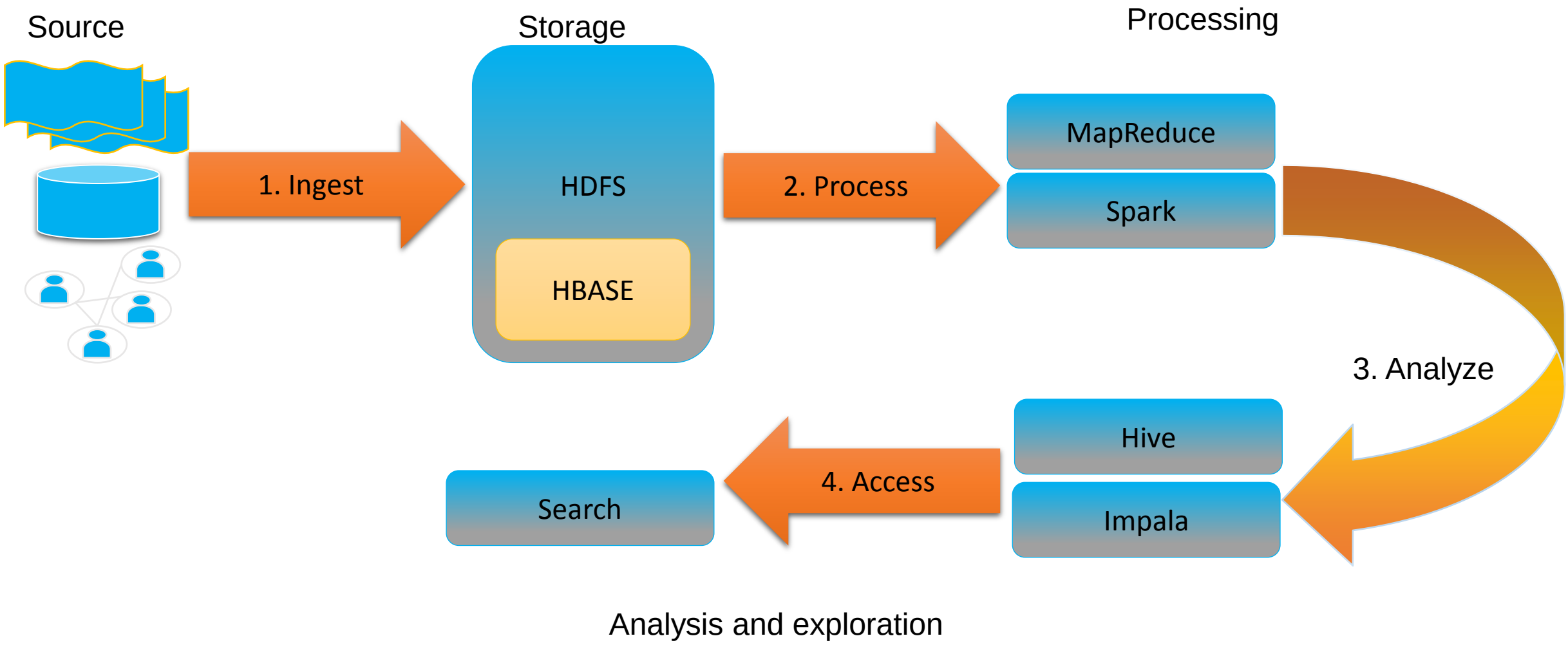


- **Small clusters may use "Classic mode"**
  - One NameNode
  - One "helper" node called the Secondary NameNode
    - Bookkeeping, not backup



FUSIONEX® experience.excellence

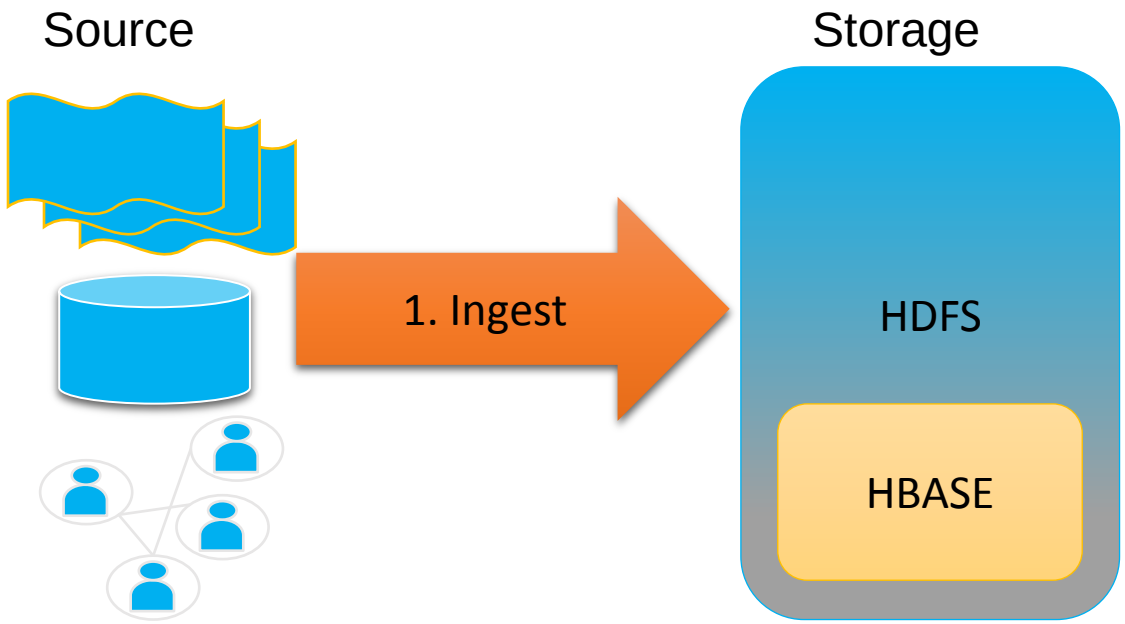
Hadoop Architecture & Ecosystem



Analysis and exploration

Hadoop Architecture & Ecosystem

Data ingestion



Hadoop ingests data from multiple formats

- RDBMS
- Imported Files
- Logs

Hadoop Architecture & Ecosystem

Data Ingestion Tools

HDFS
- Uses direct file transfer with web-based interface HUE or
- command line “$ hdfs dfs –put ~”

Apache Sqoop
- Fast importing from and to RDBMS
- Supports various standard databases such as PostgreSQL, MySQL, MongoDB, Oracle, etc.

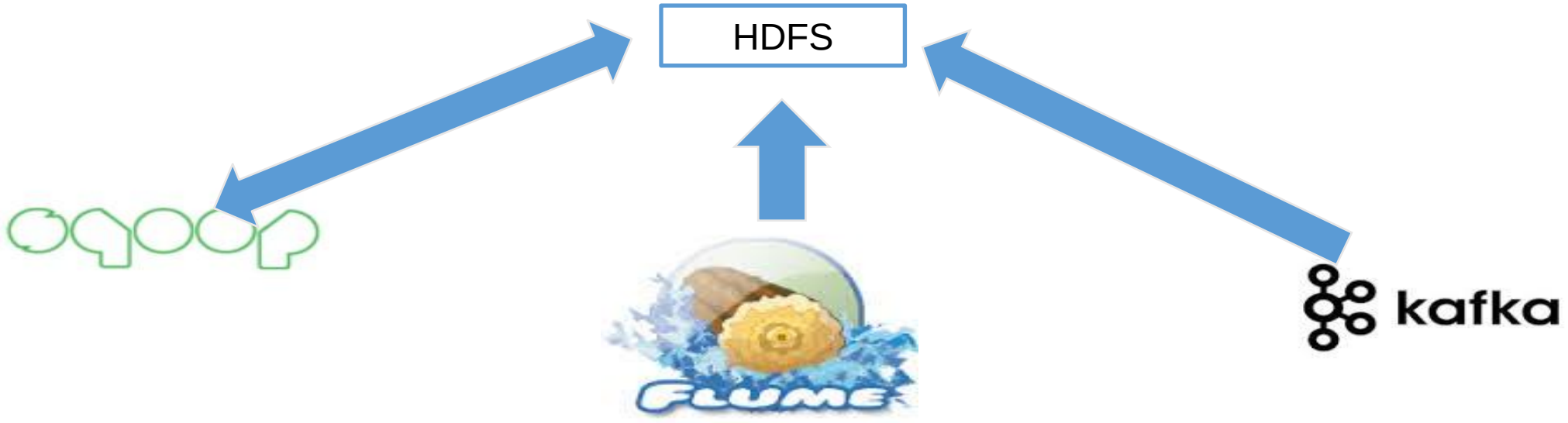
Apache Flume
- Supports multi-channel streaming data ingestion
- Suitable for event based data from multiple systems such as log files, sensor data, click streams, etc.

Hadoop Architecture & Ecosystem

Data Ingestion Tools

Kafka

- Integrated with Flume and Spark Streaming
- A distributed streaming platform
- Used for building real-time data pipelines and streaming apps.
- Highly scalable, fault-tolerant, fast



Hadoop Architecture & Ecosystem

Data Processing Engine

Apache Spark – Large scale

- General Purpose
- Runs on distributed environment and processing data in HDFS
- Supports wide range of applications
  - Streaming data processing
  - Business intelligence
  - Machine learning
  - Text processing

Hadoop Architecture & Ecosystem

Data Processing Engine

Hadoop MapReduce – Original Hadoop Framework

- **Java-based**
- **Majority of existing tools still built on MapReduce but are slowly migrating to Spark**
- **Highly fault tolerant framework, however, much slower compare to Spark**

Hadoop Architecture & Ecosystem

Data Analysis Tools

Apache Impala - High performance SQL

- **100% open source**
- **high-performance SQL engine and support SQL commands**
- **runs on Hadoop clusters**
- **data are stored as HDFS files or HBase tables**
- **very low latency**
- **ideal for interactive analysis**

Hadoop Architecture & Ecosystem

cloudera® SEARCH

Data Exploration Tools

Cloudera Search – Data exploration platform

- **100% open source**
- **Supports full interactive text search for any data on Hadoop with web-based dashboard on Hue**
- **User-friendly search interface**
- **Cloudera Search is an integration of Apache Solr with HDFS, MapReduce, HBase, and Flume**

Solr

hadoop

Hadoop Architecture & Ecosystem

Other Ecosystem Tools

HUE – Hadoop User Experience

- **100% open source**
- **Provides web-based interactive interface for**
  - **Files and Data upload, browsing, and search**
  - **Hive and Impala scripting interface**
  - **Etc…**
- **User-friendly search interface**

Hadoop Architecture & Ecosystem

Other Ecosystem Tools

Oozie – Workflow Engine

- **Coordinate and monitor the workflow**
- **Arrange and submit jobs in the right sequence**
- **Trigger event or time based reports**

Hadoop Architecture & Ecosystem

Other Ecosystem Tools

Sentry – Hadoop Security

- **Supports authentication and authorization access control to HDFS, Cloudera Search, Hive and Impala**
- **Provides security solution for entire cluster**

FUSIONEX® experience.excellence

Hands-On Session – Exercise 1

Introduction to Hands-on environment setup

- Server Access
- Google drive access
- PostgresSQL create database and tables

FUSIONEX®
experience.excellence

Data Ingestion

Data Ingestion

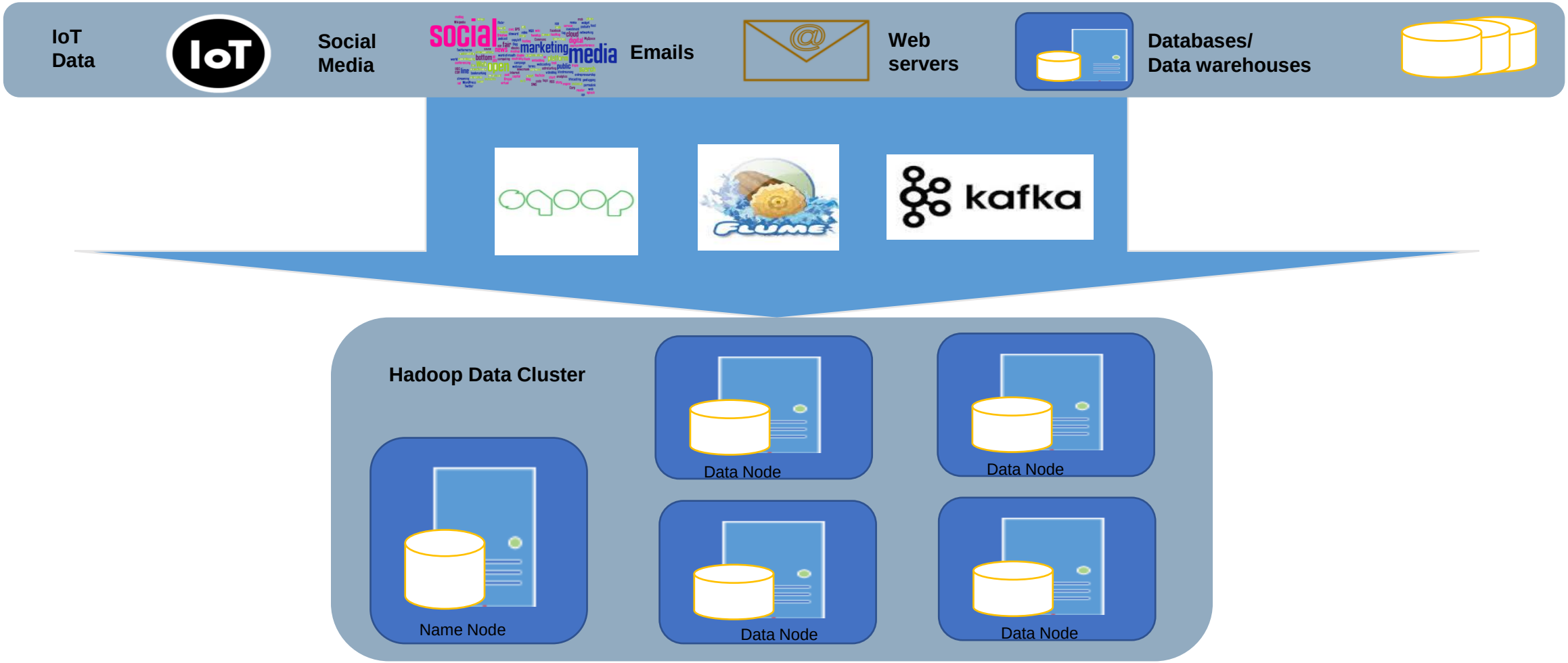
Data Ingestion Overview

- Hadoop supports data ingestions from various sources:
  - Flat files
  - Web logs
  - RDBMS
  - Streaming data from sensors
  - Social media feeds
  - Click streams logs
  - Syslogs
  - Etc.

FUSIONEX® experience.excellence

Data Ingestion

Data Ingestion Overview



Data Ingestion

Accessing HDFS

- Various methods of accessing HDFS
  - Command line:
    - - FsShell;
      $hdfs dfs
  - In Spark environment
    - Hdfs://nnhost:port/file…
  - Other programs
    - Java API
      - Backend support for Hadoop tools such as MapReduce, Impala, Hue, Sqoop, Flume

Data Ingestion

Accessing HDFS – Importing Flat Files with commands

- Examples of HDFS Commands
  - To copy a file from local directory into HDFS

(into /user/username/filename.txt)

```
$ hdfs dfs –put filename.txt filename.txt
```

  - To perform a directory listing in HDFS home directory

```
$ hdfs dfs –ls
```

  - To perform a directory listing in HDFS root directory

```
$ hdfs dfs –ls /
```

Data Ingestion

Accessing HDFS

- Examples of HDFS Commands
  - To display the content of a file

```
$ hdfs dfs –cat /user/username/filename.txt
```

  - To extract file from HDFS to local directory

```
$ hdfs dfs –get /user/username/file.txt file.txt
```

  - To create a directory in the user HDFS directory

```
$ hdfs dfs –mkdir newDirectoryName
```

  - To delete the directory and its content

```
$ hdfs dfs –rm –r newDirectoryName
```

Data Ingestion

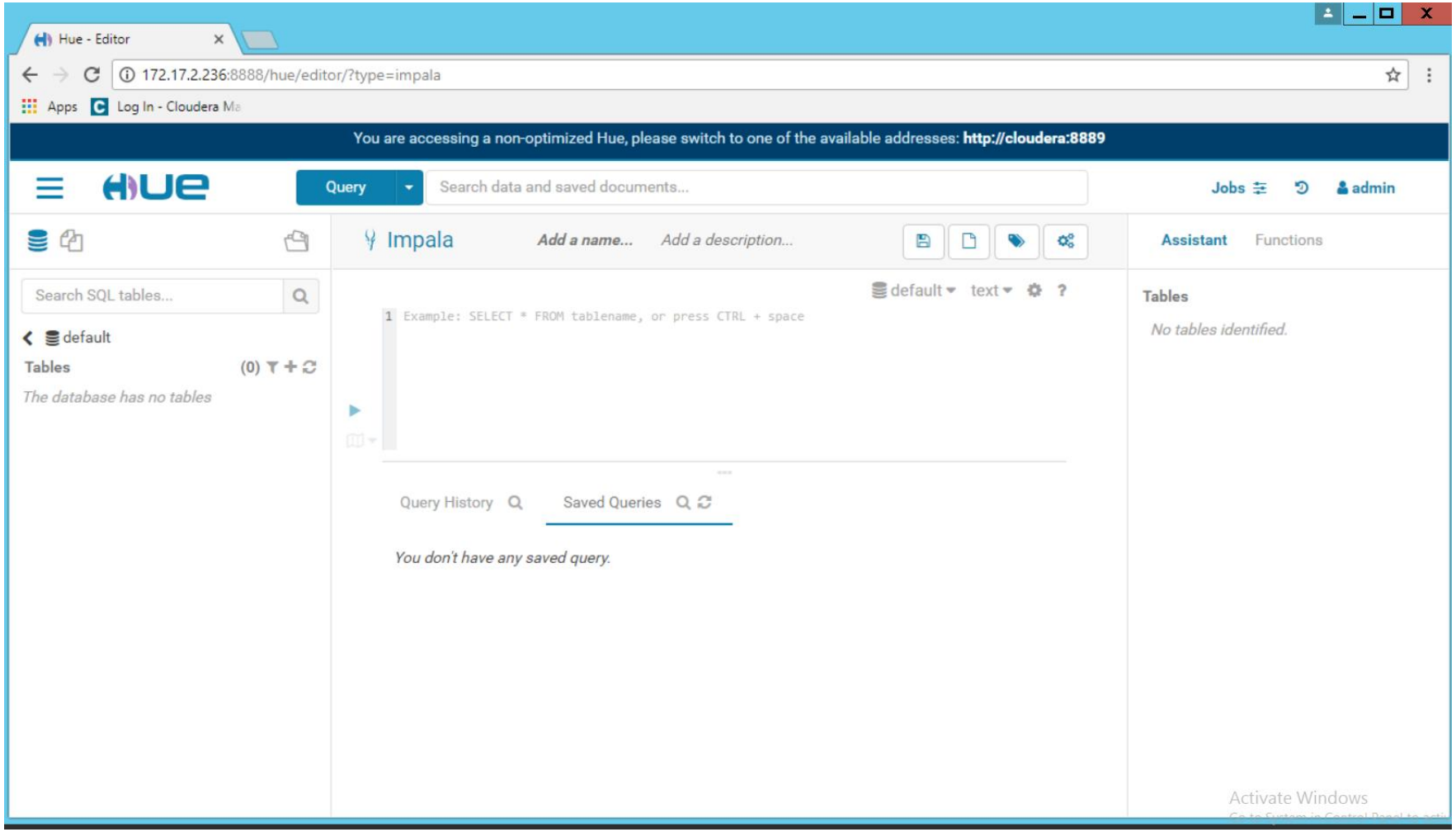
Accessing HDFS - HUE

- Using File Browser – Hadoop User Experience(HUE)
- HUE can be used to manage HDFS files and directories
- Accessing using web interface
  - http://localhost:8888

FUSIONEX® experience.excellence

Data Ingestion

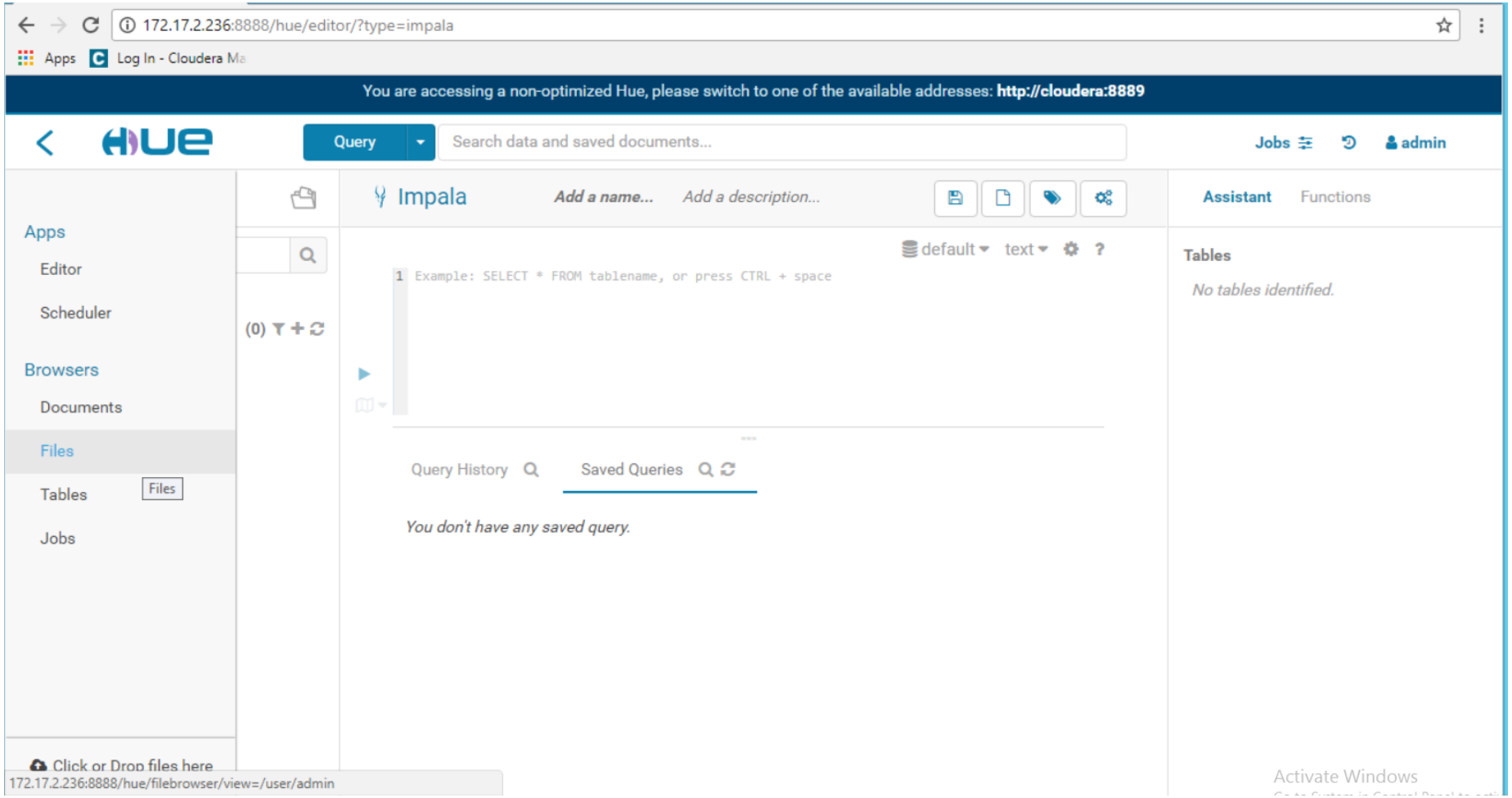
Accessing HDFS - HUE



FUSIONEX® experience.excellence

Data Ingestion

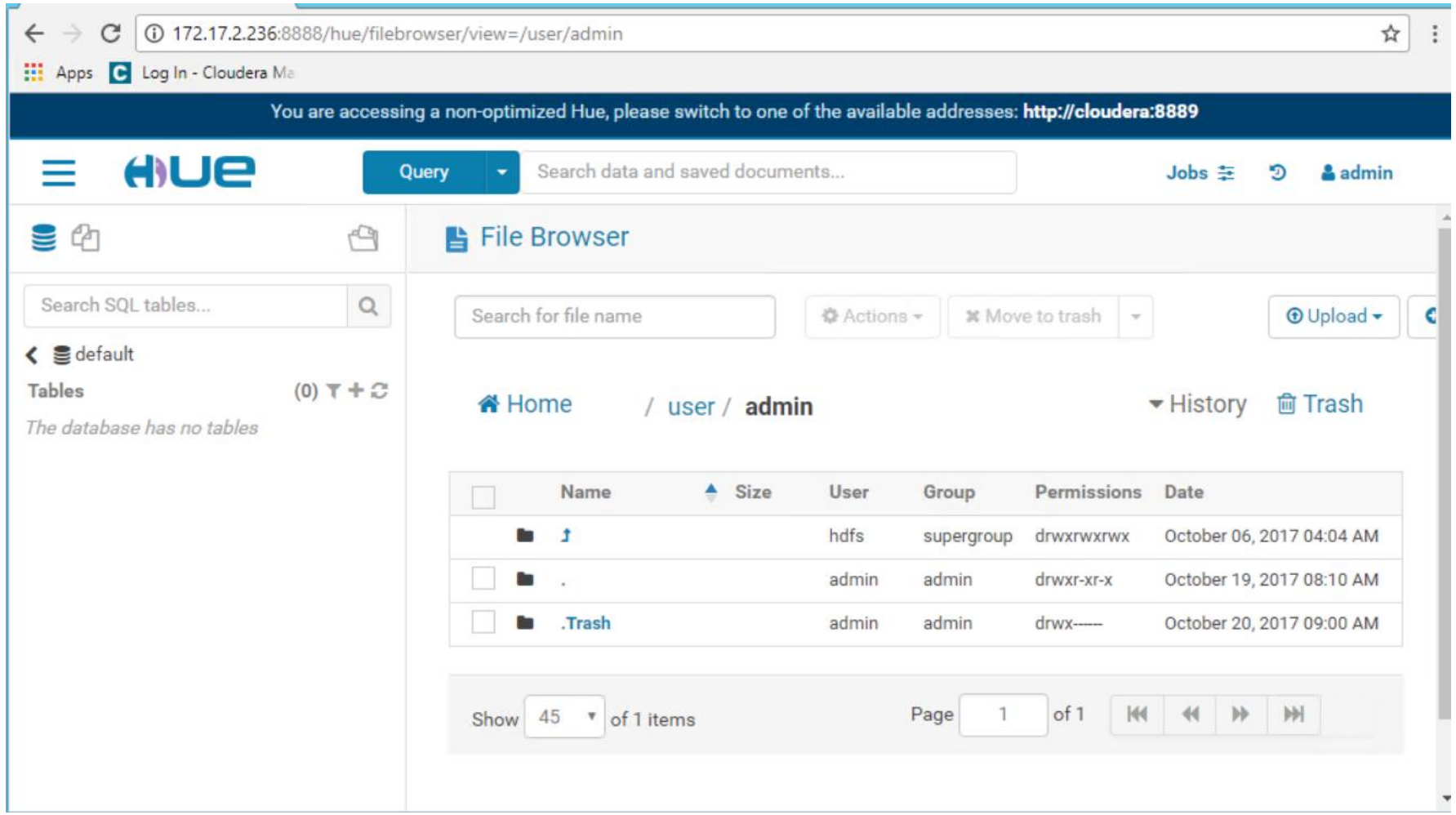
Accessing HDFS - HUE



FUSIONEX® experience.excellence

Data Ingestion

Import Flat Files – HUE – Drag and Drop to upload files



What is YARN?

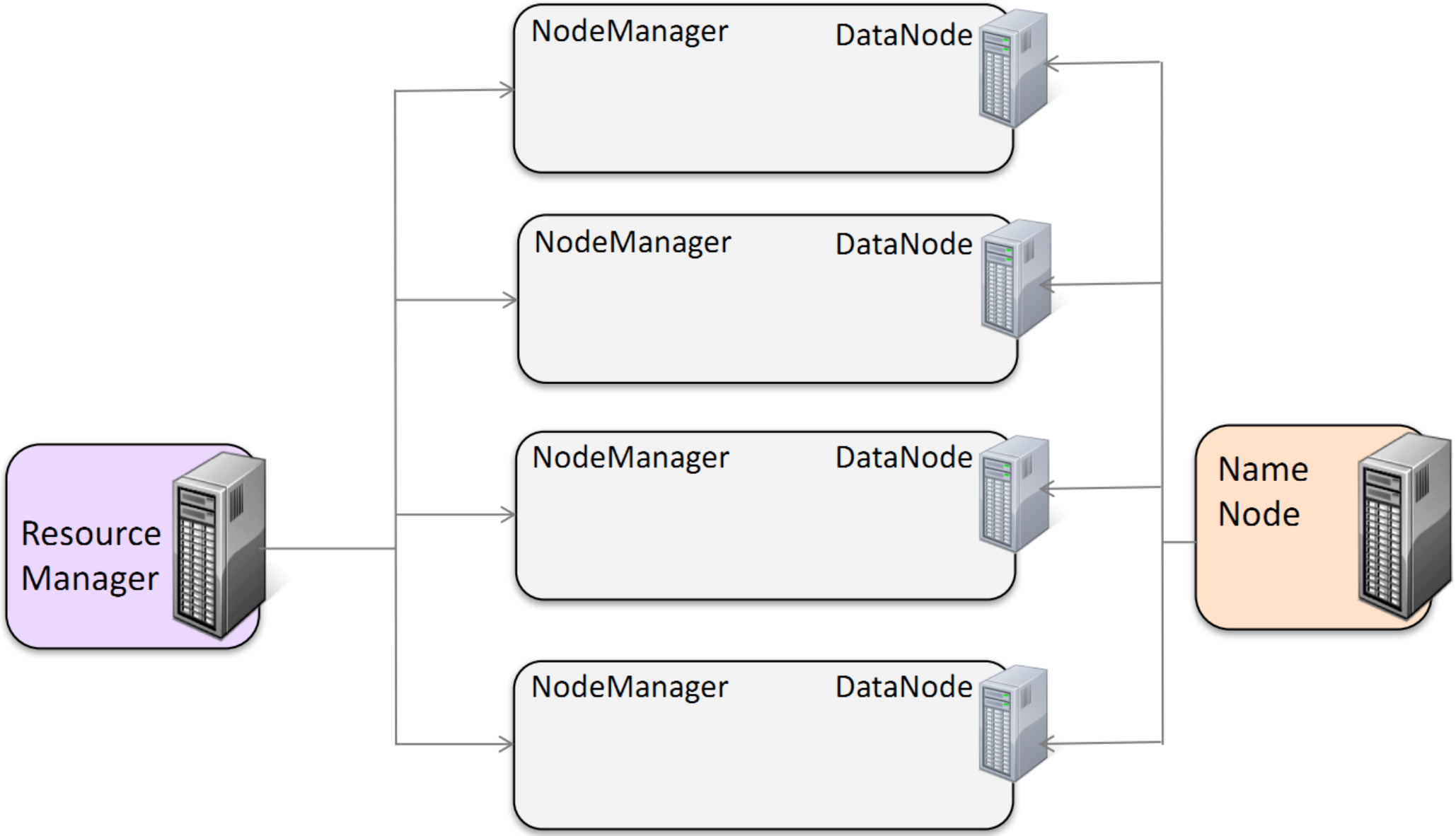
- YARN = Yet Another Resource Negotiator
- Yarn is the Hadoop processing layer that contains
  - Resource Manager
  - Job Scheduler

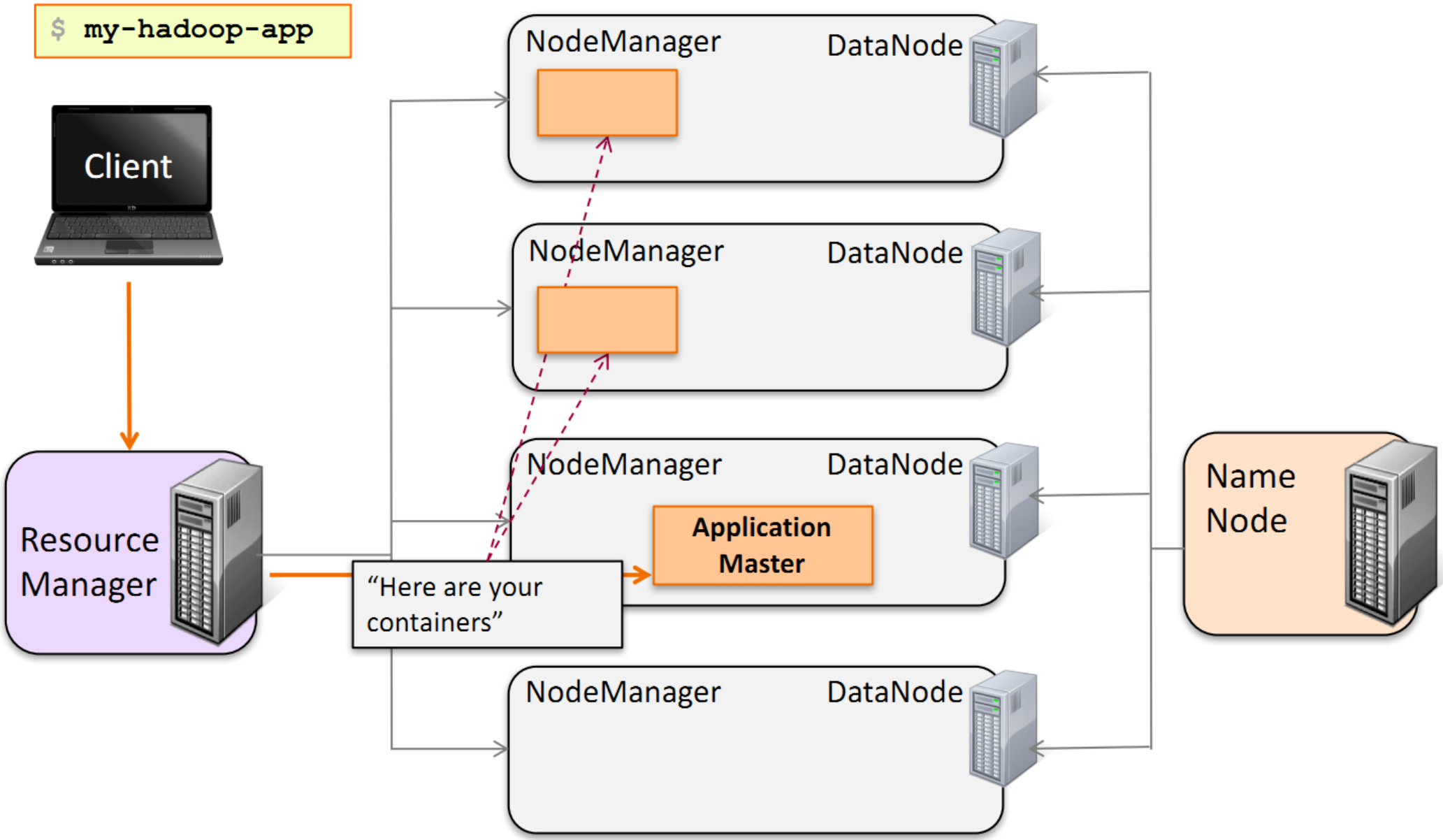
YARN Daemons

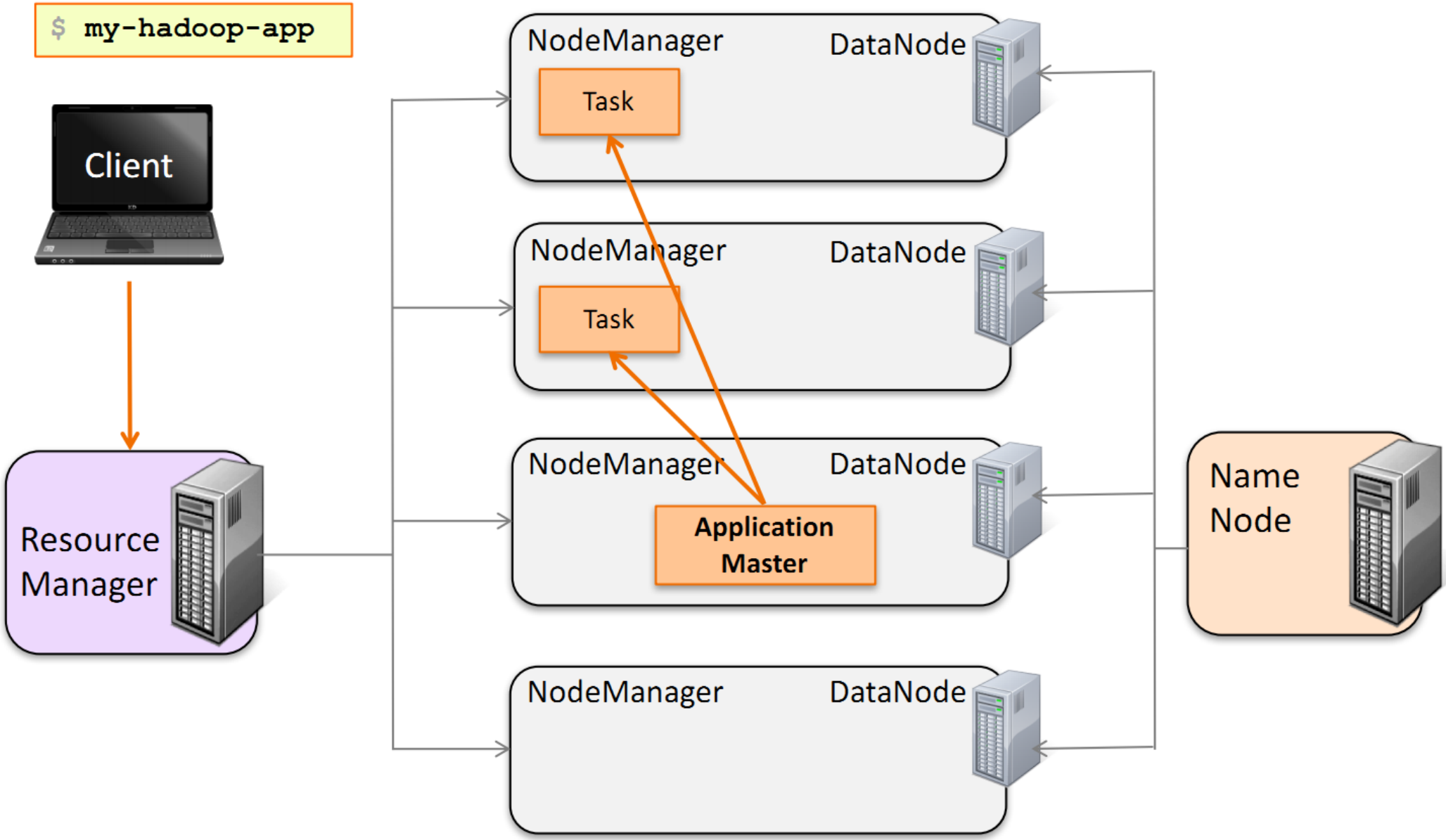
- Resource Manager (RM)
  - Runs on master node
  - Global resource scheduler
  - Coordinate between competing applications
  - Has a fair scheduler for different algorithms
- Node Manager (NM)
  - Runs on worker nodes
  - Communicates with RM
  - Manages node resources
  - Launches Containers

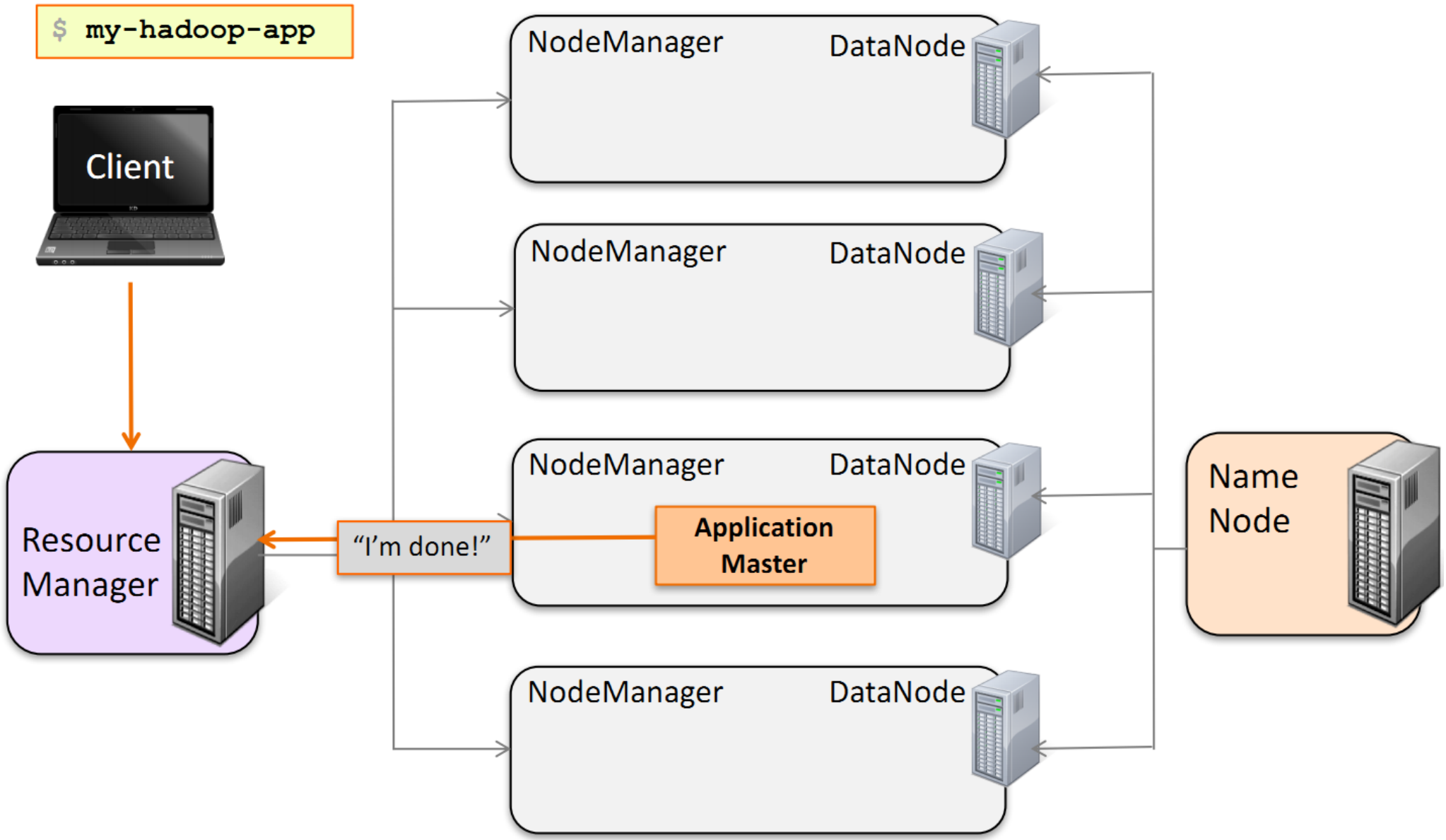
Running an Application in Yarn

- Containers
  - Created by RM upon request
  - Allocate resources (memory/CPU) on a worker node
  - Applications run in one or more containers
- Application Master (AM)
  - One per application
  - Framework/application specific
  - Runs in a container
  - Requests more containers to run more application tasks


NodeManager
DataNode
NodeManager
DataNode
NodeManager
DataNode
NodeManager
DataNode
Resource Manager
Name Node





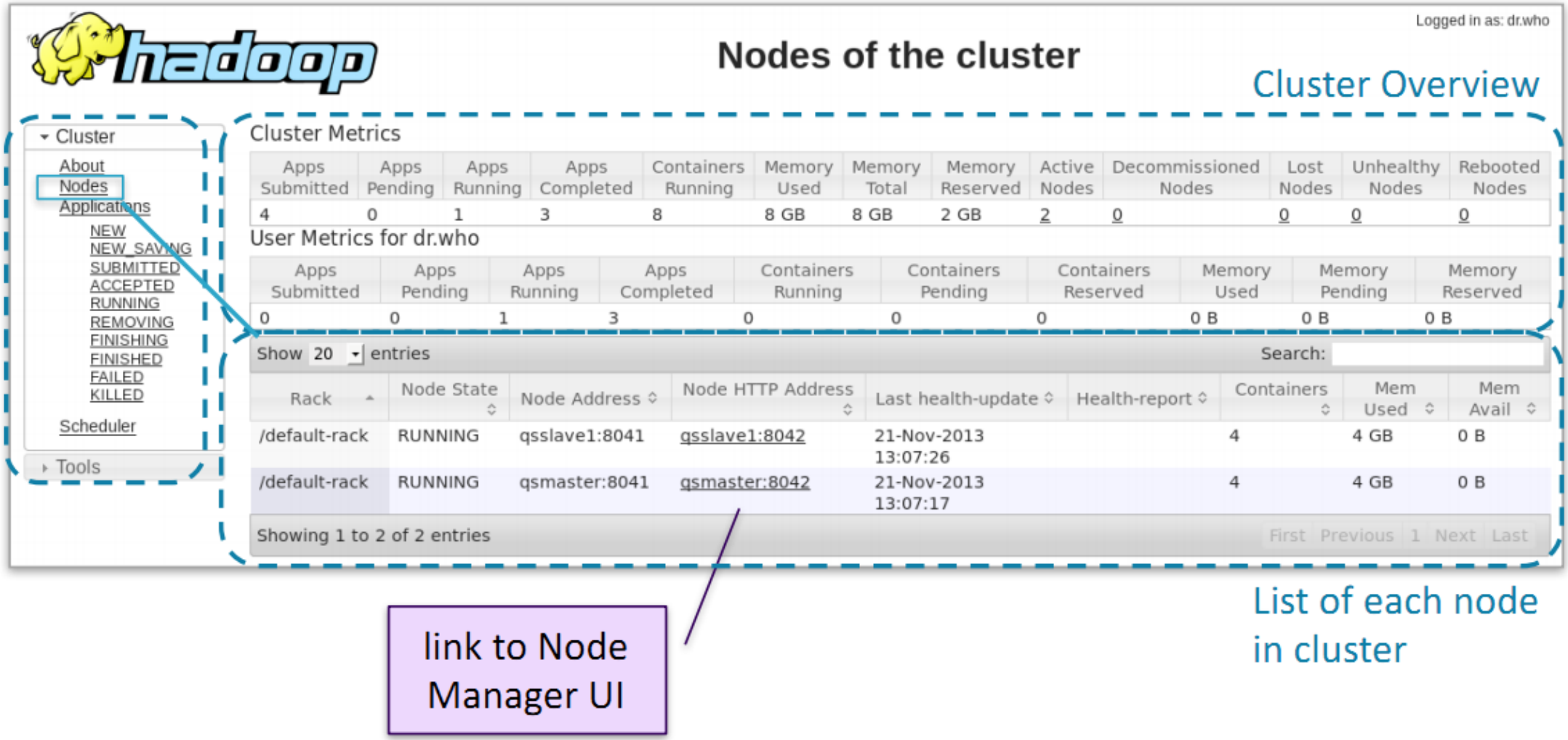

$ my-hadoop-app
Client
Resource Manager
"I'm done!"
NodeManager
DataNode
NodeManager
DataNode
NodeManager
DataNode
Application Master
NodeManager
DataNode
Name Node

The YARN Web UI

- Resource Manager UI is the main entry point
  - Runs on the RM host on port 8080 or 8088 by default
- Provides more detailed view than Hue
- Does not provide any control or configuration

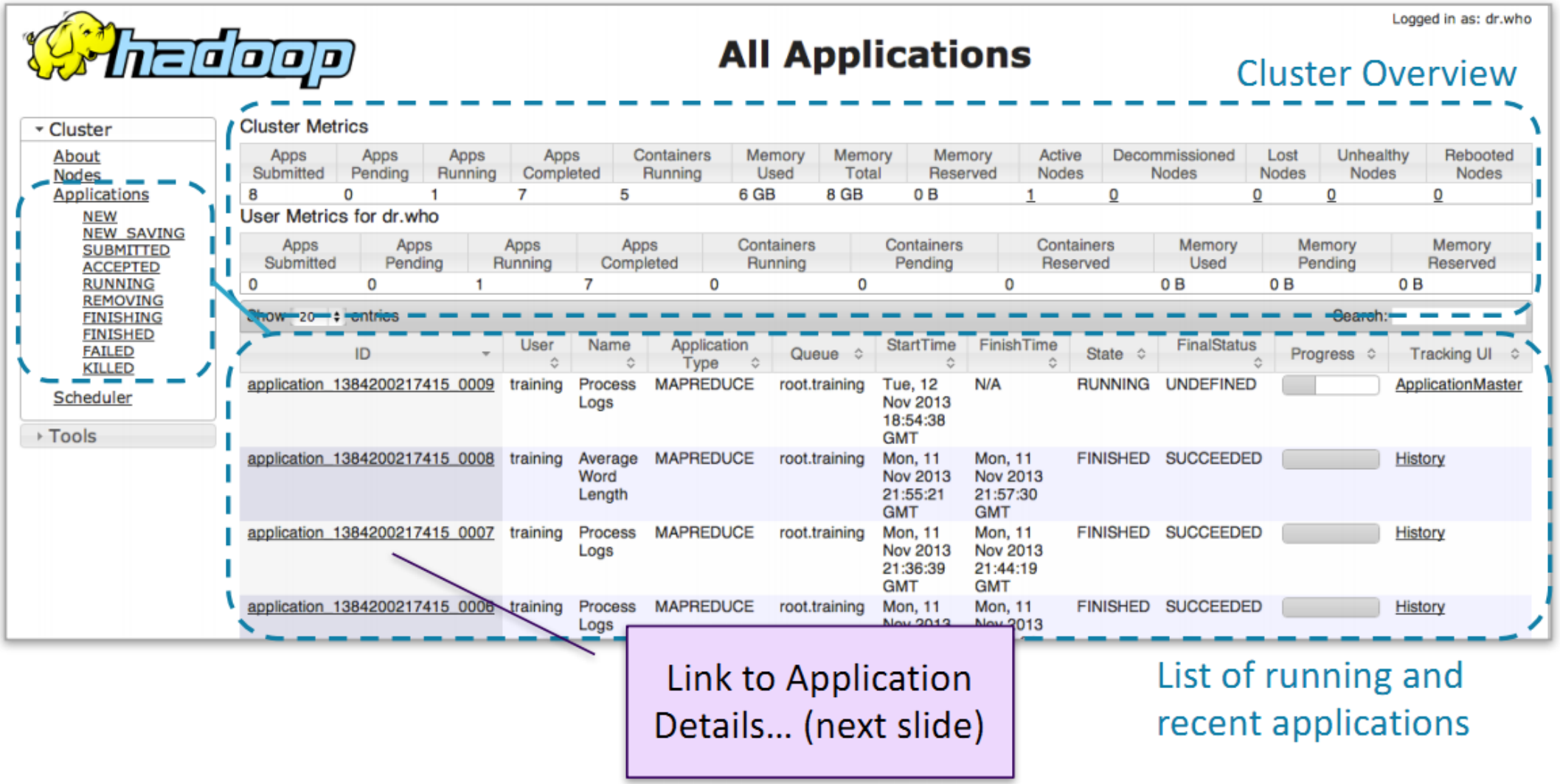
FUSIONEX® experience.excellence

Resource Manager UI: Nodes



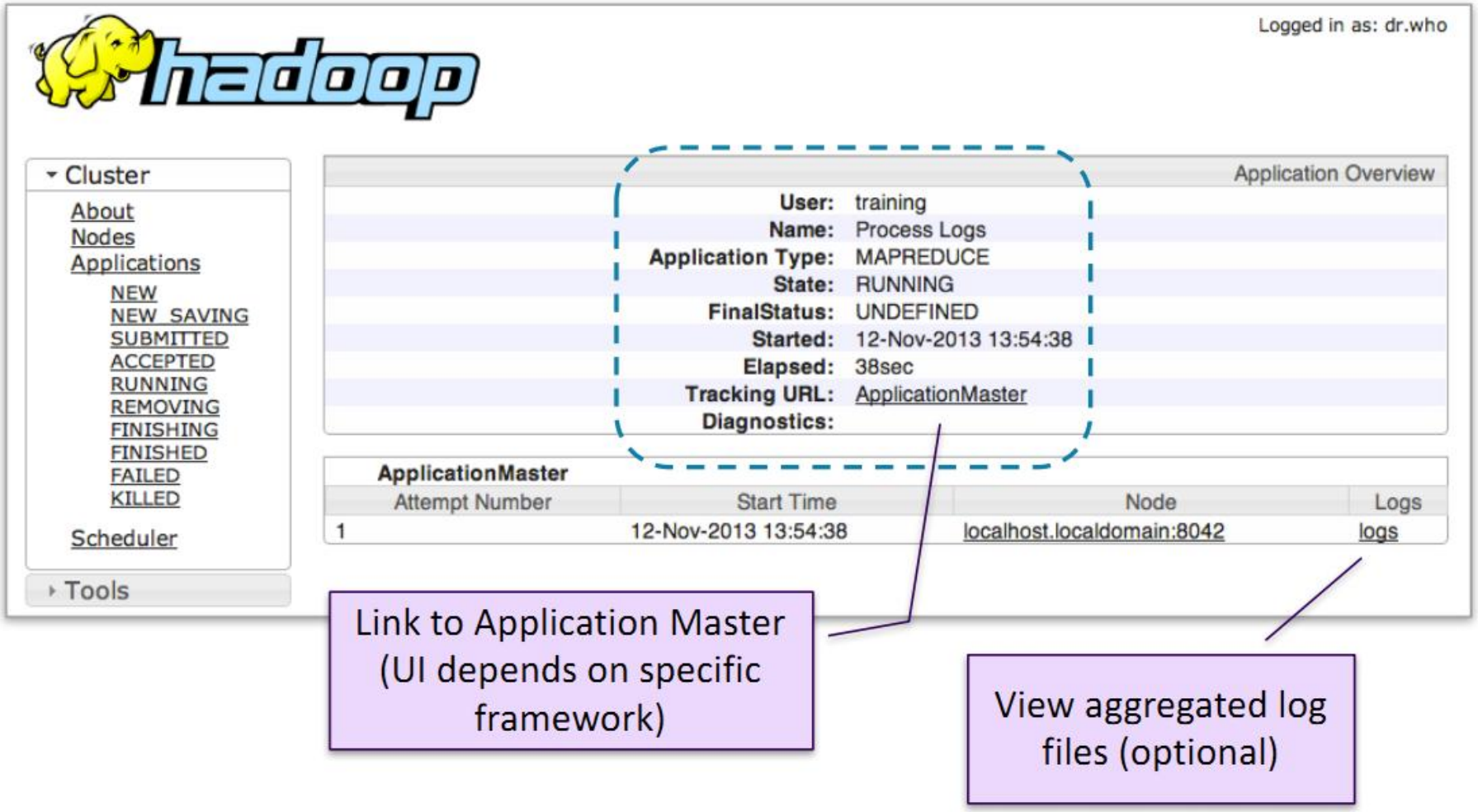
FUSIONEX® experience.excellence

Resource Manager UI: Applications



FUSIONEX® experience.excellence

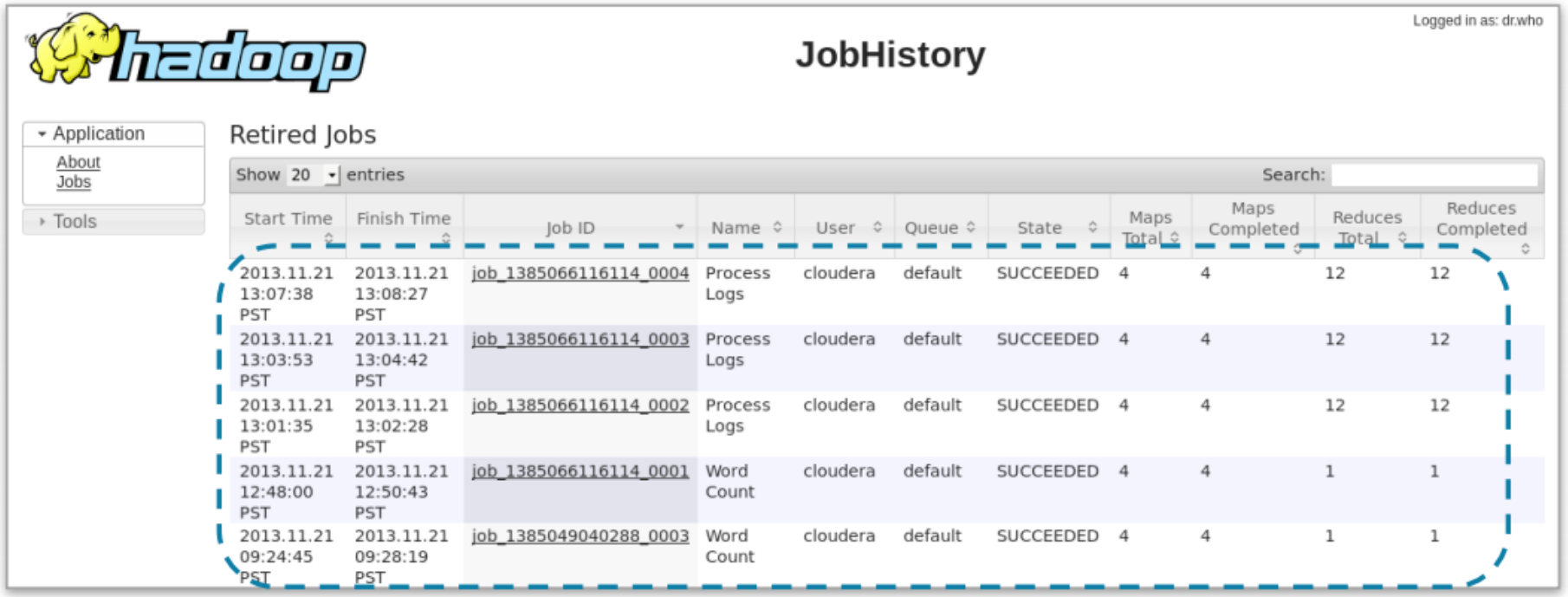
Resource Manager UI: Application Details



FUSIONEX® experience.excellence

Job History Server

- YARN does not keep track of job history
  - Runs on the RM host on port 8080 by default
- Spark and MapReduce each provide their own history server
  - Archive their job details and can be accessed through Job History UI or Hue



Start Time	Finish Time	Job ID	Name	User	Queue	State	Maps Total	Maps Completed	Reduces Total	Reduces Completed
2013.11.21 13:07:38 PST	2013.11.21 13:08:27 PST	job_1385066116114_0004	Process Logs	cloudera	default	SUCCEEDED	4	4	12	12
2013.11.21 13:03:53 PST	2013.11.21 13:04:42 PST	job_1385066116114_0003	Process Logs	cloudera	default	SUCCEEDED	4	4	12	12
2013.11.21 13:01:35 PST	2013.11.21 13:02:28 PST	job_1385066116114_0002	Process Logs	cloudera	default	SUCCEEDED	4	4	12	12
2013.11.21 12:48:00 PST	2013.11.21 12:50:43 PST	job_1385066116114_0001	Word Count	cloudera	default	SUCCEEDED	4	4	1	1
2013.11.21 09:24:45 PST	2013.11.21 09:28:19 PST	job_1385049040288_0003	Word Count	cloudera	default	SUCCEEDED	4	4	1	1

YARN Command Line syntax

- Command to configure and view information about the YARN cluster
  - -yarn <command>
  - Most YARN commands are for administrators rather than developers
- Some helpful commands for developers
  - -yarn application
    - Use –list to see running app
    - Use –kill to kill a running app
  - yarn logs –applicationId <app-id>
    - View the logs of the specified app
  - yarn –help
    - View all command options

Hands-On Session – Exercise 2

HDFS and Data Ingestion

Data Ingestion

Import Flat Files – HUE – Drag and Drop to upload files

- **HUE demo**
  - **Upload a file**
  - **Rename, Copy, Move, Download, Change Permission**
  - **Viewing/Edit a file**
  - **View summary of a file**

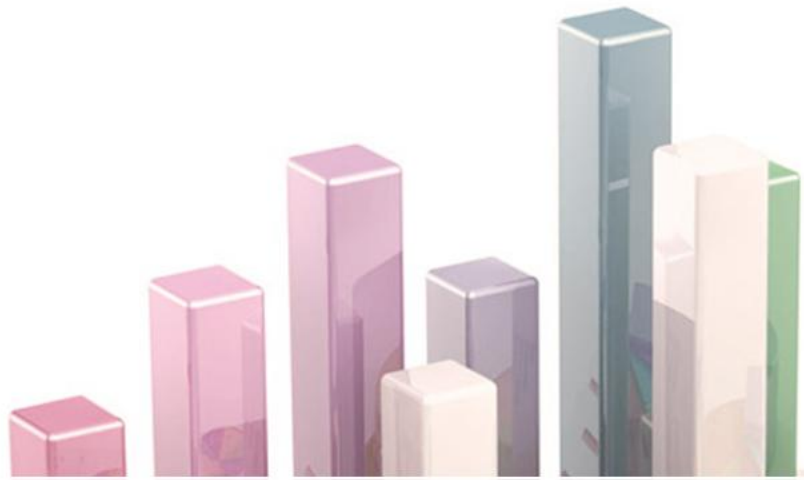
Summary of Day 1 - Discussion

Recap of what we have learned today: -

- **Data Engineering Fundamentals**
- **Best Practices of ETL/ELT**
- **Hadoop architecture and Ecosystem**
- **Basic Hadoop command line syntax**
- **Basic file ingestions**
- **Yarn resource management**

FUSIONEX®
experience.excellence

Thank You



Microsoft Partner Network | WINNER Business Intelligence
GLOBAL PARTNER OF THE YEAR

SiTF AWARDS
BEST EMERGING TECHNOLOGY
BEST GENERAL APPLICATION

BIGDATA WORLD ASIA
Data Analytics & Innovation Award

ASOCIO | WINNER OUTSTANDING ICT COMPANY 2015 · 2016

APICTA Asia Pacific ICT Alliance AWARDS | WINNER Best of Applications Tools / Platform

WTEC 世界旅游经济大会
Most Innovative Award 2017

PIKOM ICT LEADERSHIP AWARDS 2016
EXCELLENCE AWARD

amazon web services | Technology Partner 2016

Alibaba Cloud
STRATEGIC ALLIANCE PARTNER

cloudera
STRATEGIC PARTNER

MSC MALAYSIA

XBRL eXtensible Business Reporting Language

CMMI

ISO 27001 INFORMATION SECURITY

ISO 9001 QUALITY ASSURANCE