ISIT312 Big Data Management

Cluster Computing

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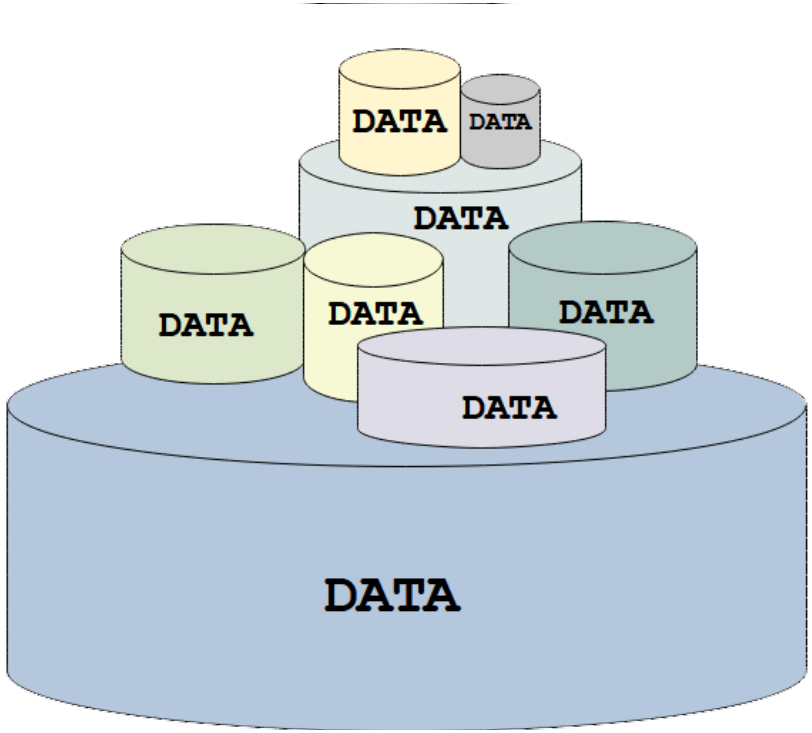
Cluster Computing

Outline

Big Data

What does Big Data mean and how big is Big Data ?

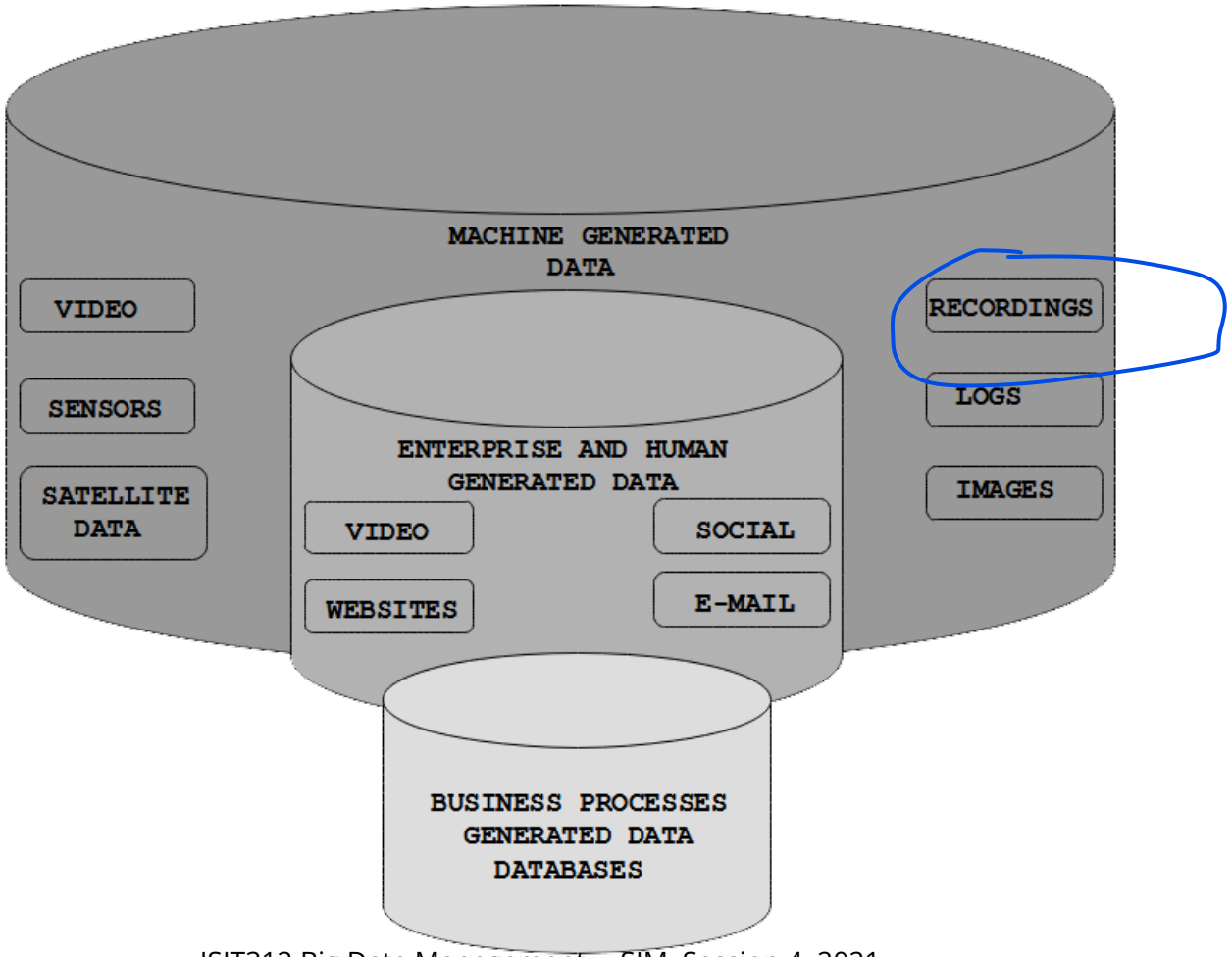


Big Data is so big that it cannot be stored on the persistent storage devices attached to a single computer system

Big Data may also mean an infinite amount of data

Big Data

What are the source of Big Data ?



Big Data

Big Data is characterized by so called 3V features:

- Volume: e.g., billions of rows ? millions of columns
- Variety: Complexity of data types and structures
- Velocity: Speed of new data creation and growth

Additional Vs:

- Veracity: Ability to represent and process uncertain and imprecise data
- Value: Data is the driving force of the next-generate business
- Viability: Benefits we can potentially have from data analysis

There are many, many other Vs, the largest number of Vs I found on Web was 42 !

- Vagueness: The meaning of found data is often very unclear, regardless of how much data is available
- Validity: Rigor in analysis is essential for valid predictions where data is the driving force of the next-generate business
- Vane: Data science can aid decision making by pointing in the correct direction
- ... and many, many others ... :)

Big Data

Examples of Big Data:

- Clickstream data
- Call centre data
- E-mail and instant-messaging
- Sensor data
- Unstructured data
- Geographic data
- Satellite data
- Image data
- Temporal data
- and more ...

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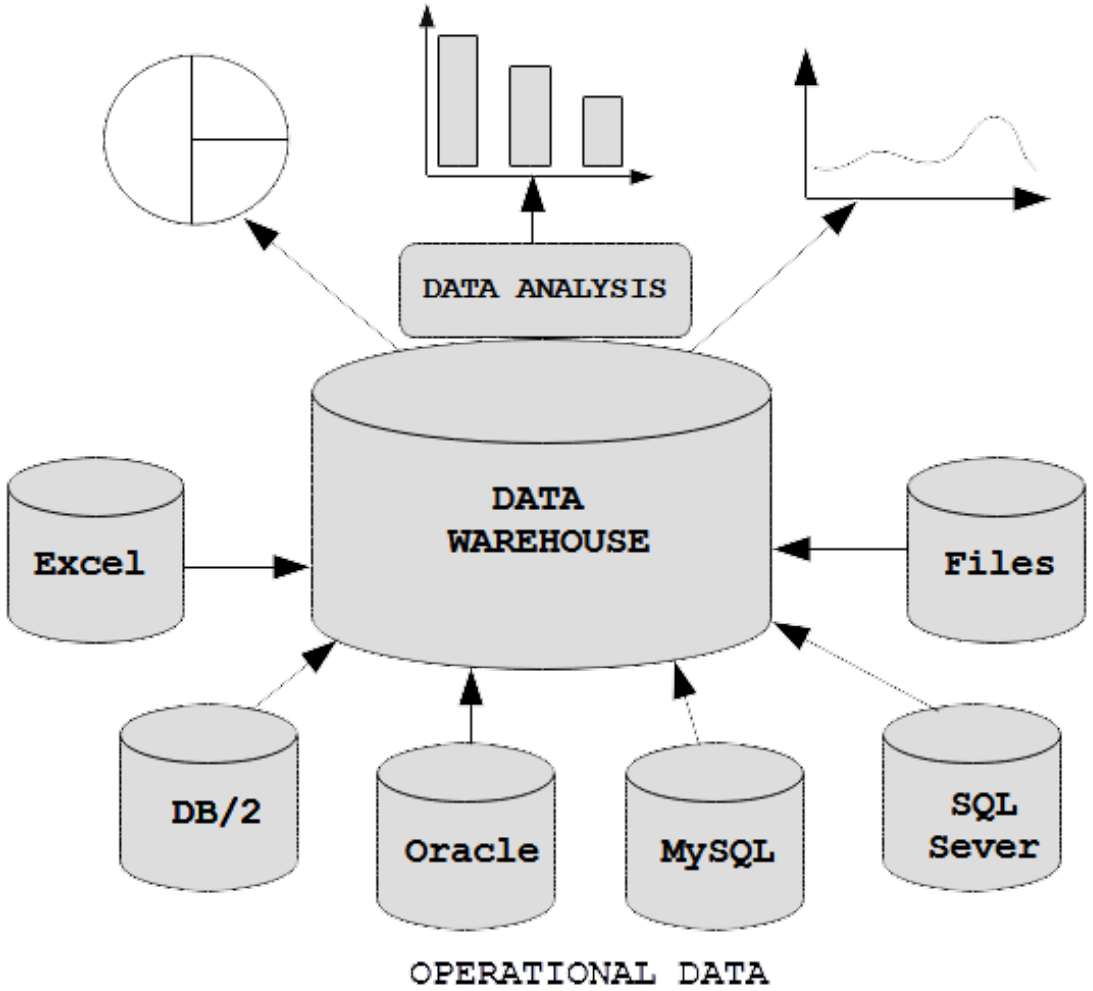
Outline

Traditional Data Architectures

Data warehousing technologies



Traditional Data Architectures

The strength of traditional data architectures:

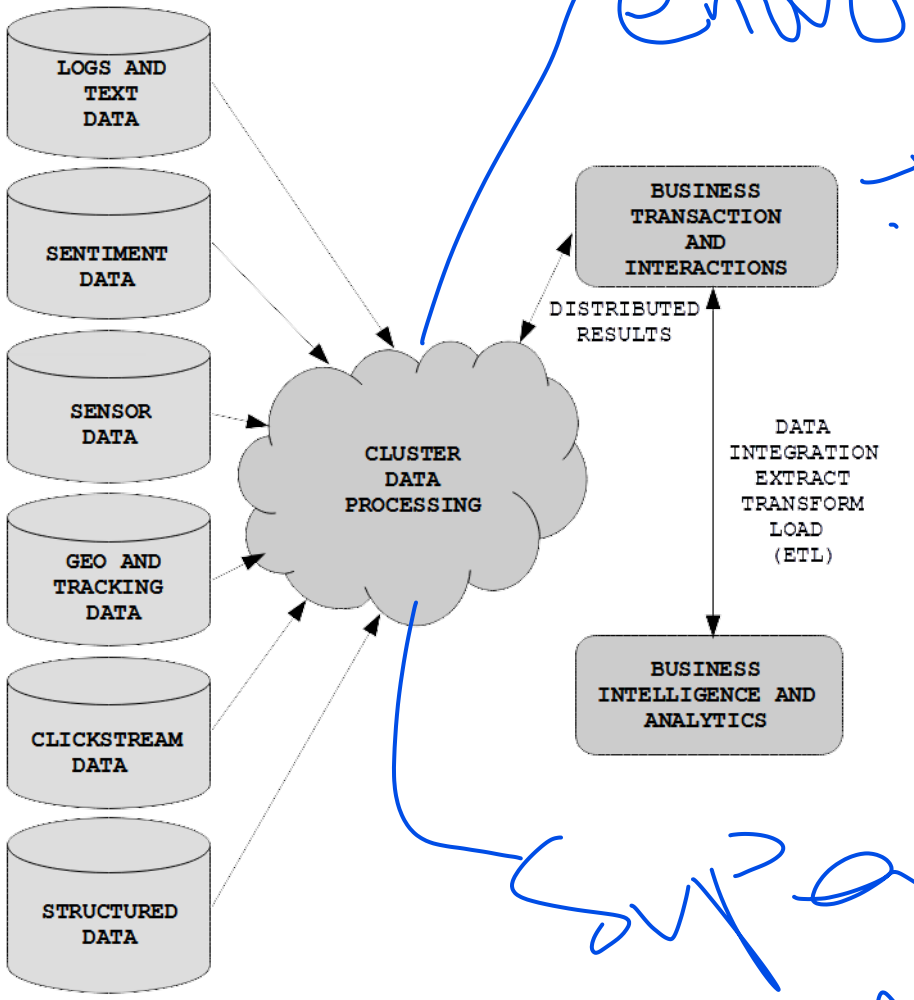
- Centralised governance of data repositories
- Light-fast inquires performed regularly in daily business
- Optimisation for OLTP and OLAP
- Security and access control
- Fault-Tolerance and backup

The challenges for traditional data architectures:

- New types of data such as unstructured data and semi-structured data
- Increasingly large amounts of data flowing into organisations
- New computational paradigms use non-traditional NoSQL databases to rapidly mine and analyse very large data sets
- Increasing cost of storing and analysing the large amounts of data
- Increasing use of data analytics, which requires significant storage and processing capabilities

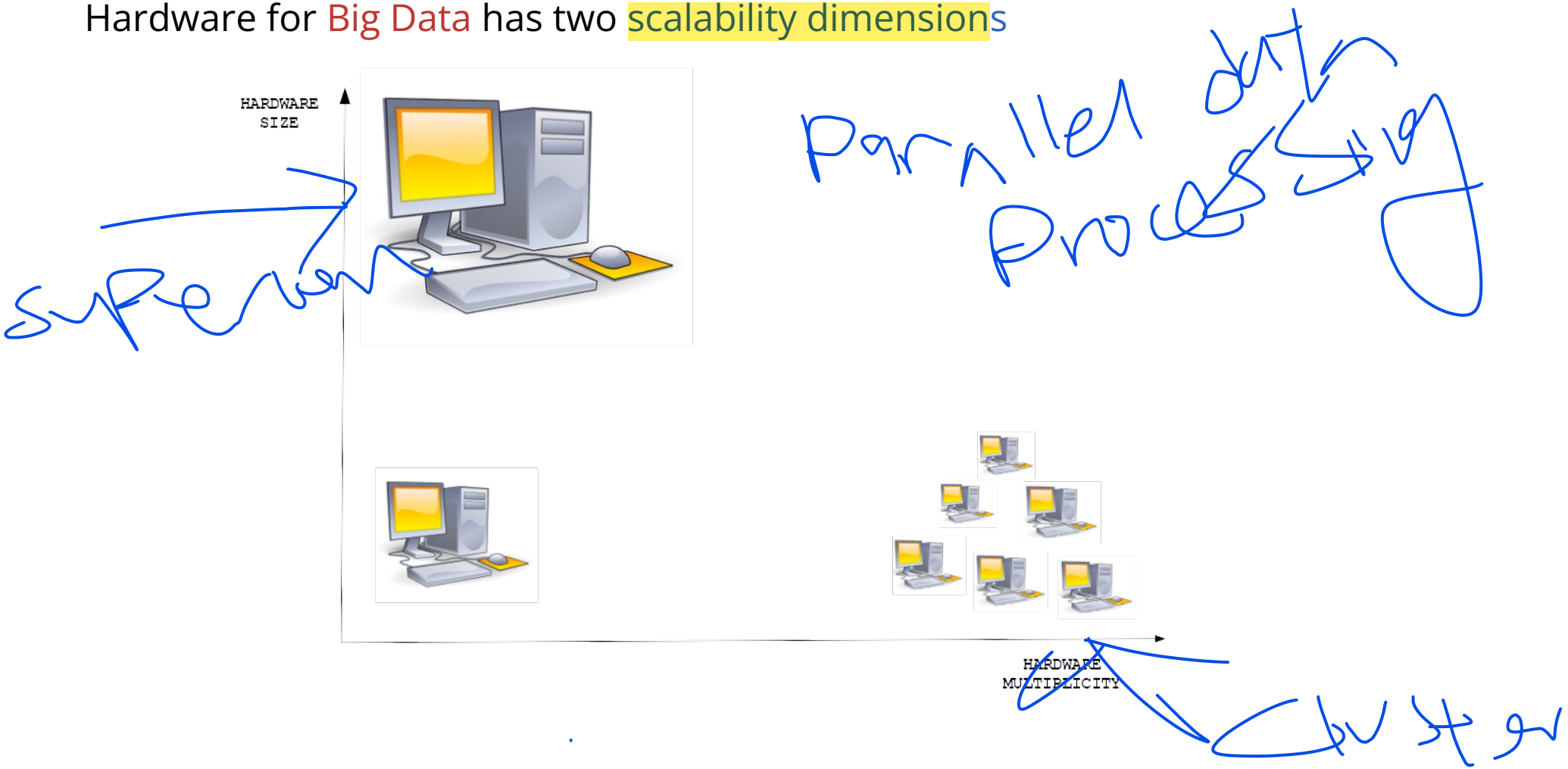
Traditional Data Architectures

A sample Data Lake architecture



Traditional Data Architectures

Hardware for Big Data has two scalability dimensions



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Outline

Meet Hadoop !

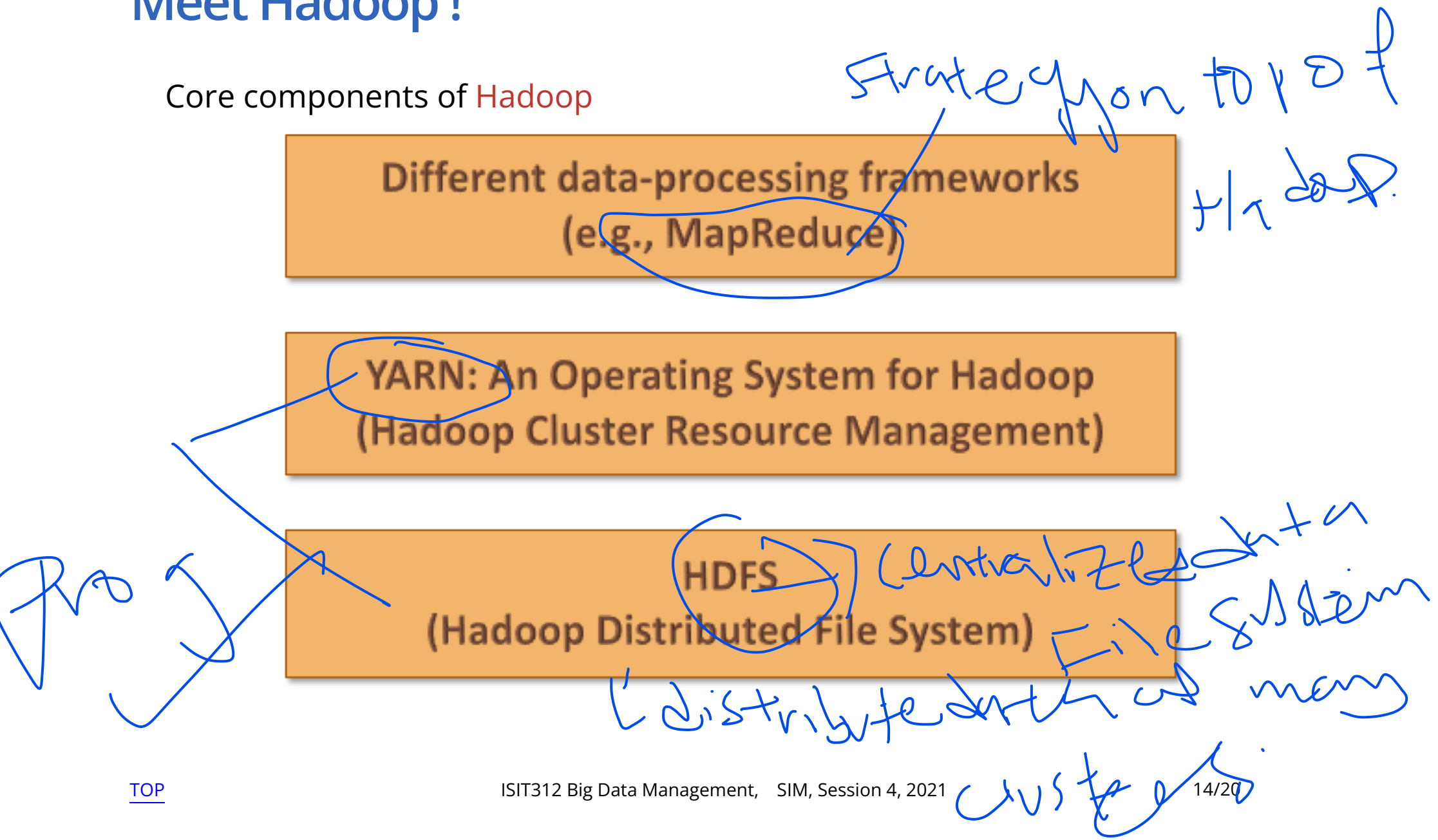
Hadoop, in terms of its developers, is a project that develops open-source software for reliable, scalable, distributed computing

Features of Hadoop

- Capability to handle large data sets, e.g. simple scalability and coordination
- File size range from gigabytes to terabytes
- Can store millions of those files
- High fault tolerance
- Supports data replication
- Supports streaming access to data
- Supports batch processing
- Support interactive, iterative and stream processing
- Implements a data consistency model of write-once-read-many access model
- Run on commodity hardware, not high-performance computers
- Inexpensive
- It can be deployed on premises or in the cloud

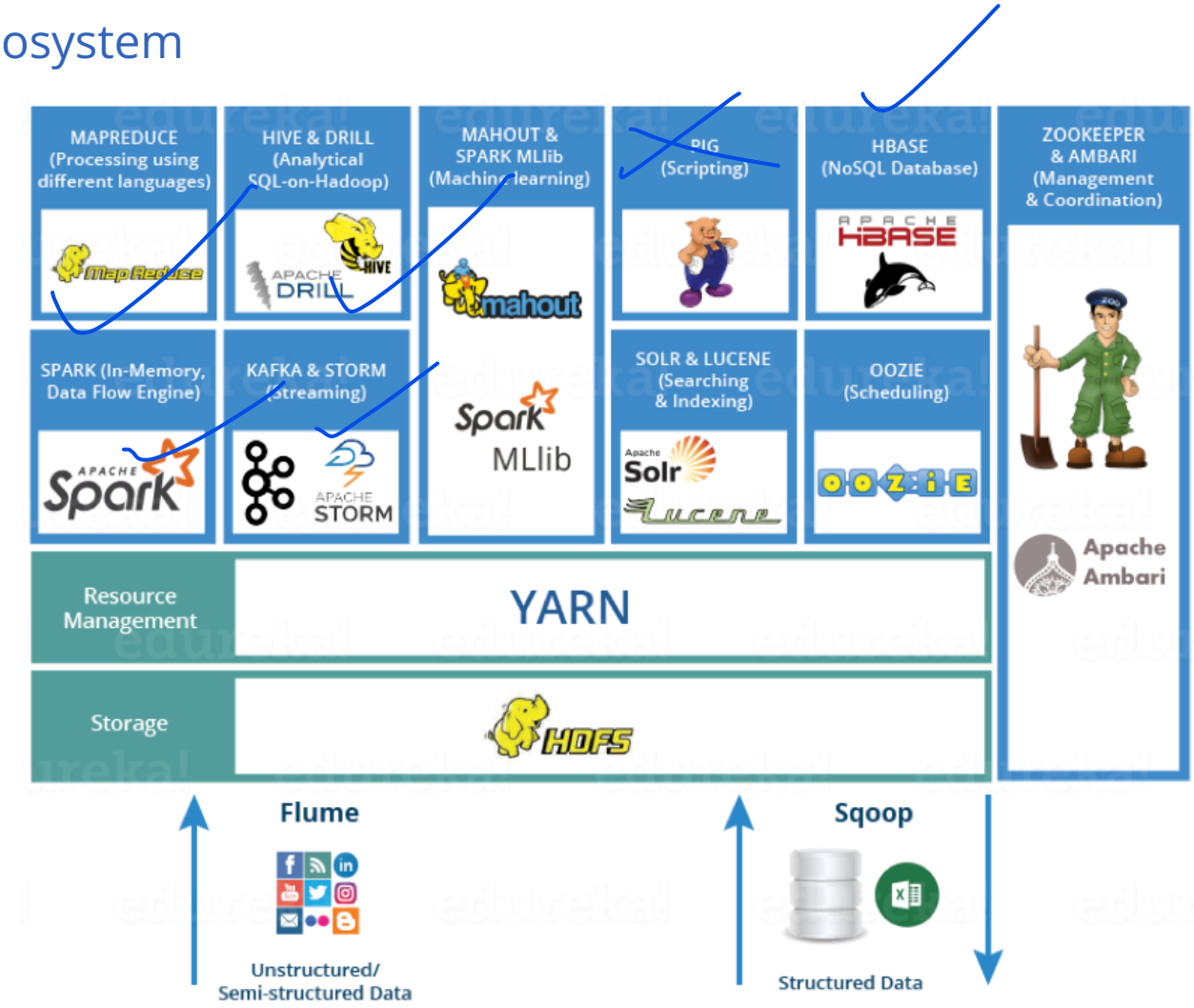
Meet Hadoop !

Core components of Hadoop



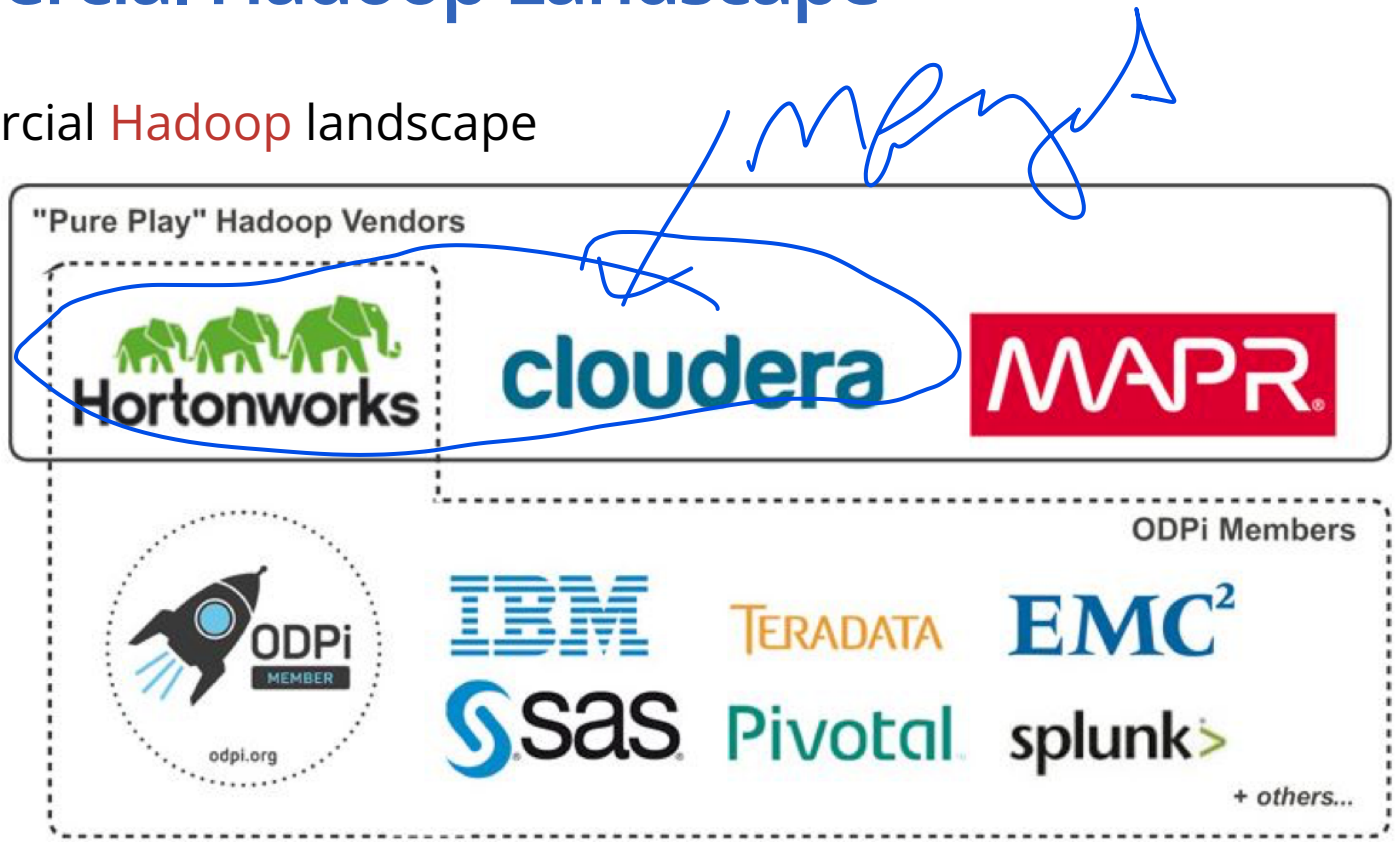
Hadoop Ecosystem

Hadoop ecosystem



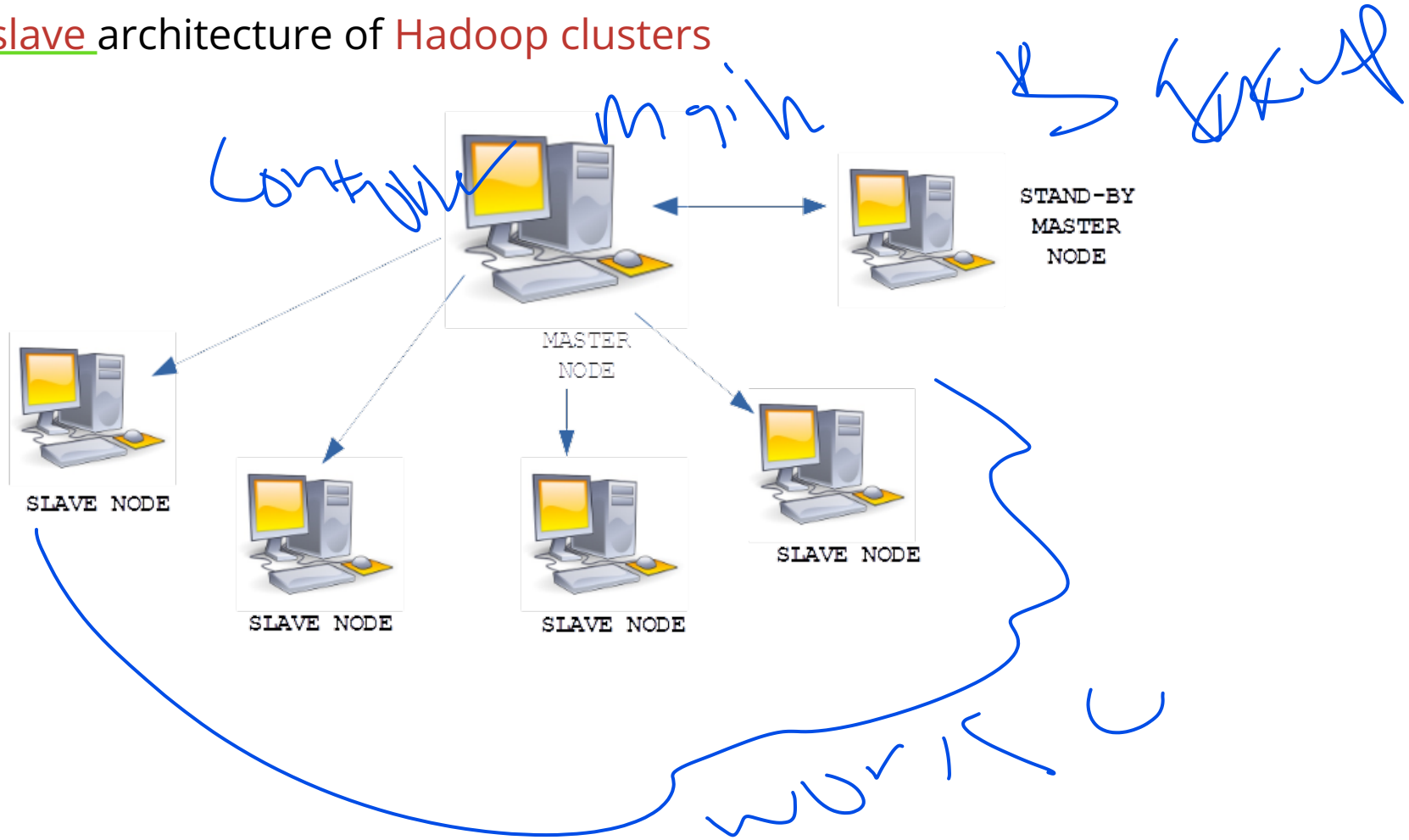
Commercial Hadoop Landscape

Commercial Hadoop landscape



Meet Hadoop !

Master-slave architecture of Hadoop clusters

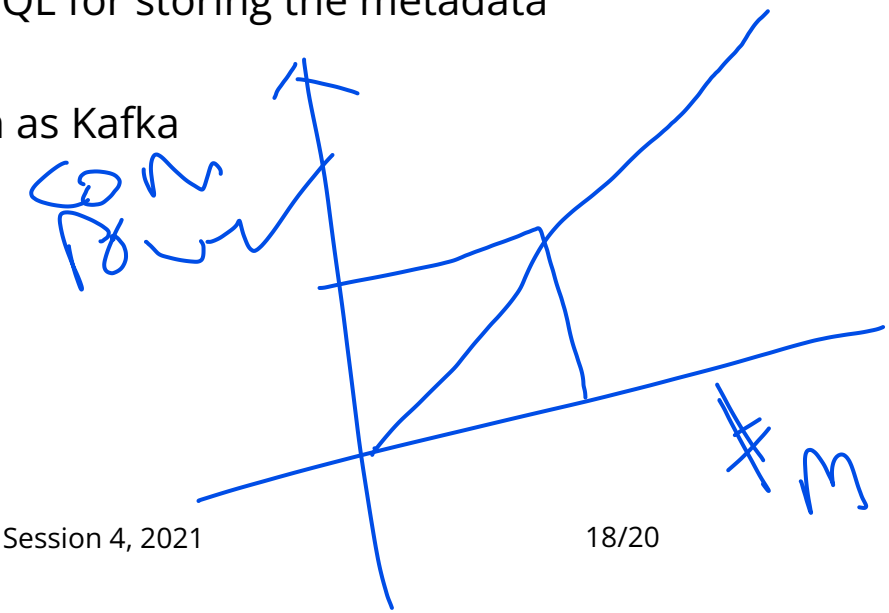


Meet Hadoop !

Hadoop clusters can support up to 10,000 server and receives near-to-linear scalability in computing power

A typical Hadoop cluster consists of:

- A set of master nodes (servers) where the daemons supporting key Hadoop frame-works run
- A set of worker nodes that host the storage (HDFS) and computing (YARN) work
- One or more edge servers, which are used for accessing the Hadoop cluster to launch applications
- One or more relational databases such as MySQL for storing the metadata repositories
- Dedicated servers for special frameworks such as Kafka



Meet Hadoop !

Hadoop also support the pseudo-distributed mode

- All HDFS and YARN daemons running on a single node.
- Highly simulate the full cluster
- Easy for beginner's practice
- Easy for testing and debug

Our lab setting is the pseudo-distributed mode

- The single node is a Ubuntu 14.04 Virtual Machine (VM)

References

White T., Hadoop The Definitive Guide: Storage and analysis at Internet scale, O'Reilly, 2015 (Available through UOW library)

Vohra D., Practical Hadoop ecosystem: a definitive guide to Hadoop-related frameworks and tools, Apress, 2016 (Available through UOW library)

Aven J., Hadoop in 24 Hours, SAMS Teach Yourself, SAMS 2017

Alapati S. R., Expert Hadoop Adiministration: Managing, tuning, and securing Spark, YARN and HDFS, Addison-Wesley 2017