What is Hadoop?

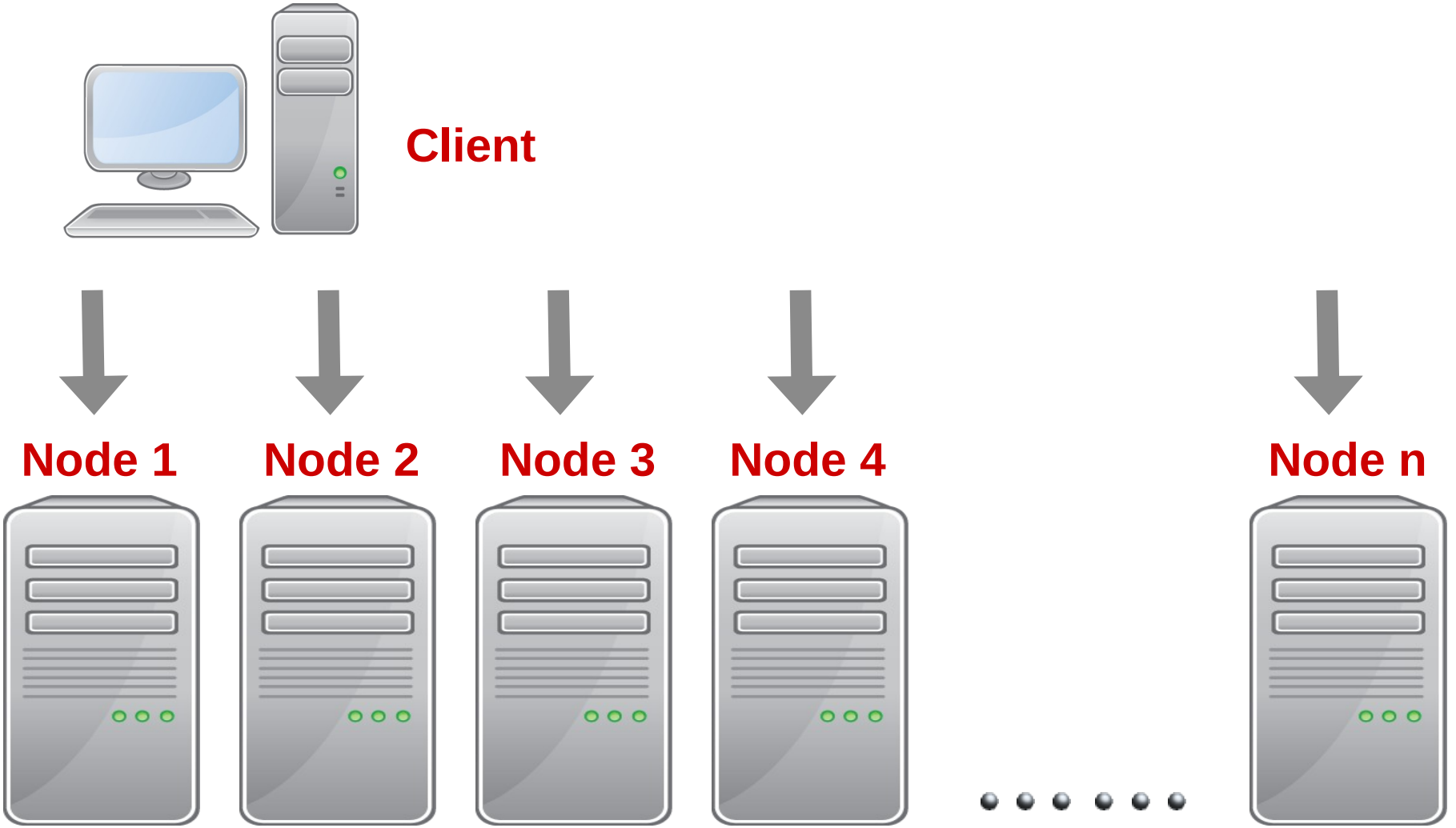
Agenda

- What is Hadoop?
- Hadoop Cluster
- History
- Hadoop System Principles
- Comparisons to RDBMS
- Hadoop Distribution Vendors

What is Hadoop?

- **Hadoop is a reliable, scalable platform for storage and analysis.**
- **It runs on commodity hardware.**
- **It is open source.**

Hadoop Cluster



Hadoop Cluster

- **A set of "cheap" commodity hardware**
  - Servers Networked together
  - Performs same task as a system

Hadoop Cluster

- No need for super-computers, It uses commodity hardware
- Not desktops

History

- **Named after an elephant toy Started as a sub-project of Apache Nutch**
  - Nutch's job is to index the web and expose it for searching
  - Open Source alternative to Google
  - Started by Doug Cutting
- **In 2004 Google publishes Google File System(GFS) and MapReduce framework papers**
- **Doug Cutting and Nutch team implemented Google's frameworks in Nutch**
- **In 2006 Yahoo! hires Doug Cutting to work on Hadoop with a dedicated team**
  - In 2008 Hadoop became Apache Top Level Project

Hadoop System Principles

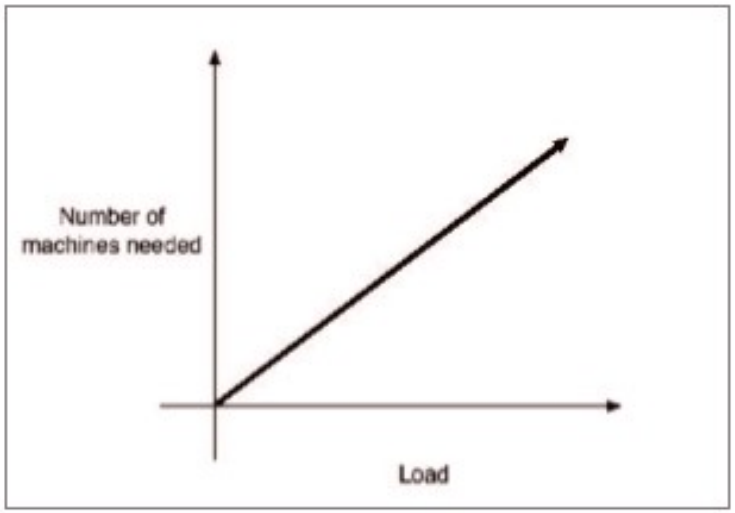
- **Scale-Out** rather than **Scale-Up.**
- Bring **code to data** rather than data to code.
- Fault Tolerance.
- **Abstract complexity** of distributed and concurrent applications.

Scale-Out Vs Scale-Up

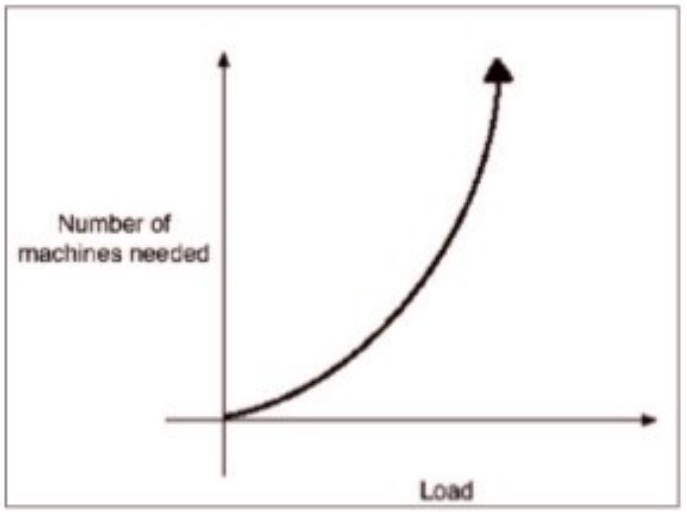
- **Scale-up(vertical)**
  - **Add additional resources to an existing node (CPU, RAM)**
  - **Moore’s Law can’t keep up with data growth**
  - **New units must be purchased if required resources can not be added**
  - **Expensive and hard to implement**
- **Scale-Out(Horizontal)**
  - **Add more nodes/machines to an existing distributed application**
  - **Software Layer is designed for node additions or removal**
  - **Hadoop takes this approach - A set of nodes are bonded together as a single distributed system**
  - **Very easy to scale down as well**

Scalability

Linear vs. Non-Linear Scalability



Linear Scalability



Non- Linear Scalability

"A linearly scalable system can maintain performance under increased load by adding resources in proportion to the increased load"

Data to Code

- **Traditional data processing architecture**
  - Nodes are divided into separate processing and storage, connected by high-capacity link
  - Many data-intensive applications are not CPU demanding causing bottlenecks in network

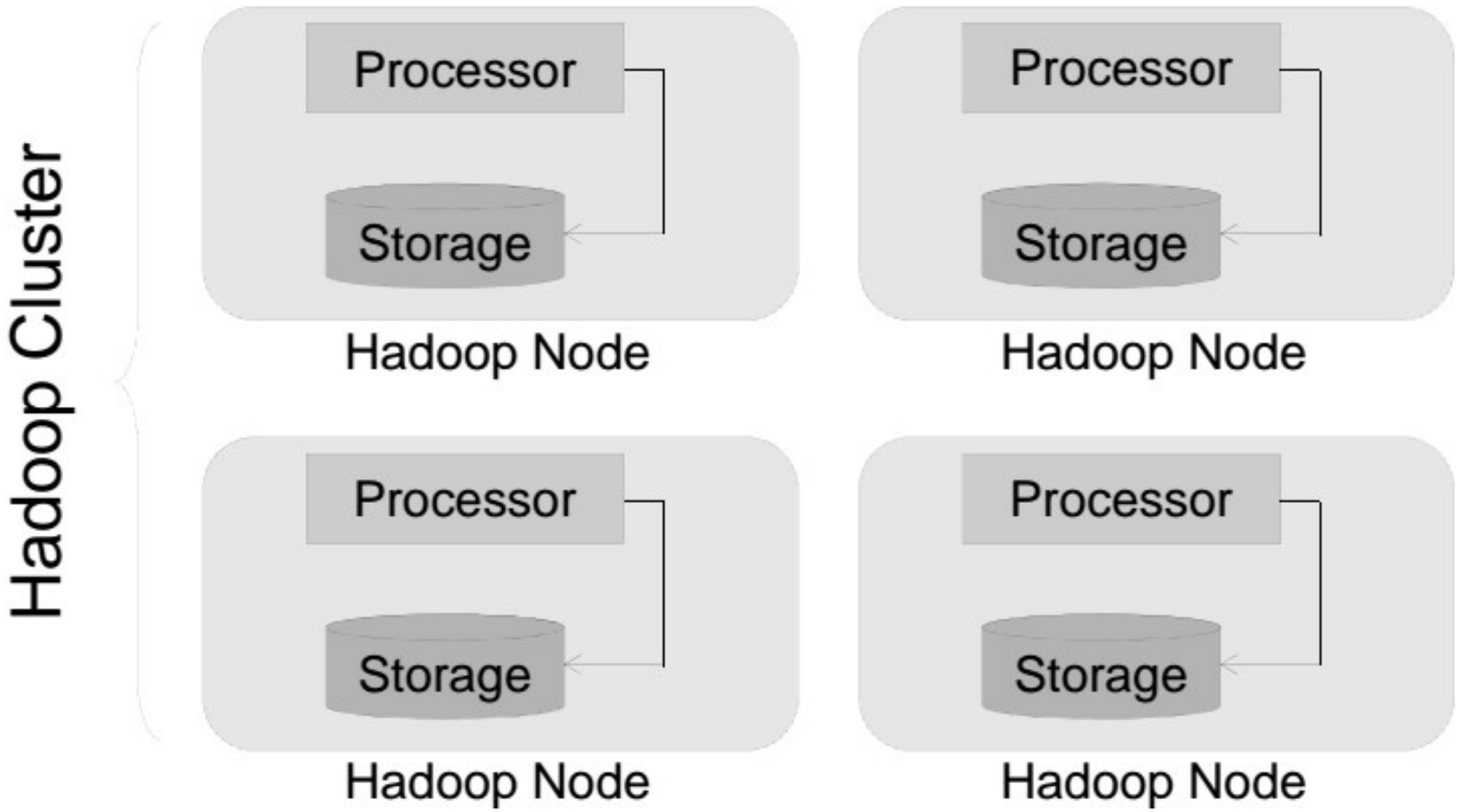
Data to Code


Processing Node
Load Data
Save Results
Storage Node
Processing Node
Load Data
Save Results
Storage Node
Risk of bottleneck

Code to Data

- **Hadoop co-locates processors and storage**
  - Code is moved to data (size is tiny, usually in Kbs)
  - Processors execute code and access underlying local storage

Code to Data


Hadoop Cluster
Processor
Storage
Hadoop Node
Processor
Storage
Hadoop Node
Processor
Storage
Hadoop Node
Processor
Storage
Hadoop Node

Fault Tolerance

- **Given a large number machines, failures are common**
- **Hadoop is designed to handle node failures**
  - Data is replicated
  - Tasks are retried

Abstract Complexity

- **Hadoop abstracts many complexities in distributed and concurrent applications**
  - **Defines small number of components**
  - **Provides simple and well defined interfaces of interactions between these components**
- **Frees developer from worrying about system level challenges**
  - **race conditions, data starvation**
  - **processing pipelines, data partitioning, code distribution etc.**
- **Allows developers to focus on application development and business logic**

Comparisons to RDBMS

- **Hadoop and RDBMS frequently complement each other within an architecture**

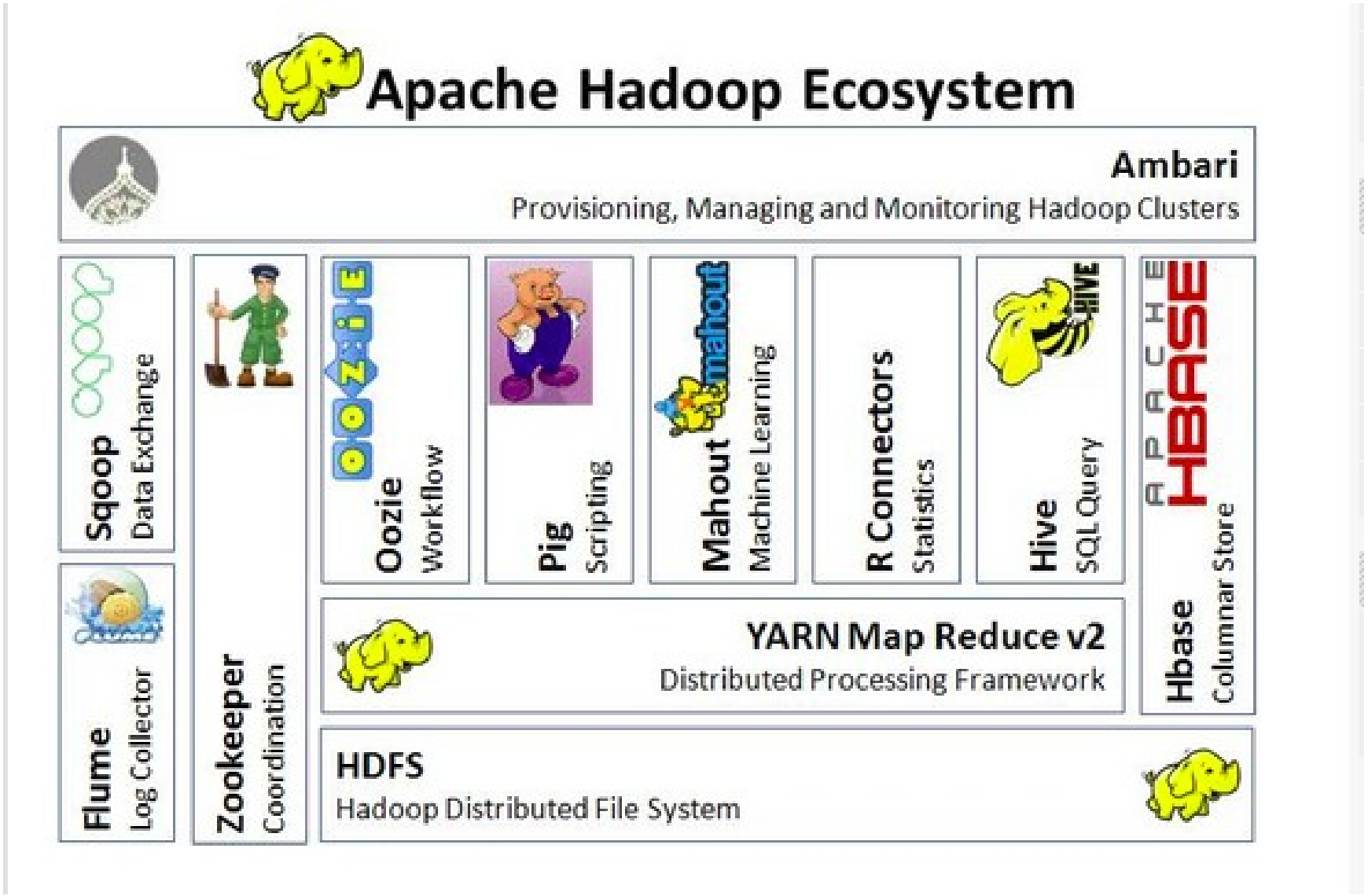
	Traditional RDBMS	MapReduce
Data size	Gigabytes	Petabytes
Access	Interactive and batch	Batch
Updates	Read and write many times	Write once, read many times
Transactions	ACID	None
Structure	Schema-on-write	Schema-on-read
Integrity	High	Low
Scaling	Nonlinear	Linear

Comparisons to RDBMS

- **For example, a website that**
  - has a small number of users
  - produces a large amount of audit logs

1. Utilize RDBMS to provide rich User Interface and enforce data integrity
2. RDBMS generates large amounts of audit logs; the logs are moved periodically to the Hadoop cluster
3. All logs are kept in Hadoop; Various analytics are executed periodically
4. Results copied to RDBMS to be used by Web Server; for example "suggestions" based on audit history

Hadoop Eco System



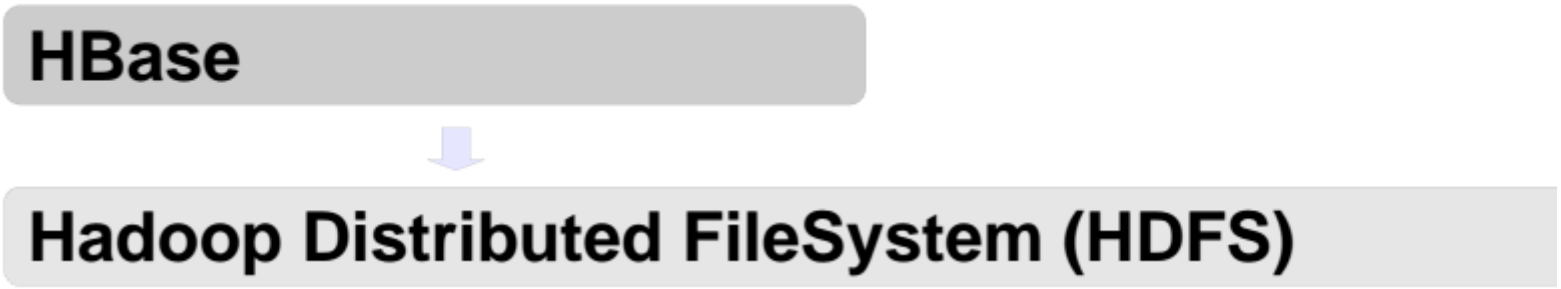
Hadoop Eco System

- **HDFS:** Hadoop Distributed FileSystem
- **MapReduce:** Distributed data processing framework
- **HBase:** Hadoop column database; supports batch and random reads and limited queries
- **Zookeeper:** Highly-Available Coordination Service
- **Oozie:** Hadoop workflow scheduler and manager
- **Pig:** Data processing language and execution environment
- **Hive:** Data warehouse with SQL interface

Hadoop Eco System

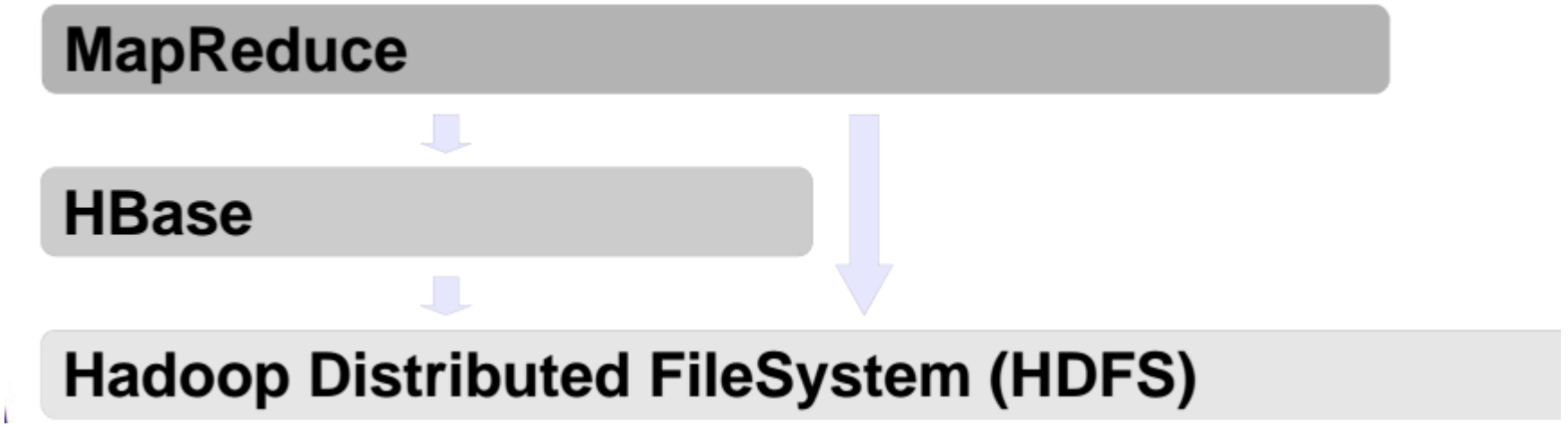
- **To start building an application, you need a file system**
  - In Hadoop world that would be Hadoop Distributed File System (HDFS)
- **Addition of a data store would provide a nicer interface to store and manage your data**
  - HBase: A key-value store implemented on top of HDFS
  - Traditionally one could use RDBMS on top of a local file system

Hadoop Eco System



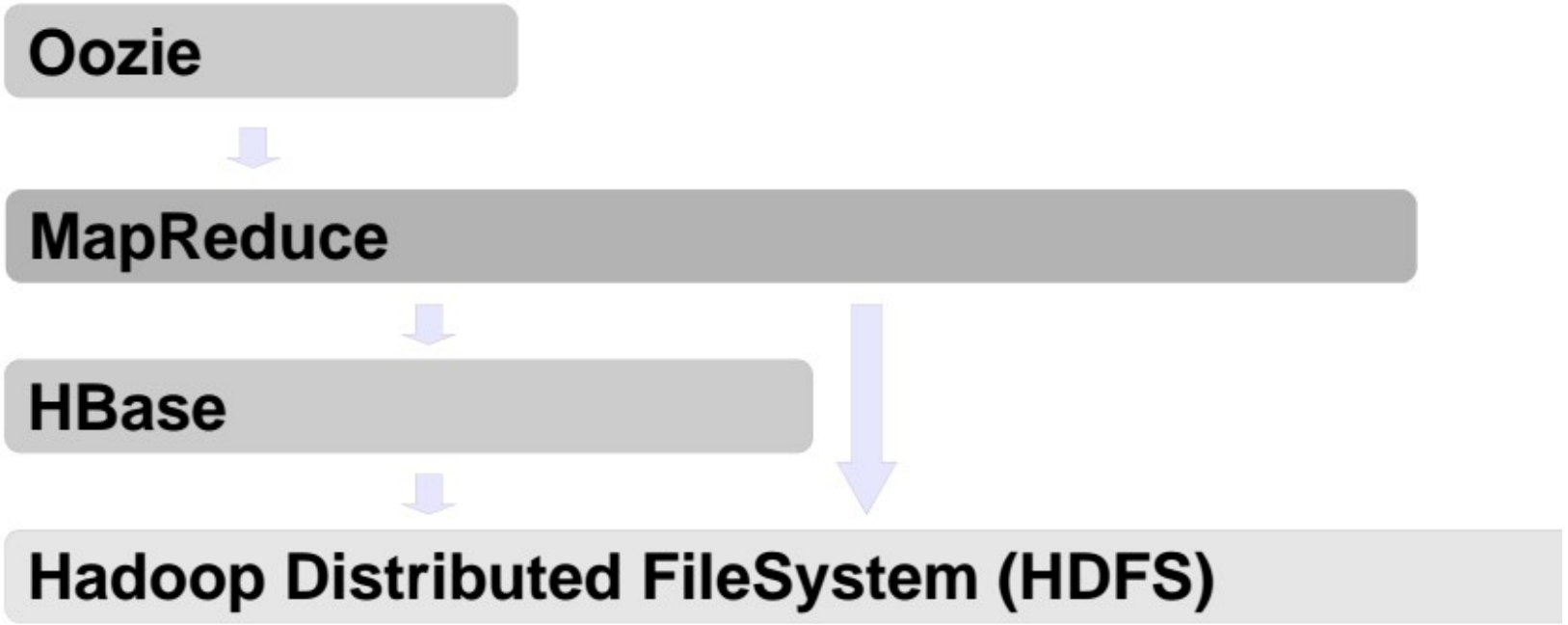
Hadoop Eco System

- **For batch processing, you will need to utilize a framework**
  - In Hadoop's world that would be MapReduce



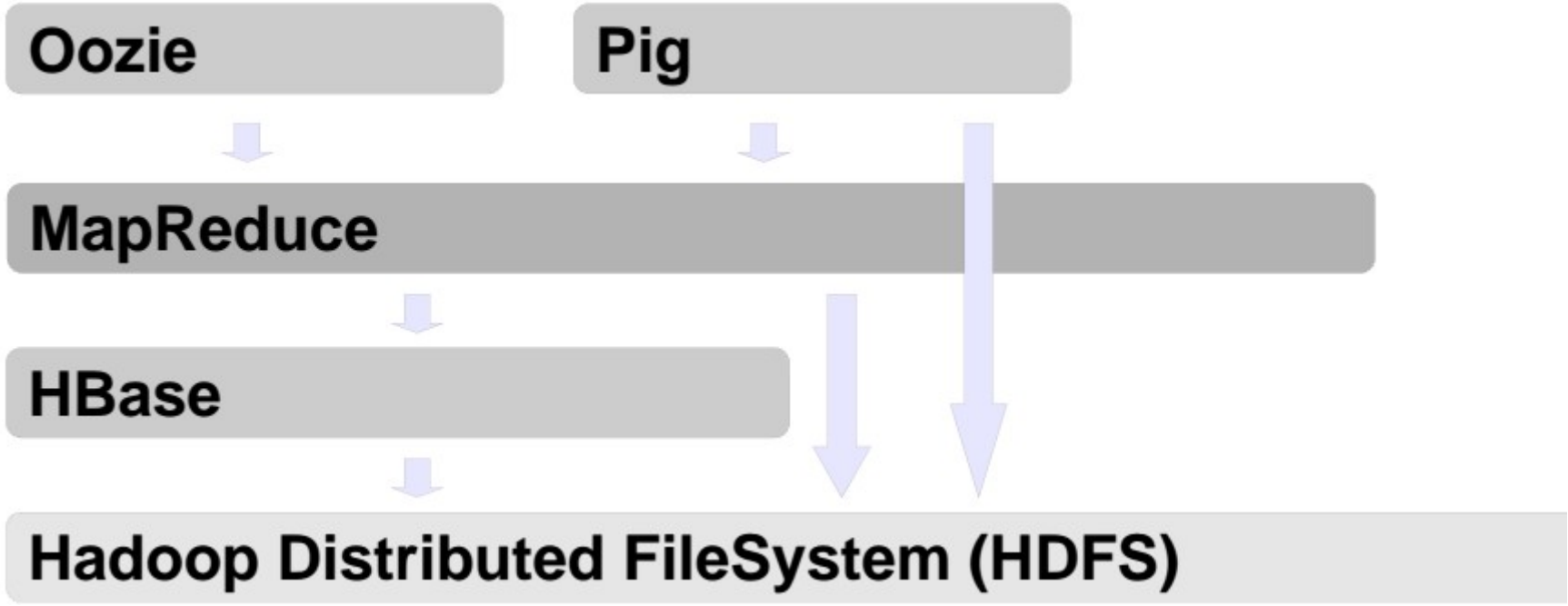
Hadoop Eco System

- **Many problems require MapReduce solution with multiple jobs**
  - Apache Oozie is a popular MapReduce workflow and coordination product



Hadoop Eco System

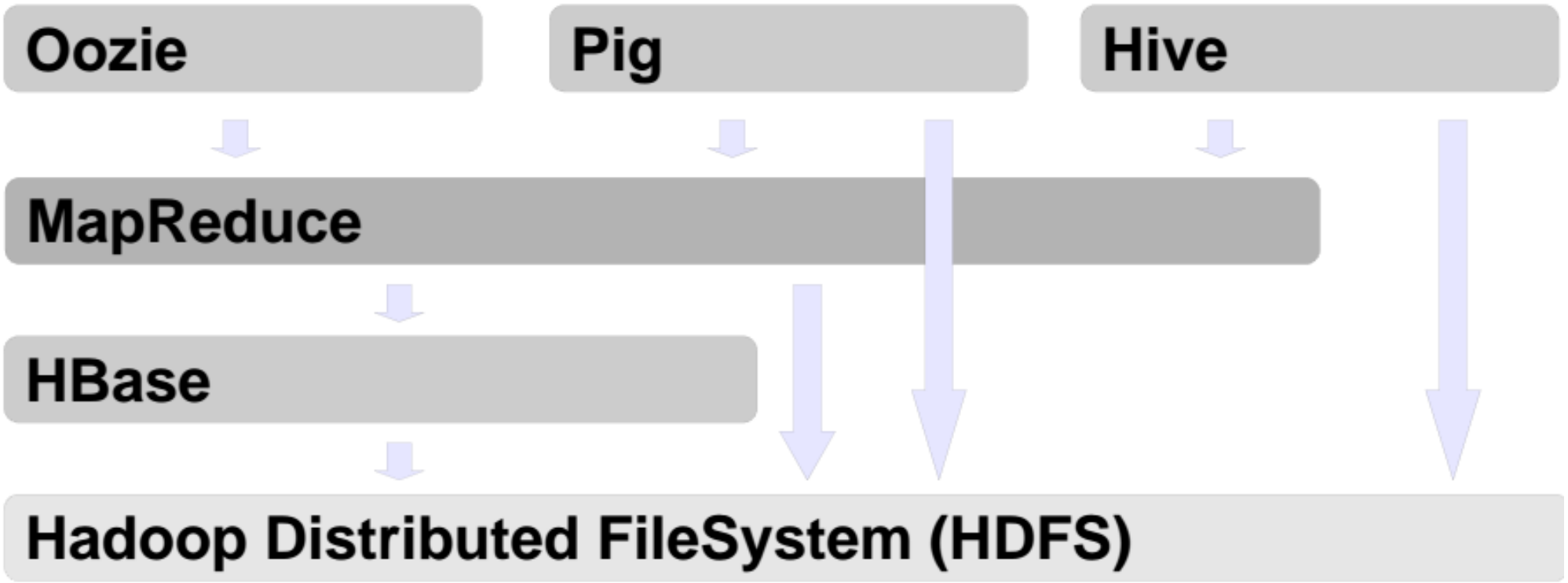
- **MapReduce paradigm may not work well for analysts and data scientists**
  - Addition of Apache Pig, a high-level data flow scripting language, may be beneficial



Hadoop Eco System

- **Your organization may have a good number of SQL experts**
  - Addition of Apache Hive, a data warehouse solution that provides a SQL based interface, may bridge the gap

Hadoop Eco System



Distribution Vendors

- **Cloudera** Distribution for Hadoop (CDH)
- **MapR** Distribution
- **Hortonworks** Data Platform(HDP)

Resources

- **Hadoop: The Definitive Guide**
  - Tom White (Author)
  - O'Reilly Media; 4th Edition.