Getting Started with Hive for Relational Database Developers

HIVE VS. RDBMS

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Overview

Understand the differences between transactional and analytical processing

Learn why Hive, an open source data warehouse, is needed

Understand the differences between Hive and a traditional RDBMS

What You Need to Know

Comfortable using the Unix/Mac/Linux command line

Familiar with relational databases and their layout

Familiar with SQL queries

Some basic understanding of Hadoop, HDFS and MapReduce

Transactional and Analytical Processing

Transactional and Analytical Processing

Order Management Support

John is responsible for tracking and delivering orders on time

Revenue Analyst

Anna is responsible for tracking and monitoring revenues

Order Management Support

20 deliveries in Kent, WA are delayed

The courier company has had a computer outage

John assigns the orders to another courier company in the region

Order Management Support

3 customers want to ship orders to a different address

John updates the address on the shipments and re-routes them

Revenue Analyst

Her manager wants an update on last month’s revenues

Last month was an unusually slow one

Anna pulls up data for the last 5 years to check for seasonal effects

Revenue Analyst

Management asks if the new TV ads this year were successful

Anna checks customer signups for a jump when the campaigns were run

Transactional and Analytical Processing

Transactional Processing

Analytical Processing

Transactional and Analytical Processing

Transactional Processing	Analytical Processing
Analyzes individual entries	Analyzes large batches of data
Access to recent data, from the last few hours or days	Access to older data going back months, or even years
Updates data	Only reads data
Fast real-time access	Long running jobs
Usually a single data source	Multiple data sources

Transactional and Analytical Processing

Small Data

Both these objectives could be achieved using the same database system

Small Data

Single machine with backup

Structured, well-defined data

Can access individual records or the entire dataset

No replication, updated data available instantaneously

Different tables store data from different sources

Transactional and Analytical Processing

BIG Data

Very hard to meet all requirements with the same database system

Big Data

Data distributed on a cluster with multiple machines

Semi-structured or unstructured data

No random access to data

Data replicated, propagation of updates take time

Different sources may have different unknown formats

The same infrastructure cannot support both **transactional** and **analytical** processing

Transactional and Analytical Processing

Transactional Processing

Traditional RDBMS

Analytical Processing

Data Warehouse

Data Warehouse for Analytical Processing

Data Warehouse

A technology that aggregates data from one or more sources so that it can be compared and analyzed for greater business intelligence.

www.informatica.com

Data Warehouse

Long running batch jobs

Optimized for read operations

Holds data from multiple sources

Holds data over a long period of time

Data may be lagged, not real-time

Data Warehouse

Examples of data warehouses

- **Vertica**
- **Teradata**
- **Oracle**
- **IBM**

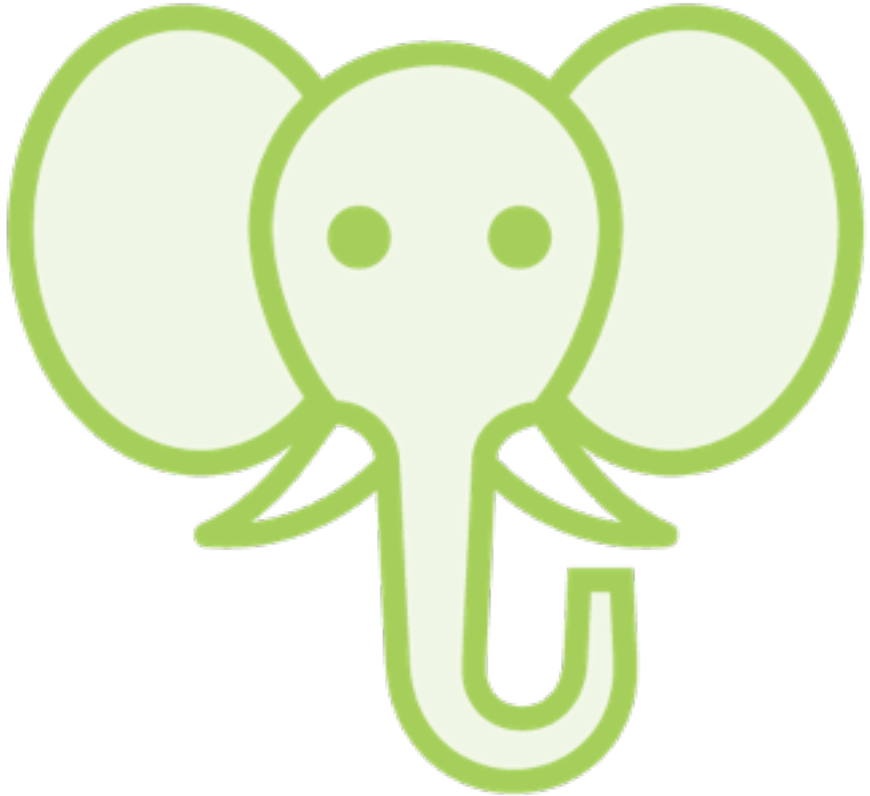
Data Warehouse

Apache Hive is an open-source data warehouse

Data Warehouse

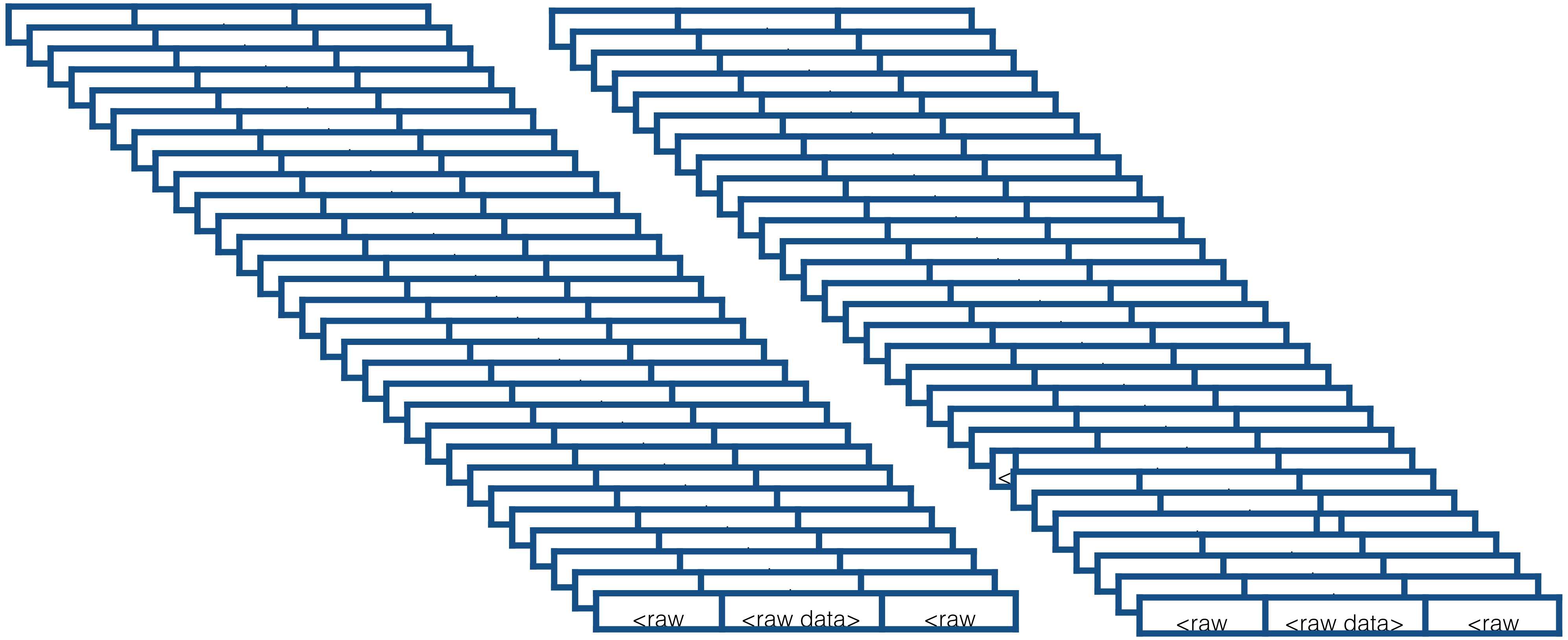
Hive is part of the larger Hadoop ecosystem

Hadoop



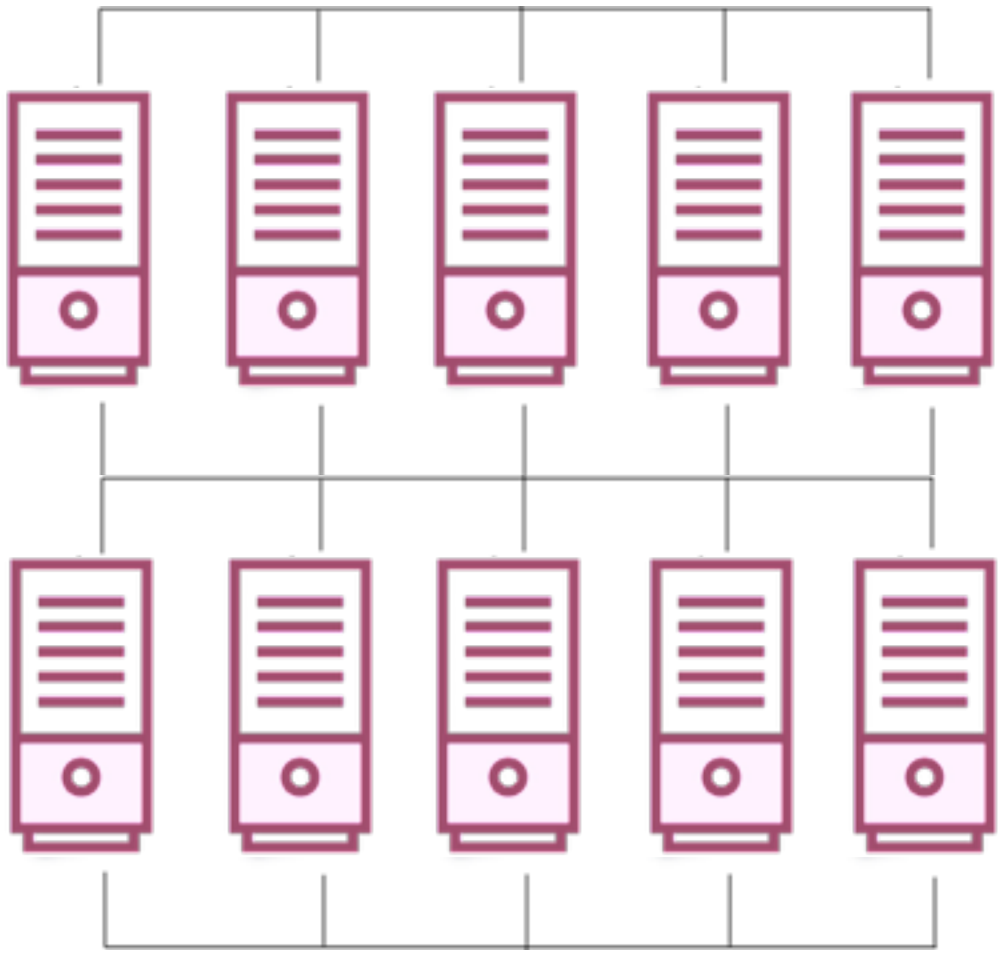
A distributed computing framework to process millions of records

Hadoop



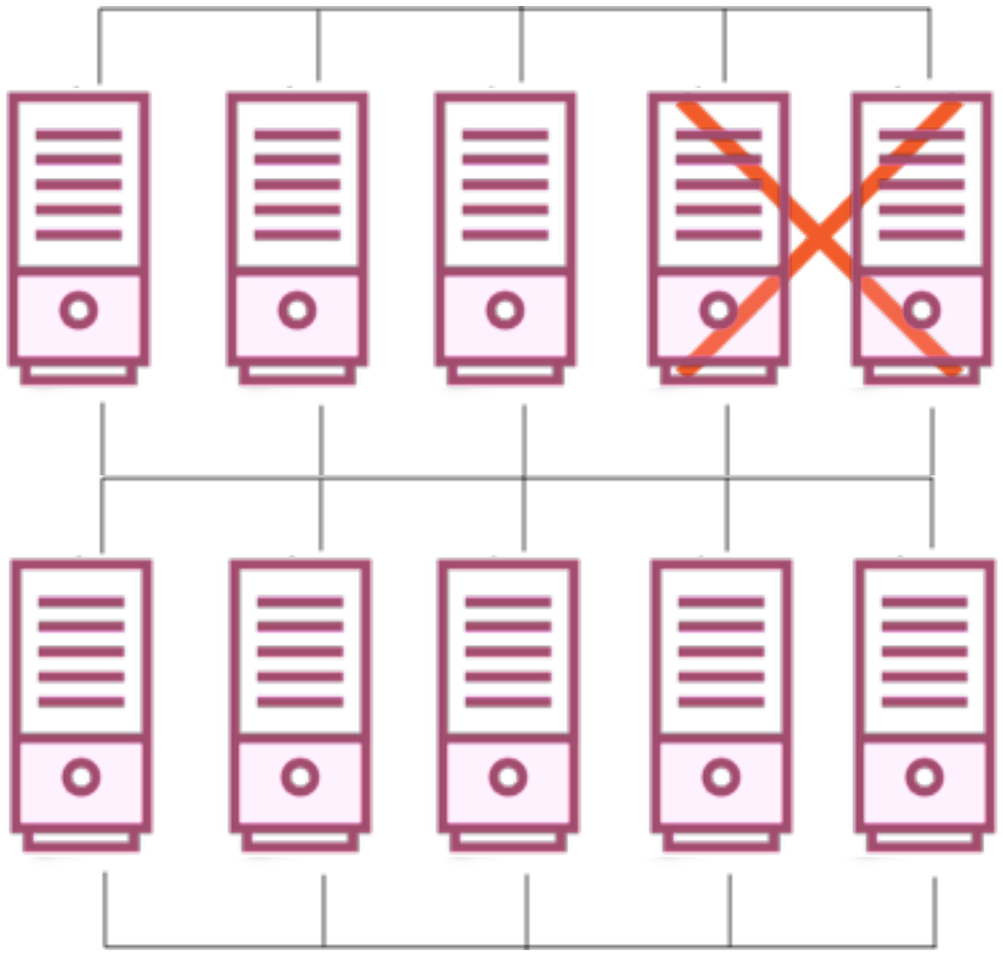
1: Store millions of records on multiple machines

Hadoop



2: Run processes on all these machines to crunch data

Hadoop



3: Handle fault tolerance and recovery when nodes crash

Hadoop

HDFS	MapReduce	YARN
File system to manage the storage of data	Framework to process data across multiple servers	Framework to run and manage the data processing tasks

Hive on Hadoop

Hive runs on top of the Hadoop distributed computing framework

Hive on Hadoop

Hive stores its data in HDFS

HDFS

Hadoop Distributed File System

Data is stored as files - text files, binary files

Partitioned across machines in the cluster

Replicated for fault tolerance

Processing tasks parallelized across multiple machines

Hive on Hadoop

Hive runs all processes in the form of MapReduce jobs under the hood

MapReduce

MapReduce

A parallel programming model

Defines the logic to process data on multiple machines

Batch processing operations on files in HDFS

Usually written in Java using the Hadoop MapReduce library

Hive on Hadoop

Do we have to write MapReduce code to work with Hive?

No

HiveQL

Hive Query Language

A SQL-like interface to the underlying data

HiveQL

Modeled on the Structured Query Language (SQL)

Familiar to analysts and engineers

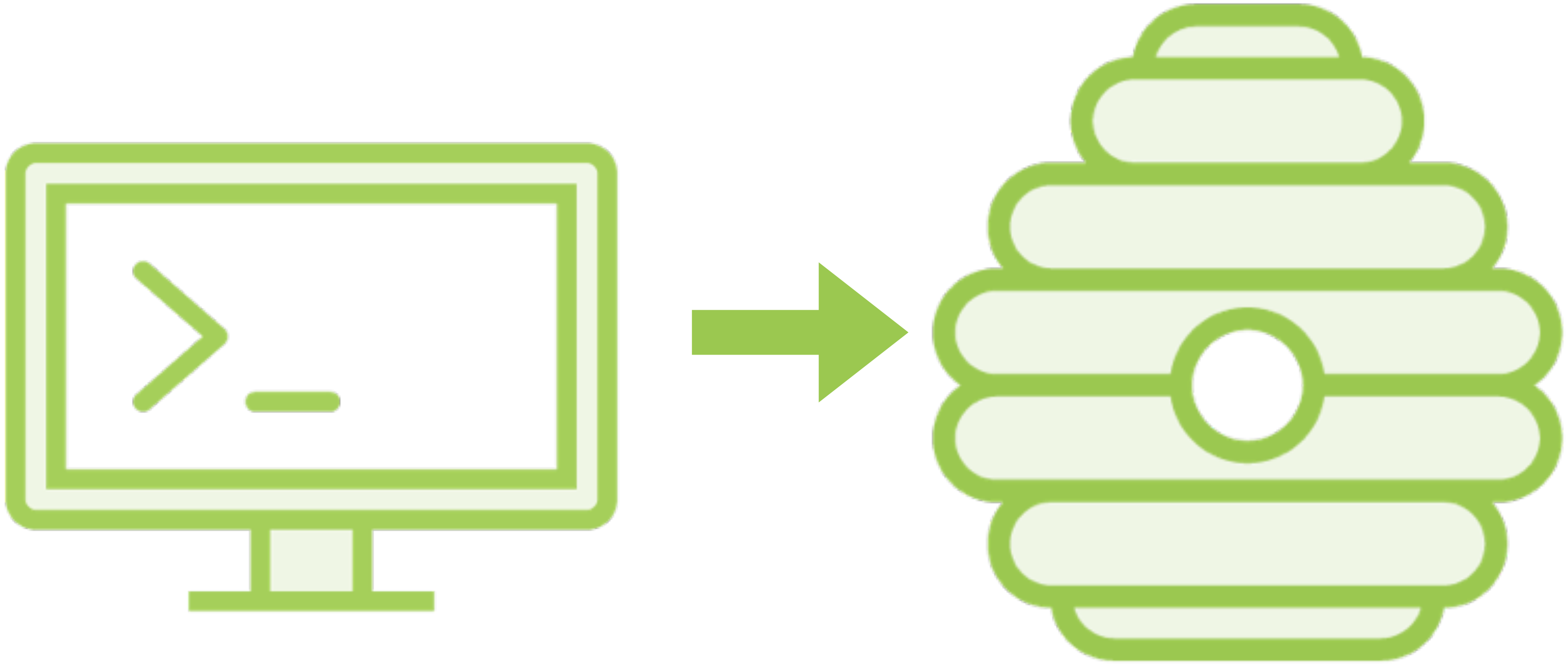
Simple query constructs

- select
- group by
- join

HiveQL

Hive exposes files in HDFS in the form of tables to the user

HiveQL



Write SQL-like query in HiveQL and submit it to Hive

HiveQL

Hive will translate the query to MapReduce tasks and run them on Hadoop

HiveQL

MapReduce will process files on HDFS and return results to Hive

Hive **abstracts away** the details of the underlying MapReduce jobs

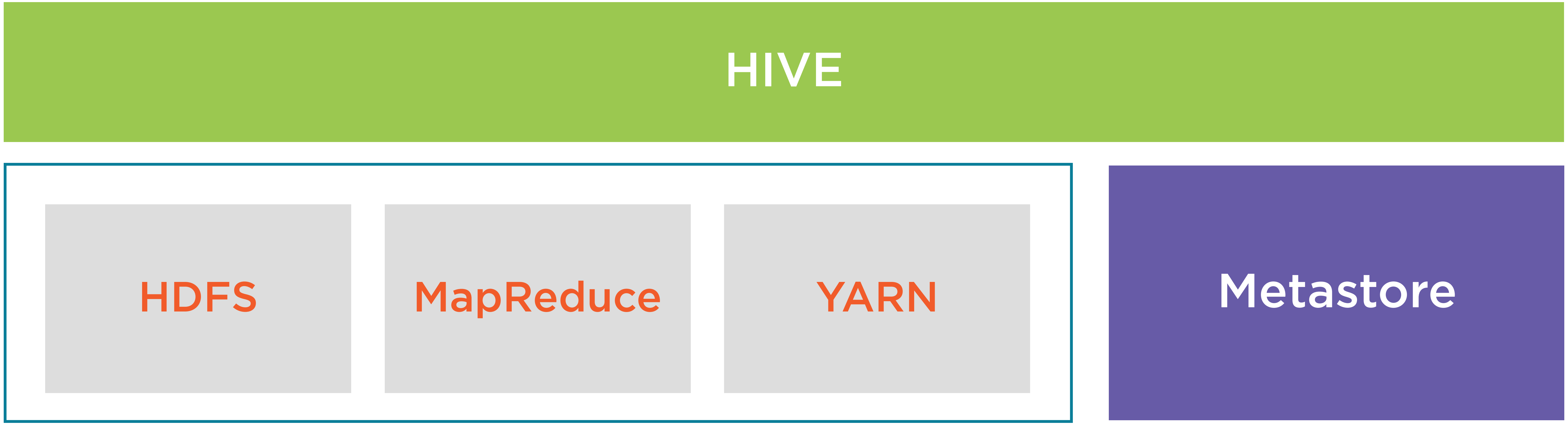
Work with Hive **almost** exactly like you would with a traditional database

The Hive Metastore

The Hive Metastore

A Hive user sees data as if they were stored in tables

The Hive Metastore



Exposes the file-based storage of HDFS in the form of tables

The Hive Metastore

Metastore

The bridge between data stored in files and the tables exposed to users

The Hive Metastore

Stores metadata for all the tables in Hive

Maps the files and directories in Hive to tables

Holds table definitions and the schema for each table

Has information on converting files to table representations

The Hive Metastore

Any database with a JDBC driver can be used as a metastore

The Hive Metastore

Development environments use the built-in Derby database

Embedded metastore

The Hive Metastore

Same Java process as Hive itself

One Hive session to connect to the database

The Hive Metastore

Production environments

Local metastore: Allows multiple sessions to connect to Hive

Remote metastore: Separate processes for Hive and the metastore

Hive vs. RDBMS

Hive vs. RDBMS

Data size	Computation	Latency
Operations	ACID compliance	Query language

Hive vs. RDBMS

Hive	RDBMS
Large datasets	Small datasets
Parallel computations	Serial computations
High latency	Low latency
Read operations	Read/write operations
Not ACID compliant by default	ACID compliant
HiveQL	SQL

Hive vs. RDBMS

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Hive vs. RDBMS

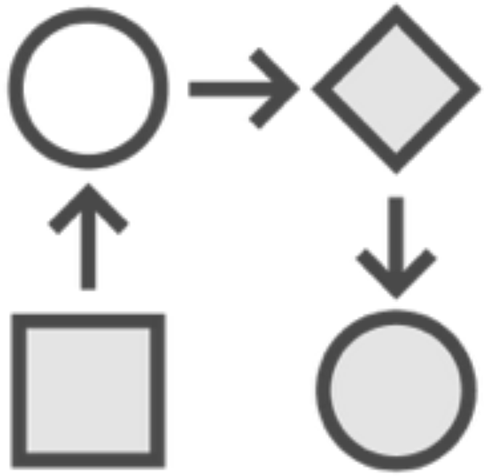
Large Datasets

Gigabytes or petabytes

Small Datasets

Megabytes or gigabytes

Hive vs. RDBMS

Large Datasets	Small Datasets
	
Calculating trends	**Accessing and updating individual records**

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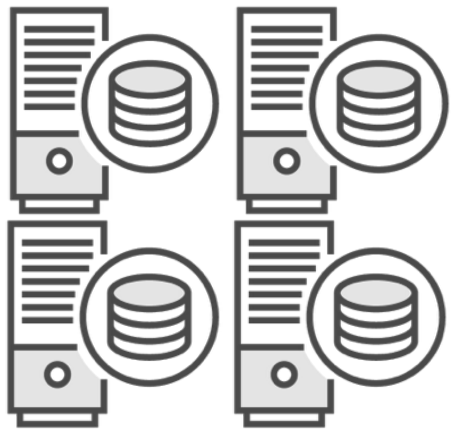
Hive vs. RDBMS

Parallel Computations



Distributed system with multiple machines

Serial Computations

Single computer with backup

Hive vs. RDBMS

Parallel Computations

Semi-structured data files partitioned across machines

Serial Computations

Structured data in tables on one machine

Hive vs. RDBMS

Parallel Computations

Disk space cheap, can add space by adding machines

Serial Computations

Disk space expensive on a single machine

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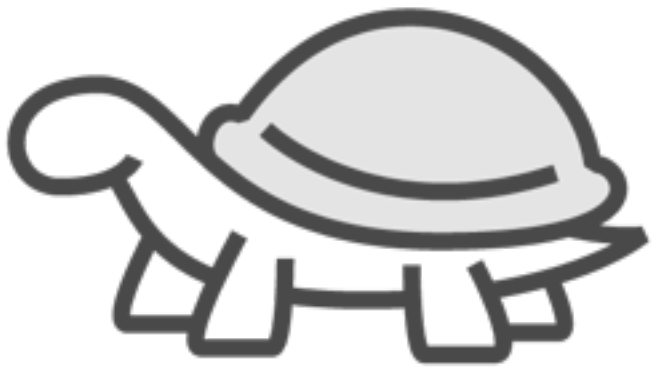
Hive vs. RDBMS

High Latency	Low Latency
	
Records not indexed, cannot be accessed quickly	**Records indexed, can be accessed and updated fast**

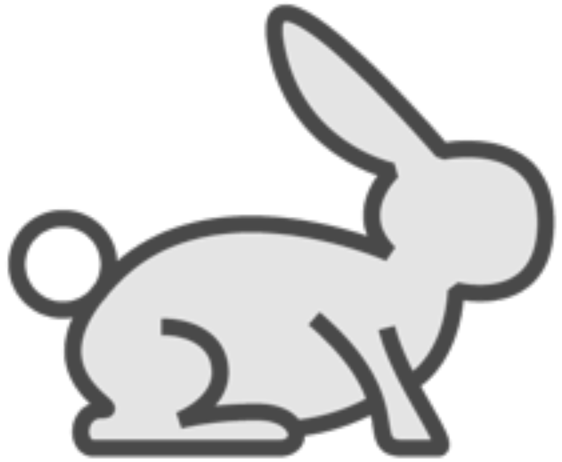
Hive vs. RDBMS

High Latency



Fetching a row will run a MapReduce that might take minutes

Low Latency



Queries can be answered in milliseconds or microseconds

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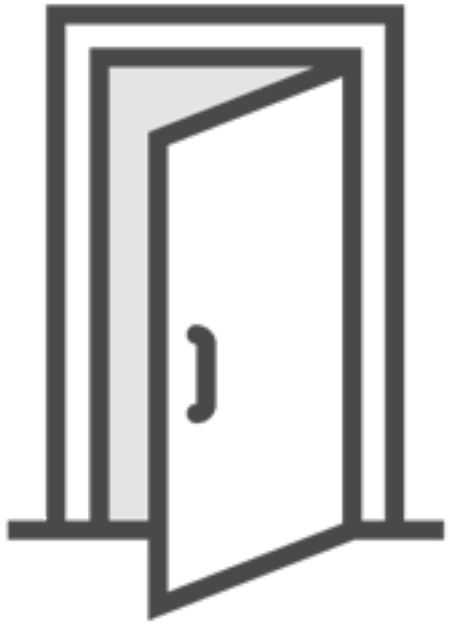
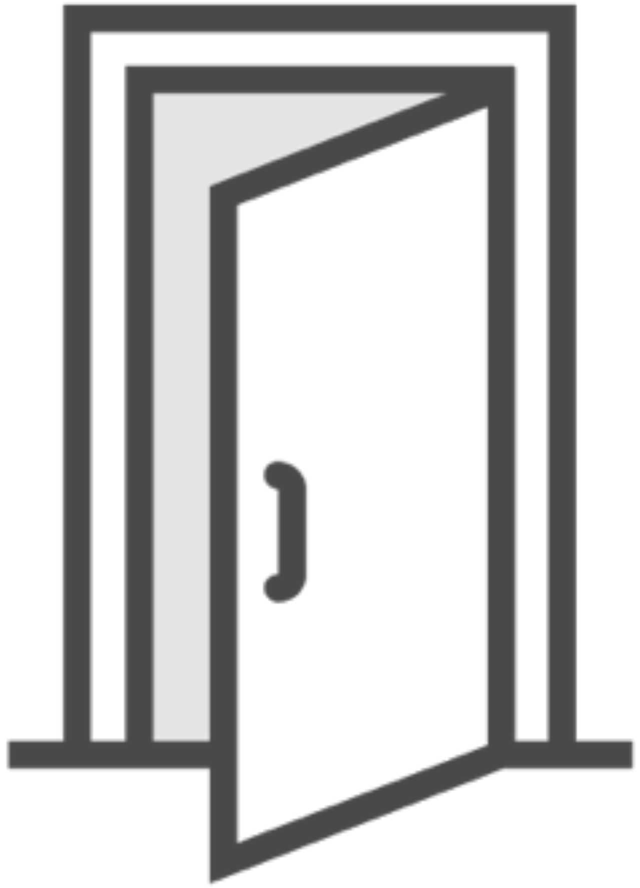
Read Operations



Not the owner of data

Read/Write Operations



No Data Ownership

Hive stores files in HDFS

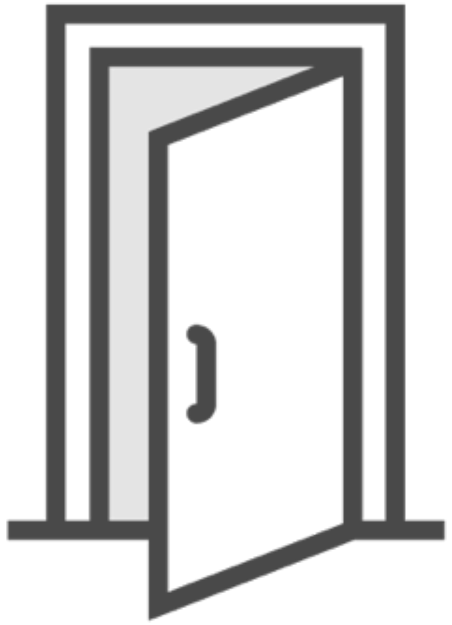
Hive files can be read and written by many technologies

- Hadoop, Pig, Spark

Hive database schema cannot be enforced on these files

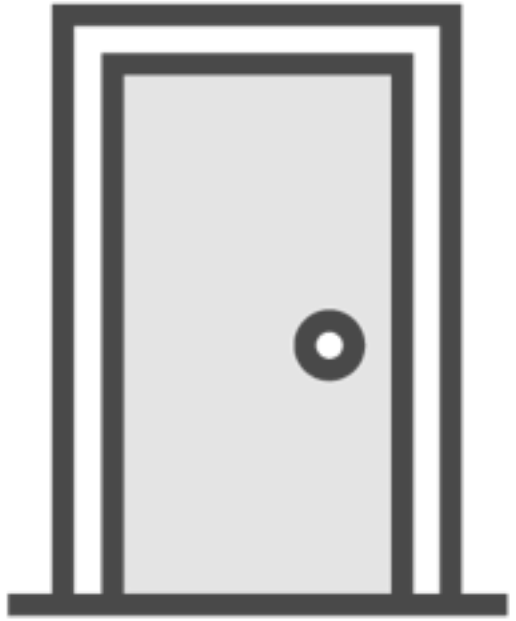
Hive vs. RDBMS

Read Operations



Not the owner of data

Read/Write Operations



Sole gatekeeper for data

Hive vs. RDBMS

Read Operations	Read/Write Operations
Schema-on-read	

Schema-on-read

Number of columns, column types, constraints specified at table creation

Hive tries to impose this schema when data is read

It may not succeed, may pad data with nulls

Hive vs. RDBMS

Read Operations	Read/Write Operations
Schema-on-read	Schema-on-write

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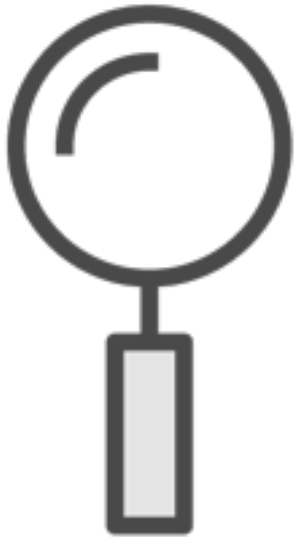
Hive vs. RDBMS

Not ACID Compliant

Data can be dumped into Hive tables from any source

ACID Compliant



Only data which satisfies constraints are stored in the database

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Hive vs. RDBMS

HiveQL	SQL
Schema on read, no constraints enforced	Schema on write keys, not null, unique all enforced
Minimal index support	Indexes allowed
Row level updates, deletes as a special case	Row level operations allowed in general
Many more built-in functions	Basic built-in functions
Only equi-joins allowed	No restriction on joins
Restricted subqueries	Whole range of subqueries

Summary

Understood the differences between transactional and analytical processing and where they are used

Learnt the need for a data warehouse for analytical processing

Understood the differences between Hive and a traditional RDBMS