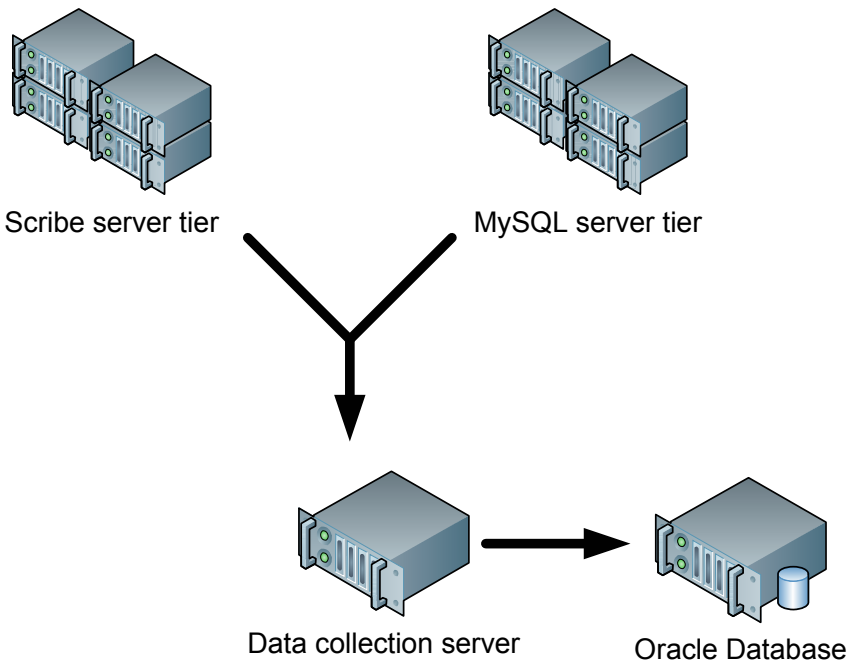
Introduction to Hive

Outline

- Motivation
- Overview
- Data Model
- Working with Hive
- Wrap up & Conclusions

Background

- Started at Facebook
- Data was collected by nightly cron jobs into Oracle DB
- “ETL” via hand-coded python
- Grew from 10s of GBs (2006) to 1 TB/day new data (2007), now 10x that.



Hadoop as Enterprise Data Warehouse

- Scribe and MySQL data loaded into Hadoop HDFS
- Hadoop MapReduce jobs to process data
- Missing components:
  - Command-line interface for “end users”
  - Ad-hoc query support
    - … without writing full MapReduce jobs
  - Schema information

Hive Applications

- Log processing
- Text mining
- Document indexing
- Customer-facing business intelligence (e.g., Google Analytics)
- Predictive modeling, hypothesis testing

Hive Components

- Shell: allows interactive queries like MySQL shell connected to database
  - Also supports web and JDBC clients
- Driver: session handles, fetch, execute
- Compiler: parse, plan, optimize
- Execution engine: DAG of stages (M/R, HDFS, or metadata)
- Metastore: schema, location in HDFS, SerDe

Data Model

- Tables
  - Typed columns (int, float, string, date, boolean)
  - Also, list: map (for JSON-like data)
- Partitions
  - e.g., to range-partition tables by date
- Buckets
  - Hash partitions within ranges (useful for sampling, join optimization)

Metastore

- Database: namespace containing a set of tables
- Holds table definitions (column types, physical layout)
- Partition data
- Uses JPOX ORM for implementation; can be stored in Derby, MySQL, many other relational databases

Physical Layout

- Warehouse directory in HDFS
  - e.g., **`/home/hive/warehouse`**
- Tables stored in subdirectories of warehouse
  - Partitions, buckets form subdirectories of tables
- Actual data stored in flat files
  - Control char-delimited text, or SequenceFiles
  - With custom SerDe, can use arbitrary format

Starting the Hive shell

- Start a terminal and run

```
$ cd /usr/share/cloudera/hive/
$ bin/hive
```

- Should see a prompt like:

```
hive>
```

Creating tables

```
hive> SHOW TABLES;


hive> CREATE TABLE shakespeare (freq
  INT, word STRING)  ROW FORMAT
  DELIMITED FIELDS TERMINATED BY '\t'
  STORED AS TEXTFILE;


hive> DESCRIBE shakespeare;
```

Generating Data

- Let's get (word, frequency) data from the Shakespeare data set:

```
$  hadoop jar \
   $HADOOP_HOME/hadoop-*-examples.jar \
   grep input shakespeare_freq '\w+'
```

Loading data

- Remove the MapReduce job logs:

```
$ hadoop fs -rmr shakespeare_freq/_logs
```

- Load dataset into Hive:

```
hive> LOAD DATA INPATH "shakespeare_freq"
      INTO TABLE shakespeare;
```

Selecting data

```
hive> SELECT * FROM shakespeare LIMIT 10;

hive> SELECT * FROM shakespeare
   WHERE freq > 100 SORT BY freq ASC
   LIMIT 10;
```

Most common frequency

```
hive> SELECT freq, COUNT(1) AS f2
    FROM shakespeare GROUP BY freq
    SORT BY f2 DESC LIMIT 10;

hive> EXPLAIN SELECT freq, COUNT(1) AS f2
    FROM shakespeare GROUP BY freq
    SORT BY f2 DESC LIMIT 10;
```

Joining tables

- A powerful feature of Hive is the ability to create queries that join tables together
- We have (freq, word) data for Shakespeare
- Can also calculate it for KJV
- Let's see what words show up a lot in both

Create the dataset:

```
$ tar zxf ~/bible.tar.gz -C ~
$ hadoop fs -put ~/bible bible
$ hadoop jar \
    $HADOOP_HOME/hadoop-*-examples.jar \
    grep bible bible_freq '\w+'
```

Create the new table

```
hive> CREATE TABLE kjv (freq INT,
  word STRING) ROW FORMAT DELIMITED
  FIELDS TERMINATED BY '\t' STORED AS
  TEXTFILE;

hive> SHOW TABLES;
hive> DESCRIBE kjv;
```

Import data to Hive

```
$ hadoop fs -rmr bible_freq/_logs

hive> LOAD DATA INPATH "bible_freq"
      INTO TABLE kjv;
```

Create an intermediate table

```
hive> CREATE TABLE merged
      (word STRING, shake_f INT,
      kjv_f INT);
```

Running the join

```
hive> INSERT OVERWRITE TABLE merged
   SELECT s.word, s.freq, k.freq FROM
   shakespeare s JOIN kjv k ON
   (s.word = k.word)
   WHERE s.freq >= 1 AND k.freq >= 1;

hive> SELECT * FROM merged LIMIT 20;
```

Most common intersections

- What words appeared most frequently in both corpuses?

```
hive> SELECT word, shake_f, kjv_f,
    (shake_f + kjv_f) AS ss
    FROM merged SORT BY ss DESC
    LIMIT 20;
```

Some more advanced features…

- “TRANSFORM:” Can use MapReduce in SQL statements
- Custom SerDe: Can use arbitrary file formats
- Metastore check tool
- Structured query log

Project Status

- Open source, Apache 2.0 license
- Official subproject of Apache Hadoop
- 4 committers (all from Facebook)
- First release candidate coming soon

Related work

- Parallel databases: Gamma, Bubba, Volcano
- Google: Sawzall
- Yahoo: Pig
- IBM Research: JAQL
- Microsoft: DryadLINQ, SCOPE
- Greenplum: YAML MapReduce
- Aster Data: In-database MapReduce
- Business.com: CloudBase

Conclusions

- Supports rapid iteration of ad-hoc queries
- Can perform complex joins with minimal code
- Scales to handle much more data than many similar systems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