CLOUD COMPUTING APPLICATIONS

HIVE

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Hive: Background

- Started at Facebook
- Data was collected by nightly cron jobs into Oracle DB
- "ETL" via hand-coded Python
- HQL, a variant of SQL
- Translates queries into map/reduce jobs, Hadoop YARN, Tez, or Spark
- Note
  - No UPDATE or DELETE support, for example
  - Focuses primarily on the query part of SQL

Hive: Example

- Hive looks similar to an SQL database

- Relational join on two tables:
  - Table of word counts from Shakespeare collection
  - Table of word counts from Homer

Hive: Example

SELECT s.word, s.freq, k.freq FROM shakespeare s
  JOIN homer k ON (s.word = k.word) WHERE s.freq >= 1 AND k.freq >= 1
  ORDER BY s.freq DESC LIMIT 10;

```
the     25848    62394
I       23031    8854
and     19671    38985
to      18038    13526
of      16700    34654
a       14170    8057
you     12702    2720
my      11297    4135
in      10797    12445
is      8882     6884
```

Hive: Behind the Scenes

SELECT s.word, s.freq, k.freq FROM shakespeare s
JOIN homer k ON (s.word = k.word) WHERE s.freq >= 1 AND k.freq >= 1
ORDER BY s.freq DESC LIMIT 10;

(Abstract Syntax Tree)

(TOK_QUERY (TOK_FROM (TOK_JOIN (TOK_TABREF shakespeare s) (TOK_TABREF homer k) (= (.
(TOK_TABLE_OR_COL s) word) (. (TOK_TABLE_OR_COL k) word)))) (TOK_INSERT (TOK_DESTINATION (TOK_DIR
TOK_TMP_FILE)) (TOK_SELECT (TOK_SELEXPR (. (TOK_TABLE_OR_COL s) word)) (TOK_SELEXPR (.
(TOK_TABLE_OR_COL s) freq)) (TOK_SELEXPR (. (TOK_TABLE_OR_COL k) freq))) (TOK_WHERE (AND (>= (.
(TOK_TABLE_OR_COL s) freq) 1) (>= (. (TOK_TABLE_OR_COL k) freq) 1))) (TOK_ORDERBY
(TOK_TABSORTCOLNAMEDESC (. (TOK_TABLE_OR_COL s) freq))) (TOK_LIMIT 10)))

(one or more of MapReduce jobs)

Hive Components

- Shell: allows interactive queries

- Driver: session handles, fetch, execute

- Compiler: parse, plan, optimize

- Execution engine: DAG of stages (MR, HDFS, metadata)

- Metastore: schema, location in HDFS, etc.

Metastore

- Hive uses a traditional database to store its metadata
  - A namespace containing a set of tables
  - Holds table definitions (column types, physical layout)
  - Holds partitioning information
- Can be stored in MySQL, Oracle, and many other relational databases

Physical Layout

- Warehouse directory in HDFS
  - E.g., /user/hive/warehouse
- Tables stored in subdirectories of warehouse
  - Partitions form subdirectories of tables
- Actual data stored in flat files
  - Control char-delimited text, or SequenceFiles
  - Can be customized to use arbitrary format