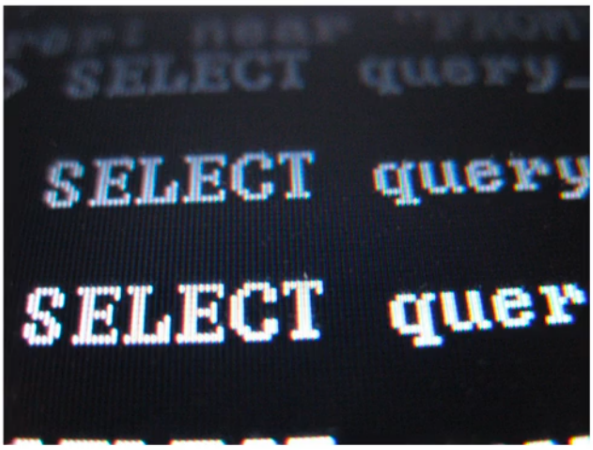
Hive

Why Hive?

- Uses familiar SQL syntax (HiveQL)
- Interactive
- Scalable – works with "big data" on a cluster
  - Really most appropriate for data warehouse applications
- Easy OLAP queries – WAY easier than writing MapReduce in Java
- Highly optimized
- Highly extensible
  - User defined functions
  - Thrift server
  - JDBC / ODBC driver



The Hive Metastore

- Hive maintains a "metastore" that imparts a structure you define on the unstructured data that is stored on HDFS etc.

```
CREATE TABLE ratings (
       userID INT,
       movieID       INT,
       rating INT,
       time   INT)
ROW FORMAT DELIMTED
FIELDS TERMINATED BY '\t'
STORED AS TEXTFILE;

LOAD DATA LOCAL INPATH '${env:HOME}/ml-100k/u.data'
OVERWRITE INTO TABLE ratings;
```

External Hive Metastores

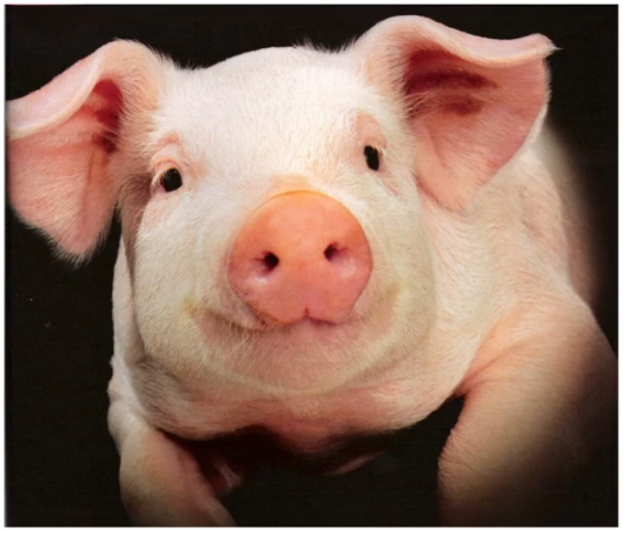
- Metastore is stored in MySQL on the master node by default
- External metastores offer better resiliency / integration
  - AWS Glue Data Catalog
  - Amazon RDS

Other Hive / AWS integration points

- Load table partitions from S3
- Write tables in S3
- Load scripts from S3
- DynamoDB as an external table

Apache Pig

- Writing mappers and reducers by hand takes a long time.
- Pig introduces *Pig Latin*, a scripting language that lets you use SQL-like syntax to define your map and reduce steps.
- Highly extensible with user-defined functions (UDF's)



How Pig Works


```
ratings = LOAD '/user/maria_dev/ml-100k/u.data' AS (userID:int, movieID:int, rating:int, ratingTime:int);

metadata = LOAD '/user/maria_dev/ml-100k/u.item' USING PigStorage('|')
    AS (movieID:int, movieTitle:chararray, releaseDate:chararray, videoRelease:chararray, imdbLink:chararray);

nameLookup = FOREACH metadata GENERATE movieID, movieTitle,
    ToUnixTime(ToDate(releaseDate, 'dd-MMM-yyyy')) AS releaseTime;

ratingsByMovie = GROUP ratings BY movieID;

avgRatings = FOREACH ratingsByMovie GENERATE group AS movieID, AVG(ratings.rating) AS avgRating;

fiveStarMovies = FILTER avgRatings BY avgRating > 4.0;

fiveStarsWithData = JOIN fiveStarMovies BY movieID, nameLookup BY movieID;

oldestFiveStarMovies = ORDER fiveStarsWithData BY nameLookup::releaseTime;

DUMP oldestFiveStarMovies;
```

Pig / AWS Integration

- Ability to use multiple file systems (not just HDFS)
  - i.e., query data in S3
- Load JAR's and scripts from S3

Amazon S3

HBase

- Non-relational, petabyte-scale database
- Based on Google's BigTable, on top of HDFS
- In-memory
- Hive integration

APACHE HBASE

Sounds a lot like DynamoDB

- Both are NoSQL databases intended for the same sorts of things
- But if you're all-in with AWS anyhow, DynamoDB has advantages
  - Fully managed (auto-scaling)
  - More integration with other AWS services
  - Glue integration
- HBase has some advantages though:
  - Efficient storage of sparse data
  - Appropriate for high frequency counters (consistent reads & writes)
  - High write & update throughput
  - More integration with Hadoop

HBase / AWS integration

- Can store data (StoreFiles and metadata) on S3 via EMRFS
- Can back up to S3

presto sql query about all servers are peta byte of storage

Presto

- It can connect to many different “big data” databases and data stores at once, and query across them
- **Interactive** queries at **petabyte scale**
- Familiar SQL syntax
- Optimized for OLAP – analytical queries, data warehousing
- Developed, and still partially maintained by Facebook
- This is what Amazon Athena uses under the hood
- Exposes JDBC, Command-Line, and Tableau interfaces

Presto connectors

- HDFS
- S3
- Cassandra
- MongoDB
- HBase
- SQL
- Redshift
- Teradata

Apache Zeppelin

- If you're familiar with iPython notebooks – it's like that
  - Lets you interactively run scripts / code against your data
  - Can interleave with nicely formatted notes
  - Can share notebooks with others on your cluster
- Spark, Python, JDBC, HBase, Elasticsearch + more

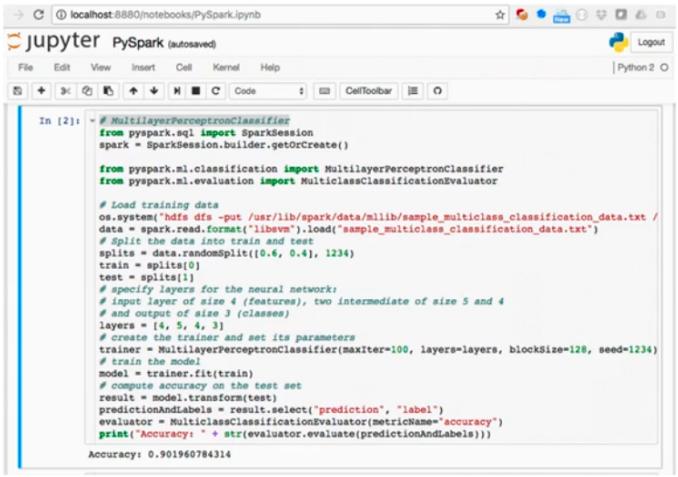
Zeppelin + Spark

- Can run Spark code interactively (like you can in the Spark shell)
  - This speeds up your development cycle
  - And allows easy experimentation and exploration of your big data
- Can execute SQL queries directly against SparkSQL
- Query results may be visualized in charts and graphs
- Makes Spark feel more like a data science tool!

amazon offers emr notebook

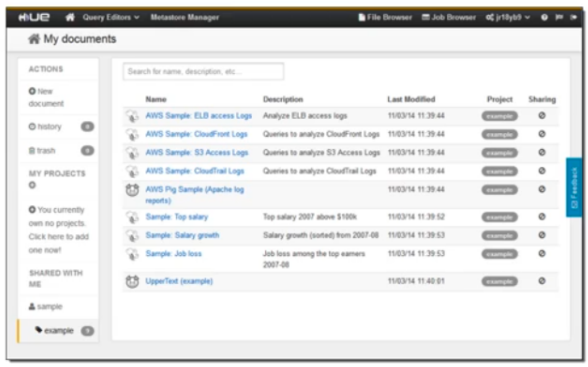
EMR Notebook

- Similar concept to Zeppelin, with more AWS integration
- Notebooks backed up to S3
- Provision clusters from the notebook!
- Hosted inside a VPC
- Accessed only via AWS console



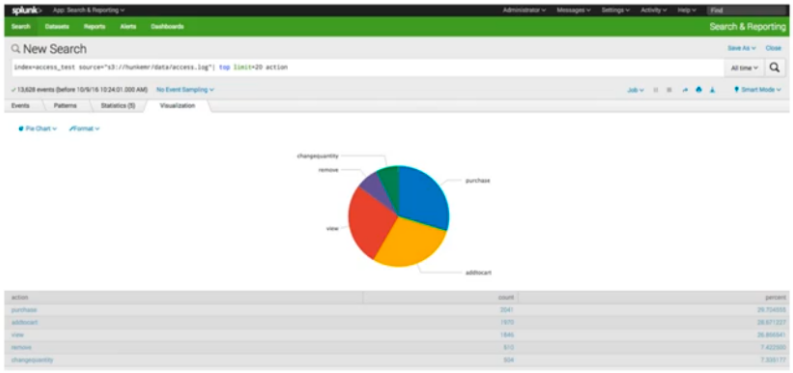
Hue

- Hadoop User Experience
- Graphical front-end for applications on your EMR cluster
- IAM integration: Hue Super-users inherit IAM roles
- S3: Can browse & move data between HDFS and S3



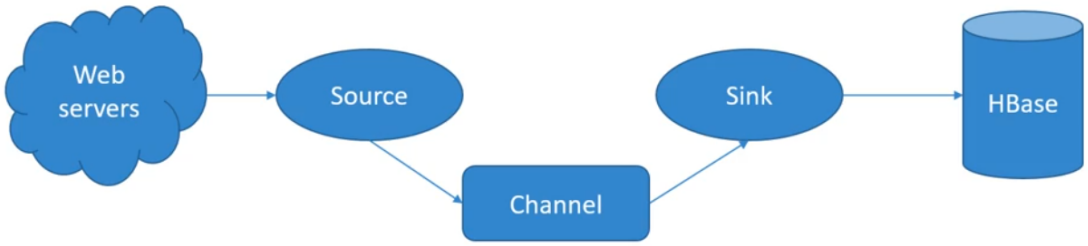
Splunk

- Splunk / Hunk “makes machine data accessible, usable, and valuable to everyone”
- Operational tool – can be used to visualize EMR and S3 data using your EMR Hadoop cluster.



Flume

- Another way to stream data into your cluster
- Made from the start with Hadoop in mind
  - Built-in sinks for HDFS and HBase
- Originally made to handle log aggregation



other libarares

Other EMR / Hadoop Tools

- **Ganglia** (monitoring)
- **Mahout** (machine learning)
- **Accumulo** (another NoSQL database)
- **Sqoop** (relational database connector)
- **HCatalog** (table and storage management for Hive metastore)
- **Kinesis Connector** (directly access Kinesis streams in your scripts)
- **Tachyon** (accelerator for Spark)
- **Derby** (open-source relational DB in Java)
- **Ranger** (data security manager for Hadoop)
- Install whatever you want

EMR Security

- IAM policies
  - Grant or deny permissions
  - Allow user actions
  - Combine with tagging to control access per cluster
- Kerberos
  - Secure user authentication
- SSH
  - Secure connection to command line
  - Tunneling for web interfaces
  - Can use Kerberos or EC2 key pairs
- IAM roles
  - Control access to EMRFS data based on user, group, location of data
  - Each cluster must have a service role and a role for the EC2 instance profile
  - IAM policies attached to roles
  - Auto-scaling role
  - Service-linked roles

EMR Security

- "Block public access"
  - Easy way to prevent public access to data stored on your EMR cluster
  - Can set at the account level before creating the cluster.

EMR: Choosing Instance Types

- Master node:
  - m5.xlarge if < 50 nodes, larger if > 50 nodes
- Core & task nodes:
  - m5.xlarge is usually good
  - If cluster waits a lot on external dependencies (i.e. a web crawler), t2.medium
  - Improved performance: m4.xlarge
  - Computation-intensive applications: high CPU instances
  - Database, memory-caching applications: high memory instances
  - Network / CPU-intensive (NLP, ML) – cluster computer instances
- Spot instances
  - Good choice for task nodes
  - Only use on core & master if you're testing or very cost-sensitive; you're risking partial data loss