Big Data Paper Summary

HIVE – A Petabyte Scale Data Warehouse Using Hadoop

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A Comparison of Approaches to Large-Scale Data Analysis

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Michael Stonebraker on his 10-year Most Influential Paper Award at ICDE 2015

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HIVE Stacked On Hadoop

- Data that is being collected and analyzed by large companies is growing exponentially, thus traditional data warehouse solutions very expensive
- Hadoop, a relatively new open-source map-reduce implementation that is being used by major companies such as Yahoo, Facebook, and others.
  - Hadoop allows large sets of data to be processed, and is a solution to the problem addressed above
  - Hadoop allows data to be stored at a petabyte scale, all on commodity hardware
- The map-reduce programming model is very difficult to maintain because custom code is needed to be developed for specific jobs
  - This is not easy for end-users
  - This lacks the expressiveness of SQL
- Hive is an open-source data warehouse solution that is stacked on top of Hadoop, used to manipulate all of the data stored using Hadoop

HIVE, How Is It Being Used

- As previously stated, Hive is an open-source data warehouse solution that is stacked on top of Hadoop
  - HiveQL is the query language used to manipulate the data being stored.
  - HiveQL supports queries similar to SQL, which are compiled into map-reduced jobs, executed using Hadoop
  - HiveQL supports tables with primitive types, collections of arrays and maps, and more
  - Similar to SQL, there is a system catalog that contains schemas and statistics (Metastore)
- HIVE is used to avoid the map-reduce language for jobs being executed in Hadoop
- HIVE allows users to use the expressiveness of SQL on the data stored within Hadoop

Analysis of HIVE

- HIVE allows a solution to the tedious and difficult map-reduce programming model
- This software allows end users to take data manipulation, storage, and analysis into their own hands
- Whether it is partitioning existing data or creating new tables, HiveQL gives the end-user control
- HiveQL is also very powerful because it allows analysis expressed as map-reduce programs in the programming language of the end-users choice
  - This allows complex logic expressed in map-reduce programs to be executed into HiveQL queries effortlessly
- Hive is great solution to managing the data stored in Hadoop, and even though it is still in the works, it has proven its usefulness and power

A Comparison of Approaches to Large-Scale Data Analysis

- MapReduce (MR) is a large-scale data analysis computing model, which is the new “hype” in the big data world, which is part of Hadoop
- This paper compares MapReduce and parallel database systems
  - Both models are evaluated based on development complexity and performance
  - Multiple tasks are ran on both models, and the performance of the two models are compared

MR vs Parallel DBMSs

- 5 Tasks were executed on Hadoop MR, Vertica, and DBMS-X (Vertica and DBMS-X being the parallel DBMSs)
  - The tasks that were conducted showed several different statistics
  - Each task was executed in three different scenarios
    - Some scenarios used as little as 1 node, where the biggest cluster was up to 100 nodes
- From software configuration, and storage testing, to analytical tasks, the power of these tools were tested and the results were quite shocking
- EX: One test was was taken directly from the original MapReduce paper
  - This task specifically tests the scanning abilities for the programs
  - Each program needed to scan through a 100-byte data set, searching for a specific pattern

Analysis of MR vs. Parallel DBMSs

- It was seen that the parallel DBMSs outperform Hadoop MR on all levels of cluster scaling (up too 100 nodes)
- Hadoop MR showed to be the slowest, compared to Vertica being the fasted on all cluster scaling and DBMS-X coming in second after Vertica
  - An advantage of MR that was seen was uploading data to be stored did take significantly quicker in comparison to the parallel DBMSs
- Another factor that was seen throughout this paper was the fact that MR executes a complete table scan, where the parallel DBMSs can take advantage of the clustered indexes, reducing time
- As more data and nodes were added to the trials, Hadoop MR showed to be affected the most
  - This is due to the start-up costs as more nodes are added to the cluster, which proportionately results in larger fraction of query time compared to the other two models

Comparison of ideas and Implementation

- The HIVE paper took a different approach of implementation
  - This was more of a using and testing approach to better Hadoop
  - Hive was stacked on Hadoop and used to manipulate data
  - The idea was to have a query language similar to SQL for users to have an easy transition to HiveQL
  - HiveQL was the solution for avoiding the difficult MapReduce code that was hard to maintain and reuse
- Comparing MapReduce to two parallel DBMSs resulted in shocking results
  - It was seen that the two parallel DBMSs out-performed MR
  - The parallel DBMSs and MR were given 5 tasks to perform
    - The parallel DBMSs out-performed MR in all tasks including analytical tests
  - Some of these tasks were jobs such as data storage, data scanning, and aggregating values

Stonebreaker Talk: Main Ideas

- One size fits none!
  - Traditional row stores do not do the job anymore and are obsolete!
- Changing storage to main memory
  - Placing all data in main memory is more effective and cheap
  - This results in light transactions, along with different SQL techniques compared to row storage
- All major vendors have now or will have column stores
  - These column stores are"2 orders of magnitude" faster than row stores
- Complex Analytics
  - Column stores, array stores, or another potential statistical package will take this market (as well as the graph analytics market)
  - Row stores (SQL) perform these analytic algorithms too slowly for today's expectations
- New ideas
  - The "bottleneck" seems to be at networking, higher speed networks will potentially fix this problem
  - Non-volatile RAM will get rid of flash-memory
    - Processor diversity will increase due to main memory databases growing exponentially
- What about the "elephants"
  - The traditional developers or innovators will need to transition while trying to not lose market share
  - Stonebreaker believes that SQLServer and Hekaton will be the legacy vendors that lead this transition

Advantages & Disadvantages of HIVE

In Comparison with the comparison Large Scale Data Analysis and Stonebreaker's Talk

- Advantages:
  - Hadoop is a column storing database which results in faster execution than a row store database
  - HiveQL alleviates the struggle of learning MR, and provides the users with a language that has the expressiveness of SQL
  - HiveQL allows SQL users to adjust to this query language quickly, resulting in Legacy Vendors having users adapt to this relatively new engine
  - Using Hive, Hadoop has the potential to take over markets such as graph analysis and complex analytics
- Disadvantages
  - MapReduce is very inefficient in comparison to parallel DBMSs
    - Statistics show that parallel DBMSs produce faster analytical tasks compared to MR
    - There is also a very steep learning curve when dealing with MR, which results in wasted time from users learning MR
  - Hadoop and Hive is also inefficient because it does not split its tasks amongst databases (it does use multiple nodes though), resulting in tasks being completed at a slower rate
    - Having an updated version would help this problem but make it difficult for the original version to be converted to this new system
    - Stonebreaker speaks about how you can have specific databases for certain tasks