Cloudera Runtime 7.1.8

Planning for Apache Impala

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Guidelines for Schema Design

Use the guidelines in this topic to construct an optimized and scalable schema that integrates well with your existing data management processes.

Prefer binary file formats over text-based formats

To save space and improve memory usage and query performance, use binary file formats for any large or intensively queried tables. Parquet file format is the most efficient for data warehouse-style analytic queries. Avro is the other binary file format that Impala supports, that you might already have as part of a Hadoop ETL pipeline.

Although Impala can create and query tables with the RCFile and SequenceFile file formats, such tables are relatively bulky due to the text-based nature of those formats, and are not optimized for data warehouse-style queries due to their row-oriented layout. Impala does not support INSERT operations for tables with these file formats.

Guidelines:

- For an efficient and scalable format for large, performance-critical tables, use the Parquet file format.
- To deliver intermediate data during the ETL process, in a format that can also be used by other Hadoop components, Avro is a reasonable choice.
- For convenient import of raw data, use a text table instead of RCFile or SequenceFile, and convert to Parquet in a later stage of the ETL process.

Use Snappy compression where practical

Snappy compression involves low CPU overhead to decompress, while still providing substantial space savings. In cases where you have a choice of compression codecs, such as with the Parquet and Avro file formats, use Snappy compression unless you find a compelling reason to use a different codec.

Prefer numeric types over strings

If you have numeric values that you could treat as either strings or numbers (such as YEAR, MONTH, and DAY for partition key columns), define them as the smallest applicable integer types. For example, YEAR can be SMALLINT, MONTH and DAY can be TINYINT. Although you might not see any difference in the way partitioned tables or text files are laid out on disk, using numeric types will save space in binary formats such as Parquet, and in memory when doing queries, particularly resource-intensive queries such as joins.

Partition, but do not over-partition

Partitioning is an important aspect of performance tuning for Impala. Set up partitioning for your biggest, most intensively queried tables.

If you are moving to Impala from a traditional database system, or just getting started in the Big Data field, you might not have enough data volume to take advantage of Impala parallel queries with your existing partitioning scheme. For example, if you have only a few tens of megabytes of data per day, partitioning by YEAR, MONTH, and DAY columns might be too granular. Most of your cluster might be sitting idle during queries that target a single day, or each node might have very little work to do. Consider reducing the number of partition key columns so that each partition directory contains several gigabytes worth of data.

You can reduce the Parquet block size to as low as 128 MB or 64 MB to increase the number of files per partition and improve parallelism. But also consider reducing the level of partitioning so that analytic queries have enough data to work with.

Run COMPUTE STATS after loading data

Impala makes extensive use of statistics about data in the overall table and in each column, to help plan resource-intensive operations such as join queries and inserting into partitioned Parquet tables. Because this information is only

available after data is loaded, run the COMPUTE STATS statement on a table after loading or replacing data in a table or partition.

Having accurate statistics can make the difference between a successful operation, or one that fails due to an out-of-memory error or a timeout. When you encounter performance or capacity issues, always use the SHOW STATS statement to check if the statistics are present and up-to-date for all tables in the query.

When doing a join query, Impala consults the statistics for each joined table to determine their relative sizes and to estimate the number of rows produced in each join stage. When doing an INSERT into a Parquet table, Impala consults the statistics for the source table to determine how to distribute the work of constructing the data files for each partition.

Verify sensible execution plans with EXPLAIN and SUMMARY

Before executing a resource-intensive query, use the EXPLAIN statement to get an overview of how Impala intends to parallelize the query and distribute the work. If you see that the query plan is inefficient, you can take tuning steps such as changing file formats, using partitioned tables, running the COMPUTE STATS statement, or adding query hints.

After you run a query, you can see performance-related information about how it actually ran by issuing the SUMM ARY command in `impala-shell`. Prior to Impala 1.4, you would use the PROFILE command, but its highly technical output was only useful for the most experienced users. SUMMARY, new in Impala 1.4, summarizes the most useful information for all stages of execution, for all nodes rather than splitting out figures for each node.