Optimal Resource Allocation and Job Scheduling to Minimise the Computation Time under Hadoop Environment

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Abstract- Bigdata handles the datasets which exceeds the ability of commonly used software tools for storing, sharing and processing the data. Classification of workload is a major issue to the Big Data community namely job type evolution and job size evolution. On the basis of job type, job size and disk performance, clusters are been formed with datanode, namenode and secondary namenode.To classify the workload and to perform the job scheduling, mapreduce algorithm is going to be applied. Based on the performance of individual machine,workload has been allocated. Mapreduce has two phases for processing the data: map and reduce phases. In map phase,the input dataset taken is splitted into key-value pairs and an intermediate output is obtained and in reduce phase that key value pair undergoes shuffle and sort operation. Intermediate files are created from map tasks are written to local disk and output files are written to distributed file system of Hadoop. Scheduling of different jobs to different disks are identified after completing mapreduce tasks. Johnson's algorithm is used to schedule the jobs and used to find out the optimal solution of different jobs.It schedules the jobs into different pools and performs the scheduling.The main task to be carried out is to minimize the computation time for entire jobs and analyze the performance using response time factors in Hadoop distributed file system. Based on the dataset size and number of nodes which is formed in Hadoop cluster, the performance of individual jobs are identified.

Keywords – Workload classification, Mapreduce algorithm, Hadoop distributed file system, Jobscheduling using Johnson's algorithm

I. INTRODUCTION

Bigdata is defined as the large collection of datasets which is complex to process.The organisation face difficulties to create, manipulate and manage the large datasets. For example,if we take the social media facebook, there will be some posts on the page. The number of likes, shares and comments are given at a second for a particular post it leads to creation of large datasets which gives trouble to store the data and process the data. It involves massive volume of both structured and unstructured data.Facebook handles 50 billion photos from its user base.Data mining and Data warehousing technique involves 95% time for gathering data and only 5% for analyzing the data and no parallel process been carried out. Bigdata spends 70% time for gathering data and 30% time for analysing the data.It will speed up the complex queries and parallel process which are carried out in bigdata platform.
The rest of the paper explains about literature support in section II,proposed work in section III and in Section IV implementation details are explained.

II.LITERATURE SUPPORT

A. DYNAMIC SLOT ALLOCATION TECHNIQUE

Dynamic Hadoop Fair Scheduler(DHFS)

It schedules the job in order manner, it has pool-independent DHFS(PI-DHFS) and pool-dependent DHFS(PD-DHFS).Pool dependent DHFS have each pool which satisfy only its own map and reduce tasks with its shared map and reduce slots between its map-phased pool and reduce-phased pool,it is known to be intra pool dynamic slots allocation. Pool independent DHFS considers the dynamic slots allocation from the cluster level itself,instead of pool-level.The map tasks have priority in the use of map slots and reduce tasks have priority to reduce slots are called as intra phase dynamic slots allocation.When the respective phase slots requirements met excess slots be used by other phase are referred as inter phase dynamic slots allocation.

Dynamic slot allocation

It is a technique for managing global session resources and it allows dynamic resizing of the cache per-client, per-load basis . The client communicates to the server about whether resources are filled in all slots or not filled in the slots. The server then decides how many slots it should allocate to that client in the future. Communication occurs via the sequence operation, which means that updates occur on every step.

Process of Hadoop Fair Scheduler

It runs small jobs quickly, even if they are sharing a cluster with large jobs. The users should only need to configure, it support reconfiguration at runtime, without requiring a cluster restart.Fair scheduling is a method of assigning resources to jobs. When there is a single job running, that job uses the entire cluster. When other jobs are submitted, tasks slots that free up are assigned to the new jobs, so that each job gets roughly the same amount of CPU time.

B. JOB SCHEDULING FOR MULTI-USER MAPREDUCE CLUSTERS

Job scheduling process

Job scheduling in Hadoop is performed by the job master,which manages a number of worker nodes in the cluster. Each worker has a fixed number of map and reduce slots,which can run tasks.The workers periodically send heartbeats to the master to reporting the number of free slots and tasks. The objective of scheduling is to determine the job schedules that minimize or maximize a measure of performance. It can be characterized by a set of jobs, each with one or more operations.

Multi user cluster scheduling

The jobs are composed of small independent tasks,it is possible to isolate while using cluster efficiently.The steps in multi user cluster scheduling are to make tasks small in length having small tasks make other new jobs to startup quickly.

Delay scheduling

The job which is to be scheduled next, should wait for the previous job to be completed. After completion of the previous job,the current job should be processed and delay occurs.This type of job scheduling are known as delay scheduling.

Copy compute splitting

HDFS copy tasks that because they perform large amounts of memory copies when merging map outputs, there is little gain from copy-compute (copy tasks compete with compute tasks with CPU).

III. PROPOSED WORK

This section provides a basic background on the MapReduce framework and outline about Johnson's algorithm used for constructing the optimized job schedule.

A. MAPREDUCE ALGORITHM

The Mapreduce algorithm is a two-step method for processing a large amount of data. It process the parallel problems across huge datasets. These frameworks supports upto petabytes of data.

Map step: The dataset is given as a client input into hadoop distributed file system.Under the map process,the given dataset is splitted into individual lines or words using mapper instances and an intermediate output is obtained by output.

Reduce step: Shuffle,sort and reduce are the three process to be done in reduce phase.The intermediate output obtained in map phase undergoes shuffle,and it gets sorted order. At the final phase reduce ,the dataset get reduced. Each step starts only after the previous step is completed.

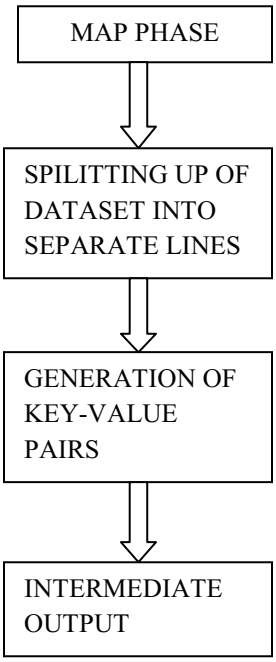

Figure1 Map processing steps

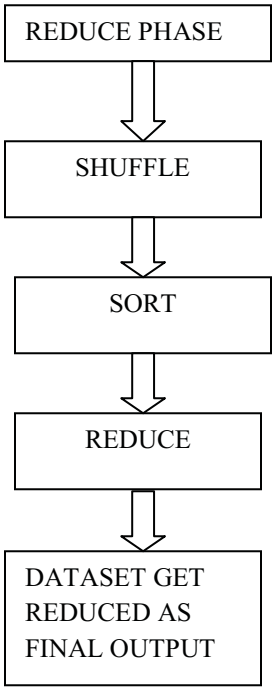

Figure2 Reduce processing steps

B. JOHNSON'S ALGORITHM

Johnson's algorithm is used to find an optimal solution of order for different sets of jobs to be processed. It obtains minimal makespan(computation time); Johnson's algorithm will identify only one solution.

1. List A_i and B_i in two columns
2. Find smallest in two columns. If it is in A, schedule it next, if it's in B, then last.
3. Continue until all jobs scheduled.

Consider an example for job scheduling using Johnson's algorithm,

A_i be the processing time of job I on machine A
B_i be the processing time of job I on machine B

Step 1:

JOB	A	B
1	4	2
2	(1)	3
3	6	8
4	7	9
5	10	5

Here Job 2 is smallest, so it goes first.
The order of job sequence is 2.

Step 2:

JOB	A	B
1	4	(2)
2	(1)	3
3	6	8
4	7	9
5	10	5

1.Job 2 goes first.
2. Job 1 is next smallest in B, so goes last .
The order of job sequence is 2, , , ,1

Step 3:

JOB	A	B
1	4	2
2	1	3
3	6	8
4	7	9
5	10	5

Here Job 2 is smallest again, so it exists in same sequence of job order. The order of job sequence is 2, , , , , ,1

Step 4:

JOB	A	B
1	4	2
2	1	3
3	6	8
4	7	9
5	10	5

Here Job 1 is smallest again, so it exists in same sequence of job order.The order of job sequence is 2, , , , , ,1

Step 5:

JOB	A	B
1	4	2
2	1	3
3	6	8
4	7	9
5	10	5

1. Job 2 goes first.
2. Job 1 goes last.
3. Job 5 is smallest, in B column, so it goes next .

The order of job sequence is 2,5 , , , , ,1

Step 6:

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JOB	A	B
1	4	2
2	1	3
3	6	8
4	7	9
5	10	5

1. Job 2 goes first.
2. Job 1 goes last.
3. Job 4 goes next.
4. Job 5 smallest in B, comes next to first.

The order of job sequence is 2,5 , ,3 ,1

Step 7:

JOB	A	B
1	4	2
2	1	3
3	6	8
4	7	9
5	10	5

1. Job 2 goes first.
2. Job 1 goes last.
3. Job 5 goes next.
4. Job 3 before last.
5. Job 4 comes next.

The order of job sequence is 2,5 ,4 ,3 1

Hence by applying Johnson's algorithm the Hadoop job schedule is performed based on the size of job and job evolution.

IV.IMPLEMENTATION DETAILS

In this chapter the implementation details like the algorithms that will be used to resolve the problem and the framework that will be used to produce the simulation methods are also analyzed and proposed for the work. Hortonworks Sandbox tool is a virtual machine with Apache Hadoop pre-configured installation. It's a quick and easy way to start experimenting with Hadoop. Hadoop is an Apache top level project being built and it is licensed

under the Apache License 2.0.It is designed to scale up from single servers to thousands of machines, each offers local computation and storage.

Workload classification poses many challenges to the Big Data community as their major challenges namely, Job type evolution and Job size evolution. Going to classify the workload based on disk performance and allocate the resources for scheduling of jobs.Dataset is going to be given as input under Hadoop distributed file system.The dataset which is taken initially undergoes mapreduce algorithm.It consists of two steps in map phase.The dataset is passed into the individual mapper instances and it splits the datas into individual lines. Splitting of input gives an key-value pair as an intermediate output under mapping task. Next we need to perform reduce phase. It consists of shuffling,sorting and reduce operations to be performed. During shuffling and sorting ,an intermediate output produced gets shuffled and sorted in a sequence order. At reduce phase the dataset given is reduced to give final output.The jobs are divided into pools and resources are allocated. If single job is running it occupies the entire cluster. If there comes next job to process, it should process in allocated pools. Minimisation of jobs and its computation time can be computed using job scheduling technique.By applying Johnson's algorithm scheduling of jobs are properly done with minimum completion time. Different datas are allocated to different disks to perform job scheduling process,it will process based on the size of the data.Finally, the jobs are scheduled within minimal time to manage the Bigdata.

MODULE DESCRIPTION

There are four modules designed to implement the project.The four modules are:

1. Formation of clusters using Hadoop distributed file System.
2. Establishing Mapreduce function for the datasets.
3. Optimization of job scheduling process.
4. Performance Analysis through Make span and Response time factors.

MODULE-I Formation of clusters using Hadoop distributed file System

Setting up the Hadoop cluster in Hadoop distributed file system with the use of data node,name node.secondary namenode,job tracker,task tracker to perform Hadoop operations using mapreduce algorithm.Here individual nodes perform its own operations . Data node stores the data in Hadoop file system.Name node keeps the directory of all files in the filesystem. Multinode clusters are formed to perform the tasks for large datasets. A typical file in HDFS is gigabytes to terabytes in size. It should support tens of millions of files in a single instance.The nodes of clusters are initially formed in this module.

MODULE-II Establishing Mapreduce function for the datasets

The workload is classified and given to the mapreduce framework for MAP and REDUCE process.It splits the dataset into individual lines by using mapper instances and schedule the jobs inaccordance with hadoop cluster components.Workload undergoes splitting, shuffling, sorting and reducing operations. Mapreduce allows for distributed processing of the map and reduction operations. Provided that each mapping operation is independent of the others, all maps can be performed in parallel,it is limited by the number of independent data sources .

MODULE-III Optimization of job scheduling process using Johnson's algorithm

In the module,job scheduling of the individual disks are performed. Assigning tasks to every individual node are performed by mapreduce task assignment slots. By using Johnson's algorithm then scheduling of jobs among different disks are been performed.When a pool contains jobs, it gets at least its minimum share, but when the pool does not need its full guaranteed share, the excess is split between other pools. If the single job is running ,it occupies entire Hadoop cluster,if next job starts to process the jobs are divided into pools and individual resources are allocated based on the disk performance.

MODULE-IV Performance Analysis through Make span and Response time Factors

To identify the performance analysis of the disks located in Hadoop distributed file system by identifying its computation time and its response factors. The analysis dependent on parameters such as: dataset size, number of nodes, number of reducers and loading overhead. The results indicate strong dependence on the amount of reducers and IO performance of the cluster, which proves the common opinion that Mapreduce is IO bound. These results can help to compare performance behavior of different languages and serve as a basis for understanding the influence of configuration parameters on the final performance.

V.CONCLUSION

In this project work, the study of map reduce algorithm is performed under Apache Hadoop framework. It deals with workload classification and minimizing the computation time of entire jobs. The Hadoop cluster is formed and jobs are allocated to the specific pools. Data node,Name node,Job tracker and Task tracker are the Hadoop cluster components which does their tasks in complete manner. If client sends dataset to the Hadoop distributed file system, it separates the tasks to master node and slave node and performs the job using mapreduce concepts taken under map stage and reduce stage. By using Johnson's algorithm, the optimal solution for individual jobs for different disks are been calculated. Further,the efficiency of the computation task can be computed by the datasets taken and number of nodes that is generated in Hadoop distributed file system.

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