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Cost based Model for Big Data Processing with Hadoop Architecture

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Received: 13 December 2013 Accepted: 5 January 2014 Published: 15 January 2014

Abstract

With fast pace growth in technology, we are getting more options for making better and optimized systems. For handling huge amount of data, scalable resources are required. In order to move data for computation, measurable amount of time is taken by the systems. Here comes the technology of Hadoop, which works on distributed file system. In this, huge amount of data is stored in distributed manner for computation. Many racks save data in blocks with characteristic of fault tolerance, having at least three copies of a block. Map Reduce framework use to handle all computation and produce result. Jobtracker and Tasktracker work with MapReduce and processed current as well as historical data that?s cost is calculated in this paper.

Index terms— big data, hadoop, cloud computing, mapreduce.

1 Introduction

echnologies are changing rapidly, with lot of competition. In past, hardware cost was meaningful, as storage was a big issue for technological development, because of it's cost. Software and hardware, both having same cost at that time. After that software becomes complex in terms of development, but easy to use. Nowadays, with decrement in cost of hardware, the limitations of storage is not an issue. As functional programming, works with several functions **??**1] , so it requires large amount of space to run a program, reducing the execution time to a great extent [2]. So today's scenario is about faster execution without focusing on hardware cost. As industry is growing, hardware cost is getting lowered so sufficient amount of storage is available without difficulties. Earlier technologies were having specific views on hardware usage, now even 1TB is not a big deal for our commodity system.

Many social network use Resource Description Framework (RDF) [3]. Facebook's Open Graph [4], Freebase [5] and DBpedia **??**6] are having structured data. Facebook's Open Graph [4] show connection of user to its real functioning. Freebase [5] provide structured directories for music. DBpedia [6] provide structural contents from wikipedia. As per records till 2012, every minute usage of social networking site 'Facebook', having largest number of users, generating share of 684,478 pieces of contents, 'Youtube' users upload 48 hours video, 'Instagram' users share 3,600 new photos and 'Tumbir' sees 27,778 new post published **??**7]. A Boeing 737 engine generate 10 terabytes of data in every 30 minutes of flight **??**8]. All these data are information regarding weather conditions, positioning of plane, travelers information and other matters. So volume, velocity and complexity of data generation is increasing day to day. That require tool to handle it and more importantly with in time limit. Traditional database is not sufficient for doing all these calculation under the time limit. Here Hadoop fulfill all current requirements. Facebook, Google, LinkedIn, Twitter are establishing their business in Big Data. Many companies are still not having Hadoop professionals but they hire those from other companies. World's second largest populated country, India, having four times the population than USA, start trend of Big Data and is implementing Biometric System with unique ID number of every person. This project is called "Aadhar Project" that is world largest Biometric Identity project [9] with use of smart card technology and specification of International standard for electronic identification cards. With research perspective on Big Data, apart from Computer Science, other fields like Mathematics, Engineering, Business and Management, Physics

and Astronomy, Social Science, Material Science, Medicine, Arts are also taking keen interest in that [10]. USA is on top, in research of Big Data issues, followed by China [10].

In today's world Big Data is moving towards cloud computing. Cloud computing provides required infrastructure as CPU, bandwidth, storage spaces at needed time. Organization like Facebook, LinkedIn, Twitter, Microsoft, Azure, Rackspace etc. have moved to cloud and doing Big Data analytic work, like Genome Project **??**11] that is processing petabytes of data in less amount of time. These technologies use MapReduce, for proper functioning. For moving Big Data to cloud, all data is moved and processed at data center [12], as being available at one place, cloud facilities can be easily provided.

In this paper section 2 is focusing on importance of MapReduce technique in current system and its practical uses there. Section 3 elaborate about features of Hadoop system with its functionalities.

2 Mapreduce: Visual Explanation

MapReduce is framework that work in distributed environment with server and client infrastructure. SPARQL is an RDF query language which used in social networking for data processing. SPARQL produce triplet as result of query process [3]. MapReduce provide functionality for processing query result. Facebook's close friend list, is output of processing of this technology in which 'selection' query processed then 'join' operation start functioning. Every 'join' process run one MapReduce function [13]. This is two layer mapping [3], refer to provide unnecessary MapReduce function for data processing. SPARQL generate triplet form of table in which 'selection' apply followed by 'join' operation. 'Selection' generate KEY-VALUE pair that is need for processing of MapReduce. Triplet ID is KEY assessment while its result is VALUE. Reduce function perform its functionality with same KEY-VALUE pair. 'Multiple join with filter' [3] proposed system with one layer mapping in which filter key used along with 'selection' and 'join' operations. MapReduce provides the services as text processing (wordcount, sort, terasort), web searching (pagerank) and machine learning (bayesian classification). HiBench [14] is providing MapReduce function to generate random data to include work load. MapReduce functioning consist four phases as 'map', 'shuffle', 'sort' and 'reduce'. 'Map' process generate intermediate result that need to be process further for resultant, 'reduce' phase start working preceded by shuffle and sort function. If there are 'P' no. of servers in cluster then shuffle phase has traffic O(P2) flows [15]. The standard concluding output size in Google jobs is 40.3% of the intermediate data set sizes. In the Facebook and Yahoo jobs consider in [16], the fall in size between the intermediate and the output data is even more distinct: in 81.7% of the Facebook jobs with a reduce segment, the final output data size is only 5.4% of the intermediate data size [15].

Server is responsible for assigning task for MapReduce. If there are 'P' systems and 'N' blocks of data then N/P blocks stored per system by server. Usually block size is user dependent and by default it is 64 MB. 'Map' phase generate (key, value) pair of data where each value have unique ID as key.

Server can run reduce function one time or more. It compute result based on (key, value) pair on server. Task, like web search query reduce function run one time that is sufficient for result [15]. Client is an application which used by end user and provide task to master and slave node for process. It ensure distributed data processing and distributed data storage. Apart from submitting job to cluster client machine it instruct for 'map' and 'reduce' and at last get the result as output. Client application accept job for processing and break it into blocks. Client take suggestion from master node about empty spaces and distributed these blocks to slaves.

3 b) Master Node and Slave Node

Master node consist with Namenode and Jobtracker while slavenode consist with Datanode and Tasktracker as shown in fig. 2. Client ask Namenode about distribution of blocks. For safety of system block is replicated by minimum three. It is default replicas and it can be set further by user. Namenode provide list of Datanodes to client where data can be stored. Namenode stores meta data which store in RAM that consist information about all Datanodes, racks information, blank spaces, namespace of entire system like last modified time, create time, file size, owner permission, no. of replicas, block-ids and file name. Data retain in Datanode as it never fail; out of three copies one copy retain in by one Datanode in a rack whiletwo other copies put in another same rack but in different Datanodes. This feature gives the quality of fault tolerance with less chance of failure of Datanode and rack simultaneously. Transfer of all block is TCP connection so proper acknowledgment is there with pipeline processing with no wait for completion. Namenode keep updating its meta data as it receives acknowledgment from Datanode. Datanode keep sending signal with interval of three seconds indicating its aliveness; if it not receive by Namenode within 10 minutes then Datanode consider as dead and make it's replica to other node by master node.

If any file need to be executed then client ask Jobtracker to start executing file that reside in Hadoop Distributed File System (HDFS). Jobtracker takes information from Namenode about residence of operative blocks. After that Jobtracker instruct Tasktracker to run program for execution of file. Here 'map' function start and reported by signal to Jobtracker. Output of 'map' result store in Tasktracker's local memory. 'Map' results intermediate data and send it to a node which function by gathering all intermediate data for performing 'reduce' task. At last output is written to HDFS and sent to client.

4 c) Hadoop Distributed File System

Hadoop use HDFS for storing the data that is distributed in nature and storing large data with streaming data pattern. Google file system (GFS) [24] also chunk based file system, use design of one master and many chunkservers. HDFS support fault tolerance with high throughput and can be built out of commodity hardware. But it is not useful for large amount of small files with low latency data access. GFS and HDFS do not execute POSIX semantics [25].

5 Evaluation Cost in Hadoop Architecture

Consider a system where Client, Namenode, Datanode are connected. Let assume client (C) is connected to switches (P) in client side, Switches (Q) are in Datanode side where (D) numbers of Datanodes are connected to each other in a rack as fig. 3. These racks are connected as pipeline pattern. Such structure is reflected as architecture of Hadoop. Bandwidth between both switches is limited as B P,Q 1. When any task comes to client for processing it consult with Namenode. Namenode regularly aware about rack storage for its availability with Datanodes. For engagement of further proceeding value XC;N take decision about connection signal between Namenode and client. Decision cost will be:

2. Client consult with Namenode which have information about rack system. Namenode having knowledge about which Datanode is free to occupy blocks of file which come to client for processing. This file is divided at least in three parts (up to user Decision Cost(X C,N) = 1 if X>0 0 if X=0**(1)**

choice). Namenode gives the address of maximum bandwidth rack first and continue with decreasing order of bandwidth. If assume data rate is _P;Q and total amount need to transfer is Gd(t) then bandwidth cost B P,Q will be:

Where p, q, d are one of the component from switches and Datanodes. This information store in RAM of Namenode. Gen2 Hadoop use secondary Namenode which access information for backup of Namenode's data from its RAM and store it to hard disk. Secondary Namenode is not a replacement of Namenode. decide the factor of current or historical data. If any Datanode not sending signal from 10 min. then assume to 0 but newly allocated data will be transferred to another node by estimation factor.

6 Conclusion

This paper elaborated the architecture of Hadoop with its growing usage in industries as well as function of MapReduce on which current technologies moving. Among rack that consist of Datanodes and Tasktrackers choose by Namenode on basis of routing cost as showing in paper. It also evaluate cost of result that produce by different Datanodes. Decision of establishing communication of client with Datanode will also be decide by link between Namenode and client. Datanode may consist of historical data that's cost also get evaluated in this paper. Year 2014

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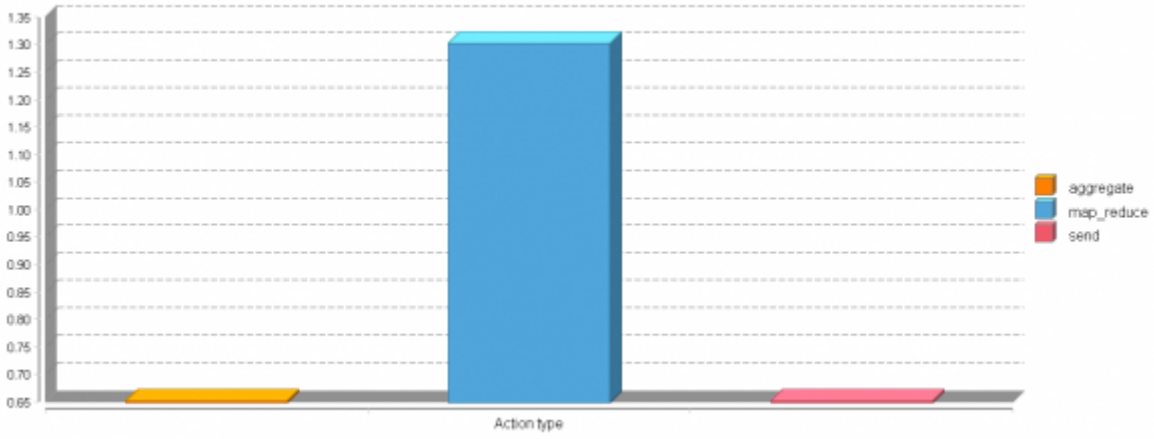
u=T u=1 R G d (u)**(3)** [1]

[1]

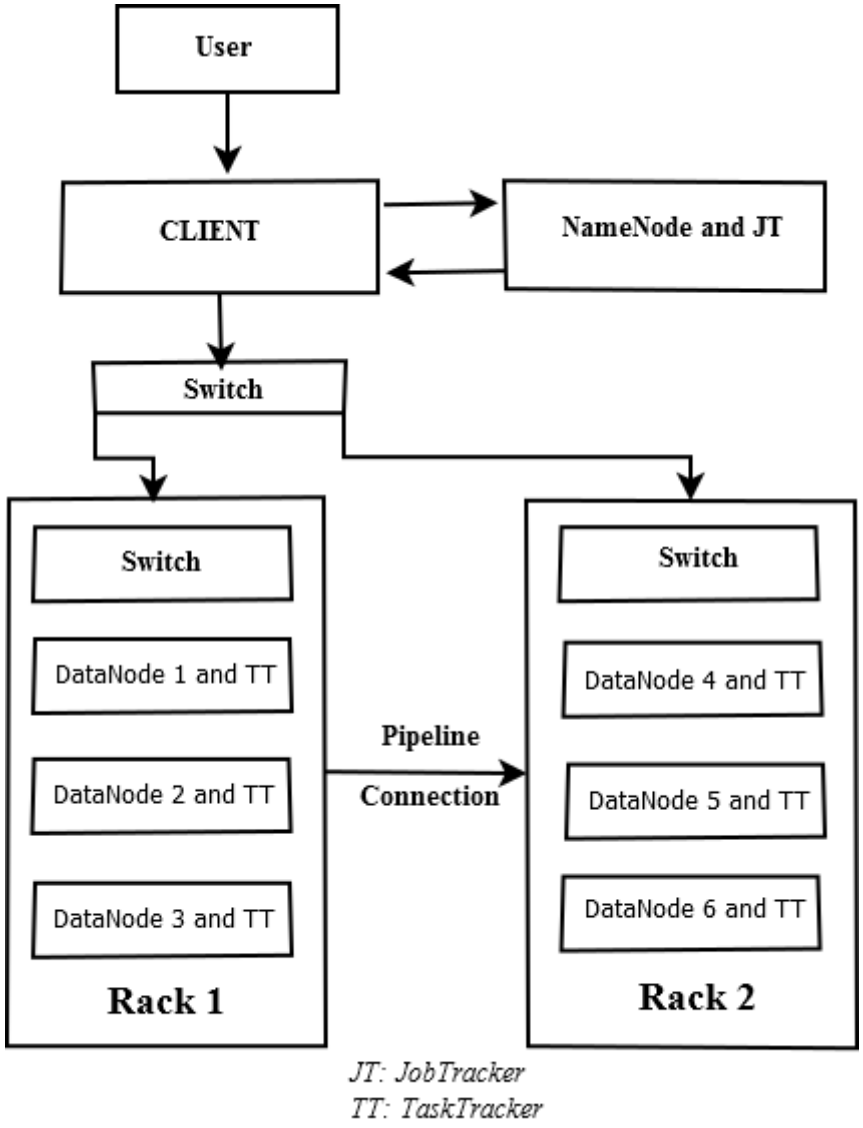
1

Figure 1: Figure 1 :



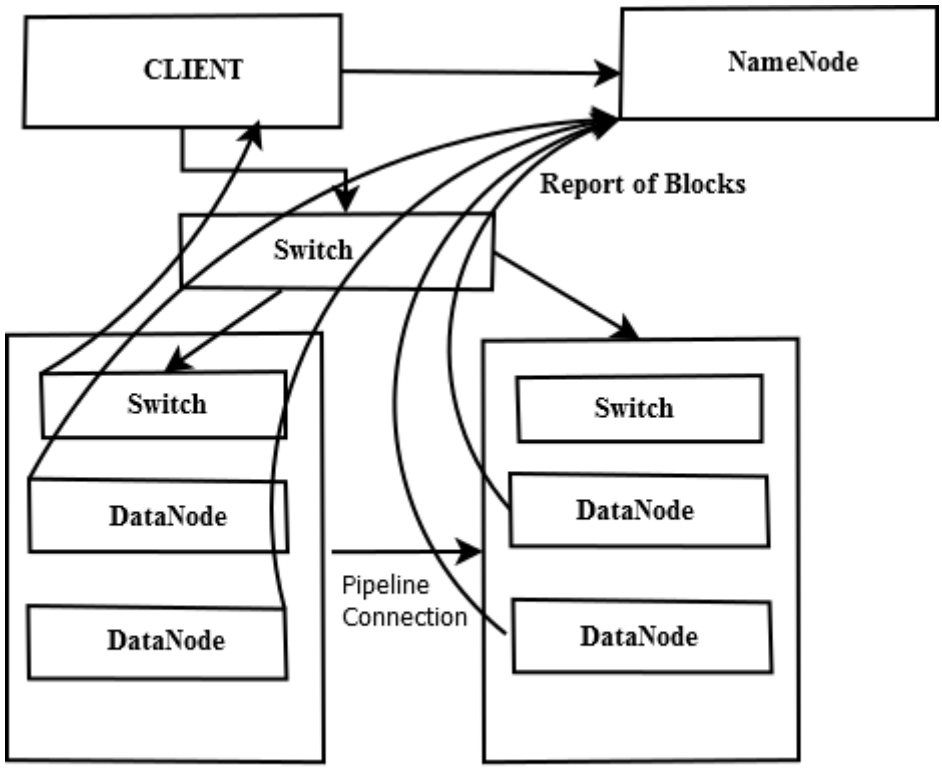
2

Figure 2: Figure 2 :



3

Figure 3: Figure 3 :



4

Figure 4: Fig. 4 :

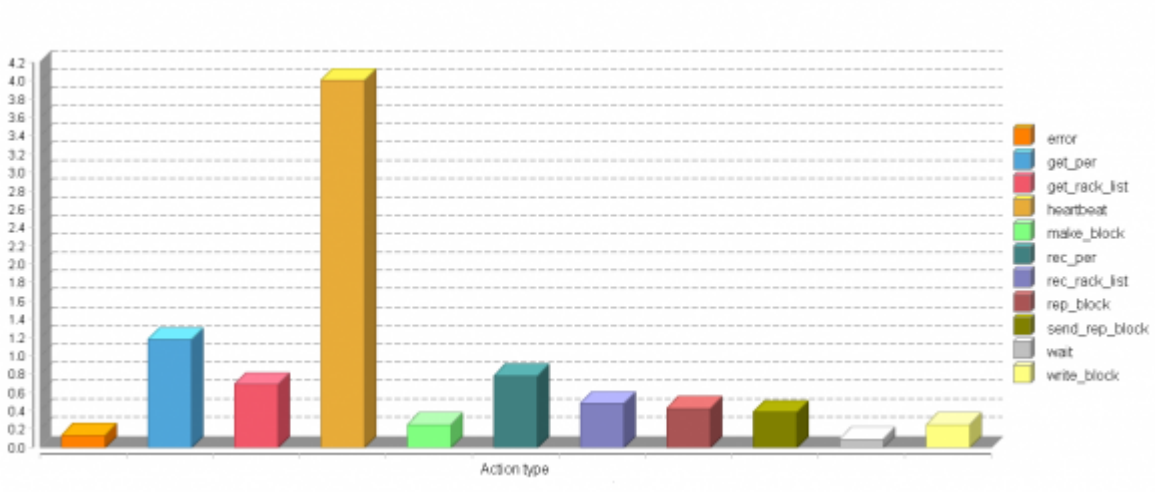


Figure 5: Volume

[Open Graph] , https://developers.facebook.Com/docs/opengraph *Open Graph*

[Human Genome Project] , http://www.ornl.gov/hgmis/home.shtml.11.www.researchtrends.com *Human Genome Project*

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