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Big data Security and Privacy

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Abstract- Big Data is an important issues in the recent years, enables computing resources to be provided as Information Technology services with high efficiency and effectiveness. Big data is a new technological paradigm for data that is generated at high speed, high volume, and with great diversity.On social media thousands of posts are generated per second. Its nature, sharing, storage management, and security and privacy are some crucial issues which are taken up for consideration in this paper. The issues are thoroughly discussed and analysed.

Keywords— Big Data, Hadoop, MapReduce, HDFS, NoSQL, , Security, Privacy

I. Introduction:-

Big data refers to the concept of very large data sets involving three major dimensions or properties named (3Vs). Data can be structured, unstructured, or semi-structured generated either by humans or machines.

First is a volume according to the amount of data located in the storage medium. Second is Variety which refers to the various heterogeneous and complex types of data. The third is velocity which indicates the speed of data processing required to handle that large amount of data.

Most definitions of big data focus on the size of data in storage. Size matters, bu there are other important attributes of big data, namely data variety and data velocity. In addition, each of the three Vs has its own ramifications for analytics.

Eighty percent of data which is generated by social media is unstructured data which cannot be handled by traditional software i.e. DBMS, OLAP etc. Data analysis has been named by many names in 1970 it was named by decision support system, in 1990 it became business intelligence and from 2008 it has now become data analytics. In order to process big data we require other sophisticated tools like Hadoop, R, Hive, NoSQL, search and knowledge discovery, in memory fabric, distributed file system, HDFS, Pig , data virtualization, Polybase, data integration, Sqoop, Presto, etc. The contradictions of big data are identity, transparency, and power [23]. Lambda and kappa are the big data architectures. In order to preserve the privacy, security, threats, vulnerabilities, and attacks some prevention and counter measures are needed. A system is treated secure if is access controlled, integral, authentic, and confidential. Threats and risks are exploited by adversary [24-29].

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Some policies and mechanisms are framed to prevent, detect, and correct the security attacks on important data. Anti spam, antivirus, firewalls, internet security may be used to thwart the attacks

II.Challenges of Big Data Quality

Big Data can bring cost saving, risk control, improvement of management efficiency, and increment of value into enterprise. In the meanwhile, Big Data brings some challenges:

- Unevenness of Data Quality

The large amount of data. Though the first step of processing data is to gather data, if the gather all data in spite of quality, it is possible to make wrong predictions and decisions. according to view of this condition, after gathering data, it is necessary to select relative data and clean conflicting data.[13]

- Lack of skills

Big data application requires enterprise to design new data analysis models. That's because traditional models are fit to process structured data not big data including multi-type data. Thus, it needs some data science to apply to enterprise data management. The enterprise is short of talents who can design new data analysis models. The talents who not only can design new data analysis models but also know the financial management are fewer. Lack of talents is a severe and long-term issue. Big Data is a sword with two blades. Through affecting the idea, function, mode, and method of financial management, it can bring cost saving, risk control, improvement of management efficiency, and increment of value into enterprise. In the meanwhile, it brings a lot of challenges. Only through fostering strengths and circumvent weaknesses, can an enterprise remain invincible in Big Data era.[13]

III. Big data Features

Figure 1. The six V's of Big Data.

❖ Volume

Refers to the tremendous volume of the data. We usually use TB or above magnitudes to measure this data volume. Velocity means that data are being formed at an unprecedented speed and must be dealt with in a timely manner.

❖ Variety indicates that big data has all kinds of data types, and this diversity divides the data into structured data and unstructured data. These multi typed data need higher data processing capabilities.[14]

❖ The diversity of data sources brings abundant data types and complex data structures and increases the difficulty of data integration

❖ One data type is unstructured

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data, for example, documents, video, audio, etc. The second type is semi-structured data, including:software packages/modules, spreadsheets, and financial reports. The third is structured data. The quantity of unstructured data occupies more than 80% of the total amount of data in existence.

- ❖ Data change very fast and the "timeliness" of data is very short, which necessitates higher requirements for processing technology

- ❖ Due to the rapid changes in big data, the "timeliness" of some data is very short. If companies can't collect the required data in real time or deal with the data needs over a very long time, then they may obtain outdated and invalid information.

- ❖No unified and approved data quality standards have been formed in China and abroad, and research on the data quality of big data has just begun.

- ❖ In order to guarantee the product quality and improve benefits to enterprises, in 1987 the International Organization for Standardization (ISO) published ISO 9000 standards. Nowadays, there are more than 100 countries and regions all over the world actively carrying out these standards. This implementation promotes mutual understanding among enterprises in domestic and international trade and brings the benefit of eliminating trade barriers. By contrast, the study of data quality standards began in the 1990s.[14]

IV. Big Data Analysis

Big data analytics is differences from traditional analytics Because of the big increase in the volume of data and that led to Many researchers have suggested commercial DBMS and this not suitable with size of data. This type of data is impossible to handle using traditional relational database management systems. New innovative technologies were needed and Google found the solution by using a processing model called MapReduce. There are more solutions to handle Big Data, but the most widely-used one is Hadoop, an open source project based on Google's MapReduce and Google File System. Hadoop was founded by the Apache Software Foundation. The main contributors of the project are Yahoo, Facebook, Citrix, Google, Microsoft, IBM, HP, Cloudera and many others. Hadoop is a distributed batch processing infrastructure which consists of the Hadoop kernel, Hadoop Distributed File System (HDFS), MapReduce and several related projects.[15]

Big Data Analytics refers to the process of collecting, organizing, analyzing large data sets to discover different

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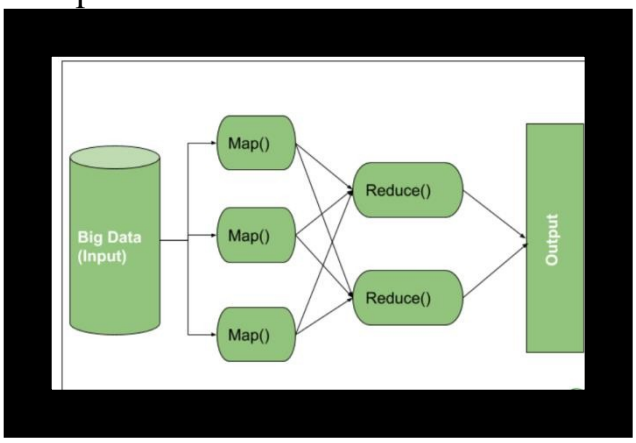
patterns and other useful information. Big data analytics is a set of technologies and techniques that require new forms of integration to disclose large hidden values from large datasets that are different from the usual ones, more complex, and of a large enormous scale. It mainly focuses on solving new problems or old problems in better and effective ways.

1. MapReduce

MapReduce nothing but just like an Algorithm or a data structure that is based on the YARN framework. The major feature of MapReduce is to perform the distributed processing in parallel in a Hadoop cluster which Makes Hadoop working so fast. When you are dealing with Big Data, serial processing is no more of any use. MapReduce has mainly 2 tasks which are divided phase-wise:
In first phase, Map is utilized and in next phase Reduce is utilized.



Here, we can see that the Input is provided to the Map() function then it's output is used as an input to the Reduce function and after that, we receive our final output. Let's understand What this Map() and Reduce() does.
As we can see that an Input is provided to the Map(), now as we are using Big Data. The Input is a set of Data. The Map() function here breaks this DataBlocks into Tuples that are nothing but a key-value pair. These key-value pairs are now sent as input to the Reduce(). The Reduce() function then combines this broken Tuples or key-value pair based on its Key value and form set of Tuples, and perform some operation like sorting, summation type job, etc. which is then sent to the final Output Node. Finally, the Output is Obtained.
The data processing is always done in Reducer depending upon the business requirement of that industry. This is How First Map() and then Reduce is utilized one by one.

2. HDFS

HDFS(Hadoop Distributed File System) is utilized for storage permission is a Hadoop cluster. It mainly designed for working on commodity Hardware devices(inexpensive devices), working on a distributed file system design. HDFS is designed in such a way that it believes more in storing the data in a large chunk of blocks rather than storing small data blocks.

Hadoop File System (HDFS) is a distributed file system. All types of files can be stored in the Hadoop file system. HDFS in Hadoop provides Fault-tolerance and High availability to

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the storage layer and the other devices present in that Hadoop cluster. Data storage Nodes in HDFS.

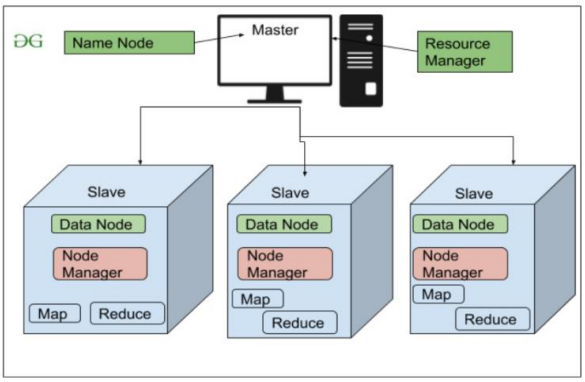
- NameNode(Master)
- DataNode(Slave)

NameNode:NameNode works as a Master in a Hadoop cluster that guides the Datanode(Slaves). Namenode is mainly used for storing the Metadata i.e. the data about the data. Meta Data can be the transaction logs that keep track of the user's activity in a Hadoop cluster.

Meta Data can also be the name of the file, size, and the information about the location(Block number, Block ids) of Datanode that Namenode stores to find the closest DataNode for Faster Communication. Namenode instructs the DataNodes with the operation like delete, create, Replicate, etc.

DataNode: DataNodes works as a Slave DataNodes are mainly utilized for storing the data in a Hadoop cluster, the number of DataNodes can be from 1 to 500 or even more than that. The more number of DataNode, the Hadoop cluster will be able to store more data. So it is advised that the DataNode should have High storing capacity to store a large number of file blocks.

High Level Architecture Of Hadoop



File Block In HDFS: Data in HDFS is always stored in terms of blocks. So the single block of data is divided into multiple blocks of size 128MB which is default and you can also change it manually.

This is because for running Hadoop we are using commodity hardware (inexpensive system hardware) which can be crashed at any time. We are not using the supercomputer for our Hadoop setup. That is why we need such a feature in HDFS which can make copies of that file blocks for backup purposes, this is known as fault tolerance.

Now one thing we also need to notice that after making so many replica's of our file blocks we are wasting so much of our storage but for the big brand organization the data is very much important than the storage so nobody cares for this extra storage. You can configure the Replication factor in your hdfs-site.xml file.

Rack Awareness The rack is nothing but just the physical collection of nodes in our Hadoop cluster (maybe 30 to 40). A large Hadoop cluster is consists of so many Racks . with the help of this

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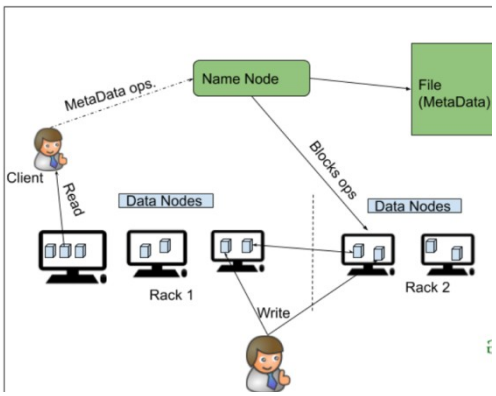
Racks information Namenode chooses the closest Datanode to achieve the maximum performance while performing the read/write information which reduces the Network Traffic.

HDFS Architecture



3. YARN(Yet Another Resource Negotiator)

YARN is a Framework on which MapReduce works. YARN performs 2 operations that are Job scheduling and Resource Management. The Purpose of Job schedular is to divide a big task into small jobs so that each job can be assigned to various slaves in a Hadoop cluster and Processing can be Maximized. Job Scheduler also keeps track of which job is important, which job has more priority, dependencies between the jobs and all the other information like job timing, etc. And the use of Resource Manager is to manage all the resources that are made available for running a Hadoop cluster.

Features of YARN

- Multi-Tenancy
- Scalability
- Cluster-Utilization
- Compatibility

4. Hadoop common or Common Utilities

Hadoop common or Common utilities are nothing but our java library and java files or we can say the java scripts that we need for all the other components present in a Hadoop cluster. these utilities are used by HDFS, YARN, and MapReduce for running the cluster. Hadoop Common verify that Hardware failure in a Hadoop cluster is common so it needs to be solved automatically in software by Hadoop Framework.

V. How we can secure big data:

- **Secure Data Storage and Transaction Logs**

Storage control is a critical component of Big Data reliability. By using signed message digests to have a cryptographic identifier for each digital file or record and to use a technique known as a secure untrusted data repository (SUNDR) to detect unauthorized file modifications by malicious server agents

- **Endpoint Filtering and Validation**

Using a mobile device management solution, you can use trusted

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credentials, perform resource verification, and link only trusted devices to the network. Using statistical similarity detection and outlier detection strategies, you can process malicious inputs while defending against Sybil attacks (one person posing as several identities) and ID-spoofing attacks.

- **Real-Time Compliance and Security Monitoring**

Organizations can use techniques like Kerberos, safe shell, and internet protocol protection to get a grip on real-time data by using Big Data analytics. It's then simple to monitoring logs, set up front-end security mechanisms like routers and server-level firewalls, and start putting security controls in place at the cloud, network, and application levels.

Graph Databases uses graph architecture for semantic inquiry with nodes, edges, and properties to represent and store data. Role of Graph Databases in Big Data Analytics

- **Preserve Data Privacy**

Employee awareness training centers on new privacy laws and ensures that information technology is kept up to date by using authorization processes. In addition, data leakage from different databases can be regulated by analyzing and tracking the infrastructure that connects the databases.

- **Big Data Cryptography**

Mathematical cryptography has improved significantly. Enterprises can run Boolean queries on encrypted data by creating a method to scan and filter encrypted data, such as the searchable symmetric encryption (SSE) protocol.

- **Granular Access Control**

The two main aspects of access management are limiting and allowing user access. The key is to create and execute a policy that automatically selects the best option in any given situation.

To set up granular access controls:

1. Immutable elements should be denormalized, and mutable elements should be normalized.
2. Please keep track of confidentiality provisions to make sure they're followed.
3. Keep track of control marks.
4. Keep track of administrative information.
5. To ensure proper data federation, use a single sign-on (SSO) and a labeling system.

Strategies for Granular Access Control, some are listed below :

1. Point out mutable elements and immutable elements.
2. Access labels should be maintained, track admin data too.
3. Use single sign-on, and maintain a proper labeling scheme.
4. Perform audit layer/orchestrator

- **Granular Auditing**

In Big Data protection, granular auditing is essential, particularly after a system attack. Organizations should develop a unified audit view following an attack and include a complete audit

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trail with quick access to the data to reduce incident response time.
The integrity and security of audit records are also important. Audit data should be kept isolated from other data and safeguarded with granular user access controls and routine reporting. When configuring auditing, keep Big Data and audit data separate, and allow all necessary logging. An orchestrator tool like ElasticSearch can make it easier to do.

- **Data Provenance**

It's provenance metadata that Big Data applications produce. This is a different kind of data that requires special protection. Creating an infrastructure authentication protocol that manages access and sets up daily status alerts, and constantly checks data integrity with checksums.

6. Conclusions

Big data are not safe. The aim of Big Data analytics for safety is to obtain information that can be activated in real time. While Big Data analytics have a lot of promise, they still have a way to achieve full potential. Numerous security procedures were submitted for Big Data Analytics. A particular protocol should be used because of the safety issues and the application. Large data analytics focus on security and privacy issues and enhance the safety and pry- vacy of Big Data platforms.We've identified a number of security and privacy issues that Big Data technologies should consider in this article. We also discussed some potential solutions and strategies for protecting this distributed system. We also address few privacy violations and also discussed encryption algorithms used in Big Data analytics. Some of these protective mea- sures will be included in an open source Big Data analysis tool as part of future development. Currently, several privacy-preserving strategies for Big Data exist, such as anony- mization protection technology, access control, encryption, unstructured distribution, data tracing, differential privacy protection, anonymization, and so on. We end with a few re commendations for improving the efficiency of a Big Data project, and provide secure possible techniques and proposed solutions and model that minimizes privacy violation showing four different types of data protection violations and the involvement of different entities in reducing their impacts. However, in algorithms as well as in system areas, further research is needed to deal with the increasingly many problems ahead.

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