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DATA MINING OF THE ASSOCIATION RULES BASED ON THE CLOUD COMPUTING

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ABSTRACT

Data Mining is the process of analyzing data from different perspectives and summarizing it into useful information. Association rules are dependency rules which predict occurrence of an item based on occurrences of other items. Cloud computing has demonstrated that processing very large datasets over commodity clusters can be done by giving the right programming model. There are numerous data in the cloud database and among these data, much potential and valuable knowledge are implicit. The key point is to discover and pick up the useful knowledge automatically

KEYWORDS

data mining, cloud computing.

INTRODUCTION

Cloud computing is developed on the basis of distributed processing, parallel processing and grid computing, and it is a new method based on the shared architecture [1]. It distributed all the computing tasks on the resource pool that is made from many computers, making sure all the application systems can acquire desired computing power, memory space and software service according to its demand. All computing will be provided to the terminal user by the form of service; all the application software will be shared on the shared cloud as shared resources. In this sense, all the terminal users can get their desirable service as they want and needn't to pay for the software. It is predicated that as it develops overtime, more and more companies and people will save their own data in all the storage cloud, which will make the data mining based on the cloud computing become one of the trends in the future data mining systems.

There are mass data in the cloud database, and among these many of them are potential valuable knowledge. How to pick up and discover such useful knowledge is the key point in database research. The data mining is the process of picking up the hiding and unknown knowledge and regulations, which possess potential values for the decision making from the big amount of the databases [2]. It mainly has several steps: data pre-processing, data alternating, data mining operation, rule expression and evaluation. A data mining system includes: control unit, used to control all the parts in a harmonious way; database interface, used to generate and process database according to the given inquiry requirement; database, used to store and manage relevant knowledge; focus, which refers to the data extent that needs to be inquired; model extracting, which refers to the various data mining algorithms; knowledge evaluation, used to evaluate the extracted conclusion.

The association rule is one of the main model in data mining research; it is used to focus on the relationship among different areas while defining the data, and find the connection that can meet the given threshold value of both degree of confidence and degree of support [3]. The target of the association rules is transaction database. It can be used in many areas, such as sales, analysis of the transaction data, giving valuable information to the purchasing behavior, improving the retail industry, etc. It also can be used in the medical diagnosis, by analyzing various medical diagnosis cases, the symptom and reaction of the disease can be known. Besides, it can be used in the information processing in criminal cases, by analyzing the relationship between criminal means and cases to get more valuable clues and information [4].

II. DATA MINING TECHNIQUES

Various algorithms and data mining techniques like Classification, Clustering, and Association Rules etc are used for knowledge discovery [5] [6]. We have described the following data mining techniques.

A. Association rules

Association rule mining tries to find frequent item set among large data sets [7]. It aims to extract interesting correlations, frequent patterns, associations or casual structures among sets of items in the transaction databases or other data repositories and describes association relationship among different attributes. Such finding helps businesses to make certain decisions like customer's behaviour analysis. However the number of possible Association Rules for a given dataset is generally very large and most of them are usually of less value. Association mining is an important research area in data mining.

B. Clustering

Clustering is one of the well-known data mining techniques and can be defined as the identification of similar classes of objects [8]. It is a common descriptive task in which one seeks to identify a finite set of categories or clusters. By using clustering techniques we can discover the overall distribution pattern and correlations among data attributes. Classification approach can also be used for effective means of distinguishing groups or classes.

C. Classification

Classification is the most commonly applied data mining technique, which employs a set of pre-classified examples to develop a model that can classify the population of records at large [9]. It is the discovery of a predictive learning function that classifies a data item into one of the several predefined classes. Fraud detection and credit risk applications are particularly well suited to this type of analysis. The data classification process involves learning and classification. In Learning the training data are analysed by classification algorithm.

III. ADVAATAGES OF USING DATA MINING WITH CLOUD COMPUTING

Cloud computing combined with data mining can provide powerful capacities of storage and computing and an excellent resource management [7]. Due to the explosive data growth and amount of computation involved in data mining, an efficient and high-performance computing is very necessary for a successful data mining application. Data mining in the cloud computing environment can be considered as the future of data mining because of the advantages of cloud computing paradigm. Cloud computing provides greater capabilities in data mining and data analytics [21]. The major concern about data mining is that the space required by the operations and item sets is very large. But if we combine the data mining with cloud computing we can save a considerable amount of space [20]. This can benefit us to a great extent.

IV. DISADVAATAGES OF USING DATA MINING WITH CLOUD COMPUTING

There are certain issues associated with data mining in the cloud computing. The major issue of data mining with cloud computing is security as the cloud provider has complete control on the underlying computing infrastructure [20]. Special care has to be taken so as to ensure the security of data under cloud computing environment.

V. ASSOCIATION RULES

One of the well techniques of data mining is association rules which are used to find out the relationship or association between various items. The problem of finding relation between items is often termed as market basket analysis. In this problem the presence of items within baskets is identified so that the customers buying habits can be analysed. The technique is used in inventory management, sales promotion etc [19].

The discovery of association rules is primarily dependent on finding the frequent sets. This can require multiple passes through the database. The algorithms aims at reducing number of passes by generating a candidate set which should turn out to be frequent sets. Many different algorithms are designed to find out the association rules. The algorithm differs on the basis of how they handle candidate sets and how they reduce number of scans on the database. Some of the recent algorithms of association rule mining do not create candidate set. Practically the frequent sets generated are very large in number and this can be constrained by selecting only those items in which the user is interested.

Let us consider a set of items and a transaction database which is again a set of transactions. The association rule takes the following form for a transaction database: $X \Rightarrow Y$, where X and Y are the sets of items called item sets.

Now there are two important terms related to association rules: support and confidence. The support of an item or the set of items is the percentage of transactions in which that item occurs. The confidence measures the strength of the rule and is defined as the ratio of the number of transactions that contain X or Y to the number of transactions that contain X [22].

The two thresholds namely minimal support and minimal confidence is set to find out reasonable support and confidence.

VI. METHODS TO DISCOVER ASSOCIATION RULES

The association rule mining is the method that finds out the association rules which satisfy the predefined minimum support and minimum confidence. The association rule mining is usually carried out in 2 steps. In the first step those items from the database are found out which exceed the predefined threshold. Such items are stated as frequent items or big items. In the second step the association rules are generated out of frequent items found in first step.

Various algorithms like Apriori algorithm, partition algorithm, pincer search algorithm, dynamic item set counting algorithm, FP tree growth algorithm, Éclat and dÉclat etc have been developed to find out the frequent items from the transaction database [5].

The Apriori algorithm is the most general and widely used association rule mining algorithm [7]. It uses an iterative method called layer search to generate $(k+1)$ item sets from k item sets. The concept of Apriori and Apriori Tid was given by 1994 Agrawal et al. Other algorithms like SETM and AIS were also used for association rule mining but the performance of Apriori and Apriori Tid was better than these algorithms. This is because SETM and AIS generated too many candidate sets which were later found out to be infrequent among data sets. With large amount of data and with the advent of parallel computing technology various association mining algorithms like count distribution algorithm, data distribution algorithm, candidate distribution algorithm and improved Apriori algorithms have been proposed [9] [13]. These algorithms can be used under cloud computing environment.

Reducing time for generating frequent item sets can boost the performance of an association rule mining algorithm. Keeping this in mind various other algorithms were developed later. The concept of hashing can be used for pruning (removing infrequent item sets) which reduces time to generate frequent item sets. The process of association rule mining can be fastened by removing the infrequent item sets as quickly as possible though pruning can be problematic sometimes. The frequent patterns algorithm without candidate generation eliminates the costly candidate generation. It also avoids scanning the database again and again. So, we can use Frequent Pattern (FP) Growth ARM algorithm that is more efficient structure to mine patterns when database grows. FP tree growth algorithm is also used for mining and it does not create the candidate set. It rather creates a tree like structure to find the frequent sets [24].

VII. ASSOCIATION RULES IN DISTRIBUTED SYSTEMS

The association rule mining is one of the most important data mining techniques due to its wide application. However most of the ARM algorithms are made for centralized systems where there are no external communications [25]. With the increase in the size of data, the computation time and the memory requirements increase to a great extent [12]. These difficulties have lead to the parallel and distributed algorithms [11]. To accomplish this concept the concept of dividing the database and then distributing it to different nodes is used.

The association rules mining from the cloud can be done using sector/sphere framework [10]. Due to the development of network and distributed paradigm the implementation of association rule algorithm have been possible in cloud computing. The famous IT corporations such as Google, Amazon and IBM have their different cloud computing architectures [18]. Google has its Google App Engine which is composed of Google File System (GFS), BigTable and MapReduce [15]. Amazon provides its cloud services by Amazon Web Service (AWS), which contains Simple Storage Service (S3), Simple DB and Elastic Computing Service (EC2) [16]. A cloud-based infrastructure to support data mining applications was developed by Grossman et al which consists of a storage cloud called Sector and a compute cloud called Sphere [17].

An improved Apriori algorithm has been developed on map reduce which can handle vast amount of data [23]. Here large numbers of nodes are used based on the Hadoop platform. The various parallel algorithms for association rule mining faces the problem of large inter site communication cost. This is due to large number of space which is required to maintain local count when the candidate set is large. To overcome this problem in distributed association rule mining algorithms a de-clustering approach is used to eliminate the inter cost communication between sites [14]. An another interesting distributed association rule mining algorithm known as FDM (fast distributed mining of association rules) generates a small number of candidate sets and reduces the number of messages to be passed at mining association rules. It has been observed that FDM has better performance than sequential algorithm [26].

VIII. CONCLUSION

Cloud computing is an architecture which is known for its powerful capability of computation and storage and resource sharing. These features make cloud computing favorable to data mining service in network environment. We have discussed association rule mining in cloud environment and various parallel and distributed mining algorithms. The implementation of association rule in the distributed systems can be efficiently done on Hadoop. Further, the data transfer among the nodes and the situations like node failure etc are taken care of by Hadoop. This adds robustness and scalability to the system. Various parameters affect the performance of algorithms such as time taken to generate frequent item sets, inter site communication cost, number of scans through the database etc. The integration of association rule mining and cloud computing in this paper is at the initial stage of our research on data mining service in cloud environment and requires further improvement.

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