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Analysis on Prediction of Network Traffic through Association Rule Mining

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Abstract - Data Mining is a process that analyzes a large amount of data to find new and hidden information that improves business efficiency. Various industries have been adopt data mining to their mission-critical business processes to gain competitive advantages and help business grows. Association Rule Mining (ARM) is a technique in the Data mining system. This paper depicts the research issues on prediction of network traffic via association rule mining. Concurrently, it also paves a way for budding researchers to overcome the issues in Association Rule Mining.

Keywords: Data Mining, Association Rule Mining, Data Accessibility and Network Traffic.

I. INTRODUCTION

Data Experter's are suffocating in information, however craving for extracting the knowledge. Since the beginning of the Internet period in 1994, electronic business and e-information are developing [1]. With the internet development, several business users wished to move their data to the online and view their organization in better position. This technology innovation prompts to store huge amount of information through various information sources like data warehouses, XML repository and data warehouses. Researchers treat Data mining as the crucial procedure of Knowledge Discovery in Database (KDD) [7]. The KDD procedure is appeared in Fig. 1. It is otherwise called as extraction of data, information/pattern investigation, information antiquarianism, Data cleaning, Data Grouping and insights of an organization. The data mining is mainly divided into two types namely [2]

I. Descriptive Data Mining: Using the information repositories, the common attributes of the data are grouped and extracted to derive the knowledge.
II. Prescriptive Data Mining: This type of data is used for predicting the knowledge for future actions from the past data. Examples of this system were the association rule mining, classification and clustering.

The data can be classified into a) Relation data b) Transactional data c) Spatial data d) Temporal and time series data e) World Wide Web data.

a) Relational data:
Most part of the information is put away in social database. Social database is one of the greatest assets of our mining resources [3]. As we know social database is exceptionally organized information repository, information are portrayed by the pack of features and saved as in tables format. With the well developed database, information mining on social database is not troublesome one. Information mining on social database, mostly concentrates on finding patterns.

b) Transactional Data:
Transactional database alludes to the accumulation of transaction records. Eg. Sales transaction in market based analysis. With the aid of personalized PC, the transactional-oriented database is possible. Information mining on transaction- oriented database concentrates on the mining of association rule mining, discovering the relationship among the items in transactional records [3].

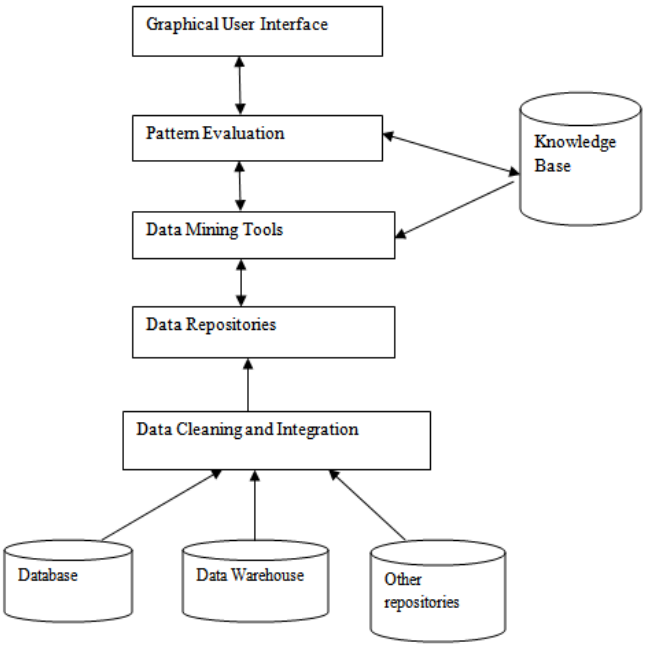

Fig.1. Process of Knowledge Discovery in Database [2]

c) Spatial Data:
A spatial database includes both traditional and geographic data. The association rules based spatial data discovers the spatial oriented relationship between the records by mining the features [3].

d) Temporal and Time-series data:
It differs from the conventional database. The time based data are stored in this database. Temporal association rules can be more useful and informative than basic association rules [3].

e) World Wide Web data:
As data on the web increments, the web becomes ubiquitous. Web mining is normally partitioned into three primary classes, web use mining, web structure mining and web content mining [3].

f) Basics of Association Rule Mining
Let S is a universe of Items and T is a set of transactions. It is accepted to disentangle an issue that each item x is bought

once in any given exchange T [4]. Commonly, the transaction is denoted as Tid. Presently, it is expected that X is an itemset then an exchange t is expected to X iff X ⊆ T. Henceforth, it is clear that an association rule is a ramifications of the structure X=>Y where X and Y are subsets of S. The important metrics in Association Rule Mining are the Support and Confidence.

Support:

Support is the percentage of exchanges that contain an itemset. Frequencies of patterns are shown in support. The likelihood of an exchange T that contains both itemsets X and Y is known as support [4].

$$P(\mathrm{X},\mathrm{Y}) = \frac{No.oftransaction\sin cludingXandY}{Tota\ln umberoftransactions} \quad (1)$$

Confidence:

It quantifies how regularly items in Y show up in exchanges that contain X. Confidence is the likelihood of acquiring an itemset Y in an arbitrarily selected exchange T that rely on upon the acquiring of an itemset X. The confidence measure is given by [4]:

$$P(\frac{Y}{X}) = \frac{No.oexchangesthatcontainXandY}{No.ofexchange\sin X} \quad (2)$$

The paper is organized as: Section 1 depicts the importance of data mining in the business world and basic terms in association rule mining. Section 2 depicts the review of association rule mining that was applied in the field of traffic prediction. Section 3 summarizes the research issues for future actions.

II. LITERATURE SURVEY

Hanlin Goh et al, 2009 proposed a fuzzy associative conjuncted map networks. The Fuzzy Associated Conjuncted Maps (FASCOM) is a fluffy neural system that coordinates the information of nonlinearly related inputs and outputs. In the system, every information or output dimension was represented by feature map that was parceled into fuzzy or fresh sets. These fuzzy sets are then conjuncted to frame predecessors and successors, which are related to form IF–THEN rules. The acquainted memory was encoded through a logged off clump mode learning procedure comprising of three continuous phases. They analyzed on toy problems and real world data in terms of accuracy on traffic density prediction. The directed period of Hebbian learning was in charge of distinguishing weights for fuzzy principles. In layers 3 and 4, the representation of multiple antecedents and consequences resulted in the reduction in crosstalk for non-mutually orthogonal input patterns.

Georgios Y. Lazarou et al, 2009 described a network traffic using the index of variability. They measured variability such as Index of Variability H_v (T) which described the degree of variability for many traffic models. They generated two dimensional (2D) and three dimensional (3D) indexes of variability curves. They introduced a down to earth technique for assessing the Index-of-Variability bend over the traffic traces. Utilizing this system, they appraised the Index-of-Variability bends for 12 long NLANR system activity follows. The outcomes shown that the variability of real network traffic fluctuates with time-scales and that the Index of Variability can recognize subjective contrasts between network traffic acquired from distinctive systems. The outcomes shown that the variability of traffic traces from different networks was better. In this manner, the Index of Variability offers the possibility for the dynamic networks. Kashi Venkatesh Vishwanath et al, 2009 proposed Swing technique that supplied realistic and responsive network traffic generation. The Swing was a closed-loop, network responsive traffic generator that correctly predicts and stores the packet communications using a simple structural model. It automatically collects the distribution of users and their behaviors. They explored swing ability to differentiate user characteristics and wide area network conditions to project traffic characteristics into vary scenarios. They characterized traffic era to bring about the time stamp based packet arriving and departing from the network interface at the layer 3 and layer 4. Swing's precision will be restricted by the exactness of the models, it extricates for client, application, and system behavior. The nature of their traces affects our outcomes. Case in point, they have discovered inter-packet timings in pcap follows that ought to measured capacity. At last, utilizing homogeneous convention stacks on end-hosts constrains our capacity to duplicate the blend of system stacks (e.g., TCP flavors) over a unique trace.

Sumantra R.Kundu et al, 2009 framed architecture for predicting the characterization of network traffic. They proposed a substitute way to deal with traffic portrayal by firmly connecting the flow measurement engineering with the estimation technique. Their estimation system stored complete data identified with Short Lived Flow (SLFs) while the incomplete data was identified with LLFs. For constant partition of LLFs and SLFs, they introduced a novel algorithm based on information theory. They validated the accuracy and performance of novel techniques using traffic traces from internal LAN. Thus, the streaming problem performed on the concept of typical sequences. The study was based on the number of packets to traffic duration longevity of the flow. Flora S. Tsai, 2009 framed association rule using network intrusion detection. Network Intrusion identification incorporated a set of malignant activities that settled the integrity, confidentiality and data accessibility. The enormous expansion of novel digital attacks has made information mining based interruption identification systems which is valuable for their network detection. They portrayed the framework incorporated the association rule mining to detect the network intrusion. This method was utilized to create assault rules that will identify the assaults in network data utilizing anomaly detection. At the point when information mining is to be connected to substantial volumes of network traffic information to hunt down designs, it can give important experiences to assault designs, subsequently permitting us to manufacture a more powerful location model. The standards accuracy was best seen at 100% as they give more steady results contrasted with 90%. On the other hand, by permitting standards with lower precision to pass, more assault classes can be recognized. Sunita Soni et al, 2010 framed associative classifiers for predictive analysis in health care systems. They presented the joined approach that coordinates association rule mining and classification rule mining called Associative

Classification (AC). The mix was finished by concentrating on mining an uncommon subset of association rules called Classification Association Rule (CAR). This CAR was used for grouping the frequent sets. Based on the associative classifiers, the system was modeled to obtain decisions. Weighted Associative Classifiers is another idea that allocates diverse weights to distinctive elements and can get more precision in prescient demonstrating framework like medical field and so forth. Javier J. Sanchez et al. 2010 proposed a solution for traffic signal optimization using Genetic algorithms, traffic micro-simulation and cluster computing. They developed and tested on new model for traffic signal optimization based on three key features, namely, 1) genetic algorithms (GAs) for the optimization task 2) cellular-automata-based micro simulators for evaluating every possible solution for traffic light programming times and 3) a Beowulf Cluster, which is a multiple-instruction–multiple-data (MIMD) multicomputer of excellent price/performance ratio. They presented their results on large scale real world test cases in a congestion situation using various fitness functions of Genetic algorithms. Their aim is to concentrate on the execution and conceivable downsides of our model in an extensive congested traffic system. The runtime function was not affected even if the fitness functions changes over the parallel processes. Wei-Hsun Lee et al, 2011 discovered traffic bottlenecks in urban network by spatiotemporal data mining on location based services. They proposed spatiotemporal traffic bottleneck mining (STBM) model that included various traffic patterns and raw data of location based services to discover traffic in urban networks. They implemented STBM prototype on taxi dispatching system in Taipei, urban network. A STB is a traffic bottleneck with spatial and temporal data system, which demonstrated the network object over the traffic bottleneck may come about because of over-load activity request and may be the root reason for related neighborhood clog. Once a STB has been found, some traffic activities, for example, activity sign control, manual convergence control, reversible path, or blockage message by CMS can be practiced to mitigate the blockage and upgrade the system execution. The results had shown the traffic prediction of 79% in workdays and 72% in weekends. The STPs and STCA rules found in stage II portray the relationships between activity requests and clog, which exhibit blockage demands and congestion. The decision support system paves a way to enhance the global network system.

Yun Yang et al, 2011 framed a time series clustering via RPCL network ensemble with different representations. They exhibited an unsupervised group learning way to deal with time series clustering so as to group the Rival Penalized Competitive Learning (RPCL) systems with diverse representations of time series. In their methodology, the RPCL system outfit was utilized for clustering analysis in light of diverse representations of time series at whatever point accessible, and an ideal determination capacity was connected to figure out a last agreement allotment from numerous segment competitors yielded by applying different agreement capacities for the blend of focused learning results. Their methodology neither uses the former information on time arrangement nor needs a parameter-tuning process. As a result, their proposed methodology gives a reasonable yet successful path for time series based clustering analysis. Daniela Brauckhoff et al, 2012 framed an anomaly extraction in backbone networks using association rules. They utilized meta-information from histogram-based indicators to recognize suspicious streams, and at that point they applied associative rule mining to discover and compress the anomalies streams. Utilizing rich traffic information from a backbone system, they demonstrated that their method successfully discovers the streams connected with the atypical event(s) in every single examined anomaly. Their anomaly detection scheme essentially lessened the work-hours required for signal alarms. They are interested with the issue of distinguishing the traffic streams connected with an abnormality amid a period interim with an alarm. An algorithm was developed based on histogram based detector. The designed anomaly extraction is simple to use. It reduces the time consumption level. Mr.B.Dwarakanath et al, 2012 studied on detection and prediction of malware using Association Rule Mining. Malware is a programming model intended to harm a PC framework without the proprietor's information (e.g., infections, indirect accesses, spyware, Trojans, and worms). Assembled data that prompts loss of protection or abuse, increase unapproved access to framework assets, and other injurious behavior. Various assaults made by the malware represent a noteworthy security danger to PC clients. From the three set of analyses, they proposed a successful classifier building system and consolidate it to the enhanced malware discovery framework CIMDS. All the test studies are led under the environment of Windows XP working framework in addition to Intel P4 1.83 GHz CPU and 1 GB of RAM.

Mohammad Hashem Haghighat et al, 2013 framed a payload attribution via character dependent multi-bloom filters. They introduced a novel data structure called payload attribution called Character Dependent Multi-Bloom filters with additional supporting of wildcard queries. Based on the query response, a false positive rate was calculated. They obtained a data reduction ratio of 265:1. The main contribution of CMBF is its ability to respond to wildcard queries in a reasonable time. When reacting to questions, VBS needs to handle the selection just once. Then again, WBS requires the extract to be manipulated twice and likewise WMH requires times the WBS preparing on the portion. Bloom channel lessened the required space size; however compressed data without causing any expense is highly impossible. . In fact doing exhaustive search in response to a wildcard query, which is done by prior techniques, is practically infeasible.

Anita Rajendra Zope et al, 2013 suggested data mining approach in security information and event management. Security data and event administration framework is the industry-oriented term in PC security, alluding to the gathering of information ordinarily log records or occasion logs from different sources into a focal repositories. Event logs are created by different systems administration gadgets, Operating Frameworks and Application Servers. In the event that the comparability result is higher than the user-specified threshold, it implies that the dataset has no interruptions. The ordinary class dataset is reference information, which ought not to have interruptions. Dilpreet kaur et al, 2013 studied on user future request prediction methods using web usage mining. In developing prominence of the World Wide Web, an extensive number of clients accessing the sites throughout the world. At

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the point when client get to a sites, an extensive volumes of information, for example, locations of clients or URLs seeked are accumulated naturally by Web servers and gathered in access log which is imperative on that multiple occasions client over and again get to the same sort of site pages and the record is kept up in log documents. The reasons of delay are the web servers under heavy load, Network congestion, Low bandwidth, Bandwidth underutilization and propagation delay. The solution is to increase the bandwidth but this is not proper solution because of economic cost. For that propose, this technique proposed in which reducing the delay of client future requests for web objects and getting that objects into the cache in the background before an explicit request is made for them.

Zuleika Nascimento et al, 2013 framed A Hybrid Model for Network Traffic Identification Based on Association Rules and Self-Organizing Maps (SOM). In this setting, predicting the traffic that occurs in network is a mind boggling errands, since access to the Internet is increasing day-by-day, carrying with it new clients with diverse objectives. Numerous distributed (P2P) applications are progressively prominent and available, for example, eMule, Ares and BitTorrent. The goal of the system was to extract the association rules for a network traffic system. The results demonstrated that the proposed hybrid system is better than a rule based model, with results that surpass 91% of accuracy with the maintenance of low rates of false positives and false negatives for the most applications.Ranjita Singh and Sreeja Nair, 2014 framed an efficient anomaly detection system using featured histogram and fuzzy rule mining. Anomaly identification is an idea broadly connected to various areas. Various strategies are utilized for discovering the anomalous assaults. As the network traffic builds, an effective framework to screen the packet investigation of system stream information. Because of this successive item set mining is chief issue in field of information mining and learning system. The principle point of their work was the identification of abnormalities in huge databases with high estimation of low positive rate and low estimation of false negative rate. The mining calculations can effectively find the association rules between the itemsets in huge databases. As the extent of the database builds, the quantities of assaults or oddities are also incremented.

Guojun Mao, 2014 framed a mining temporal association rules in Network Traffic Data. They generated necessary sub-operators between itemsets and interval operators between time intervals to mine temporal association rules. Based on these, they developed new algorithm called MTAR-Sub to mine the temporal association rules. They faced two problems namely, how to reduce the numbers to scan the database in order to make I/O at lower costs and how to use constraints in order to mine the rules more effective. Indeed, they are confronting two difficulties in mining association rules from an extensive of databases: (1) how to lessen the numbers to filter the database to make I/O expense lower and (2) step by step instructions to utilize to obtain simple rules. The first issue was solved by creating Sub-belong to construct the one – time scanning algorithm. The temporal constrains are maintained to solve the association rule related to specific interval time. Hao Li et al, 2014 framed an optimal matching on multiple PDUs for fine grained traffic identification. They proposed an algorithm Rule Organized Optimal Matching (ROOM) that divided the identified rules into several fields and organize the matching order of fields. It activated all possible hit rules. The ROOM supported the rules over the multiple protocol data units for traffic identification. It also supported the multiple thread parallel programming and achieved the success rate of throughput over 40 Gb/s for real traces. The ideal development of LMT is shown to be NP-hard, and in this way, a heuristic calculation was created. Additionally, they outlined and executed model frameworks for MP-ROOM and its related works. Moreover, an extensive assessment demonstrated that MP-ROOM model accomplishes 6.5 times higher throughput with just 80% memory expenses and contrasted with nDPI.

Azadeh Soltani et al, 2014 proposed a confabulation inspired association rule mining for rare and frequent itemsets. This algorithm was developed based on cogency. The algorithm was very effective in dealing the infrequent items. This system was evaluated on the synthetic and real data sets. This methodology reduced the memory space than the conditional frequent patterns growth algorithm. The functionality to manipulate the cogency measure was resolved by Association Rule Mining (ARM). The algorithm named Confabulation Inspired Association Rule Mining (CARM). The knowledge links are connected using single database. The rules are generated using confabulation theory. Cogency Enhancement is the primary key of confabulation scheme. The outcomes demonstrated the prevalence of CARM over CFPgrowth strategy as far as runtime and memory use. Faisal Khan et al, 2014 framed streaming solutions for fine grained network to produce traffic measurements and analysis. They suggested a Multi-Resolution Tiling (MRT) approach that performs a sequential analysis of traffic data into subregions of interest. They proposed three novel traffic streaming algorithms that overcome the limitations of MRT and can cater to varying degrees of computational and storage budgets, detection latency, and accuracy of query response. They evaluated the streaming algorithms on a highly parallel and programmable hardware as well as traditional software-based platforms. They assessed the methods on various hardware and programming based estimation stages, for nearby also as appropriated estimation settings. The outcomes exhibited a stamped 100% change in location accuracy in contrasted with MRT, with a moderate increment in storage and computational complexities.

Kamini Nalavade et al, 2014 framed Mining Association Rules to Evade Network Intrusion in Network Audit Data. With the development of hacking and misusing instruments and creation of better approaches for interruption, intrusion identification and prevention is turning out into the significant challenge in the realm of network security. The expanded traffic creation and information on Internet is making this task on demand. They utilized KDD 1999 dataset for network intrusion detection. This system obtained high precision rate and high productivity. Alexander A. Frolov et al, 2015 suggested seven methods of factor analysis and their evaluation by information gain. They studied on seven techniques for Boolean Factor Analysis (BFA) in settling the Bar Problem (BP), which is a BFA benchmark. The execution of the routines was assessed by information gain. Investigation of the outcomes obtained in BP of diverse levels of multifaceted nature has permitted to uncover qualities and shortcomings of these techniques. It was demonstrated that the Likelihood Maximization Attractor

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Neural Network with Increasing Activity (LANNIA) was the most proficient BFA technique in unraveling BP. The objective of BFA is to identify this masked structure of the information set and to shape a representation in which these objects are exhibited unequivocally. The same result was acquired for the KEGG data set. The fewer elements can clarify the masked structure of the information set. Khin Moh Moh Aung et al, 2015 framed association rule pattern approaches for anomaly detection. Association rule based information mining innovation can be broadly utilized as a part of interruption discovery framework to acquire an examination between the regular and irregular pattern. Manual examination is not required for this system. One of the primary focal points is that same information mining instrument can be connected to distinctive information sources. Their system worked effectively to locate the infrequent things.

III. CONCLUSION

Association Rule Mining is one of the best data mining techniques. From the above study, we find several problems existing in association rule mining to predict the network traffic creating users. Proper rule set is to be discovered in finding inter and intra class similarity. Parallel computation is not widely deployed in the association rule mining. Minority classes in transactional databases are omitted in the cluster or classification form. Lack of multimodality behavior of data mining. Subset optimality is not yet focused in research area. Goodness of fit is not obtained for target rules. Functional independency problems among the data in classes.

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