

Customer Privacy Maintenance with Social Relational Rule Mining To Avoid Un-Preferred Product Suggestion

^IDr R.S. Vetrivel, ^{II}T. Nandhini, ^{III}P Jeyanthirani

^IProfessor, Computer Science, Subramanya College of Arts & Science, Palani.

^{II}Research Scholar, Computer Science, Subramanya College of Arts & Science, Palani

^{III}Assistant Professor, Computer Science, Subramanya College of Arts & Science, Palani

Abstract

Online Social Networks (OSNs) provide users ability to organize messages send by their personal classified space to avoid un-preferred content. However, OSNs provides less support and adaptability to message being depicted in the user's private space. The data mining technologies collects the user information's from various social networks that extract the decision makers for providing an efficient product suggestion. Customer privacy consists of individual or confidential information about customer which includes social protection records, home address, acknowledgment numbers, obtained performance and credit ratings. But, the privacy concerns provide security problems on hiding the information or secure information.

Customer Privacy Maintenance with Social Relational Rule Mining is developed to provide an efficient social network. Customer information is obtained from different users as feedback command and it provides the preferred message about the products. Customer's privacy feedback list is produced from their social media activity and their occurrence. The fundamental ID for a customer is used to announce their occurrence and social organize remove long-term likability for preventing the user tracking with the help of digital signatures for verification. Mobile social networks are allowed to mobile users to determine and relate with contacts that are occurred in their physical vicinity.

The relation in social network provides opposition that are questioning about other users' personal information and location information for extracting the information. Social relation rule mining is provided for allowing the customers to identify preferred messages about the product and to avoid the un-preferred messages given about the product suggestions. Relational filters allow users to quickly filter out user's un-preferred messages to become friends and prevent a social coordinates to provide better suggestion result.

Relational Data Mining (RDM) approaches are based on Inductive Logic Programming (ILP). It is developed for identifying the patterns that involve multiple relations from a relational database. A relational pattern in web mining is extended with classification rule and association rule for representing the customer privacy information in social network. After the identification of customer patterns, feedback list is produced for privacy maintenance. With the of feedback list, un-preferred product suggestions are detected given by the customer in social network. Finally, Relational Rule Mining approach avoids the un-preferred suggestion provided by the customer to the products.

Feasibility and effectiveness of the proposed approach are tested using real online implementation on the social networking space and also using following Metrics. The evaluation is carried out in terms of time taken for pattern classification, pattern matching loss rate, scalability and true positive rate.

Key words

Online Social Networks, Relational Data Mining, Inductive Logic Programming and Relational Rule Mining.

I. Introduction

A. Web Mining

The application of data mining technique is preferred with web mining for determining the model of web. Web mining operations are progressed with three services such as clustering operation, association operation and sequential operation. Web mining is divided into three different types of category namely, Web usage mining, Web content mining and Web structure mining. The basic structure of web mining for extracting the information is explained in given below equation.

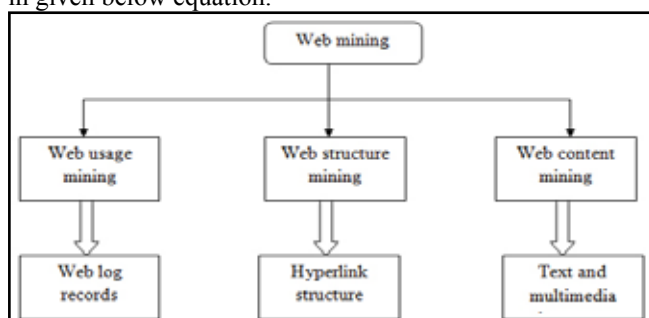


Fig. 1.1 : structure and categories of web mining

Figure 1.1 explains the structure of web mining that involves three processes for discovering the routes to extract the useful information from web servers. Initially, usage processing is involved for extracting the information like IP addresses, user information, and site clicks. With this negligible quantity of information available, it is harder to path the user through a site. Therefore, next content process is used for extracting the conversion of Web information like text, images, scripts and others into useful forms. They cluster and categorized the web information based on specific content and images offered on web server. Finally, process of web structure is carried out for analyzing the web page structure that is presented in a web site.

Web usage mining is relatively independent which are not separately grouped with other mining applications. Web usage mining technique illustrates the user's usage pattern and predicts the user behaviors. Next, Web content mining is developed for discovery or retrieval the information from various Web contents data and document. Then, Web structure mining provides underlying link structure of the web. The difference between web content mining and web structure mining provides apparent information.

1. Web Usage Mining

The process of extracting useful information from various server Web logs is given by Web usage mining process. The collection Web information from web pages is provided with accessing the path that gathers information automatically from web server. Referrer logs, user subscription information and survey logs are offered for collecting the web information. The internet based application uses the data mining technique for collecting the information and produces the productive information for the customers. Web usage mining is the application of data mining technique for determining the usage patterns from web data. With the help of obtained web usage data, a web user is identified and captures the performance of web site.

Web information produces various user values that results in more efficient manner and increases the product transactions. The marketing abilities are also improved with attained usage data from web server. The web mining produces the routes to services which allow the path for the web servers. Commercial application servers have considerable characteristic to allow e-commerce applications to track various kinds of business events and log them in application server logs.

Web usage mining process is divided into three phases namely, pre-processing, pattern discover and pattern analysis. The information in web server is presented with noisy, imperfect and unpredictable according to the requirements. Pre-processing is carried out for cleaning of data, combination of data and transferring them with reduced data reduction. After the transmission of data, user patterns are identified and analysis the pattern discover.

2. Web Structure Mining

Web structure mining used to identify the relationship between Web pages linked by information or direct link connection in web mining applications. The structure mining extracts previously unidentified relationships between Web pages and offer the business uses. They link the information of its own Web site to facilitate routing and cluster information into site maps. The path is established using hyperlink hierarchy to relate the information within the sites and produces connection through search engines.

Web Structure Mining is provided with the arrangement of hyperlink structure that includes hypertext, relational learning and inductive logic programming. Wide area application is attained with social network and web contains collection of web documents. The varieties of objects are not used directly from database management or information retrieval. Web structure mining is the process of using graph theory to analyze the node and connection structure of a web site. According to the type of web structural data, web structure mining can be divided into two kinds such as extracting the patterns from hyperlinks and mining the document structure. A hyperlink is a structural component that connects the web page to a different location. The document structure with mining process provides analysis of tree-like structure of page to describe HTML or XML tag usage.

3. Web Content Mining

Web content mining extracts the useful information or knowledge from web page contents. Web content mining is associated but they are different from data mining and text mining. Web mining is related to text because web contents are provided in texts. Web pages consist of text, graphics, tables, data blocks and data records and uses the data mining principles for detection process.

B. Pattern discovery

Web mining is the solution element for pattern discovery. Pattern discovery meet the algorithms and techniques such as statistics, association rule, classification and sequential pattern. Web site information or knowledge is extracted using statistical technique based on different variables. The attained reports are presented for improving the security and support for decision making web pages. Association rule mining techniques can be used to determine unordered relationship between items found in a database of transactions. Clustering analysis is a technique to group users or data items with the similar characteristics. The user information or pages can facilitate the development and execution of marketing strategies. The performance of web mining in e-commerce application provide personalized web content to individual users and produces similar navigation pattern.

Web master uses pattern classification technique to establish user's report that belongs to pattern class or category. Supervised inductive learning algorithm is used for classification process that classifies web information and extracts the features of users. Sequential pattern offers different temporal analysis for detecting similar patterns.

C. Pattern Analysis

Pattern Analysis is a concluding phase of the entire Web usage mining. The main purpose of pattern analysis is to eliminate the irrelative rules or patterns and to extract the interesting rules or patterns from the output of the pattern discovery process. The Web mining algorithms are not able to form a suitable extraction process for direct human consumption. There are two most common approaches for the patter analysis such as, the knowledge query mechanism for instance SQL and multi-dimensional data cube to perform OLAP operations

D. Relational Data Mining

Relational data mining is the data mining technique for relational databases. Relational data mining algorithms appear for patterns among multiple tables (relational patterns). For most types of propositional patterns, there are corresponding relational patterns. Relational data mining provided with several approaches such that inductive logic programming, statistical relational learning, graph mining and multi-view learning.

Multi-relational association rule is simple association rules that are used to extract the web data from multi-relational databases. A relational data mining algorithm is provided to identify the patterns used in data mining. The pattern space is considered for achieving better efficiency for reducing the loss of information from web server.

II. Literature Survey

1. A Review of Differential Privacy in Individual Data Release

The paper [1] presents a mechanism of differential privacy users for improving the user quality of behavior and incredible quantity of medical information. Cryptography classical method and anonymous series model determines the mobile applications. In order to provide a security-controlled privacy assurance, differential privacy is used as privacy opinion. Histogram, tree structures, time series, graphs and frequent pattern mining data methods are comprised for attaining final suggestion about the particular product.

Differential user privacy is processed with two models namely, non-interactive and interactive model. It is also referred as online query models and offline query models that collect the information during an interface of datasets. Non-interactive model transfer the query results from the user request for removing the noise results. Number of queries is unrestricted with privacy budget to develop the higher accuracy on query results. Similarly, interactive model based on differential privacy and data request obtain the data from original database. Therefore, it provides maximum number of queries with reducing noise information of web database.

2. Reducing Side Effects of Hiding Sensitive Item sets in Privacy Preserving Data Mining

Privacy preserving data mining is an important approach to recover and investigate information from large quantity of data. A novel Hiding-Missing-Artificial Utility (HMAU) algorithm was proposed in [2] for hiding sensitive item sets during transaction deletion. The transaction is removed by selecting the maximum ratio of sensitive to non-sensitive database. Hiding sensitive item sets are considered in transaction process for the reduction of hiding failures, missing item sets and artificial item sets. This transaction is carried out according the requirement of users. Hiding failure dimension, missing item set dimension and artificial item set dimension are the transaction process. Initially, the transaction is processed with hiding failure algorithm to provide minimum values on removing from database. Next, an item set of each transaction process is evaluated for missing item set dimension for refinement. Finally, artificial item sets are evaluated in each processed transaction that maintains all infrequent item sets. Three dimensional item sets are defines as the process that produces the evaluation correlation process between the transactions and side effects. The weight of dimension is given based on the user's web page usage for hiding the effects and proposed HMAU algorithm shows better transaction of hiding information.

3. A Novel Web Classification Algorithm Using Fuzzy Weighted Association Rules

A novel web classification algorithm using the principles of fuzzy association rule mining was presented in [3]. Association rule mining generates the rule with the help of associative classification method that converted into classification rules. Association rule mining technique identifies the relation between various web pages that are comprehensive in web environment. The basic relations between the items are considered by weighted fuzzy association rule mining technique for their transactions. The transaction is based on their weighted item that classifies the web pages into various groups to organize access patterns in the form of classification rules.

Web page classification algorithm is derived based on web page weight and web access class for the classification purpose. Initially, web pages are converted in database format according to fuzzy weights. Then, it is sort listed with decreasing order and maximum web page is selected as the class sequence. Remaining pages are considered in classification rule which is greater than threshold values. Finally, association rule sequence is selected for classification process and identifies the frequent patterns using fuzzy weight association algorithm.

4. Efficiently Hiding Sensitive Item sets with Transaction Deletion Based on Genetic Algorithms

A compact prelarge genetic based (cpGA2DT) algorithm was

presented in [4] for deleting the transactions for hiding sensitive item sets. The useful information or knowledge from a database is extracted using data mining approach. Data mining technique provides privacy preserving data mining to remove the original database for hiding the sensitive information's. The proposed algorithm deletes the transactions by implementing both compact GA-based (cGA) mechanism and the prelarge concept.

A suitable transaction is designed with flexible fitness function to provide minimum effects of hiding failure, reduced cost on missing and artificial item sets. The compact GA-based mechanism and the prelarge concept reduce the computation of database for proposed approach. Prelarge item sets reduces the time taken during data movements and occurrence of transaction deletion and it operate like as buffer.

5. A Scalable and Privacy-Aware Location-Sensing Model for Ephemeral Social Network Service

A Scalable Location-Sensing model based on RFID-sensing architecture was proposed in [5] using ephemeral social network service. Social network services are used to connect the users from various sources with an unstable speed. Ephemeral Social Network Service holds the ephemeral interactions and conference meeting happen in environments. ESNs involve the arrangement for holding the physical proximity between people for providing better scalability, privacy protection, and cost of the system.

Ephemeral Social Network considers the characteristic requirements of usability, QoS, scalability, and privacy. Usability is considered with flexible and scalable where the specific apparatus is accepted by the users. Power consumption and positioning accuracy are the two major parts utilized in quality of service. Scalability is required for supporting the user's when the user requirements are get failed and finally, privacy achieves higher accuracy of user's location information.

6. Negative and Positive Association Rules Mining from Text Using Frequent and Infrequent Item sets

Both positive and negative association rule mining algorithm [6] shows benefits of medical domain. Frequent and infrequent item sets are used for mining both positive and negative association rule. The mining of association rule is provided with two conditions, such that identify frequent and infrequent item sets and obtains positive and negative association rules from the identified item sets.

The proposed association rule mining produces the solution for diagnosis disease and symptoms in order to minimize the error during the identification. A decision support system is developed for easy identification of disease with a negative association rule. This mining technique is included in the development of medical decision system, association and dissociations and health related technologies.

7. A Novel Method of Interestingness Measures for Association Rules Mining Based on Profit

The paper [7] explains Interestingness Function Based on Profit (IFBP) to show individual preference and individuality of specific application object. These proposed method develops a methods as bi-lift, bi-improve and bi-confidence. Bi-lift method is developed for measuring the relationship between different users with help of association rule mining technique. Bi-deduction algorithm is improved for the detection of negative limitation and provides better consistency on objects.

The probability occurred during the detection of specific applications affects the evaluation with high values. Therefore, bi-improve method is considered for detecting the occurrence ratio probability given for item sets. The appearance of item sets indicated by confidence of association rule mining that provides correlation between the item sets. The values produced by confidence are improved as bi-confidence with a set of given records. It consists of both correlation factor and probability factor for producing the effectiveness of association rule mining. The occurrence of weak correlation rule is minimized by using support bi-confidence.

8. Privacy-Preserving Mining of Association Rules from Outsourced Transaction Databases

Privacy Preserving Mining of Association Rules were presented in [8] for preserving outsourced mining. It is designed with an attack model based on background knowledge and creates a outsourced transaction database. The data is transferred from the user to the server with mining queries and recover the patterns established from the server. Encryption and decryption scheme is introduced in mining of association rules. The transaction of database is performed with respect to encryption scheme. They carried out by the substitution of each plain and fake transaction is achieved. Fake transaction is created by the addition of items and it performs the transmission process to the server. The execution of pattern mining query in a web server enables computation of frequent patterns. Therefore, encryption and decryption scheme provides privacy preservation pattern mining for realizable transactions of database.

9. Supporting Regularized Logistic Regression Privately and Efficiently

A new cryptographic method for [9] preserving privacy was designed with normalized logistic regression and it is majorly used in arithmetic model among different domains. A distributed method was developed to make an efficient security on model estimation with improved privacy and avoids the interface attacks. The proposed cryptographic protection is an efficient framework for sustaining regularized logistic regression across different establishment.

Privacy preserving approach is based on an adapted Newton-Raphson method for providing an efficient computation. A distributed computation and centralized aggregation is performed with the help of hybrid features. After performing the certain computation, privacy model estimation results in neighboring association and center stage aggregation. Naive bayes centralized secure scheme is used to produces an significant distribution of computations.

10. Towards semantically secure outsourcing of association rule mining on categorical data

The paper [10] presents an Outsourcing Association Rule Mining model that consists of four algorithms. The proposed algorithms are namely Sys Setup, Add Enc Trans Record, Retrieve Trans Record, and Get Freq Item Sets. Initially, Sys Setup algorithm is performed in public parameters and data owner's secret key. Before outsourcing data to a cloud server, the transaction records are encrypted using Add Enc Trans Record algorithm. The data owner retrieves the transaction records with outsourcing association rule mining from the encrypted data with the development of Retrieve Trans Record algorithm. Finally, Get Freq Item Sets algorithm is

introduced between data owner and a cloud server. They execute the cloud data mining requests along with the token keys resulted in encrypted data. Therefore, the entire data owner retrieves their item sets frequent from the encrypted data mining.

11. A Methodology for Direct and Indirect Discrimination Prevention in Data Mining

A new preprocessing discrimination prevention methodology [11] was developed to provide an effective removing of direct and/or indirect discrimination. The proposed method include various data transformation to prevent direct and indirect discrimination or together at the identical instance. Initially, discrimination and collection of individual data is measured by means of decision-making processes. Next, measured data is transferred for eliminating all those discriminatory biases. Finally, discrimination-free data models can be created without critically spoiling the data quality from transformed data set. Here, discriminatory decision rules from direct and/or indirect form training data sets are removed and rules are changed to reasonable (nondiscriminatory) classification rules.

12. Privacy-Preserving Outsourced Association Rule Mining on Vertically Partitioned Databases

Privacy-preserving outsourced frequent item set mining solution [12] was focused on privacy preserving mining on vertically partitioned databases. Data analysis technique for various applications uses an association rule mining and frequent item set mining for collecting the data sets. The information about the sensitive data is collected with association rule mining along with frequent item set mining solution. An efficient homomorphic encryption scheme and a secure comparison scheme are introduced for improving the data privacy. The cipher text units or group of units in collected data is analyzed by using the frequency analysis to separate conventional ciphers such as replacement ciphers. Some of the attackers recover the frequencies of message units or group of units with plaintext.

13. Privacy-by-design in big data analytics and social mining

The paper [13] explains privacy-by-design paradigm technology framework with social mining and big data analytical technologies. The big data analytics approach produces higher protection and there is a responsive individual data in mining approach. The data attacks are determined and classify the queries for privacy preservation. Next, adversary model or a malicious adversary model is defined in proposed framework for the execution of social data with their characteristics. Finally, a privacy-aware approach proposes a suitable transaction between data privacy and data utility.

14. An approach for prevention of privacy breach and information leakage in sensitive data mining

The personalized anonymization approach was proposed in [14] to facilitate protection against privacy issues and shows better results on privacy protection. The Top-Down Greedy algorithm is used in proposed approach to provide high-dimensional space regions and end point of data. Both public and private organization data is collected evenly and stored in a database. Data mining algorithm uses decision making process for extracting the hidid data from the stored data that are collected for privacy protection. In addition to that, k-anonymity is projected as privacy preserving data mining

technique for the protection of leakage information.

15. Secure Mining of Association Rules in Horizontally Distributed Databases

A protocol for secure mining of association rules were proposed in [15] for distributing the data horizontally with improved privacy and efficiency. The private sub sets are computed by integrating a secure multi-party protocol with mining association rule. There are numerous sites in distributed database such that share the data with different database which is placed in horizontally partitioned.

III. Customer Privacy Maintenance With Social Relational Rule Mining To Avoid Un-Preferred Product Suggestion

Customer privacy maintenance with social relational rule mining is developed to filter an un-preferred suggestion for open social network. Customer privacy protection is addressed by getting feedback forms from the user friend-like's nomenclature and is able to determine potential friends with preferred message. Social rule mining is preferred for exchanging the product suggestion between the friends. A collection of un-preferred information's or messages is identified by analyzing real suggestions provided to the product. After the identification, privacy feedback list is generated from social network and they use mobile users for interacting with friends about the product suggestions.

Initially, some of the product suggestions from customer privacy maintenance are stored with their specification. All the products consist of both preferred and un-preferred suggestions and they compared with stored suggestions about the product. The social relational rule mining technique is used to avoid un-preferred product suggestions produced by customer reviews. They are broadly divided into the collection of product suggestions, providing the feedback list of customer privacy, detection of un-preferred suggestions and avoiding un-preferred suggestions using social relational rule mining.

Inductive logic programming is developed for representing the product suggestion with relational mining technique. A relational data base is used for transferring the logic suggestions provided as a source data. The customer privacy data about product suggestion are listed with preferred and un-preferred suggestions. Here, un-preferred messages are given about other product information and locations for extracting particular suggestion of product.

Social relation rule mining allows customers quickly to filter the product suggestions to become friends and prevent the final product results. This extracts customer privacy maintenance with product suggestions to estimate the solution. Customer privacy computation allows certain algebraic operations to perform rule mining technique that results in plain texting.

1. System Architecture

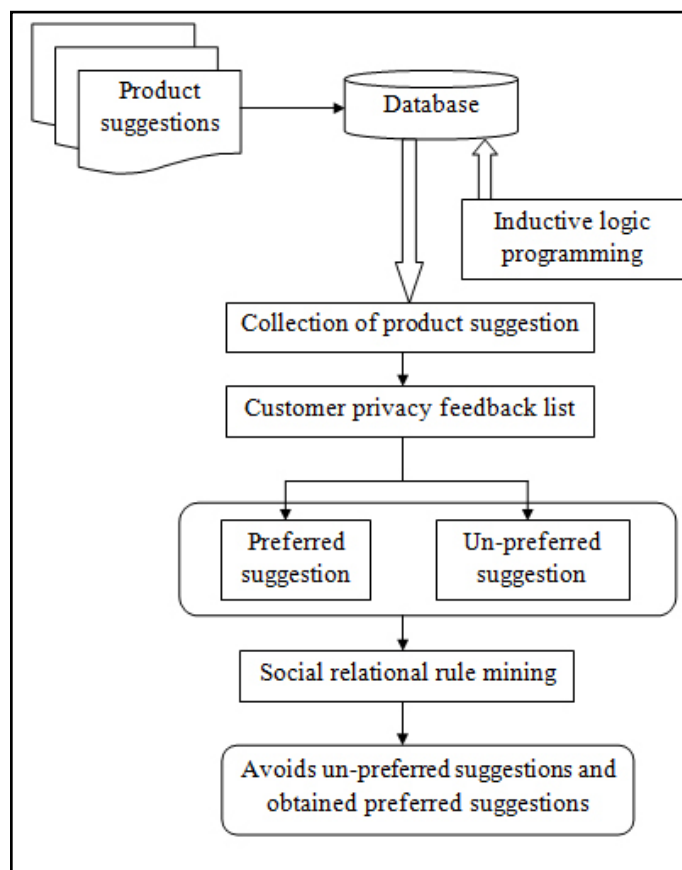


Fig.3.1 : system architecture diagram of customer privacy maintenance with social relation rule mining to avoid un-preferred product suggestions

Above figure 3.1 explains about the system architecture of customer privacy maintenance of product suggestions. The rule mining determines the summarization of feedback list that contains both preferred and un-preferred suggestions. The product name and an entry page for all evaluation of product is given as the input system. Finally, experimental results are shown in the detection of un-preferred product suggestions. The process of Social Relational Rule Mining to avoid un-preferred product suggestion is separated into following steps.

- Inductive Logic Programming
- Customer Privacy Feedback List
- Detection of Un-Preferred Product Suggestions
- Social Relational Rule Mining

a) Inductive Logic Programming

The customers communicate their opinions or reviews on different product features in a single review. Co-occurrence relative patterns among product suggestions and words are measured and quantified. The product review commands are identified by utilizing the characteristic about particular product. There are three different terms provided by relational rule mining for attaining the customer suggestions about product such as feature-opinion, feature-feature, and opinion-opinion.

Initially, pre-processing stage is carried out with inductive logic programming that collects product suggestions from various review pages. The terms inductive is referred as suggesting the products according to original data of product. The collected suggestion consists of different labels and documents that are performed to avoid the un-preferred product suggestions. The

extracted review suggestions are stored in the relational database at the sentence level.

b) Customer Privacy Feedback List

Customer privacy feedback lists are generated about the product suggestions from social network activity and their presence of customer review. The virtual ID is used by the customer to declare the suggestion on online social network. Customer privacy eliminates long-term relational capacity and uses customer signatures for verification to avoid un-preferred suggestions. Mobile networks are used in social activities for communicating the customers about the product with the relational patterns in mining technique. After the identification of customer patterns, feedback list is produced for privacy maintenance.

c) Detection of un-preferred product suggestion

The customer privacy information in social network provides relational patterns that are extended with classification and association rule for the detection of un-preferred suggestions. Social network provides customer personal information and location who presents the suggestions about the product. With the of feedback list determined from the customer privacy, un-preferred product suggestions are detected given by the customer in social network.

d) Social relational rule mining

Relational Rule Mining approach avoids the un-preferred suggestion provided by the customer to the products. The suggestions from various customers consist of different commands about product that presents preferred and un-preferred suggestions. A relational database consists of collection of suggestions about a particular product. The customer maintenance is estimated from different products by using social relational rule mining approach. The process of Social Relational Rule Mining (SRRM) for avoiding the un-preferred product suggestion is given below:

Input : Number of product suggestion in relational database
Output: Avoiding un-preferred product suggestion
Begin
Step 1: Perform inductive logic programming for collecting product suggestion from all the customer reviews
Step 2: For each customer suggestion in data base
Step 3: Perform relational patterns for representing customer privacy information
Step 4: Perform the customer feedback list in customer reviews
Step 5: Perform social relational rule mining approach
Step 6: Avoids un-preferred product suggestion by customers
Step 7: End

IV. Performance Analysis

The performance analysis is carried out in this paper with the metrics of Time Taken for Pattern Classification, Pattern Matching Loss Rate, Scalability and True Positive Rate. The performance metric evaluates and analyzes the values in java environment. Following metrics are used for experimental purposes.

- i. Time Taken for Pattern Classification
- ii. Pattern Matching Loss Rate
- iii. True Positive Rate

1. Time Taken for Pattern Classification

The customer privacy information is classified with relation patterns and relational data mining is used to identify the patterns. It is defined as the product of total number of customer information and time taken for classifying the individual customer information. Time taken is measured in terms of milliseconds (ms).

Table 4.1 Tabulation of Time Taken for Pattern Classification (ms)

Number of product suggestion	Time Taken for Pattern Classification (ms)	
	Open Social Network(OSN) Filtering	Social Relational Rule Mining (SRRM)
10	1.28	1.05
20	1.86	1.46
30	2.13	1.89
40	2.74	2.34
50	3.22	2.74

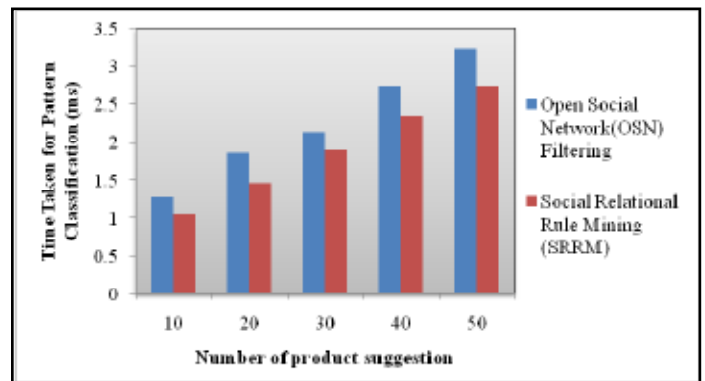


Fig. 4.1 : Measure of Time Taken for Pattern Classification (ms)

Above figure shows the time taken for pattern classification with respect to different number of product suggestions ranges from 10 to 50 that are obtained from customers. Figure shows the comparison of existing Open Social Network Filtering (OSN)) and proposed Social Relational Rule Mining (SRRM). When the number of product suggestions are increased, time taken for pattern classification is also get increased. Therefore, Social Relational Rule Mining approach achieves minimum time for the pattern classification. As a result, time taken for pattern classification is reduced by 16% when compared to the existing Open Social Network Filtering method.

2. Pattern Matching Loss Rate

The pattern matching loss rate for customer privacy information is measured based on the number of suggestions taken as input for experimentation and the number of suggestions considered as preferred suggestion. The pattern matching loss rate for customer privacy information measures the ratio of difference between the number of suggestion provided by customer and the number of suggestion preferred to the total number of suggestions. It is expressed in terms of percentage (%).

Table 4.2 : Tabulation of Pattern Matching Loss Rate (%)

Number of product suggestion	Pattern Matching Loss Rate (%)	
	Open Social Network (OSN) Filtering	Social Relational Rule Mining (SRRM)
10	72.33	63.47
20	74.89	65.89
30	76.89	67.69
40	78.32	69.13
50	80.23	71.58

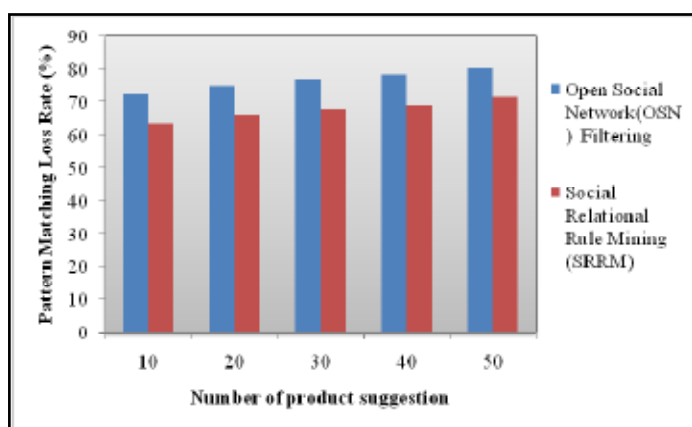


Fig. 4.2 : Measure of Pattern Matching Loss Rate (%)

Above figure explains the analysis of pattern matching loss rate with respect to different number of product suggestions ranges from 10 to 50 that are obtained from customers. Figure shows the comparison of existing Open Social Network Filtering (OSN)) and proposed Social Relational Rule Mining (SRRM). When the number of product suggestions are increased, loss rate during pattern matching is also get increased. Therefore, Social Relational Rule Mining approach achieves minimum loss rate on pattern matching. As a result, pattern matching loss rate is reduced by 12% when compared to the existing Open Social Network Filtering method.

3. True Positive Rate

The true positive rate is defined as the measure of preferred suggestions provided by the customer on social service networks. It avoids the un-preferred messages successively according to different number of suggestions that provides from customer review commands. True positive rate is defined as the ratio of total number of product suggestion to the preferred suggestions from customer. It is measured in terms of percentage (%).

Table 4.3 Tabulation of True Positive Rate (%)

Number of product suggestion	True Positive Rate (%)	
	Open Social Network (OSN) Filtering	Social Relational Rule Mining (SRRM)
10	69.48	79.39
20	72.45	82.32
30	75.36	85.56
40	70.29	80.18
50	72.35	82.24

10	69.48	79.39
20	72.45	82.32
30	75.36	85.56
40	70.29	80.18
50	72.35	82.24

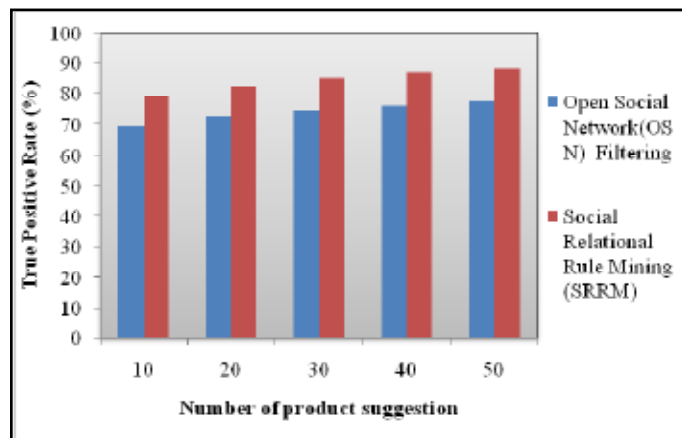


Fig. 4.3 : Measure of True Positive Rate (%)

Above figure illustrate the measure of true positive rate with respect to different number of customers that ranges from 5 to 25 users. The comparison is made with existing Open Social Network Filtering (OSN)) and proposed Social Relational Rule Mining (SRRM). When the number of product suggestions increased, true positive rate is also get increased. Therefore, Social Relational Rule Mining approach achieves higher true positive rate during avoiding the un-preferred product suggestions. As a result, true positive rate is improved by 14% when compared to the existing Open Social Network Filtering method.

V. Conclusion and Future Work

Finally, a Customer Privacy Maintenance with Social Relational Rule Mining is developed to provide an efficient social network with enhanced products. With increasing popularity of mobile social networks, secure and practical protocols are developed to enable users to effectively interact with each other. Customer's privacy feedback list is produced with the fundamental ID for a customer with the help of digital signatures for verification. Inductive Logic Programming is developed for identifying the patterns that involve multiple relations from a relational database. Social relation rule mining is provided for allowing the customers to identify preferred messages about the product and to avoid the un-preferred messages given about the product suggestions. The future work is carried out some other mining approach that is implemented for real time application environment.

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