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Time based Ontology Prediction of User's Preferences using Structural Balance Theory

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ABSTRACT: Today, many E-commerce systems adopt various recommendation techniques like Collaborative filtering, hybrid filtering techniques are used to realize the product recommendation. A key problem of collaborative filtering is how to combine the weight preferences of user neighbors. To overcome from the problem, Structural Balance Theory (SBT) is used to recommend a product for the target users. SBT determines the target user's friends and enemies. The main two approaches of SBT are user based recommendation and item based recommendation. Many recommendation systems focused on time factors consider for change the users preference. To seize the most recent preference of the users and try to improve the accuracy of the recommendation a time sensitive collaborative filtering model is proposed in the work. A novel profile visualization approach is taken to acquire profile feedback. The ontological classes and collaborative recommendation algorithms are used to recommend products seen by similar people for current topics of interest. Ontology is a formal representation of inference is shown to improve user profiling, external ontological knowledge is used for successful bootstrap recommender system and the profile visualization is employed to improve profiling accuracy.

Keywords: Structural Balance Theory, Data sparsity, Time-stamp, Ontology and Bootstrap

I. INTRODUCTION

Recommendation system is a system that seeks to predict the preferences of users according to their choices. They are user to predict the rating or preference that a user would give to an item. Through E-commerce, users can browse, evaluate and select the product objects that they like in a convenient way. Today, many E-trade corporations have provided diverse product objects to their large on-line customers. Generally, in every E-trade organization, there are a selection of product items which can be equipped to be as compared, selected and purchased by goal users. Many recommendation techniques are used by E-Commerce systems e.g., the widely recognized Collaborative Filtering (i.e., CF) is used .The CF Recommendation performs well only if target user owns similar friends or the product items preferred by the target owns one or more similar product items .But, due to the null or inadequate remarks incentive in E-trade services, many on line purchasing users aren't inclined to give their ratings on product items which generates a huge but sparse user-product rating matrix. In this example, for the target user, his/her similar friends and similar product items are both absent from the user-product purchase network, which may result in a failure of traditional CF. Considering the above challenge Structural Balance Theory-based recommendation (i.e., SBT-Rec) technique is proposed. In case of conventional CF based recommendation look for "similar friends" or "similar products", but SBT-Rec, search for the target user's dissimilar "enemy" and then search for the "possible friends" of E-trade target user, according to "enemy's enemy is a friend" rule of Structural balance concept. The products obtained by the target's "possible friends" are regarded as the recommendation candidates for target user; likewise, for the product items desired by using target user, we first determine their "possible similar product items" based on "enemy's enemy is a friend" rule of Structural balance theory, and regard them as the recommended candidates for target user.

The widely recognized recommendation approach is Collaborative Filtering based recommendation. The traditional CF-based recommendation totally works well, while the target user has one or more similar friends or the target user's purchased and similar product items own one or greater similar product items. But, many online users aren't inclined to present their ratings on product items generating a big but sparse user-product rating matrix. In this situation, if the goal customers similar friends and similar product objects if both are absent in the person-product purchase network, in an effort to result in a failure of the conventional CF-primarily based filtering advice and brings a big undertaking for correct product object advice for the target user. Considering the above limitation we put forward a Structural Balance concept –based recommendation method over big rating data in E-trade. Consistent with SBT, if the "direct friend relationship is absent, we are able to discover the "indirect friend relationship" by means of thinking about the subsequent rules.

1. Enemy's enemy is a friend
2. Enemy's friend is a enemy
3. Friend's friend is a friend
4. Friend's enemy is an enemy

Ontology is a formal specification of shared conceptualization of a domain, and it is able to examine the area knowledge and make domain assumptions easier. Ontology is representation of knowledge by a set of concepts/classes within domain and the relationship between those concepts. The main objective is to provide an ontology-based totally customized recommender system framework. Integrating multi-supply and heterogeneous statistics via constructing a site ontology, and a person's long time preference and choice ontology may be constructed based on the person's demographic characteristics. To seize the most up-to-date choice of the customers and enhance the accuracy of the recommendation, a time sensitive collaborative filtering version is used.

The early researchers regularly focus on the users, items and ratings. But time factor is also an vital parameter to be considered. A person's preference can be especially regular, however the level of his desire will trade through the years. The time when a user decided on an object constantly suggests the level of the person's choice.

II. RELATED WORKS

Several techniques, such as Normalized cut, is used to derive a cluster-based collaborative filtering set of rules that goes beyond other state-of-the-art techniques in terms of class accuracy. This method is used for selecting associates and displaying its effectiveness as compared to different cluster-based totally strategies [1]. To find vast subgroups, the Multiclass CoClustering (MCoC) is formulated. Ultimately, we suggest a unified framework to increase conventional CF algorithms by means of the usage of subgroup statistics to enhance their N advice advanced overall performance [2]. A unique structural balance theory-based recommendation system (SBT-Rec) with set of rules, are used to predict the ratings by exploring the consumer-product subgroup analysis. Concurrently, wherein a user-product subgroup is defined as a domain including a subset of objects with comparable attributes and a subset of customers who have pastimes in those items [3]. Collaborative Filtering (CF) is a popular technology for recommender systems. CF methods suffer from problems such as data sparsity and big-error in predictions. Computation is more as we have to estimate the sensitivity of different number of user groups. The cost of these preprocessing procedures depends on the particular clustering method used and can be higher [4]. In the case of scattered data set, to improve the accuracy of the calculation of similarity is to improve the quality of the recommendation. A calculation method is proposed that is combined with the relevant theoretical knowledge of the theory of attributes and of the current research [5]. A new Robust Substructure Structural Learning (RSSL) set of rules that integrates image understanding and learning of features right into a joint learning framework. The learned area is followed as an intermediate area to reduce the semantic gap among low-stage visuals and excessive-degree semantics. To ensure that subspace is compact and discriminative, the intrinsic data geometry and local and global structural consistency on labels are simultaneously exploited inside the proposed set of rules [6]. Personalized ontology-based recommendation system are to represent items and user-profiles in order to provide personalized services using semantic web applications. It shows high accuracy when semantically enhanced methods are applied in recommendation systems [7]. A content-based recommender system that are used in ontology information to calculate the degrees of similarity between a user's preferences and point of interest to provide personalized recommendations [8]. An approach to adapt the existing item-based (movie-based) collaborative filtering algorithm based on the timestamp of ratings to recommend movies to users at opportune moments is proposed [9]. Web service predictions are based only on quality of service. The methodology applied here is K-means Clustering to find the quality of the web service component. For the same web service component is recommended using collaborative filtering [10] [11]. Structural balance theory was implemented through the social balance theory for recommendation to the user [12]. In cold start recommendation Monte Carlo algorithm using random process theory and also same thing is recommended via a hybrid approach of recommendation system [13] [14].

III. PROPOSED SYSTEM

A. Structural Balance Theory

Structural balance concept was delivered by psychologist F. Heider in 1958. F. Heider analyzed the structural relationships amongst three parties (i.e., P, O and X), and categorized the structural relationships into 8 categories (four stable relationships are specified). Four strong structural relationships are supplied, in which the dashed line denotes the "enemy" relationship at the same time as the strong line denotes the "friend" relationship. Subsequently, we introduce the four structural relationships with extra intuitive and easy-to-recognize specifications respectively as shown in Fig. 1. (a) if O is a friend of P and X is a enemy of O, then X is a possible friend of P with a big opportunity (b) if O is an enemy of P and X is an enemy of O, then X is a likely friend of P with a large probability (c) if O is a friend of P even as X is an enemy of O, then X is a likely enemy of P with a large probability (d) if O is an enemy of P at the same time as X is a friend of O, then X is a possible enemy of P with a large probability. Therefore, according to Structural stability idea, while the "direct friend relationship" is absent, we can search for the "indirect friend relationship" using the guidelines, e.g., "enemy's enemy is a friend". In view of this observation, we recommend a recommendation method considering Structural Balance Theory, i.e., SBT-Rec

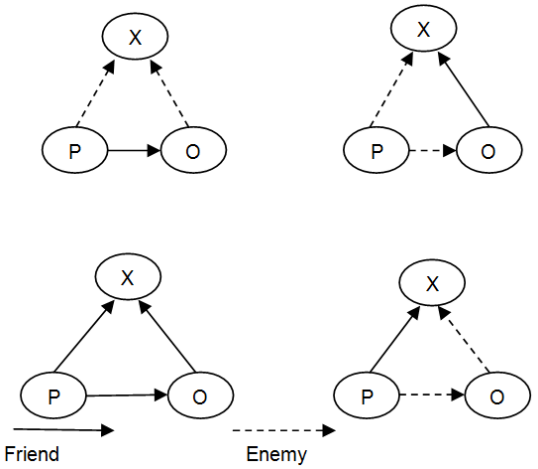

Fig. 1. Four stable relationships among P, O and X according to SBT_Rec.

B. Ontology

A novel profile visualization approach is taken to acquire profile feedback. A personalized ontology-based recommendation system is used to represent items and user-profiles in order to provide personalized services using semantic web applications. This paper shows high accuracy when semantically enhanced methods are applied in recommendation systems. Ontological inference is shown to improve user profiling, external ontological knowledge used to successfully bootstrap a recommender system and profile visualization employed to improve profiling accuracy. A recommendation system based on an ontology can also solve the cold start problem that depend on insufficient user information from the past.

C. Time Stamp

The present time-stamp based algorithms generally include time component. To seize the most newest preference of the users and improve the accuracy of the recommendation, a time sensitive collaborative filtering model is proposed.

By ordering the items by time for each user, our proposed time-sensitive collaborative filtering algorithm provide better accuracy than the traditional user-based collaborative filtering algorithm on the MovieLens dataset.

D. Architecture

The architecture diagram for recommendation system is shown in Fig. 2.

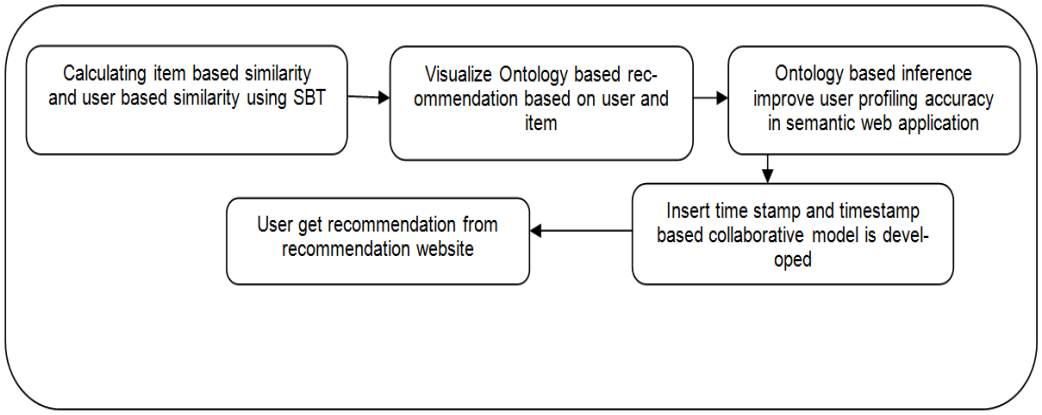

Fig. 2. Architecture diagram.

E. Methodology and Approach

In structural balance theory similarity is calculated using the following formulas

User-similarity: **Sim(User$_{target}$,User$_i$)**

$$= \sum_{pro\_item_j \in I} \frac{(R_{target\_j} - R_{target}) * (R_{i\_j} - \overline{R_i})}{\sqrt{\sum_{pro\_item_j \in I_{target}} (R_{target\_j} - \overline{R_{target}})^2} * \sqrt{\sum (R_{i\_j} - \overline{R_t})^2}}$$

Item-similarity: **Sim(pro_item$_{target}$,pro_item$_j$)=**

$$= \sum_{user} \frac{(R_{i\_target} - R_{target}) * (R_{i\_j} - \overline{R}_t)}{\sqrt{\sum_{user_i \in user_{target}} (R_{target\_j} - \overline{R_{target}})^2} * \sqrt{\sum_{user_i \in user_i} R_{i\_j} - \overline{R_t}}}$$

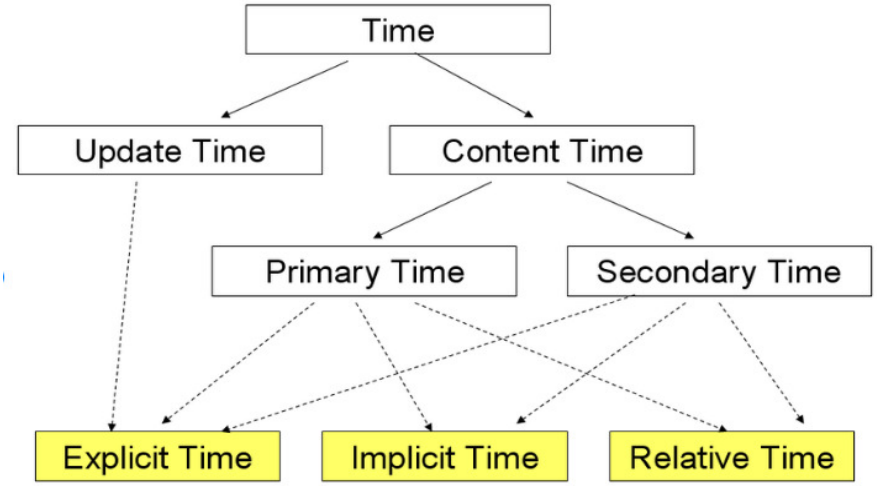

Fig. 3. Time Based Ontological Representation.

As a way to make a first rate advice, it is important to ensure that the characteristics of the endorsed activities wholesome with the consumer's pursuits. Ontology offers a semantic integration of the multi-beneficial aid heterogeneous data in the recommender machine. A specific area ontology helps the recommendation and plays a key function in the advice gadget. Hence location ontology is built by way of integrating multi-useful resource and heterogeneous information. The structure of ontology is shown in Fig. 3.

IV. RESULTS AND DISCUSSION

The result for recommendation system is displayed in GUI as shown in Fig. 4.

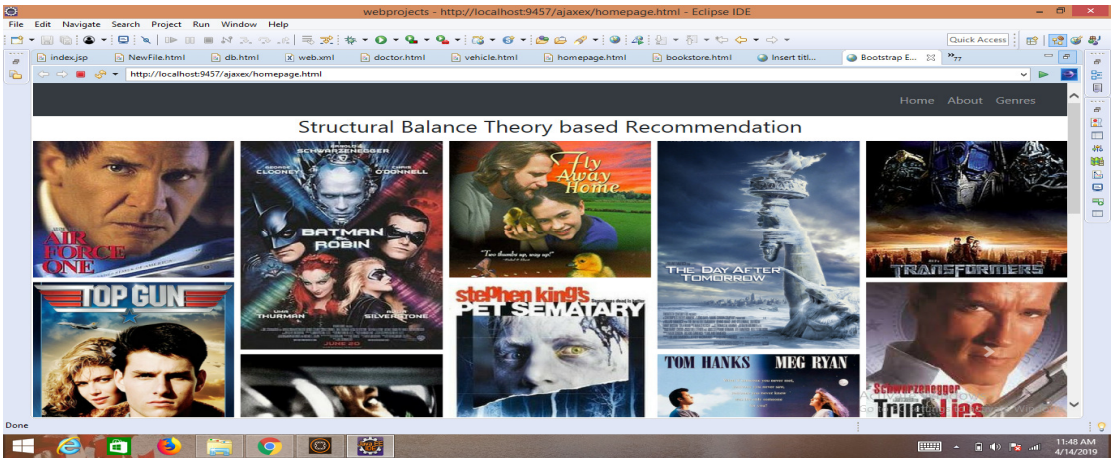

Fig. 4. Home page.

The recommended movies are displayed as shown in Fig. 5

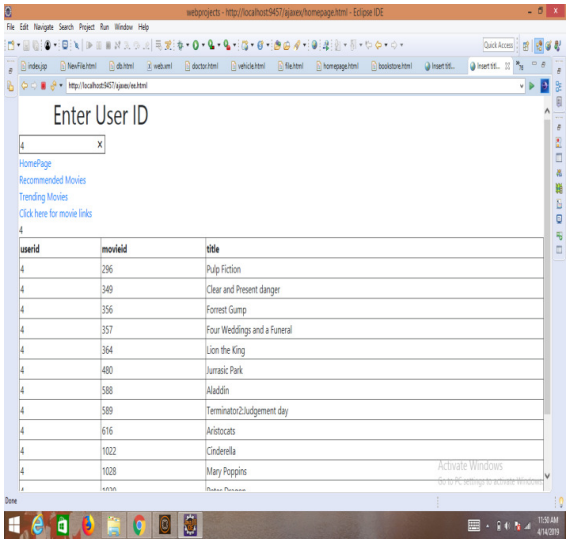

Fig. 5. Recommendation Page.

The recommended movies along with images are shown in Fig. 6

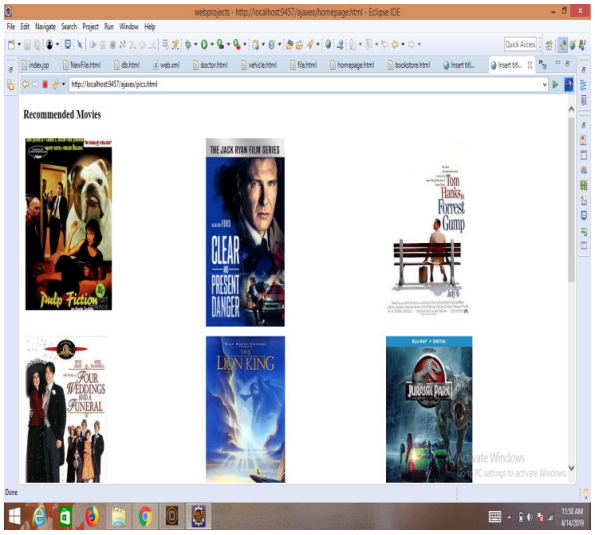

Fig. 6. Recommended Movies Page.

The results for trending movies that the user may prefer are shown in Fig. 7.

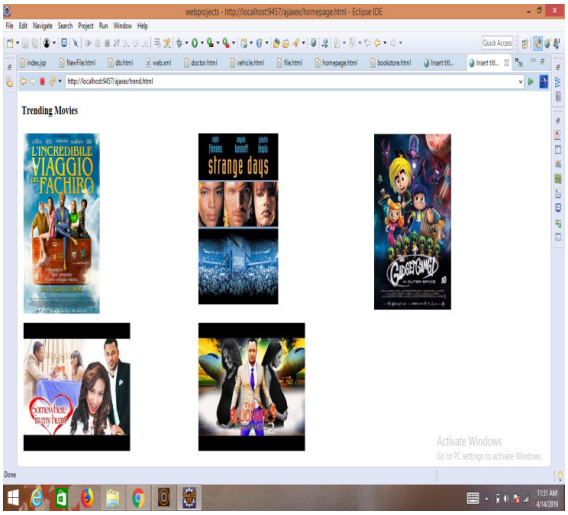

Fig. 7. Trending Movie page.

Movie id's and their corresponding links are in Fig. 8. Recommendation accuracy comparison between SBT-Rec and SBT-SR. The results are presented as shown in Fig. 9.

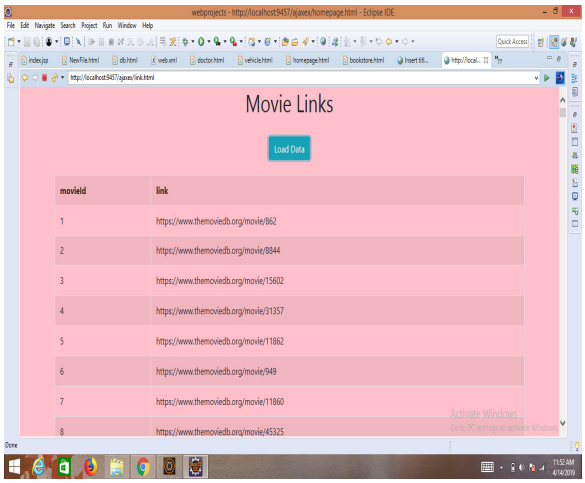

Fig. 8. Movie Links Page.

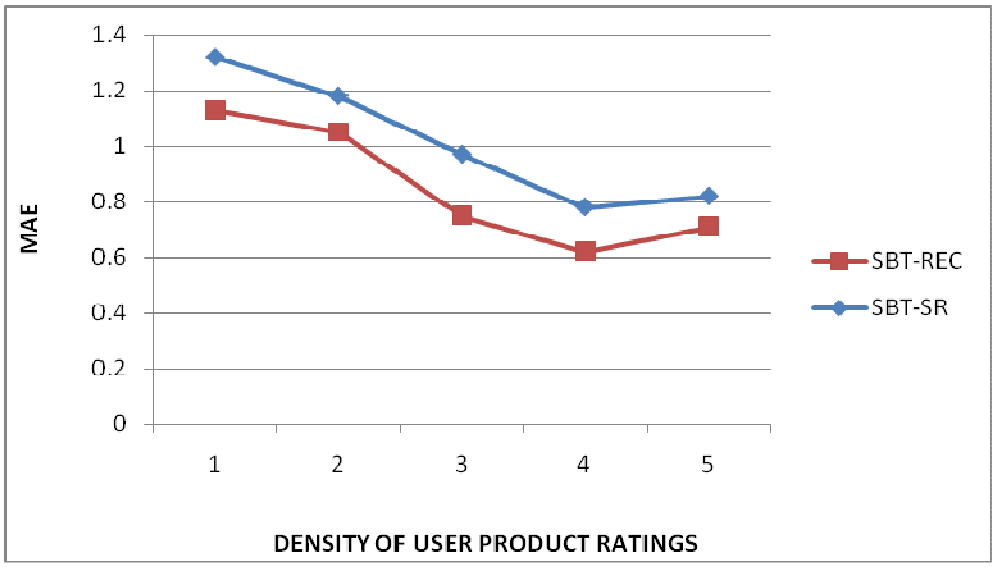

Fig. 9. Recommendation accuracy comparison.

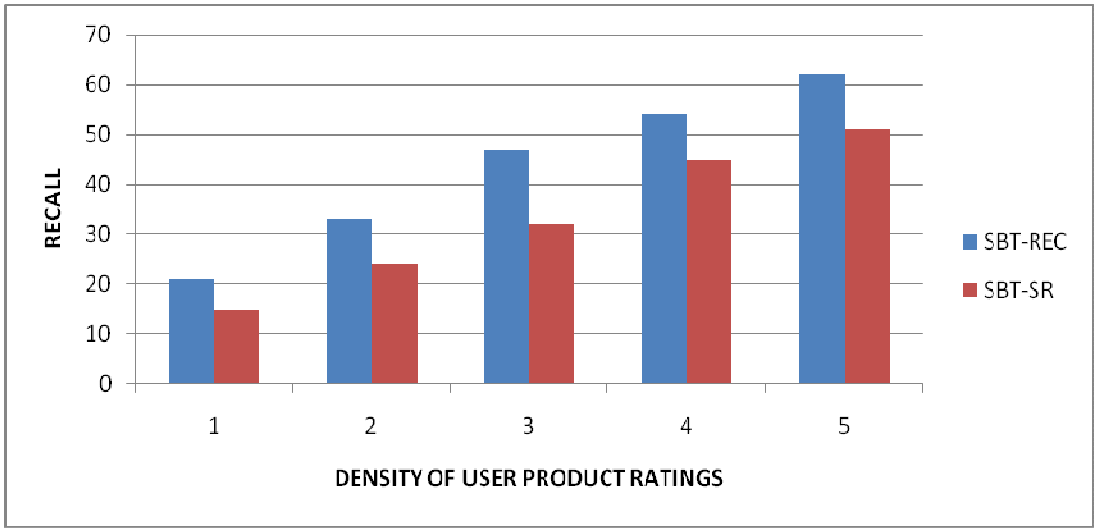

Fig. 10. Recommendation recall comparison between SBT-Rec and other approaches.

The results of recommendation recall between SBT-Rec and SBT-SR are shown in Fig. 10.

V. CONCLUSION AND FUTURE WORK

According to big rating data in E-commerce, a novel product object recommendation approach named SBT-Rec is added, for dealing with the particular conditions when the target user has no similar friends and the product objects desired through target user have no similar product items. On one hand, SBT-Rec makes full use of the structural balance data hidden in user-product purchase network, via thinking about "enemy's enemy is a friend" rule and "enemy's friend is an enemy" rule in Structural balance theory. On the other hand, SBT-Rec integrates each consumer-based CF recommendation and object based totally CF recommendation, so as to improve the recommendation recall.

Time based ontology is mainly focused on three factors like thematic, Theme and Time. The Time ontology is appreciated in the field of semantic web in too for the temporal mining and spatial mining. In the work recommender system, recommend the products for the customers in a unique manner by means of the time based ontology. For the type of recommendation plenty numbers of methods exist in the mathematical model like Apriori algorithm, Rule based algorithms is the first and foremost algorithm that plays a inevitable role in recommending products to the web users. Time, location, thematic is the subject oriented recommendations getting triggered in the recent research arena. The final verdict of the work is to provide the useful recommendations to the commodity based customers through the vital methodology applied through SBT. The SBT technique is useful for the web based customers to get unique products without any confusion and mess-ups.

In the imminent studies, the analysis is automated by similarity threshold placing approach, in order to deal with the customized requirements from specific E-commerce users.

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