Design of Rating Prediction System based on Social Sentiment Review Analysis

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Abstract-In recent years, shopping online is becoming more and more popular. When it need to decide whether to purchase a product or not on line, the opinions of others become important. It presents a great opportunity to share our viewpoints for various products purchase. However, people face the information overloading problem. How to mine valuable information from reviews to understand a user's preferences and make an accurate recommendation is crucial. Traditional recommender systems (RS) consider some factors, such as user's purchase records, product category, and geographic location. In this work, it propose a sentimentbased rating prediction method (RPS) to improve prediction accuracy in recommender systems. Firstly, it propose a social user sentimental measurement approach and calculate each user's sentiment on items. Secondly, it not only consider a user's own sentimental attributes but also take interpersonal sentimental influence into consideration. Then, consider item reputation, which can be inferred by the sentimental distributions of a user set that reflect customers' comprehensive evaluation. At last, by fusing three factors-user sentiment similarity, interpersonal sentimental influence, and item's reputation similarity into recommender system to make an accurate rating prediction. It conduct a performance evaluation of the three sentimental factors on a real-world dataset collected from Amazon. Experimental results show the sentiment can well characterize user preferences, which help to improve the recommendation performance.

Keywords-Item reputation, Reviews, Rating prediction, Recommender system, Sentiment influence, User sentiment

I. INTRODUCTION

With the development of e-commerce, shopping online is becoming more and more popular. When we need to decide whether to purchase a product or not on line, the opinions of others become important. The convenience of new web technologies enables us to freely express our opinions and reviews for various products we have purchased. How to mine these review data to understand customers' preferences and make recommendations [1],[2] is crucial to merchants and researchers. With the development of Web, more and more people are connecting to the Internet and becoming information producers instead of only information consumers in the past, resulting to the serious problem, information overloading. There is much personal information in online textual reviews, which plays a very important role on decision processes. For example, the customer will decide what to buy if he or she sees valuable reviews posted by others, especially user's trusted friend. People believe reviews and reviewers will do help to the rating prediction based on the idea that high-star ratings may greatly be attached with good reviews. Hence, how to mine reviews and the relation between reviewers in social networks has become an important issue in web mining, machine learning and natural language processing. It focus on the rating prediction task. However, user's rating star-level information is not always available on many review websites. Conversely, reviews contain enough detailed product information and user opinion information, which have great reference value for a user's decision. Most important of all, a given user on website is not possible to rate every product or item. Hence, there are many unrated products or items in a user-item-rating matrix. In such case, it's convenient and necessary to leverage user reviews to help predicting the unrated items.

Amazon is one of the largest online vendor in the World. People often gaze over the products and reviews of the product before buying the product on amazon itself. But the reviews on amazon are not necessarily of products but a mixture of product of product review and service review (amazon related or Product Company related). The buyer is misled as the overall sentiment (rating classification) that amazon gives is a collective one and there is no bifurcation between a service review and product review. The proposed model satisfactorily segregates product review, in addition to this it also classifies the review as Feature review if the user talks about some particular product feature. A featured review is nothing but a product review and also gives sentiment of the text about the product feature. For example, if the user writes in his review, "the camera for this phone is very good.", then we also classify camera feature as positive. Building a system that visualizes the review's sentiment is important.

Sentiments are nothing but emotions of the user. It may be good, excellent, bad or neutral. Analysis of such emotions is known as sentiment analysis. In other words we can say that, it is language processing task that uses computational approach to identify the opinion of user and classify it as negative, positive or neutral. Sentiment Analysis [4],[5] is a Natural Language Processing and Information Extraction task that aims to obtain writer's feelings expressed in positive or negative comments, questions and requests, by analyzing a large numbers of documents.

Sentiment analysis is also known as opinion mining, opinion extraction. Sentiment analysis and opinion mining are subfields of machine learning. They are very important in the current scenario because, lots of user opinionated texts are available in the web now. This is a hard problem to be solved because natural language is highly unstructured in nature. The interpretation of the meaning of a particular sentence by a machine is tiresome. But the usefulness of the sentiment analysis is increasing day by day. Machines must be made reliable and efficient in its ability to interpret and understand human emotions and feelings. Sentiment analysis and opinion mining are approaches to implement the same. Sentiment analysis, or opinion mining, aims at user's attitude and opinions by investigating, analyzing and extracting subjective texts involving users' opinions, preferences and sentiment.

II. EXISTING SYSTEM

G. Zhao, X. Qian and X. Xie [6] proposed a concept of the rating schedule to represent user daily rating behavior and the similarity between user rating schedules to represent interpersonal rating behavior similarity. Z. Fu, K. Ren and J. Shu [7] address the problem of personalized multi-keyword ranked search over data by considering the user search history.

Y. Cai, H. Leung, Q. Li, H. Min, J. Tang, and J. Li [8] uses CF recommendation method called TyCo. It selects neighbors' of users' similarity based on their typicality degrees instead of co-rated item by user. D. Tang, Q. Bing and T. Liu [3] addressed the issue by incorporating user- and product- level information into a neural network approach for document level sentiment classification. Shreya Banker and Rupal Patel [9] addressed that sentiment analysis is one kind of computational technique of Artificial Intelligence. It is the task of identifying positive and negative opinions, emotions, and evaluations. Their article represents Sentiment analysis, it's issues, applications and some of the methods used to evaluate the review using sentiment analysis. Survawanshi R. K and Amrit Priydarshi [10] discussed importance of Recommendation Systems, various social factors, user interest and methodologies, which influence Personalized Recommendation System.

Limitations of Existing System

- The product recommended by existing system doesn't have performance accuracy and product quality together.
- Earlier system recommend product on positive and negative reviews of the user but did not consider brand value, price and rating of products during recommendation.
- The existing "Recommender System" only give information about the items which are reviewed but does not give the information about the items for which the rating and reviews are not given.

III. AIM AND OBJECTIVE

A. Aim

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The aim of the project is to build a recommender system based on sentiment analysis of the textual reviews given by the people. The proposed system will recommend the products which are having the best possible positive reviews. The system will work on the rating prediction which will be collected from the dataset. The system also works on the item reputation of the product which depends on the brand value, quality and price of the product similarities and take it into consideration for the recommender system to make an accurate rating prediction. The system give the information and recommend the items which are not even have reviews or rating by item reputation. The data of textual reviews is collected from amazon dataset.

B. Objectives

- To mine valuable information from reviews to understand a user's preferences and make an accurate recommendation by performing sentimental analysis.
- To improve prediction accuracy in recommender systems by considering item reputation and a sentiment-based rating prediction method (RPS).
- To improve the performance of recommendation system by considering user's own sentimental attributes, interpersonal sentimental influence and product reputation.
- To help the user to do their work in less time and with good quality product for healthy life.

IV. LITERATURE REVIEW & RELATED WORK

Background History

Most of the predictive tasks previously performed on this dataset have rating predictions primarily based on user and business attributes. Sentiment analysis is machine learning

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approach in which machine analyzes and classifies the human's sentiments, emotions, and opinions about some topic which are expressed in the form of either text or speech. SA is an ongoing research field. [11] contains overview of the recent updates in this field. Many recent algorithms and various SA applications are explained briefly. The main target is to give detailed explanation of SA techniques and the related fields.

The purpose is to give the illustration of the recent trend of research in the sentiment analysis and its related areas.

Sentiment analysis basically aims at determining the attitude of a speaker or a writer with respect to some topic or the overall feeling in a document. Businesses and market research firms have carried out traditional sentiment analysis for some time, but it requires significant resources. This is also use for saving the time of customers. web application is unique for one service that is it provide the analyzation of all comments and provide the information in few time.

Related Work

1. K. KALPANA and S. BAIRAVEL (2015) "ASPECT BASED SENTIMENT ANALYSIS FOR TEXTUAL REVIEWS USING PROBABILISTIC ASPECT RANKING ALGORITHM"

Focused on the emotion classification of different documents extracted from social web sites. Documents may sometimes contain only a few words and are often written by creative people with the intention to "provoke" emotions, and consequently to attract the readers' engrossment. These specialties make this type of text particularly suitable for use in automatic emotion recognition. The proposed work is movie review aspect ranking framework to identify the important aspects of movie from various customer reviews. The framework contains the three major components, (a) Movie Aspect Selection, (b) Sentiment Analysis, (c) Aspect Ranking. First, find the positive and negative reviews to improve aspect selection and sentiment analysis from free text reviews. Then develop a probabilistic aspect ranking algorithm to find the importance of various aspects of a movie from large reviews. The algorithm simultaneously finds the aspect frequency and the influence of customer opinion given to the each aspect over the overall opinions. The movie aspects are finally ranked based on importance of scores. The experimental result shows the effectiveness of the proposed approaches. Apply the aspect ranking algorithm into two real world applications. (i) Document based sentiment Analysis. (ii) Review Summarization. The proposed work improves the efficiency of the result in sentiment analysis. [13]

Sentiment analysis or opinion mining is a field of study that analyzes people's sentiments, attitudes, or emotions towards certain entities. Author tackles a fundamental problem of sentiment analysis, sentiment polarity categorization, which is one of the fundamental problems of sentiment analysis. Data used is a set of product reviews collected from Amazon [14]. The aforementioned flaws have been somewhat overcome in the following two ways: First, each product review receives inspections before it can be posted and second, each review must have a rating on it that can be used as the ground truth. The rating is based on a star-scaled system, where the highest rating has 5 stars and the lowest rating has only 1 star. Author performed the results for both sentence-level categorization and review-level categorization. [15]

3. B. Sun, V. Ng (2014) "Analyzing sentimental influence of posts on social networks"

analyzes the sentimental influence of posts and compare the result on various topics and different social media platforms. A method is also proposed to estimate the sentiment of posts through the emotion detection, based on which their sentimental influence can be judged. In order to measure the personal sentimental influence more accurately, the topics are categorized into public topics and personal topics, as users are likely to be affected by external sources on public topics, such as current affairs and news. If the topic is generated by a user who first posted it, the sentiment of its replies should be mainly influenced by the user's post. The sentiment on different topics should be different. The sentimental influence has been defined in two types: compliance and opposition. In order to know whether the types of the influencers' sentiment have different effect on their sentimental influence, the average complying rate and average opposing rate are calculated for the influencers with positive and negative sentiment separately. [16]

4. B. Wang, Y. Min, Y. Huang, X. Li, F. Wu (2013) "Review rating prediction based on the content and weighting strong social relation of reviewers"

proposed a Review Rating Prediction(RRP) method has three major contributions. Firstly, incorporating the character of reviewer's social relations, as regularization constraints, into content-based methods. Secondly, proposed a method to classify the social relations of reviewers into strong social relation and ordinary social relation. For strong social relation of reviewers, it give higher weight than ordinary social relation when incorporating the two social relations into content-based methods. Thirdly, based on regression model, it propose a type of a regularization methods by incorporating the social relation of reviewers into content-based method for RRP. Review content is a very important information source for RRP. [17]

5. X. Yang, H. Steck, and Y. Liu (2012) "Circle-based Recommendation in Online Social Networks"

a novel approach to presented improving recommendation accuracy by introducing the concept of inferred circles of friends". The idea is to determine the best subset of a user's friends, i.e., an inferred circle, for making recommendations in an item category of interest. It presents an effort to develop circle-based RS. It focus on inferring category-specific social trust circles from available rating data combined with social network data where social trust links across all categories are mixed together. Author propose a set of algorithms to infer category-specific circles of friends and to infer the trust value on each link based on user rating activities in each category. To infer the trust value of a link in a circle, it first estimate a user's expertise level in a category based on the rating activities of herself as well as all users trusting her. Author then assign to users trust values proportional to their expertise levels. The reconstructed trust circles are used to develop a low-rank matrix factorization type of RS. Through experiments on publicly available data, it is demonstrate that the proposed circle-based RS can better utilize user's social trust information and achieve more accurate recommendation than the traditional matrix factorization approaches that do not use any social trust information, and the existing social-trust based RS that use mixed social trust information across all categories. [18]

V. THE PROPOSED APPROACH

Recommendation System is used to recommend the product which is highly praised and having the features like brand, price and quality. Depending on the features of the product, the system will display recommendation message to the user that the recommended product is good or bad. In the system the products are categorized in four type of the product. The total recommendation process is done on the basis of reviews given to the product. The analysis is done on the total textual reviews which is also called the sentimental analysis or opinion mining. In the sentimental analysis of textual review, the review is parsed into each single word. The each single word is compared with the words of positive negative dictionary which is present in the database to decide whether the word is positive or negative. Like this every review undergone through the sentimental analysis. Depending on the count of the positive negative review the final result will display that whether the product has positive/negative/neutral review.

Sentiment analysis is the most fundamental and important work in extracting user's interest preferences. Analysis is important factor for deciding that the product is good enough or bad for the recommendation purpose. But in the given system the system not only considering the product's positivity or negativity but also its features like brand, price and the quality of the product. Depending on all these factors the final recommendation message is given that the product is good or bad. After all this process the desired output is obtained by the recommendation system.

Proposed method

The purpose of approach is to find effective clues from reviews and predict social users' ratings. We firstly extract product features from user review corpus, and then we introduce the method of identifying social users' sentiment. At last we fuse all of them into our sentiment-based rating prediction method. It proposed a Highest rating recommendation system for products and items. The contributions can be summarized as follows:

- It propose a recommendation system for the products. To develop the recommendation system, rating data sets of products and items in the particular category which is used to read the textual reviews given by the users. The main categories which are used in the application are nothing but beauty products, tools and home improvement products, Electronic products and clothing and jewelry products. The datasets used in this recommendation system is downloaded from the "Amazon" website. The review websites provides a broad thought in mining user preferences and prediction user's ratings. And the dataset used is nothing but "Online Product Rating" Dataset.
- Textual reviews obtained from data sets is categorised into three types: To identify positive reviews, To identify negative reviews and To identify neutral reviews. With the help of these types of reviews we can identify the social relation between users which will help us to categories the products.
- Sentimental dictionaries will give the information of brands, quality and price on the basis of matrix factorization. This matrix factorization can be performed by using two types of methods which are by applying conjunctive rules and another is by comparing product feature and sentiment words.

- This matrix factorization method will ultimately give the highest rating product recommendation for all types of products and items to the user. Also factors like brand, price and quality of the product are also found for the product and recommendation is done on the basis of both the rating and other factors (brand, price and quality) of the products.
- The final output will be given by the recommendation system that the given product is good enough to decide whether the product is good or bad. This recommendation system can be used by the user to select which items to be ordered or purchased and which are not. This recommendation system will help to take any decisions for any type of product.

The architecture shows steps to the recommendation system which is based on the sentimental analysis of textual reviews. The main objective of the research is to develop a recommendation system on social dataset which helps to identify the product features and best recommended product for their relevance. It will help for the users to get specific recommended product according to the user interest.

• Mathematical Model

In order to demonstrate the effectiveness of the Sentimental Analysis on textual reviews, we conduct experiments on the downloaded Amazon dataset which contains products and reviews of different categories.

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Following are the steps of the proposed system:
R= Set of review of each product p[i]
S= Sentiment Dictionary
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Step 1: for each r[i] \in \mathbb{R}
     do
     Parse r[i];
 [<sup>·:</sup> Remove Stop words and Apply Stemming]
for each w €r[i]
 do
     Split w;
     Sp = w;
 end
for each Sp €S
 do
    if Sp = +ve
      then r[i] = +ve;
    else if Sp = -ve
            then r[i] = -ve;
              else if Sp \neq +ve && Sp \neq -ve
                             then r[i] = Neutral;
```

```
end
Step 2: Generate Matrix Mf based on Brand, Price &
Ouality
Step 3: Rating Generation of p[i] based on r[i]
Step 4: if r[i] = +ve
 then
              Check Mf values:
              goto Step 5;
          else if r[i] = -ve
               then
                  Check Mf values:
                  goto Step 5;
                else if r[i] \neq +ve \&\& r[i] \neq -ve
                      then
                           Check Mf values;
                            goto Step 5;
Step 5: Recommend the product p[i].
```

Methodologies Used

The proposed system will be using methods such as:

a) Identifying the Sentiment of the Textual Reviews

The textual reviews will be read from the dataset of the products. The reviews will get distributed into three type's Positive reviews, Negative reviews and Neutral reviews by calculating that how many times the positive and negative words are used. These positive and negative words are stored into the sentimental dictionary which are used to compare and calculate the type of review. The sentiment dictionary (**SD**) includes **POS-Words** and **NEG-Words**. Besides, it have sentiment degree dictionary (**SDD**), which has highest degree sentiment words and lowest degree sentiment words. Also, built the negation dictionary (**ND**) by collecting frequentlyused negative prefix words. These words are used to reverse the polarity of sentiment words. The representative positive and negative words in the dictionaries are introduced in Table

Table: Brief introduction of the Sentiment Dictionaries

Dictionaries	REPRESENTATIVEWORDS
SD	POS-Words: attractive, clean, beautiful, comfy, convenient, delicious, delicate, exciting, fresh, happy, homelike, nice, ok,
	yum NEG-Words: annoyed, awful, bad, poor, boring, complain, crowed, dirty, expensive,
	hostile, sucks, terribly, unfortunate, worse
ND	no, nor, not, never, nobody, nothing, none,
	neither, few, seldom, hardly, haven't, can't, couldn't, don't, didn't, doesn't, isn't, won't,

end

SDD	Highest degree words: most, best, greatest,
	absolutely, extremely, highly, excessively,
	completely, entirely, 100%, highest, sharply,
	superb, awfully, better, lot, very, much, over,
	greatly, super, pretty, unusual, even, more, far,
	so, further, intensely, rather, relatively,
	slightly more, insanely, comparative
	Lowest degree words: a little, a bit, slight,
	slightly, more or less, relative, some,
	somewhat, just, less, not very, bit, little,
	merely, passably, insufficiently.

If the user review is having the positive sentiment like good product, best product, better product, etc. then the review will fall in the category of the positive review. The system will identify such review as positive review. The negative review will work likewise but it will look for the negative sentiment such as bad, worst, not good etc. If such sentiment will be identified in the reviews than such review will fall in the category of negative reviews. If both positive and negative sentiment are not identified in the reviews than it will fall in the category of the neutral reviews.

b) Matrix Factorization

Matrix factorization is one of the most popular approaches for low-dimensional matrix decomposition. Here, it review the Basic MF. The rating matrix $R \in \mathbf{R}m \times n$ (*m* is the number of users and *n* is the number of items) can be predicted according to Eq. (1), where $Uu \in Um \times k$ denotes the user Potential Eigen vectors matrix and $Pi \in \mathbf{P}n \times k$ denotes item Potential Eigen vectors matrix, and *k* is the dimension of the vectors. Ru, denotes the predicted objective star level of item *i*, \overline{R} denotes the average value of all ratings.

$$\hat{R}_{u,i} = \bar{R} + U_u P_i^T \tag{1}$$

It learn Potential Eigen vectors of users and items on the observed rating data by minimizing the objective function. The objective function Ψ is defined as follows:

 $\Psi(\boldsymbol{R},\boldsymbol{U},\boldsymbol{P}) = 12\Sigma(Ru,i-Ru,i)2u,i+\lambda 2(\|\boldsymbol{U}\|F2+\|\boldsymbol{P}\|F2)$ (2)

Where $\|X\|F$ is the Frobenius norm of matrix **X**, which is utilized to avoid over-fitting. The optimization of the objective function can be solved by gradient descent method.

c) Word Stemming

Stemming refers to the process of removing affixes (prefixes and suffixes) from words. In the information retrieval context, stemming is used to conflict word forms to avoid mismatches that may undermine recall. Stemming is the process for reducing inflected words to their stem or root form. Eg: "argue", "argued", "argues", "arguing", and "argus" reduces to the stem "argu". In many languages stemming is imperative for retrieval performance. Porter stemming Algorithm is used for word Stemming. The Porter stemmer applies a set of rules to iteratively remove suffixes from a word until none of the rules apply. The Porter stemming algorithm (or 'Porter stemmer') is a process for removing the commoner morphological and in flexional endings from words in English.

d) Functional/Stop Word Removal

Stop word removal is one of the most commonly used preprocessing steps across different applications. A stoplist is the name commonly given to a set or list of stop words. It is typically language specific, although it may contain words. The idea is simply removing the words that occur commonly across all the documents in the corpus. A search engine or other natural language processing system may contain a variety of stop-lists, one per language, or it may contain a single stop-list that is multilingual. Typically, articles and pronouns are generally classified as stop words. Some of the more frequently used stop words for English include "a", "of", "the", "I", "it", "you", and "and" these are generally regarded as 'functional words' which do not carry meaning. When assessing the contents of natural language, the meaning can be conveyed more clearly by ignoring the functional words. Hence it is practical to remove those words which appear too often that support no information for the task. All stop words, common words are removed from multiple word queries to increase search performance.

VI. RESULT AND DISCUSSION

Performance Measures

Our project contains, 25,000 items, 300,847 ratings, and we have every user's social relation. Each item has been posted by at least one comment/review. In the following experiments, we firstly evaluate our sentiment algorithm, and then investigate how to leverage review sentiment to achieve accurate rating predictions in various conditions.

A. Sentiment Evaluation

We shall note that, the task of phrase-level sentiment lexicon construction is inherently difficult. We need to tradeoff between precision and recall. As a primary step towards using sentiment lexicon for Rating prediction System (RPS), we focus on the precision as we will only use the top-10 product features in our framework, primarily to avoid the negative effects of wrong features as much as possible. We expect as the research in sentiment analysis advances, the performance of our framework will further improve as well.

Parameters for evaluation : In the context of classification, True Positives (TP), True Negatives (TN), False Negatives (FN) and False Positives (FP) are used to compare the class labels assigned to reviews by a classifier with the classes that product actually belongs to. True positive means, which are truly classified as the positive features. True positives (TP) are examples that the classifier correctly labeled as belonging to the positive class. False positive (FP) are examples which were not labeled by the classifier as belonging to the positive class but should have been. True Negative (TN) is examples that the classifier correctly labeled as belonging to the negative class. True Negative means, which are truly classified as the Negative features. At last there is False Negative (FN), which is an example which was not labeled by the classifier as belonging to the negative class but should have been. Other evaluation measures like precision, recall, F-Measure, specificity and accuracy can easily be calculated from these four variables.

1. Accuracy: A common measure for classification performance is accuracy, or its complement error rate. Accuracy is the proportion of correctly classified examples to the total number of examples, while error rate uses incorrectly classified instead of correctly. However, one should be careful to use only accuracy when one is using skewed data

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

2. Precision and recall: Precision is used to measure exactness, whereas recall is a measure of completeness.

$$Precision = \frac{TP}{TP + FP}$$
$$Recall = \frac{TP}{TP + FN}$$

 F-Measure: F-Measure is the harmonic mean of precision and recall. This gives a score that is balance between precision and recall.

$$F = \frac{2 \times Precision \times Recall}{Precision + Recall}$$

4. The experiment on 10 product of each category containing all four types of class TP, TN, FP, FN.

Review TP FP TN FN Accuracy F-measure Category Beauty 5 0.4 0.5 3 1 1 Tools & Home 3 2 3 2 0.6 0.6 Improvement Electronics 2 2 3 3 0.5 0.44 Clothing, Shoes & 0.3 0.22 1 4 2 3 Jewelry

Table: Evaluation Table



Fig. Graph of Accuracy and F-Measure

VII. CONCLUSION

In this paper, With emerging applications of social networks and considering the role of social interactions in our daily life decisions, extracting information from user's social relationships is becoming a popular method for predicting user's behavior. Sentiment analysis or Opinion mining is not only consisting of the concepts of text mining but also the concepts of information retrieval. We proposed, a recommendation model by mining sentiment information from social users' reviews. We propose social user's sentiment measurement approaches based on the mined sentiment words and sentiment degree words from users" reviews. We fuse user sentiment similarity, interpersonal sentiment influence, and item reputation similarity into a unified matrix factorization framework to achieve the rating prediction task. This rating product recommendation system which can be also used as the social relation collaboration model which can be used to identify the social relation between the users. The genuine reviews will give the rating prediction easy and user

will easily get the result in the desired time. This prediction based on rating also decides the product's or item's purchasing quality whether it is good or bad. This recommendation will also help us to identify the products reputation on the basis of good and bad reviews. Also the products or items which do not have any type of rating or do not have any reviews will also be recommended to the person or user for the good decision. This use will help the users to do their work in less time and with good quality products for healthy life.

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