

Research Status of the Usefulness of Online Comments Based on Deep Learning

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Abstract. Nowadays, online comments posted to the Internet or electronics technology enables people or company to extract useful information, such as electronics plat users who have purchased products. Therefore, it is obvious that online comments are essential and useful so how to find the usefulness of online comments starts to become the research aim of many researchers. This paper summarizes literature in the field of Deep Learning on the usefulness of online comments. It is concluded that the Deep Learning model has high accuracy. Through these models, researchers can find the real situation from lots of online comments more accurately and easier and even can predict further behavior through these online comments. This paper is beneficial for people who have an interest in studying the application of Deep Learning on the usefulness of online comments to know the current development of this field preliminarily and find better models to improve accuracy.

Keywords: Deep Learning · Online comments · Neural Network

1 Introduction

Nowadays, with the rapid development of the Internet and electronics technology, lots of e-commerce plats and online apps have access to people's lives and these platforms provide users with the function of leaving messages and comments. Users can leave feedback after using the platform, app, or website, or leave feedback after purchasing goods on the e-commerce platform. Online reviews refer to descriptions of the performance and experience of purchased products or services published by consumers, which are characterized by short length, clear views and freedom of expression [1]. Usually, it expresses consumers' emotions or attitudes towards products, which are specifically reflected in their satisfaction with product quality, cost performance, and other aspects [2, 3]. Sinha points out that online reviews are not just an exchange of information between users, but a more reliable source of information about a product or service [4]. Online reviews mainly have two functions: one is the disclosure and description of negative content, and the other is the feedback and recommendation of positive content. These two functions influence users' behavior at the same time [5].

In recent years, an online review is a popular research topic in the field of marketing. Many studies have shown that online reviews are persuasive, so many scholars have begun to study the usefulness of online reviews. Since the multi-layer neural network model in deep learning was proposed by Professor Hinton in 2006, the learning ability of the model and network has been improved. In the field of natural language processing, unstructured text, feature diversity, and semantic complexity have always been the difficulties of text processing [1]. In view of the structural flexibility of deep learning models, the missing semantic information can be made up by feature extraction, so that the semantic accuracy and the accuracy of text classification can be improved. Due to its scientific character, many scholars have begun to use Deep Learning to study the usefulness of online reviews. Xia Lu and Shanfeng Wu (2021) [6] studied the sentiment analysis of online comments, the basic emotion words had by network users by using a Neural Network algorithm and text mining technology. Yonghua Su and Zheping Wang (2022) [7] propose the combination of Multiple Linear Regression and Bp Neural Network algorithm to study whether online comments are beneficial to the box office. Jie Li and Huan Li (2018) [8] use Convolution Neural Network to classify the sentiment of short text and study the usefulness of online comments according to sentiment labels that are gotten by sentiment classification.

To sum up, the current research on user behavior based on deep learning has made a lot of achievements. This paper analyses and summarizes the research status in this field, and then put forward the limitations of the current research and potential future research directions. The overall research framework of this paper is described as follows. The first part is the introduction. This paper mainly introduces the background of the research on the usefulness of deep learning algorithms for online reviews and the problems studied in this paper, further elaborates the research motivation and significance, and introduces the main research process in this field. Part 2 is the elaboration of core knowledge points of Deep Learning and its major development history. By reading part 2, what are Deep Learning and the major principle of models related to this paper can be known. Part 3 introduces the concept and the principle of Bp Neural Network and conducts literature reviews that use Bp Neural Network to study the usefulness of online comments. Part 4 introduces the concept and the principle of other Neural Network and conducts literature reviews that use other Neural Network to study the usefulness of online comments. Part 5 is limitations and future outlooks of this paper. Part 6 is the conclusion of this paper.

2 Methodology Development

Deep Learning (DL) is one of the hottest fields in Machine Learning (ML). In the past, it was hard for computers to analyze articles or identify objects in images. However, thanks to the rapid development of computer algorithm, computers now can complete such tasks. Artificial Neural Networks (ANN) is a kind of mathematical model simulating animals' neural networks and Deep Learning originates from Artificial Neural Networks (ANN). Deep Learning is a kind of algorithm that has 3 main steps. The first step is that each piece of data is fed into the neural unit and then multiply weight and added together. The second step is passing the data which is the outcome of step one through the active function. The final step is delivering the result that got from step two to the neuron output

step and getting the final result. Since Deep Learning consists has multilayer perceptron, it can process multi-layer features. In this way can analyze texts and measure emotions more accurately.

The development of Deep Learning is about 100 years old and from the proposal of perceptron which owns only one neuron layer to the first proposal of Deep Learning is about 50 years. However, Deep Learning called today mainly refers to the proposal of the concept of Deep Learning after 2006 and it has successfully applied in many aspects such as ImageNet and the competition between AlphaGo and human beings. The reason why Deep Learning is becoming increasingly popular because of its adaptation of multi-dimensional data, efficient process and the accuracy of analysis and prediction.

Nowadays, people mainly use 3 algorithms which are Bp Neural Network, Convolutional Neural Network and Recurrent Neural Network in Deep Learning to analyze online comments. In the fields of online comments, lots of studies first extract key words and then use Deep Learning algorithms to predict the real quality of products, movies and so on.

3 Bp Neural Network

3.1 Algorithm Description

Bp Neural Network has become one of the most widely used Forward propagation models, which has several neuron layers. It mainly has 3 kinds of layers which are the Input layer, the Hidden layer and the Output layer. This model's mainly working process is that several signals propagate forward from the Input layer to the Hidden layer and from Hidden layer to Output layer and adjust the weight and deviation from Input layer to the Hidden layer and from the Hidden layer to the Hidden layer. Using errors about the result of the model and real data to adjust the weight and then update the weight of the former layer. Therefore, to find that when signals propagate to the Output layer, it's forward propagation and when the model adjusts the weight of each layer, it's backpropagation. But there is one noticeable tip the dimension of data must be equal to the number of neuron units.

3.2 Algorithm Application Analysis

Many people apply Bp Neural Network to research the usefulness of online reviews.

Lei Zhao (2021) [9] studies the usefulness of factors of online reviews of fresh agricultural products and propose a prediction model based on the Classical Persuasion model and Bp Neural Network. The factors of online reviews in this research respectively are the length of comments(X1), whether or not have any additional comments (X2), the time interval(X3), the number of images included in comments(X4), the rating of comments(X5), the number of replying comments(X6), whether or not post the profile pictures(X7) and the rating of users(X8). The propose of this model is classified into 3 steps. First, the index system is established from 3 dimensions of information content, information receiver and information transmitter, and the Conceptual model of review usefulness is established by referring to the Detailed Possibility model. Then, use Bp



Fig. 1. Comments on the conceptual model of usefulness (Photo credit: Research on the Influencing factors of the usefulness of fresh agricultural product Reviews -- Based on persuasion theory and BP neural network)

Table 1. Table of relative strength of usefulness and influencing factors (Table credit: Original)

Influence factor	Intensity
The length of comments	-2.1218
Whether or not have any addition comment	-1.7539
The time interval	2.169
The number of images included in comments	0.3788
The rating of comments	-1.6411
The number of replying comments	0.0205
Whether or not post the profile pictures	3.4551
The rating of users	0.3479

Neural Network to analyze the factors influencing the usefulness of online reviews of fresh agricultural products captured on the website called JingDong. The study's result shows that: X1, X2, and X5 have negative effects on the usefulness of online comments; X3, X4, X6, X7, and X8 have positive effects on the usefulness of online comments, as shown in Fig. 1. According to the conceptual model, the length of comments and whether there are follow-up comments have more negative effects on the usefulness of online comments, as shown in Table 1.

YongHua Su and Zheping Wang (2022) [7] combine multiple linear relationships with Bp Neural Network algorithm to study whether and how online comments affect the box office in China film market. In this research, the box office is measured by the number of long drama comments, number of short drama comments, number of news, potential



Fig. 2. BP neural network conduction path and coefficient diagram (Photo credit: Research on Product Feature Extraction and Sentiment Classification of Short Online Review Based on Deep Learning)

customers and movie scores and data is captured movies rating website. This study also uses Bp Neural Network to analyze complex nonrealtionships between elements. The study's result showed that the number of comments, number of short drama comments, number of news have significant positive effects on box office, which will provides a clearer idea and direction for the promotion of film marketing.

Gang Li (2018) [10] thinks that negative comments have significant effects on purchasuin of products or something. Therefore, he uses Bp Neural Network to construct the path coefficient between negative comments and product and situation risk and input data captured by crawling on websites to Bp Neural Network. Finally, the path coefficients are got, as shown in Fig. 2.

4 Other Algorithms

In the field of studying the usefulness of online reviews, many researchers also use other kinds of a neural networks to improve the accuracy of model prediction such as Convolution Neural Network (CNN) and Graph Convolutional Network Fusing Chunk Parsing And Feature Membership Relationship (FFGCN).

A convolution Neural Network is a kind of neural network which is different from a normal neural network. Its network structure includes 2 parts which are called the convolutional layer and pooling layer and this kind of structure has high classification accuracy and strong recognition and processing ability of noisy data.

Graph Convolutional Network Fusing Chunk Parsing And Feature Membership Relationship (FFGCN) is a kind of model based on Graph Convolutional Networks for Text Classification (TextGCN) that can effectively capture the various dependencies of

Number	1	2	3	4	5	Mean
Accuracy	90.91	93.75	85.71	92.11	97.30	91.17
Number	6	7	8	9	10	
Accuracy	90.20	93.55	88.64	88.89	90.70	

Table 2. Accuracy of result and mean (Table credit: Original)

 Table 3. Comparison of experimental effects of sub-modules (Table credit: Original)

model	Accuracy	Precision	Recall	F1-score
FFGCN	93.44	93.44	93.44	93.44

non-continuous words in text. On the basis of TextGCN, FFGCN can solve the problem that the short text data is sparse and the semantic is fuzzy when classifying text. FFGCN first preprocesses documents, such as: regularization, word classification, to stop words and so on. Then, the preprocessed word segmentation results are partitioned into blocks, and then the feature words are extracted based on the partitioned word results, and the feature words are used for composition. Finally, it is input to GCN to predict the category of document node.

Jie Li and Huan Li (2018) [8] has proposed an information feature extraction and sentiment classification model based on Convolutional Neural Network. The model first classifies sentimentally short online comments by Convolutional Neural Network and then extracts the feature words from sentiment classification labels. The result shows that the model has high accuracy about 91.17% and is efficient in the studying online reviews field, as shown in Table 2.

XueMei Li and JianHong Jiang (2022) [11] have proposed Graph Convolutional Network Fusing Chunk Parsing And Feature Membership Relationship (FFGCN), a model which can analyze combine block and study feature relationships based on TextGCN. FFGCN model can solve the problem of sparsing text data and insufficient semantic ambiguity. The result shows that FFGCN has higher accuracy than other models so information can be extracted more sufficient when using FFGCN, as shown in Table 3.

5 Limitations and Future Outlooks

5.1 Limitations

This paper conducts literature reviews of studying the usefulness of online comments based on Deep Learning. Although the paper chooses to summarize are commonly used and have cutting edges, models mentioned in this paper only account for a small part of neural networks in Deep Learning. As mentioned in this paper, the model of limited to the deep parts of the learning algorithm of a neural network, but deep learning is actually a big concept, it not only contains the neural network, as long as it is singlelayer unsupervised training but through supervision and learning to adjust all layer of the neural network, now Alex Net, VGG Net is Deep Learning that is widely used in the model. Nowadays, more models based on neural networks have been proposed to solve the problem of natural language processing which is difficult to be solved by early neural networks, and they can analyze short text online comments more effectively.

In addition, this paper only studies the usefulness of online reviews based on deep learning, but now some scholars begin to use deep learning to study the prediction model of the impact of online reviews on user behavior. Nowadays, many users read existing online reviews before purchasing goods on e-commerce platforms. Through online reviews, users can learn about the real quality of the goods and decide whether to make the final purchase. Therefore, using a deep learning model to objectively analyze online reviews, can predict whether users buy goods, which will be of great help to e-commerce platforms and sellers.

5.2 Future Outlooks

Although deep learning has matured in the research field of the usefulness of online reviews, the following issues deserve further study. Deep learning nowadays is also gradually used in natural language processing, but now is an era of information explosion, with the passage of events, every minute information is growing exponentially, how to improve the depth of the learning model can make it on the premise of guarantee the model accuracy processing a huge amount of data will be deep learning in online reviews useful one of research directions in the field of study.

In addition, many scholars usually combine sentiment analysis with deep learning algorithm models to study the usefulness of online reviews. However, the existing models are not accurate enough to grasp emotion, and human natural language is very complex. In many cases, the statements judged as neutral emotion by the machine are actually positive statements, while the actual meaning of the statements judged as positive is negative. Therefore, improving the semantic accuracy of sentiment analysis will become one of the research directions in this field.

6 Conclusion

In recent years, how to find more usefulness from online comments is always the research aim of many researchers. This paper summarizes literature in the field of Deep Learning on the usefulness of online comments. Lots of research combine Deep Learning algorithm with some models like sentiment analysis which is common in the field of text analysis to apply to the usefulness of online comments. This paper mainly summarizes literature that uses kinds of Neural Network algorithm in Deep Learning to analyze online comments and the results show that they are all-sufficient. Bp neural network is a kind of basic neural network with several neural layers and is always combined with other models to analyze text with high accuracy. Because CNN has a convolutional layer and a pooling layer, it can identify the real meaning of the sentence no matter how the sentence changes. FFGCN model can solve the problem of sparsing text data and insufficient semantic ambiguity. Through these models, researchers can find the real situation from lots of online comments more accurately and easier and even can predict further behavior through these online comments. This paper is beneficial for people who have an interest in studying the application of Deep Learning on the usefulness of online comments to know the current development of this field preliminarily and find better models to improve accuracy.

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