Research on the Bank Credit Decision Model Based on Convolutional Neural Network

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Abstract: With the continuous development of small and medium-sized enterprises, the business volume of bank loans is also increasing. Banks need to assess the credit risk of small, medium and micro-sized enterprises based on their strength and reputation, and then determine whether to lend or not and loan strategies such as loan amount, interest rate and term based on factors such as credit risk. Therefore, it is of great significance to study how to establish a complete credit risk assessment system for bank loans. In this paper, a credit decision model based on Convolutional Neural Network is established. Firstly, the Convolutional Neural Network (CNN) is trained by the invoice information and credit rating data of 123 enterprises with credit records, and then the trained CNN model is used to rate the credit of 302 enterprises without credit rating, and then the credit decision model is used to make bank credit decisions when the total credit amount is 100 million yuan. After testing, the accuracy of the Convolutional Neural Network model established in this paper can basically reach more than 80%, and to a certain extent, it can replace the operation of manually rating the credit standing of enterprises within banks.

1. Introduction

In practice, due to the relatively small scale of small and medium-sized enterprises and the lack of mortgage assets, banks usually provide loans to enterprises with strong strength and stable supply-demand relationship based on credit policies, information on transaction notes of enterprises and influence of upstream and downstream enterprises, and can offer interest rate incentives to enterprises with high reputation and low credit risk. Banks first assess the credit risk of SMEs based on their strength and reputation, and then determine whether to lend and credit strategies such as loan lines, interest rates and maturities based on factors such as credit risk. [1]

2. Credit Decision Model Based on Convolutional Neural Network

2.1 Convolutional Neural Network Training

The credit rating of an enterprise is obtained by manually viewing the input invoice and the output invoice, and some of the relationships are the results of human thinking. Using neural network can

simulate human thinking and further learn the relationship between the amount of the input invoice and the actual credit rating of the enterprise, thus saving time cost and human resource cost.

Convolutional Neural Network (CNN) is a kind of feedforward neural network with depth structure and convolution calculation, and it is one of the representative algorithms of depth learning.

CNN is essentially an input-output mapping, which can learn a large number of mapping relationships between input and output. Here, we use convolution kernel to extract the features of the data and then classify the data through a fully connected network. We take the feature space output by CNN as the input of the fully connected layer or the fully connected neural network (FCN), and use the fully connected layer to complete the mapping from the input to the label set, i.e. classification, and divide the enterprises without credit records into four credit ratings A, B, C and D for credit risk assessment. [2] The most important work in the whole process is how to iteratively adjust the network weights through the training data, i.e. the backward propagation algorithm.

In terms of data, we randomly selected the input invoice data and credit rating data of 123 enterprises with credit records and divided them into 99 training sets and 24 test sets, with a ratio of 8: 2.
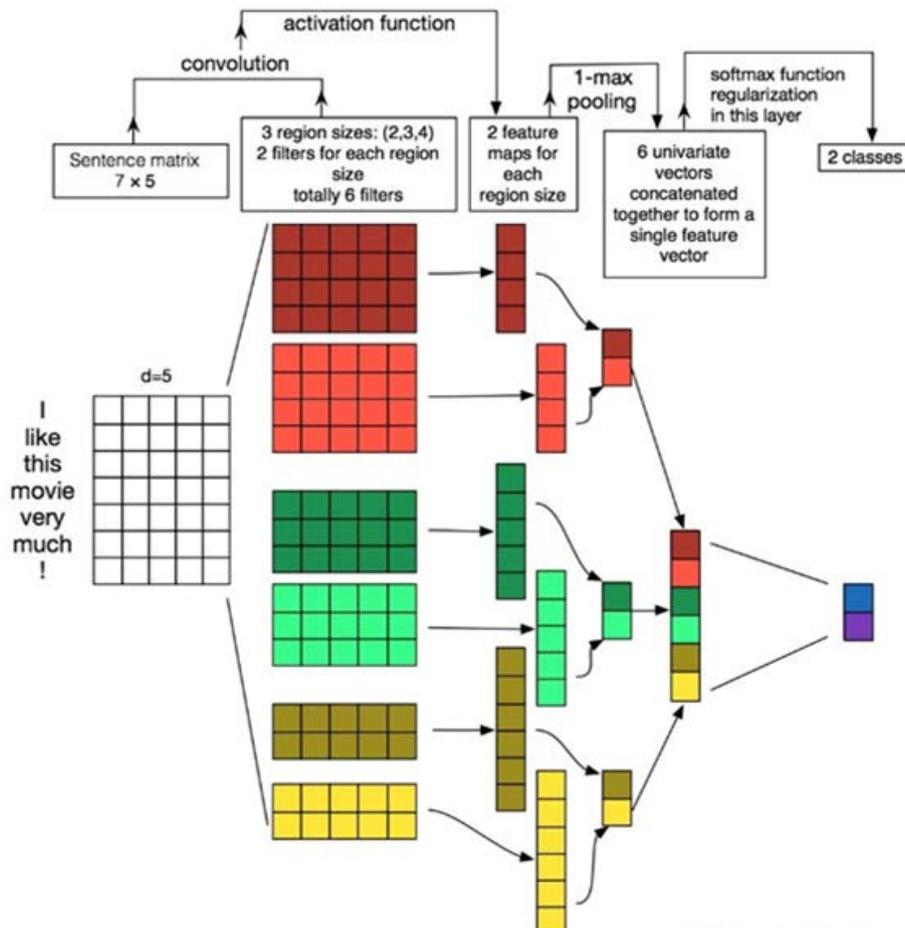

Figure 1: CNN Structure Diagram

The accuracy of the Convolutional Neural Network model established can basically reach more than 80%. Then we used the trained Convolutional Neural Network to rate the creditworthiness of enterprises without credit records, and obtained the creditworthiness ratings of 302 enterprises. [3]

2.2 Corporate Credit Strategy Development

By combining the above models, we have formulated the following strategies for these 123 enterprises:

Strategy 1: In principle, all companies with a credit rating of D will not lend.

Strategy 2: The minimum loan limit for all enterprises with negative profit is RMB100,000. Considering the impact of loan interest rate on customer turnover rate, the interest rate for Grade A enterprises is 0.0545, the interest rate for Grade B enterprises is 0.0585 and the interest rate for Grade C enterprises is 0.0625.

Strategy 3: Except for the above two types of enterprises, most of them will use Strategy 3 to make credit decisions. The maximum amount an enterprise can credit will depend on its profit margin and stability. We will calculate the credit line of the enterprise through the enterprise stability rating model and the enterprise strength rating model. Based on the softmax function, this paper defines the following formula to calculate the maximum credit limit that an enterprise can borrow: $M_{E(i)}$

$$M_{E(i)} = \frac{e^{\frac{e^{P_{E(i)}}}{\sum_n e^{P_{E(n)}}} + C_{E(i)}}}{\sum_n e^{\frac{e^{P_{E(i)}}}{\sum_n e^{P_{E(n)}}} + C_{E(i)}}} * \left(Max\left(G_{E(i)}\right) - Min\left(G_{E(i)}\right) \right) + Min(G_{E(i)})$$

Among them, $C_{E(i)}$ is the amount of credit provided by the bank; $Max\left(G_{E(i)}\right)$ is that the company in the range where the company is located can obtain the bank's The maximum amount of credit provided; $Min\left(G_{E(i)}\right)$ is the minimum amount of credit provided by the bank for the enterprise in the range where the enterprise is located.

2.3 Strategic Fine-tuning of Large Credit

After obtaining the credit ratings of 302 enterprises, we used the above credit decision model to make bank credit decisions. The total loan under the original strategy was: 47641377.48+62000 = RMB53841377.48.

When the total loan amount was RMB100 million, we adjusted our credit strategy:

1. The loan limit to all Class A enterprises was increased by RMB200,000, with a total increase of 200,000 * 110 yuan.

2. The loan limit to all Class B enterprises was increased by RMB100,000, representing an increase of RMB100,000 * 101 in total.

3. The loan limit for all Class C enterprises was increased by RMB50,000, with a total increase of 50,000 * 72 yuan.

Under the new strategy, the total loan amount is RMB89541377.36, and the portion less than RMB100 million is used for special cases, which can be adjusted according to the actual situation.

3. Expected Bank Revenue

Assuming that all enterprises make loans according to the maximum loan amount and credit rate that the bank can provide and repay them in full when the specified period (1 year) arrives, the interest that the bank can obtain for loans to enterprises can be calculated as follows:

Interest = loan amount × annual interest rate × year

After calculation and summation, the bank can obtain the income of 1,874,233.274 yuan by lending to the enterprise with credit rating A; The loan to an enterprise with credit rating B can

generate revenue of RMB1159,757.641; The loan to an enterprise with credit rating C can generate revenue of 723051.5285 yuan.

4. Conclusion

We trained the Convolutional Neural Network (CNN) by using the invoice information and credit rating data of 123 enterprises with credit records, and then used the trained Convolutional Neural Network (CNN) to rate 302 enterprises without credit rating. Finally, we used the credit decision model to conduct credit risk assessment for 302 enterprises with good credit rating and gave the bank's credit strategy.

References

[1] Heterogeneous Graph Convolutional Networks for Text Classification Rahul Ragesh, Sundararajan Sellamanickam, Arun Iyer, Ram Bairi, Vijay Lingam https://arxiv.org/abs/2008.12842
[2] Xie Liang; Li Ning; ; Credit risk of private enterprises and preventive measures [J]; Journal of Inner Mongolia University of Finance and Economics; Issue 01, 2013
[3] Research on the credit strategy of small and medium-sized enterprises in Sun Yashan's commercial bank-an empirical analysis taking Shaanxi Province as an example; Journal of Xi 'an University of Finance and Economics, 2004