Research on Financial Aid Model of Colleges and Universities Based on Artificial Neural Network

Jun Zhou, Mei Yang, Fang Wang and Chao Wang
Chongqing Business Vocational College, No.81, University Town Middle Road, Shapingba District, Chongqin, 401331, P R China.
Email: 1198768040@qq.com

Abstract. There are some problems in the recognition of financial aid objects in Colleges and Universities, such as being interfered by human factors and weak in quantification. The existing relevant research is mainly about policies, systems and measures, while the application of artificial intelligence in precise financial aid in colleges and universities needs further research. And the new generation of AI technology in deep learning can automatically extract data characteristics, and it can be used in the accurate identification of poor students, with the advantages of having no need for human intervention. This model designs and optimizes the precise identification model of university funding objects based on artificial intelligence technology, and achieves a satisfactory recognition rate, which explores a new technical way to improve the equity of education funding and its efficiency exploration.

1. Introduction
The identification of poor students in colleges and universities has always been a difficult problem in the financial aid work of colleges and universities in China, which also restricts the overall improvement of the financial aid work of colleges and universities. At this stage, there are the following problems in the accurate identification of funding objects in university funding work [1].

The basis for identification needs to be improved, There are three main ways to identify the poor students in Colleges and Universities: the first way is that the students are directly assigned by the education department to establish files and cards; the second way is that the students are directly identified as the poor students according to the certificates issued by the Poverty Alleviation Office at or above the county level. And students are directly identified as the poor students through the above two ways. In the third way, the local civil affairs department or sub district office shall seal the application reasons for confirmation, and the counsellor and student evaluation group shall identify the poor students for their personal life and consumption. Sometimes, there are some errors in the third identification process.

2. Long Short Term Memory Neural Network
Deep learning was proposed by Hinton in 2006. Recurrent Neural Network (RNN) is one of the important research directions. Its chain structure is especially suitable for the relationship simulation of time series data, and it also has certain memory function. Hochreiter and Schmiduber improved the problem of gradient disappearance when RNN was learning a long time series, and put forward the Long short term memory (LSTM) neural network. LSTM has the ability of "long-term memory" and time series data classification and prediction [2].

Figure 1 shows a typical structure of an LSTM memory unit. At time $t$, the input of the memory unit includes the hidden layer state variable $h_{t-1}$, the memory unit state variable $c_{t-1}$ and the input...
information $x_t$ at the current time. Then, through forgetting gate $f_t$, input gate $i_t$, output gate $o_t$, and these three control mechanisms, the model successively obtains the hidden layer state variable $h_t$ and memory unit state variable $c_t$ at time $t$. Finally, $h_t$ will be passed into the output layer to generate the calculation result $y_t$ of LSTM at time $t$, and the calculation will be carried out at the later time with $c_t$.

Figure 1. The structure of one LSTM memory block

The specific process is as follows: In the calculation of time $t$, the first thing to calculate is forgetting gate $f_t$. $f_t$ determines how much information to discard from the previous state. The calculation formula of $f_t$ is as follows:

$$f_t = \sigma(U_f x_t + W_f h_{t-1} + b_f)$$  \hspace{1cm} (1)

In the formula, $U_f$, $W_f$ and $b_f$ are the adjustable parameter matrices or vectors of the forgetting gate, which will be optimized in neural network training. $\sigma$ is the activation function of Sigmoid:

$$\sigma(x) = \frac{1}{1 + e^{-x}}$$  \hspace{1cm} (2)

Where, $e$ is the natural logarithm.

Next, calculate the input gate $i_t$. $i_t$ determines how much of the newly acquired information will be selected to update the status. The calculation formula of $i_t$ as follows:

$$i_t = \sigma(U_i x_t + W_i h_{t-1} + b_i)$$  \hspace{1cm} (3)

Where: $U_i$, $W_i$ and $b_i$ is the adjustable parameter matrix or vector of the input gate, which will be optimized in neural network training.

The calculation formula of newly obtained information $\tilde{c}_t$ is as follows:

$$\tilde{c}_t = \tanh(U_c x_t + W_c h_{t-1} + b_c)$$  \hspace{1cm} (4)

Where: $U_c$, $W_c$ and $b_c$ are $\tilde{c}_t$ adjustable parameter matrices or vectors of, which will be optimized in neural network training; $\tanh$ is the hyperbolic tangent activation function:

$$\tanh(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$  \hspace{1cm} (5)

Where: $\odot$ represents the matrix element product. Memory unit state variables computed tomography is the key to the LSTM maintain long-term memory. Because of its simple linear interaction with other LSTM cell states, the information can be kept unchanged for a long time, so that the LSTM model can prevent gradient disappearance or explosion when training the network.

Then, calculate the output gate $o_t$. $o_t$ can determine how much information is generated to generate hidden layer state variable $h_t$ at time $t$, and its calculation formula is as follows:
Where: $U_0$, $W_0$, and $b_0$ is the adjustable parameter matrix or vector of the output gate, which will be optimized in neural network training. Finally, $h_t$ was passed into the output layer, and after calculation, the final output $y_t$ of LSTM at time $t$ was obtained:

$$y_t = W_d h_t + b_d$$

Where: $W_d$ and $b_d$ are adjustable parameter matrices or vectors of the output layer, which will be optimized in neural network training.

3. Establishment of Consumption Database of Poor Students

The existing national scholarships and scholarships mainly include national scholarships, national inspirational scholarships and national grants. The national scholarships take learning achievement as the main funding standard, and the funding proportion is relatively low. National inspirational scholarships support students with financial difficulties and excellent academic performance, regardless of the level, and the more 5% of them are subsidized [4]. The objects of state grants are students with family financial difficulties. The levels of grants are divided into three levels, and the proportion of grants is about 20%. The sample data of NSFC is rich, which is suitable for the training and testing of deep learning model. The accurate recognition model of poor college students based on deep learning technology takes the consumption data of the students subsidized by NSFC over the years as the training and testing data.

4. Precise Funding Model Design and Development

The LSTM neural network has six layers. The first layer is the input layer, sequence input layer. The length of input data is 200. That is to say, 200 consumption records are extracted from the consumption records of impoverished students' Campus Cards funded by state grants as input. The second layer is the hidden layer, biLSTM layer, which is mainly used to extract features, the number of neurons in the hidden layer is set to 150. The third layer is dropout layer. During the training process of deep learning, the neural network unit is temporarily discarded by the third layer from the network according to a certain probability to prevent overfitting. Here, the dropout rejection rate is set to 0.3. The fourth layer is the fully connected layer, FC layer, which plays the role of feature "Classifier". The fifth layer is the likelihood layer, soft max layer, which calculates the likelihood probability of each category to determine the category. The sixth level is the output level, and finally outputs the classification results of the students to be subsidized. The output category is 4. The output is divided into four categories: the first category is the first-class financial aid for student grant, the second category is the second-class financial aid for student grant, the third category is the third-class financial aid for student grant, and the fourth category is non-financial aid.

5. Model Training and Testing

After the completion of the development and design of model, it is necessary to train and test model by using the consumption data of unfunded students and impoverished students who have been subsidized by the state. 400 sample data are extracted according to each category from unfunded students and three levels of students. A total of 800 sample data from four categories are used as model training data. In each of the four categories, and other 30 sample data were extracted in the four categories, totalling 200 sample data as test data. Each of the above sample data contains 400 consumption transaction data. The trained LSTM neural network model is used to test the sample data of known categories, and the correct recognition rate reaches 95%.

6. Conclusion

In the face of the problems existing in the funding of poor students in colleges and universities, a neural network model based on deep learning technology is established for the accurate funding of
poor students in colleges and universities. The model can effectively identify the identity of poor students, and classify the level of funding for poor students to be funded.

7. Acknowledgments

The authors also would like to thank the financial support provided by Humanities and Social Sciences Research of Chongqing Education Committee (Grants No.19SKGH282). “Noise Elimination and Identification Model of Acoustic Emission Signal Based on Deep Learning” project of science and technology research program of Chongqing Education Commission of China (Grants No.KJZD-K201904401). Artificial Intelligence Application Collaborative Innovation Center of Chongqing Business Vocational College.

8. References

[1] Chen L. The Ideological and Political Education Work Leads the University to Subsidize and Educate people [J]. Studies of Finance and Accounting in Education, 2017, 28 (5): 54-57.
[2] HINTON G E, SALAKHUTDINOV R R. Reducing the Dimensionality of Data with Neural Networks [J]. Science, 2006, 313 (5786): 504–507.
[3] Hu Y, Luo D Y, H K, etc . A review and Discussion on Deep Learning [J]. Journal of Intelligent Systems, 2019, 14 (01): 1-19.
[4] Zhang F Y. On the Theory of Precise Financial Aid for College Students [J]. Research on Heilongjiang Higher Education, 2015 (11): 78-80.