Neural Network-Bidirectional Research

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Abstract. For this assignment I designed two problems based on the given dataset(infoVis24.csv) and solved them by building two different neuron networks relatively .In the progress of first one ,I created a well-trained neuron network with high accuracy .Therefore, I do find reasonable connections between the chosen inputs and outputs. The process of resolving the second problem is more like a trial or a research. For this one, a special technique is applied to explore the possibility of building a bidirectional neuron network. The performance of this particular technique is discussed as well.

Method section / Data Set and Model Design

Choose the dataset

I chose the dataset which is for information-visualisation out of the reason that I personally think that making complicate data visualised could be very useful and interesting.

Re-encode the dataset

When I loaded the dataset into my own python environment , it shows 'the file is not UTF-8 encoded' .Therefore , I open the dataset with Excel and change the format of the dataset to 'UTF-8 encoded'. Thus , the given dataset could be successfully loaded into my python environment .

The design of the problem

Upon opening the dataset, I found the initial problem was to predict the interface they were using just from their eyegaze. However, I started to wonder that whether there could be a connection between the cultural and education background of this person and the correctness to the given question. For the reason that I think the cultural and education background do have significant impact on the process of a person's decision-making which includes behaviours like eyegazing , I decided to give up continuing with the provided problem and begin to investigate on the problem that I have been concerned with.

Investigation into the problem and pre-process

Then I take a close investigation for the dataset(infoVis24.csv) and then I find that the 'Education' , 'Major' and 'Languages' those three labels are the most related variables to the problem that modelled by myself, which is whether is a connection between the cultural and education background of this person and the correctness to the given 6 questions. On the other hand , due to the concern that the difference between each question may cause certain influence to the training results , I add the label 'Question' as well into the input neurons ,with the label 'Correct Response' as the output and the results of correctness (0 or 1) as the two output neurons.

One thing that's worth noting is that because I found it very troublesome to import the labels that needed directly from the original dataset , so I put the data with those four labels together and store them into a new dataset. I think It could be much more convenient and time-saving if researchers are dealing with complicate dataset.

Building the neuron network and applying methods

To create the neuron network , I make the advantage of the useful python library 'Pytorch' . Thus , I created a class of 'TwolayerNet' to build the neuron network of binary classification .Which has to be mentioned, I set the amount of the hidden neuron to 10 for the reason that 10 would be an appropriate amount set for the complexity of this problem. Besides, I set the learning rate to 0.001 and the numbers of the epochs which is the training times to 50000 to raise the accuracy as high as possible.

In the mean time , out of the total 288 tuples, I pick up 200 tuples for the training process, with the rest 88 tuples set for the testing process. I split up the data in this method because I discover that through repeated testing, 200 training set could reach a relatively high accuracy .

Results of the training

To ensure the performance of training in this neuron network , instead of just looking into the accuracy which is acquired by summing up the number of correct predictions and total predictions , I also apply the technique of confusion matrix. While implementing the confusion function could tell how well the network perform on different matrix , the results of this network is very clear and we have strong and enough data shows that there indeed exists a connection between the cultural and education of a person and his/her answer to the given questions, provided with the dataset 'infoVis24.csv' .

Introduce the provided technique

Furthermore, I want to explore the possibility of building a bidirectional neuron network which is based on the paper of 'BDNNClassProt'.

Background and basic concepts

From the paper 'BDNNClassProt' , we can learn some background of this research .Among lost of existing neural network models , there are only a few bidirectional neural networks .None of these bidirectional models are created based on multiple layer perceptrons. These models are also limited due to that their popularity is prevented .

People have designed bidirectional neuron networks(BDNNs) based on the multiple layer perceptrons trained by a generalised form of the error back-propagation algorithm. They can be trained as connected memories or cluster centroid finders. This helps the network get new abilities and enables us to design powerful data representation tecchniques which are a key factor in reducing network generalisation error. We demonstrate applications of this approach to extracting meaning from neural networks, and discovering the centers of the clusters .This work could be a step towards simulating via the behaviour of artificial neural networks clustering methods closer to that of the biological brain. BDNN may also be used as a simulation tool for evaluating some major cognitive psychology theories such as prototypes and dual-code theory.

Implement the provided technique

For this dataset , to implement the reverse effect of the bidirectional neuron network , I have decide to use these two labels 'Education' and 'Major' which represent the education background of a person and these two labels 'Question' and 'Correct Response' to implement the Bidirectional neural network . In the first training process of the Bidirectional neural network , I would apply these two labels 'Education' and 'Major' to predict the results of these two labels 'Question' and 'Correct Response' . Due to the reason that the formula 'y = ax + b' is implemented , we can reverse the formula 'y = ax + b' to the 'x = y/a – 1/a' and store the '1/a' and '-1/a' as the coefficient and baise for the second training process of the bidirectional neuron network . After putting all the reversed coefficients and baises in store for the next step , we then apply these two labels 'Question' and 'Correct Response' to predict these two labels 'Education' and 'Major' .

Changes/differences to the previous neuron network

We build the Bidirectional neuron network based on the former neuron network structure . Instead of former used dataset , we now this time create a new dataset just composed of two variables to predict the another two labels . During the progress of improving this neuron network , I modify the amount of the hidden neurons to 16 and the change the learning rate to 0.005 , with the number of the training epochs remaining unchanged . Through repeated improvement , the accuracy of the Bidirectional neuron network could keep around 50%~60%.

Performance of the network and results

By implementing the bidirectional network , it can be found that high accuracy (like 80%~90) can not be reached because of the natural limitations .To be frank , some of results do make sense in some extent .However , the lack of this technique is till very obvious due to the lack of information . And high accuracy of this bidirectional neuron network may never be reached .

Conclusion and Future Work

To summary , through the process of building the neuron networks with the given dataset ,conclusions could be made that there indeed exits connection between the education and the cultural background of this person and his/her correctness of answers to the provided questions.

In my point of view , the results of this neuron network could still be improved . More efficient neuron of different features will be created by my self to raise the performance of the training process .Much more and more information could be found or provided to get better and more convincing results and conclusions.

Reference

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