

Retraction

Retracted: An Empirical Study on Application of Machine Learning and Neural Network in English Learning

Mathematical Problems in Engineering

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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- [1] H. Dong and S. Tsai, "An Empirical Study on Application of Machine Learning and Neural Network in English Learning," *Mathematical Problems in Engineering*, vol. 2021, Article ID 8444858, 9 pages, 2021.

Research Article

An Empirical Study on Application of Machine Learning and Neural Network in English Learning

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With the continuous development of neural network theory itself and related theories and related technologies, neural network is one of the main branches of intelligent control technology. Artificial neural network is a nonlinear and adaptive information processing composed of a large number of processing units. In this paper, an adaptive fuzzy neural network (FNN) is used to construct an intelligent system architecture for English learning, and activation function is used to apply the knowledge of computer science and linguistics to English learning. The network neural structure diagram is presented. English machine learning model framework is established based on recursive neural network. On this basis, feature vector extraction and normalization algorithm are used to meet the needs of neural network model. After acquiring the feature vectors of users' learning styles, the clustering algorithm is used to effectively form a variety of learning styles. The validity of the English learning model was verified by designing the functional flow based on tests. Accurate mastery can activate the corresponding brain regions not only to improve the efficiency of learning, but also to better facilitate language learning.

1. Introduction

Machine learning is a relatively young and important branch of artificial intelligence, which involves many fields of interdisciplinary subjects and is widely used in intelligent systems. Machine learning is concerned with the ability of a computer system or machine to automatically improve performance in the learning of its entire experience. Machine learning has profound implications for jobs and the workforce. Because some parts of many jobs may be suitable for machine learning applications, the demand for machine learning products and the work tasks, platforms, and experts needed to produce them has increased. The economic impact of machine learning is defined as the automation of knowledge work, using computers to perform tasks that rely on complex analysis, nuanced judgment, and creative problem solving. The advancement of deep learning and neural network machine learning technology is the main driving force of knowledge work automation. Natural user

interfaces for speech and gesture recognition are other drivers of machine learning technologies that benefit greatly [1]. Machine learning has attracted extensive attention in many fields. The methods to solve the problem of multiple classifiers include Bayesian method, *K*-means, and neural network. Neural network can deal with nonlinear multiple classifiers with its powerful ability. Because of its complex hidden layer, neural networks can better represent high-dimensional parameters than other methods.

With the continuous development of computer technology, artificial intelligence algorithms are constantly evolving, and the accuracy of computer classification is also constantly improving. Artificial neural network is a mathematical model of distributed parallel information processing which imitates the behavior characteristics of animal neural network. Relying on the complexity of the system, this kind of network achieves the purpose of information processing by adjusting the interconnection relationship among a large number of internal nodes [2]. Artificial neural

network (ANN) is a mathematical model that uses structures similar to synaptic connections in the brain to process information. In machine learning and related fields, the computational models of artificial neural networks are inspired by the central nervous system of animals and are used to estimate or can rely on a large number of inputs and general unknown approximate functions. Artificial neural networks are usually presented as interconnected “neurons” that can compute values from input and are capable of machine learning and pattern recognition due to their adaptive nature [3]. Artificial neural network also has the preliminary ability of self-adaptation and self-organization. Change the weight of synapses during learning or training to adapt to the requirements of the surrounding environment. The same network can have different functions because of different learning styles and contents. An artificial neural network is a learning system that can develop knowledge beyond the designer’s original level of knowledge. Generally, its learning and training methods can be divided into two kinds. One is supervised or tutor learning, in which a given sample standard is used for classification or imitation. The other is unsupervised learning or unsupervised learning. At this time, only learning methods or certain rules are stipulated, and the specific learning content varies with the environment of the system. The system can automatically find the environmental characteristics and regularity and has a function more similar to the human brain.

2. Related Work

Considering that people’s thinking and expression often have fuzziness, some scholars connect the study of neural network with fuzzy system, which leads to the generation of fuzzy neural network. Vijayakumar applied the fuzzy neural network model to financial risk assessment. They put forward a fuzzy neural network model composed of Sigmoid-type nodes and linear nodes, and the fuzzy rules of which were given by the field experts. The model has the characteristics of simple network structure, easy-to-understand fuzzy rules, learning ability and the ability to make full use of expert knowledge, etc. The deficiency is that the determination of network connection structure and its weight excessively depends on the knowledge of domain experts, and the acquisition of expert knowledge is sometimes difficult [4]. Ambrogio et al. proposed a fuzzy neural network model composed of three different types of nodes, which can quickly remember the learning samples. Recommendation systems are mostly implemented by content-based recommendation algorithms and collaborative filtering algorithms to plan learning paths, recommend courses, and books for users [5]. Tariq et al. have built a social recommendation element model for large-scale online learning [6]. The historical data of the online learning platform of the School of Network and Continuing Education of Chen et al.’s University of Electronic Science and Technology (UESTC) was used as the experimental data source, and the collaborative recommendation algorithm based on double-attribute scoring matrix and neural network was used to realize personalized recommendation of learning resources [7].

According to the characteristics of adult English, Ghahramani designed and developed a degree word clearance software and proved the effectiveness of the software in practice [8]. Artificial intelligence technology based on the cloud platform is also one of the research hot spots. Lin et al. used big data processing capacity of cloud platform and introduced artificial intelligence translation, and the cloud platform system can track human translation, timely translate, and correctly understand each speaker modal expression of an attitude and mental representation, and semantic is often fuzzy [9]. Students with different professional backgrounds have different needs and tendencies towards fragmented English learning. Therefore, different studies present different results for learning effects. The motivational factors, restrictive conditions, and application strategies of learners in English learning environments deserve further exploration and classification. Learners are under great pressure from work and life, and those who are interested are eager to improve their vocabulary quickly in a short time.

3. Neural Network Model Construction

3.1. System Organization. As shown in Figure 1, the architecture of English learning intelligent system is divided into three layers: the user layer, the business layer, and the data layer. The data layer provides data storage services and undertakes the responsibility of ensuring the reliability and security of data. According to the actual needs of the system, the data layer stores user information database, user log behavior database, vocabulary database, corpus, user comment data, and test data. The business layer realizes the core business logic of the recommendation system, including similar word mining and similar user mining, recommending words to learners through user-based collaborative filtering algorithm, positioning users’ learning style through clustering algorithm, and adjusting push methods [10]. The user layer is responsible for the interaction between learners and the system. The server responds to user requests and displays content results, such as word learning, information registration, thumb up comments, corpus uploading, testing completion, and other functions. All user behavior data generated by this layer will be logged to the log database.

3.2. Functional Flow Design. The core function of the learning software is word learning, and the functional flowchart is shown in Figure 2. English learning is a process that requires recording, feedback, and following up. In the current application of artificial intelligence in English learning, memo ability is mainly taken as the primary consideration in English learning. The automatic evaluation scores mainly show that vocational school students accept the examination and evaluation of their own spelling and pronunciation by the intelligent system through the auxiliary learning application. The system automatically evaluates the score and the current English learning level of students in vocational schools. According to the systematic test results, vocational school students can also timely adjust the follow-

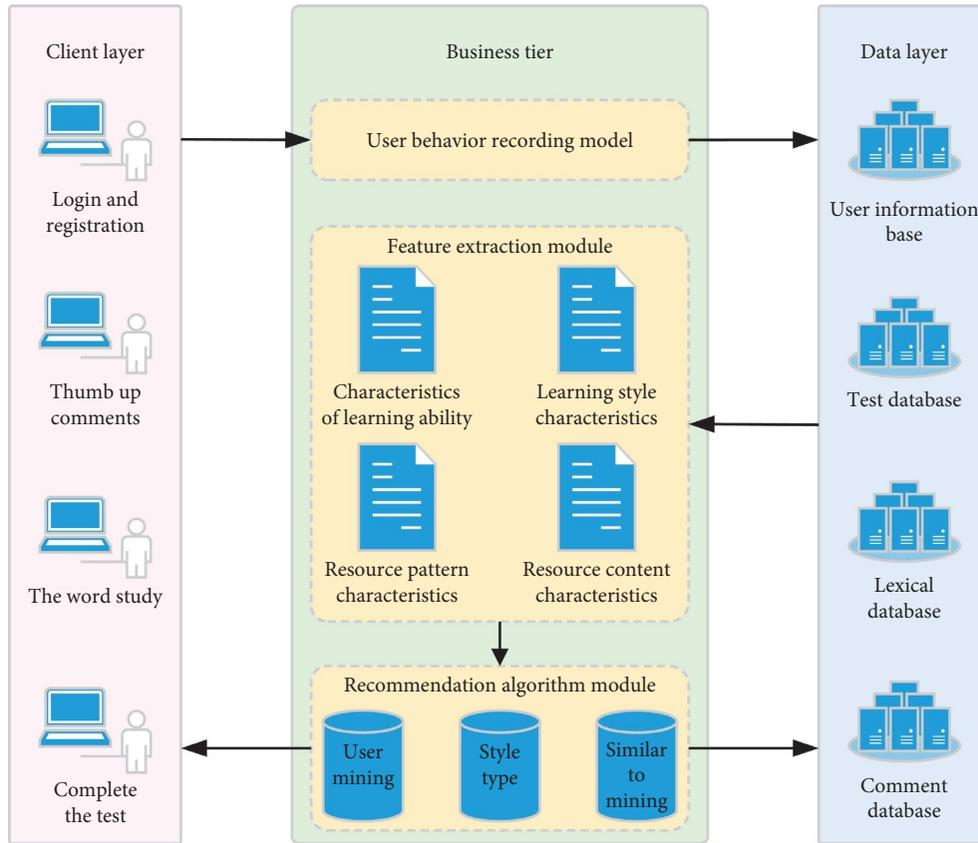


FIGURE 1: System architecture diagram.

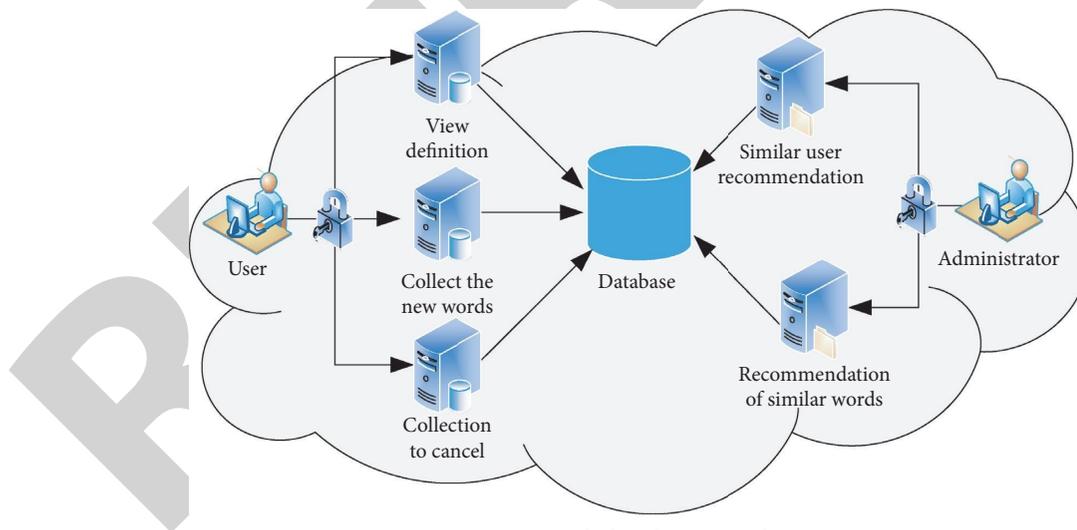


FIGURE 2: Vocabulary learning subsystem.

up English learning plan, which provides a basis for the optimization of the overall English learning plan. Personalized service is the biggest feature of artificial intelligence. As long as the operator of the artificial intelligence system, namely, the teacher, inputs the information into the system, the relevant words and sentences can be pushed regularly and quantitatively [11]. On the basis of the artificial intelligence automated test based on the auxiliary learning

application, in order to fully understand the English learning situation of vocational school students, the application of artificial intelligence in the future will realize the automatic formulation of personalized learning plan. In other words, when the intelligence test score of vocational school students is at a low level, the artificial intelligence system will automatically determine that vocational school students have a low grasp of vocabulary and grammar, etc., and select more

basic vocabulary and phrases in the push to facilitate vocational school students to continue learning. The highly accurate personalized learning program can also help vocational school students improve their personal English learning level in a short time.

The core function of learning software is word learning. When the user recites the word, the system will judge whether it is a new user. New users need to complete the test first. Users who have not completed the test for a long time, or feel that the test results do not accurately reflect their level, can choose to retake the test. According to the learning data, the system looks for similar users and highly relevant words for users to form a recommendation word list. When learning English, users can choose whether to bookmark a new word, comment on the word, or comment on the word thumb up. As the cycle goes on, the number of new words in the user's vocabulary keeps increasing. Every time when the software is opened again and the user begins to learn, the system will recommend a new batch of words according to the updated version of the vocabulary library. The system can help users to quickly find new words when learning, improve the efficiency of memorizing words, and quickly expand the vocabulary.

When the user is collecting the vocabulary, the system will automatically ask the user whether to remember the word as the core word. If not marked, the system will judge whether the word belongs to proper nouns according to the characteristics of the word itself. If not, it will be marked as a common word to show users the basic usage of definition and phonetic symbols. If it is the core word, it shows the basic usage and expands the advanced usage of the example sentence. The specific process is shown in Figure 2.

3.3. Neural Network Structure. Neural network is a model that simulates the function of human brain nervous system by modeling and connecting neurons, the basic unit of human brain, and develops an artificial system with intelligent information processing functions such as learning, association, memory, and pattern recognition. An important characteristic of neural network is its ability to learn from the environment and store the learning results in the synaptic connections of the network. The learning of a neural network is a process. Under the incentive of its environment, some sample patterns are input to the network one after another, and the weight matrix of each layer of the network is adjusted according to certain rules. When the weight of each layer of the network converges to a certain value, the learning process ends. Neural network is an acyclic graph composed of interconnected neurons. The output of the previous layer of neurons serves as the input of the next layer of neurons, which are usually arranged in a regular way and are constructed into layers of connections, each containing multiple neurons. A common neural network structure is called full connection layer [12]. Denote pair-to-pair connections of neurons between two adjacent layers, while neurons in the same layer are not connected.

The first layer of the neural network is the input layer, and the last layer is the output layer. There are countless hidden layers in the middle. When unsupervised layer-by-

layer training is used, the first layer is trained first, then the trained nodes of the first layer are used as the input nodes of the next layer, and then the next layer is trained, and so on. After the training of each layer is completed, the BP algorithm is used to train the whole neural network to realize the mapping between input target and output target. Each convolution layer contains multiple feature maps, and each feature map is a plane composed of one or more neurons.

Neural network can solve complex problems better. Common activation functions include Sigmoid function, Tanh function, and ReLU function [13]. The formula of Sigmoid function is

$$f(x) = \frac{e^x}{1 + e^x}. \quad (1)$$

Its advantages are that the output can be mapped between 0 and 1, monotone continuous, stable optimization, and easy derivation. Its disadvantage is that the output is not centered on 0, so it is easy to saturate, resulting in the disappearance of gradient and resulting in training problems. The Tanh function is the hyperbolic tangent function, and the formula is

$$f(x) = \frac{1 - e^{-x}}{1 + e^{-x}}. \quad (2)$$

Compared with Sigmoid function, it has the advantages of fast convergence speed and zero-centered output, which can compress the data to between -1 and 1, but the gradient will still disappear. ReLU function is rectified linear function, and the formula is

$$\int_a^b f(x)dx = \frac{b-a}{3} [f(a) + f(b)]. \quad (3)$$

In deep learning theory, feed forward neural network has unique advantages and plays a key role in solving various items such as classification, but its functionality is limited [14]. The model of the M-P perception is a neuron model and the multilayer perception is the multilayer neural network. In a multilayer neural network, each layer of neurons is only fully connected with the neurons in the next layer. At the same layer, neurons do not connect to each other, and neurons across layers do not connect to each other. The human brain is equipped with powerful computing power, and the classification task is only a small part [15]. Human beings can not only distinguish individual cases, but also deeply analyze the logical information sequence between input information, which contains rich content; there are also very complex time relations between the information, and the length of the information is varied. These problems can only be effectively solved by the return neural network. The key is that the network concealment can retain the historical input information, which can be used as the network output. The recursive neural network model is shown in Figure 3.

4. Neural Network Application

4.1. Neural Network English Machine Learning. In the theory of deep learning, the feed forward neural network has

unique advantages and plays a key role in solving a variety of items such as classification, but the function of feed forward neural network is limited. Categorizing is only a small part of the computing power of the human brain. Human beings can not only distinguish individual cases, but also deeply analyze the logical information sequence between input information, which contains rich content, there are also very complex time relations between the information, and the length of the information is varied. These problems can only be effectively solved by the return neural network. The key is that the network concealment can retain the historical input information, which can be used as the network output. The framework of English machine learning model based on recursive neural network is shown in Figure 4.

The display layer combines NGINX and Web server organically to optimize the model's scalability and reliability. When multiple users make requests, NGINX can not only transmit the request probability to the server, but also handle a large number of concurrent requests based on a reasonable maximum number of accesses to prevent failure. The middle layer is composed of an intermediate scheduling module and a memory database module [16]. The request information sent by the user is processed based on the intermediate scheduling module, and the attached data is transmitted efficiently and quickly based on the memory database. On the basis of improving the management and control level of scheduling module, the stability and efficiency of data transmission can be guaranteed. The decoding layer includes two decoding modules: GPU and CPU. Based on the multimodel concurrency and hybrid decoding, the model concurrency processing performance is optimized to reduce the model response latency, so as to ensure high concurrency and low latency of the whole model.

4.2. Analytical Model of English Learning Ability. Data preprocessing mainly includes monolingual and bilingual preprocessing and phrase and rule selection. The word vector generated by the trained cyclic neural network is transmitted to the recursive neural network training. The local layer number of the neural network training is highly consistent with the derivation tree of the statement generation. The training part includes phrase encoders and rule encoders. The model training framework is to preselect the phrases/rules of each sentence, obtain the initial word vector representation based on the cyclic neural network, then transfer the word vector representation to the recursive neural network, and measure the similarity between the phrases and rules through the inner product. The English translation model is oriented to the bilingual sentence modeling of the training corpus, which is mainly divided into two parts. One is to obtain word vectors through the cyclic neural network and transfer them to the recursive neural network translation model. The second one is divided into phrase encoders and rule encoders based on the translation model, and the second one is divided into monolingual and bilingual encoders. During the training, it

is crucial to adopt the monolingual encoder to gradually pretrain according to the level, then to train the bilingual encoder, and finally to balance all links through the joint training.

In the process of English learning, objective data are used to conduct correct analysis, and an application model is proposed to analyze students' learning ability in the process of English learning, that is, learning ability analysis model, as shown in Figure 5.

The model of learning ability analysis is to analyze the characteristics related to learning in the process of learning English. This model analyzes the relevant information of students' learning state and makes use of the analysis results to develop targeted learning tasks for students. In the data collection stage, the primary data collection is carried out by means of questionnaire survey. In the data extraction stage, it is necessary to preprocess the original data to eliminate the interference of useless data to the whole analysis process. Due to partial missing and omission of the original data, it is necessary to fill in the filling process according to certain standards and then input the processed data into the neural network for analysis.

Furthermore, it is necessary to determine the topology of the neural network model, the number of nodes in the input layer, the number of nodes in the output layer, and the number of nodes in the hidden layer. The calculation formula of hidden layer nodes is shown in the following equation:

$$J = \sqrt{\frac{(M+1)M}{N}}. \quad (4)$$

In equation (4), J is the number of nodes of hidden layer; M is the number of nodes in the output layer; and N is the number of nodes in the input layer. According to equation (4), the relationship between network training times and the number of nodes in the hidden layer can be obtained. In order to simplify the relationship between the two, network training times and the number of hidden layer nodes are plotted [17]. When the number of nodes in the hidden layer of the neural network is 4, the training times of the whole network model is the shortest. In normalized processing, data changes are limited to a certain range, usually at (0, 1). Because the Sigmoid function is used as the transformation function of the output layer of the neural network, the Sigmoid transfer function has the special feature that when x is close to positive or negative infinity, the output value will be close to 0 or 1, so the output variable range is (0, 1). Without normalized data, the influence of small-value neurons on the network may be much smaller than that of large-value neurons, thus affecting the training results. The normalization formula is shown in the following equation:

$$x_j = (z_j - z_j^{\min})(a_1 - a_2) \left(\frac{z_j + z_j^{\min}}{z_j^{\max} - z_j^{\min}} \right). \quad (5)$$

The output value is treated with inverse normalization, and the inverse normalization formula is shown in the following equation:

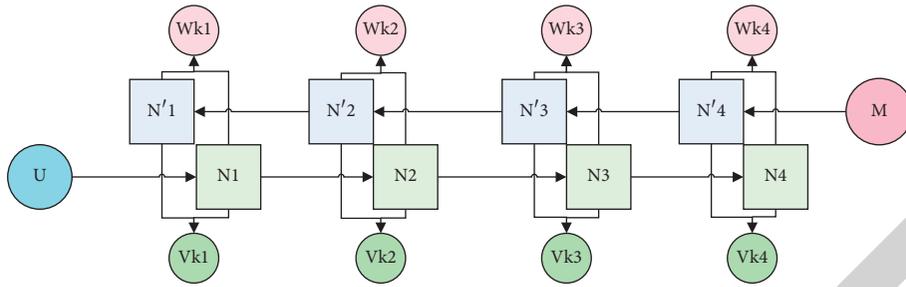


FIGURE 3: Network structure diagram.

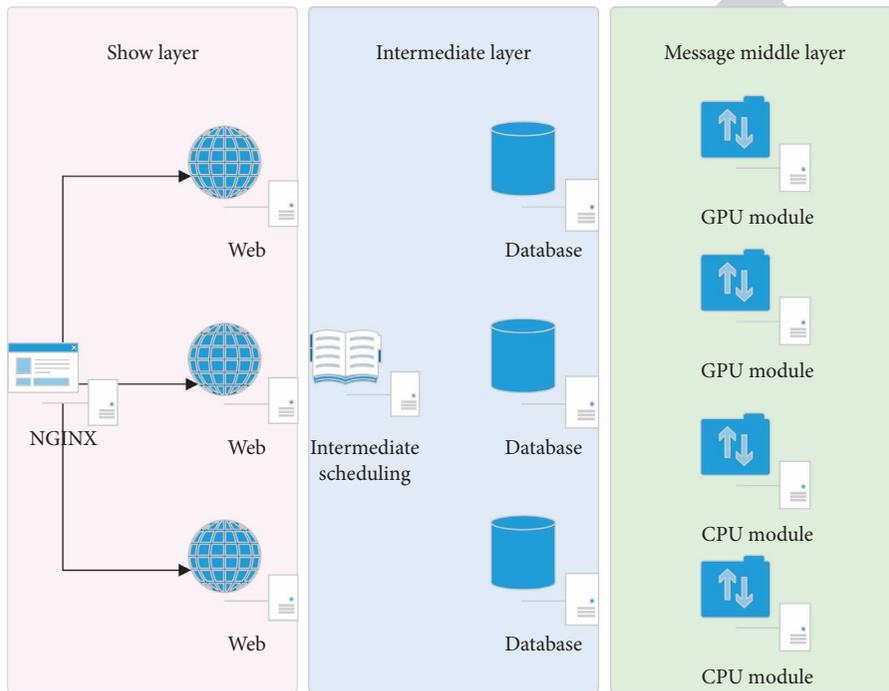


FIGURE 4: English machine learning model framework.

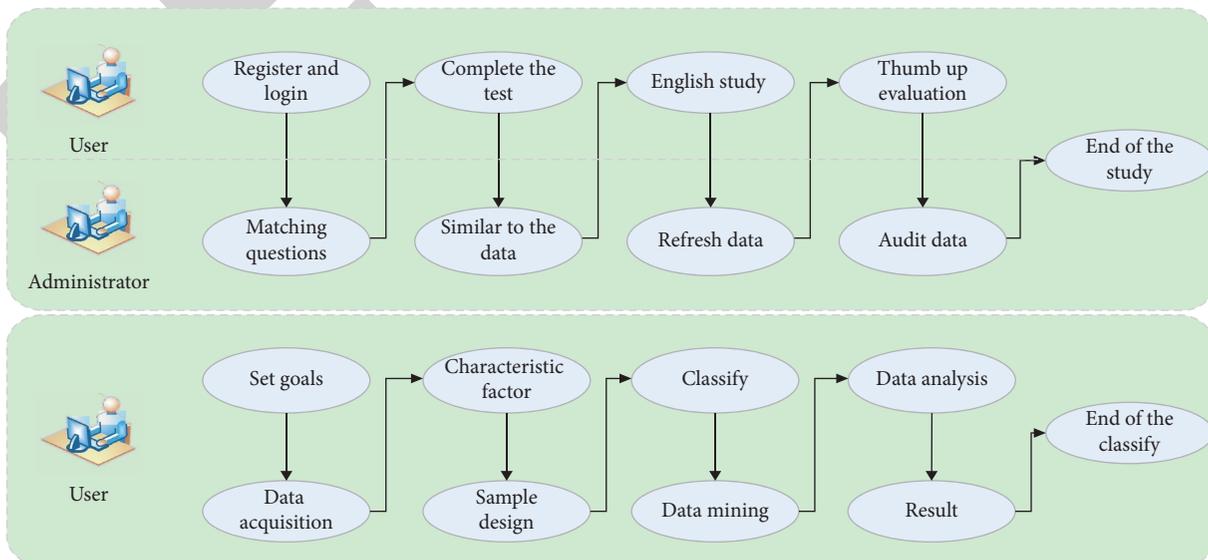


FIGURE 5: Analysis model of learning ability.

$$y_j = \left(\frac{z_j - z_j^{\min}}{a_1 - a_2} \right) (z_j^{\max} - z_j^{\min}) - z_j^{\min}. \quad (6)$$

In equation (6), x_j is the normalized value; y_j is the inverse normalized value; a_1 is the lower limit; a_2 is the upper limit; Max is the maximum value in the source data; and Min is the minimum value in the source data.

4.3. Feature Vector Extraction and Normalization. By mining and analyzing learners' learning data, such as learning duration, frequency, learning motivation, and the proportion of detailed usage of words, as input, the computer can locate learners' learning style through clustering algorithm [18].

When different features are arranged together, due to the different expression ways of features, we need to normalize the data and map it to the range of $-1 \sim 1$, so that indicators of different units or orders of magnitude can be compared and weighed [19]. For example, formula (7) traverses each data in the feature vector. Subtract the sample mean \bar{x} first, divide the difference by the sample variance S , and data standardization can be easily realized through the formula. The essence of data normalization is a linear transformation, which will not change the numerical order of the original data, but can improve the performance of the data.

$$X = (x - \bar{x})S. \quad (7)$$

This data processing method is widely used in machine learning algorithms and can improve the convergence speed of the model.

4.4. Learning Style Clustering. Learning style is mainly composed of cognitive elements, sensory elements, and physiological elements. It is a relatively stable cognitive, sensory, and physiological characteristics of learners in the process of interactive perception with the learning environment [20]. The three basic characteristics of learning style are as follows: (1) Learners have different learning style tendencies, which are relatively stable and lasting; (2) the formation of learning style not only contains internal physiological and psychological factors, but also is influenced by external education, family, society, and culture factors; and (3) learners with different learning styles show differences in learning behaviors such as information processing habits, attitudes, and strategies.

Learning style can be divided into four dimensions: (1) Learning concept refers to the attitude and understanding way students hold towards the learning process. (2) Learning motivation refers to why students learn, involving learners' goals, intentions, motivations, and learning expectations. (3) Processing strategy refers to different cognitive processing methods used by learners in learning activities. For example, some learners are good at associating words with roots and affixes, and some choose to memorize words by repeating and silently reading them for several times. (4) Adjustment strategy refers to the way that students coordinate, control, and manage their learning activities.

After obtaining the feature vector of the user's learning style, the clustering algorithm can be used to divide the data points with similar characteristics in the data set into unified categories and eventually generate a variety of learning styles [21]. The classical k -means clustering analysis algorithm is adopted. The step is to randomly select K objects as the initial clustering center, calculate the distance between each object and each subclustering center, and finally assign each object to the clustering center nearest to it. Clustering centers and the objects assigned to them represent a cluster. For each sample allocated, the cluster center will be recalculated according to the existing objects in the cluster. This process will be repeated until a certain termination condition is met—when no objects are reassigned to different clusters, or the clustering center without clusters changes again, the sum of squares of errors is minimized locally [22]. Make its loss function:

$$E = \sum_{j=1}^k \sum_{x \in e_j} \frac{\|x - y_j\|^2}{y_j}. \quad (8)$$

The idea is to divide a given sample set into K clusters so that the points within the cluster are as close as possible and the distance between the clusters is as large as possible. This algorithm has high operation efficiency and fast convergence speed, but it needs to give the clustering number K value in advance, and the clustering results fluctuate greatly under the influence of K value. Silhouette coefficient can be used to measure the quality of clustering. The silhouette coefficient will also consider the intracluster cohesion and intercluster separation of clustering results, and its value range will be between -1 and 1 . The larger the contour coefficient is, the better the clustering effect will be.

4.5. Functional Test. According to the English learning application model, users' learning is divided into 15 categories according to three dimensions: information processing, learning motivation, and learning management. The learning style data was input as the learning style feature vector for testing, and the value of k was checked when the contour coefficient was maximum, and the preliminary verification results were obtained. As shown in Figure 6, when the value of k is set at 15, the growth of contour coefficient shows an obvious gentle trend. That is, when the number of clusters is greater than 15, the clustering effect no longer significantly improves. To some extent, the test results reflect the validity of the English-learning style model. See Figure 6.

Based on 32 groups of sample data provided by the orthogonal experimental method, 26 groups of sample data were extracted as the training samples of the test model, and the test samples of the remaining 6 groups of data were analyzed through training. In order to verify the effectiveness and recommendation accuracy of the neural network English learning model, the model was simulated and tested. The coefficient of determination is used to describe the model's fit test results, as shown in Figure 7.

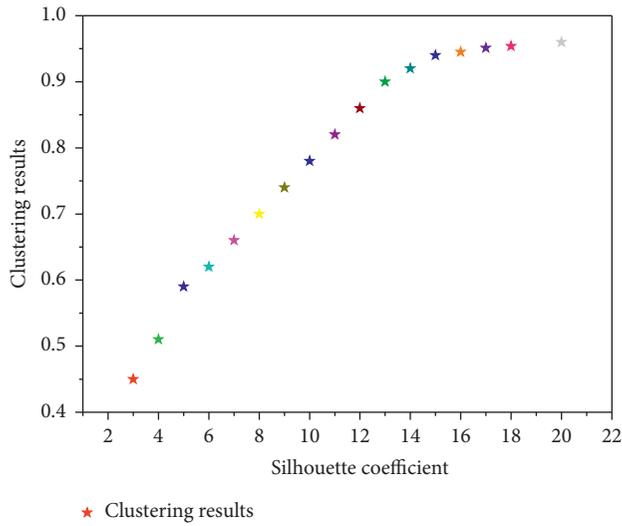


FIGURE 6: Learning style clustering test chart.

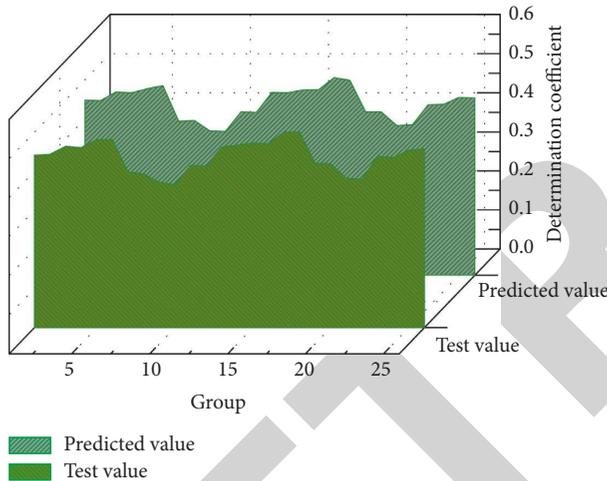


FIGURE 7: Test results of model fit degree.

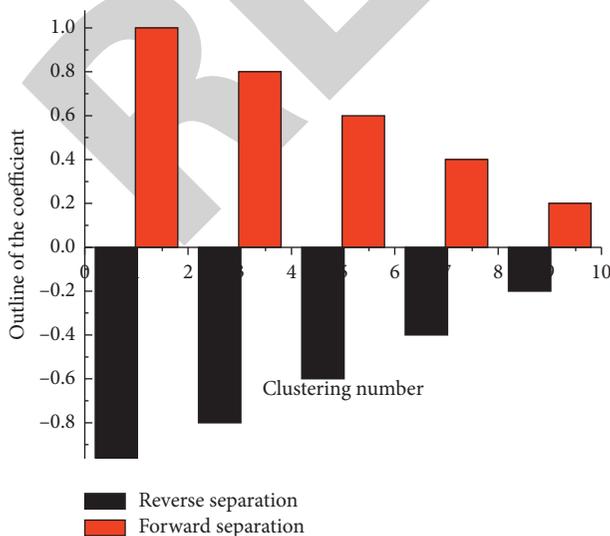


FIGURE 8: The visualization test results of prediction results.

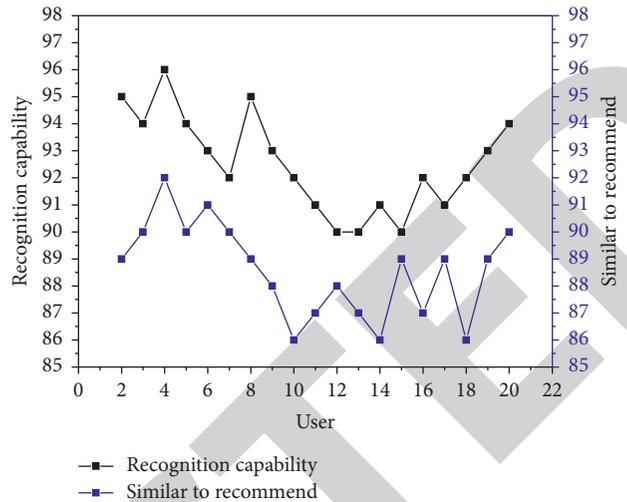


FIGURE 9: Test diagram of English machine learning model for neural networks.

The percentage of prediction error is used as the evaluation index of the backspin prediction model, and the visualization test results of prediction results are shown in Figure 8.

The experimental design was selected to gather 20 users to learn English and test the system’s function. The test results are shown in Figure 9.

5. Conclusion

In this paper, a recursive neural network English machine learning model framework is established based on the related theories and techniques of machine learning neural network theory, and eigenvector extraction and normalization algorithm are used to meet the needs of neural network model. After analyzing the neural network model and obtaining the feature vectors of users’ learning styles, the clustering algorithm is used to divide the data points with similar characteristics into unified categories and finally generate multiple learning styles. The selection set automatically evaluates the score, makes the personalized learning plan automatically, and pushes the learning guidance system of relevant words and sentences regularly and quantitatively, so as to further expand the scope of their English learning and lay the foundation for the improvement of the effect of intelligent English learning. It solves the defects of traditional English learning users in reciting words, such as outdated corpus, low precision of personalized recommended words, and traditional reciting words, and assists users in professional language learning, rapid expansion of vocabulary, good vocabulary aggregation, and learning relevant practical vocabulary. The thesaurus selected in this paper is based on the existing public free thesaurus, and the scope of the optional thesaurus still needs to be expanded and studied. The number of selected data in this study is only several thousand, which is undoubtedly small compared with the “big data” of machine learning. The thesaurus will be expanded in the future research.

Data Availability

The data used to support the findings of this study are available within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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