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EXPERIMENTAL STUDY OF MACHINE LEARNING AND NEURAL NETWORKS USING DEEP LEARNING

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Abstract: The emergence of neural network technology may be attributed to the continuous development of neural network theory and its associated theories and technologies. This branch of intelligent control technology has gained significant importance in recent years. An artificial neural network (ANN) is a kind of computational model that exhibits nonlinearity and adaptability in its information processing capabilities. The system consists of a very large quantity of processing units. In this research, the architecture of an intelligent system is designed using an adaptable fuzzy neural network (FNN). Additionally, an activation function is implemented to include information from the disciplines of computer science and languages. The diagram illustrating the neural architecture of the network is shown in this figure. The machine learning model architecture was constructed based on a recursive neural network using Deep learning , which forms the fundamental framework. The use of the feature vector extraction technique and the normalization algorithm is necessary to meet the requirements of the neural network model. The clustering approach is used to build a diverse set of learning styles by using the feature vectors derived from various users' learning styles. Through the use of testing, the design of the functional flow was established, therefore enabling the demonstration of the reliability of the Deep learning model. The precise acquisition of language skills has the potential to activate specific regions of the brain, resulting in enhanced Deep learning efficacy and increased aptitude for acquiring other languages.

Keywords: Machine Learning, Neural Networks and Deep Learning.

1. Introduction

Deep Learning by machine is a subfield of artificial intelligence that is relatively new but increasingly essential. It encompasses a broad range of multidisciplinary fields and is used extensively in many intelligent system implementations. The field of study known as machine learning studies how computer systems and other machines may automatically improve their performance via the process of Deep learning from their whole histories. The impact that machine learning will have on employment and the labor force will be significant. The demand for machine learning products, as well as the work assignments, platforms, and specialists necessary to develop them, has surged as a result of the possibility that some aspects of a wide variety of vocations may be amenable to the use of machine learning. The automation of knowledge labor, which involves programming computers to carry out activities that require complicated analysis, nuanced judgment, and creative problem solving, is one way to characterize the economic impact of machine learning. The most important factor contributing to the acceleration of the automation of knowledge labor is the development of deep learning and neural network machine learning technologies. Other significant drivers of machine learning technologies are

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natural user interfaces for voice and gesture recognition [1]. These technologies benefit enormously. Deep Learning via machines

has garnered a great deal of interest in a variety of fields. The Bayesian technique, K-means, and neural networks are some of the approaches that may be used to address the issue of many classifiers. Because of the great abilities it has, neural networks are able to cope with nonlinear multiple classifiers. Neural networks, on the other hand, are able to more accurately represent high-dimensional characteristics than other approaches are due to the hidden layer's complexity.

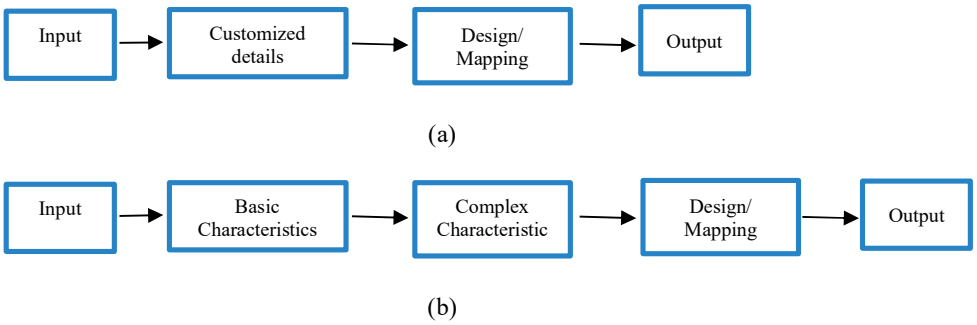

Figure 1. (a) Standard Model for Machine Learning (b)Deep (End-to-End) Machine Learning Model

The accuracy of computer classification is also continuously increasing as a result of the ongoing development of computer technology. This evolution of artificial intelligence algorithms may be attributed to the progression of computer technology. An artificial neural network is a mathematical model of distributed parallel information processing that mimics the behavior and properties of animal brain networks. This model is used to process information in a distributed manner. This kind of network accomplishes the goal of information processing by modifying the interconnection relationship among a large number of internal nodes [2]. This sort of network is dependent on the complexity of the system in order to fulfill its goals. An artificial neural network (ANN) is a kind of mathematical model that processes information using architecture that are analogous to the synaptic connections seen in the human brain. The computational models of artificial neural networks used in machine learning and fields connected to it are inspired by the central nervous systems of animals. These models are used to estimate or may depend on a large number of inputs and general unknown approximation functions. Artificial neural networks are often represented as linked "neurons" that are able to calculate values based on input and are capable of machine learning and pattern recognition owing to the adaptable nature of artificial neural networks [3]. An artificial neural network also has the potential to self-organize and self-adapt in its early stages. During the process of deep earning or training, synapses may have their strength altered to better conform to the demands of their surrounding environment. Because of the wide variety of pedagogical approaches and subject matter, a single network may serve a variety of purposes. An artificial neural network is a Deep learning system that has the potential to generate knowledge beyond the degree of information that the creator had to begin with. In general, its Deep learning and training approaches may be broken down into two distinct categories. The first method is known as supervised Deep learning or tutor learning, and it involves the use of a specific example standard for the purpose of classification or imitation. The alternative option is unsupervised Deep learning, sometimes known simply as Deep learning without supervision. At this stage, only

Deep learning techniques or certain principles are being prescribed, and the specific Deep learning material is going to vary depending on the environment of the system. The computer has a function that is more like to that of the human brain, and it is able to discover environmental features and regularities automatically.

2. Related Work

Some researchers have made the connection between the study of neural networks and fuzzy systems, which resulted in the development of fuzzy neural networks. This is due to the fact that people's thoughts and expressions often include fuzziness. Assessment of financial risk was one of the applications of the fuzzy neural network model that Vijayakumar developed. They proposed a fuzzy neural network model that was made up of Sigmoid-type nodes and linear nodes, and the fuzzy rules of the model were provided by the experts in the field. The model has the characteristics of having a basic network structure, easy-to-understand fuzzy rules, the capacity to learn, the ability to fully use expert knowledge, etc. The problem is that the determination of network connection structure and its weight excessively relies on the knowledge of subject experts, and acquiring the knowledge of domain experts may be challenging at times [4]. The deficiency is that the knowledge of domain experts is required. A fuzzy neural network model that was suggested by Ambrogio and colleagues consisted of three distinct kinds of nodes, each of which has the ability to rapidly retain the Deep learning examples. For the most part, content-based recommendation algorithms and collaborative filtering algorithms are used to create recommendation systems [5]. These algorithms are used to help users plan Deep learning routes, propose courses, and recommend books. [6] Tariq and colleagues have developed a social recommendation element model for use in large-scale online learning environments. The historical data from 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 Deep learning resources [7]. [7] This allowed for the realization of personalized recommendation of Deep learning resources.

Numerous research projects have been carried out to investigate potential answers to the issue of inadequate parking space. Recent research conducted by a number of authors (for example, [1,6–9]) has examined and evaluated already-existing intelligent parking systems and offered extensive insights into the construction of intelligent parking solutions. Predicting the availability of parking spots at a specific moment based on AI algorithms is one of the solutions that can help drivers save time looking for parking places and automobile gasoline. This is one of the solutions that can aid drivers. In this scenario, the data produced by sensors and AIoT devices are processed using MLNN techniques (that is, they are regarded to be part of an AIoT system). Research in the field of artificial intelligence has been used in a number of different studies that have been published in an effort to discover answers to the challenge of finding parking spaces. Canli et al. [10] recently suggested a deep learning and cloud-based mobile smart parking approach with the goal of reducing the difficulty associated with the search for parking locations. Ali et al. [11] presented a model that forecasts the availability of parking spaces using the Internet of Things (IoT) in conjunction with cloud computing. This model is built on a deep long short term memory network. In order to do this, they used the dataset of parking sensors from Birmingham. Tekouabou et al. [12] suggested a system for forecasting the availability of parking

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places in smart parking that blends the Internet of Things with a predictive model that is based on ensemble approaches. Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) are the two types of Recurrent Neural Network (RNN) architectures that were researched and created by Arjona et al. [13] for the purpose of forecasting the availability of parking in metropolitan areas. Exogenous factors such as hourly weather and the influence of the calendar have been taken into consideration in order to enhance the overall quality of the models. Using Long Term Evolution (LTE)-based Channel State Information and Convolutional Neural Network (CNN), Sonny et al. [14] suggested a technique for determining whether or not an outdoor parking spot is occupied by using Convolutional Neural Networks (CNN). It was reported by Piccialli et al. [15] that a Deep Learning-based ensemble approach may be used to estimate the occupancy of parking spaces. In addition to this, a genetic algorithm was used in order to maximize the predictors' parameters. The suggested approach was tested on a genuine Internet of Things dataset that included more than 15 million records gathered from various sensor readings. The design of CNN was updated by Rahman et al. [16] so that it could categorize parking spots and boost the work efficiency of the smart parking system in terms of processing information about parking availability. When taking into account the many different MLNN algorithms, one of the technical challenges is to choose the MLNN model that is best appropriate for estimating the availability of parking spaces. Because the performance of any MLNN model might vary greatly depending on the applications it is being used for.

Chen et al. [17] investigated and compared four distinct classifiers, including RF, Linear Discriminant Analysis (LDA), Support Vector Machines (SVMs), and KNN, as well as combinations of these classifiers with various feature selection approaches. In order to do this, they made use of three well-known datasets. Having said that, this work is not particularly specialized for the use of smart parking. To the best of our knowledge, quite a few studies have been done that attempt to study and compare the performance of various MLNN algorithms for the purpose of forecasting the availability of parking spaces in a car park. The performance of a number of MLNN algorithms was assessed by Awan et al. [18] using the Santander's parking dataset. Using a different dataset (i.e., the San Francisco dataset), we analyze the performance of various additional MLNN algorithms such as LSTM, Single Layer Perceptron (SLP), and Categorical Naive Bayes (CNB) in this study. We also took into account certain other measures, such as the amount of time it took for the algorithms to be executed. In addition, in contrast to [18], which analyzed only one voting classifier (the Ensemble Learning algorithm), we implement and assess a significant number of alternative combinations of different MLNN algorithms (i.e., more than 50 combinations) in order to provide a thorough analysis. This allows us to provide a more accurate picture of the data. We, however, make use of the walk forward validation, in contrast to [18]. When it comes to the analysis of time series data, it offers performance that is superior to that of k-fold cross validation [19].

Large datasets from a variety of applications are good candidates for the use of Machine Learning and Neural Network-based (MLNN) techniques, which may be used to both extract information that is important to the application and make predictions. Nevertheless, the outcomes of the algorithms could be different based on the datasets and the application that are being utilized. Therefore, finding the approach that is best suited for the particular datasets and applications at hand may be seen as a significant benefit [2].

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3. Types of Neural Networks Using Deep Learning

Convolutional neural networks have unique computational patterns that require a lot of computational power to train and evaluate, even on GPUs, DSPs, or other power-efficient silicon frameworks. For optimal neural network performance, modern processors like Cadence's Tensilica Vision P5 Digital Signal Processor provide a broad variety of processing and memory capabilities.

Numerous image recognition experiments have indicated that multi-level algorithms, which perform various filter operations at each level and employ earlier findings in deeper levels, are more successful than single-level algorithms. Filters for each level may boost deep algorithm performance. Multi-resolution filters are useful for showing a picture's features at multiple resolutions. Comparing satellite photographs of metropolitan regions shows that business sectors have more buildings and wider streets than residential ones. Different networks with diverse features have shown semantic picture interpretation efficacy. Popular satellite image processing network configurations are shown below.

Deep Neural Networks (DNNs): These networks include an input layer, at least one hidden layer, and an output layer, according to [36]. Each layer is in charge of processing its own set of pixels. The training procedure that follows might thus be referred to as deep learning.

Recursive Neural Networks (RNNs): They must avoid being perplexed by repeated neural networks, which are recursive neural networks (RNNs). After the incoming data has been organized, these networks—which are also used to manage speech and understanding—can be effectively used. These networks may also be used to real-world situations, such as recursive-architecture images [5]. Thus, semantic contexts may be divided and annotated using RNNs.

Convolutional Neural Networks (CNNs): These networks were created to more precisely classify images into different categories. [3] asserts that over a million photographs may be divided into over a thousand different groups. This is achieved by combining an unlimited number of internal parameters, three completely connected layers, and five convolutional layers. Regularization is used by the algorithm to ignore the problematic variables and lessen overfitting.

Generative Adversarial Networks (GANs): These networks allow for the adversarial training of two multilayer Perceptron-based models, G and D, where G regulates data distribution and D establishes the likelihood that a sample will be obtained from the training data. The multidimensional input data for semantic category labeling is represented by the letter D as well.

4. Neural Network Model Construction

4.1. *System Organization.* The architecture of the intelligent system for learning is shown in Figure 1 as having three levels: the user layer, the business layer, and the data layer. Each of these layers is responsible for a different function. The data layer is responsible for providing services related to data storage as well as taking on the task of ensuring that data is reliable and secure. The user information database, the user log behavior database, the vocabulary database, the corpus, the user comment data, and the test data are all stored in the data layer since they are relevant to the real requirements of the system. The business layer is responsible for the realization of the core business logic of the recommendation system, which includes mining for similar words and users, recommending words to students using a user-based collaborative filtering algorithm, positioning students' learning styles using a clustering algorithm, and adjusting push methods [10]. Learners' interactions

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with the system are managed at the user layer, which bears responsibility for this aspect of the architecture. The server is responsible for responding to user queries and displaying content results, including but not limited to word learning, information registration, thumbs up comments, uploading corpus data, and the successful completion of testing. The log database will be populated with all of the data about user activity that is produced by this layer.

4.2. Functional Flow Design. Figure 2 depicts a functional flowchart for the software that is used for learning, and the primary purpose of the program is word learning. Learning is a process that involves recording, receiving feedback, and following up on what you've learned. The memorization capacity of a learner is regarded as the most important factor in acquisition in the context of the present applications of artificial intelligence in this domain. The ratings given by the automated assessment primarily demonstrate that students attending vocational schools are okay with the examination and evaluation of their own spelling and pronunciation carried out by an intelligent system through an auxiliary learning application. Students enrolled in vocational schools have their scores as well as their current level of proficiency evaluated by the system automatically. According on the findings of the standardized tests, students at vocational schools are also able to adapt the follow-up procedures in a timely manner.

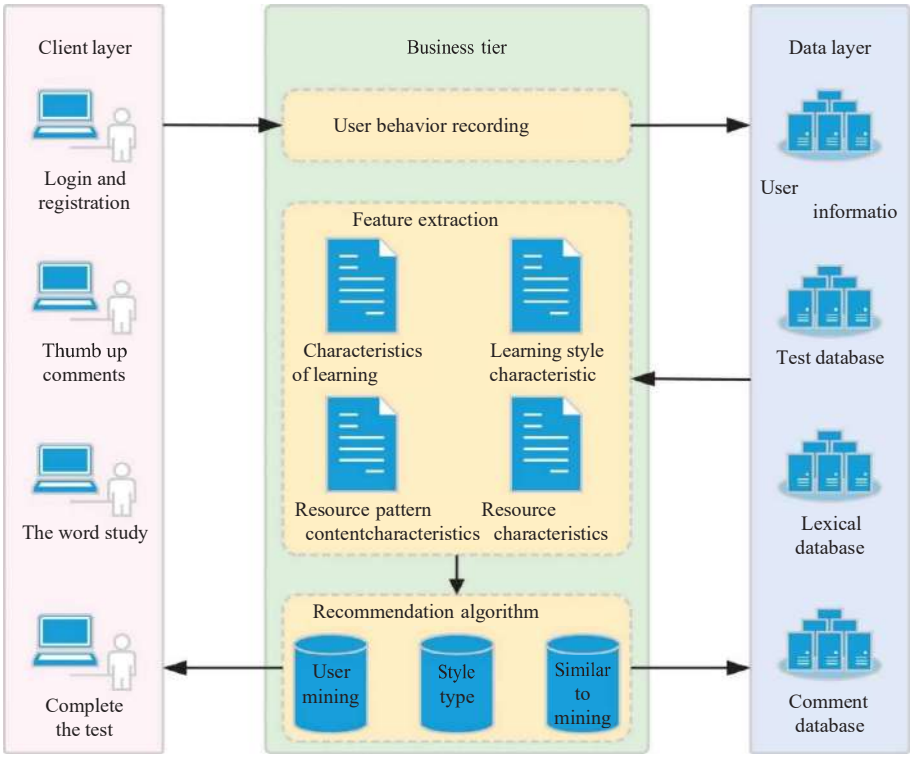

FIGURE 2: System architecture diagram[1].

4.3. Neural Network Structure. A neural network is a model that replicates the function of the human brain and nervous system by modeling and connecting neurons, the fundamental unit of the human brain, and developing an artificial system with intelligent information processing capabilities such as learning, association, memory, and pattern recognition. This is accomplished by modeling and connecting neurons. The capacity of a neural network to acquire knowledge from its surrounding environment and to remember that knowledge inside the network's synaptic connections is an essential aspect of this kind of network. Learning in a neural network is a process that takes place over time. Some sample patterns are fed into the network one after the other while it is being

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incentivized by its surroundings, and the weight matrix of each layer of the network is altered according to particular rules as it progresses through the layers. The learning process is finished when the weight of each layer of the network converges to the same value. A neural network is an acyclic graph that is made up of neurons that are linked to each other. The output of one layer of neurons serves as the input for the subsequent layer of neurons. Neurons are typically created in layers of connections, with each layer comprising numerous neurons, and each layer is structured in a manner that is consistent with prior layers. The entire connection layer is a structure that is often seen in neural networks [12]. Pair-to-pair connections are those that exist between neurons in two layers that are next to one another; connections between neurons in the same layer do not exist.

5. Neural Network Using Deep Learning Application

Deep Learning using Neural Networks on Machines. The feed forward neural network, which is central to the theory of deep learning, has a number of distinct benefits and is essential to the resolution of a wide range of problems, including classification, however the purpose of the feed forward neural network is restricted. Only a tiny portion of the computer capacity of the human brain is dedicated to categorizing information. Not only are people able to differentiate between specific situations, but they can also do in-depth analysis of the logical information sequence between input information. This information has rich content, there are also extremely complicated temporal linkages between the information, and the duration of the information varies. Human beings have the ability to do all of these things. The only reliable method for solving these issues is the use of the return neural network. The fact that the network concealment may save the historical input information, which can be utilized as the network output, is the most important thing to keep in mind. The recursive neural network serves as the basis for the structure of the machine learning model.

In order to enhance the scalability and dependability of the model, the display layer incorporates NGINX and the Web server in an organic manner. When several users make requests, NGINX is able to not only provide the request probability to the server but also manage a large number of concurrent requests based on a realistic maximum number of accesses in order to avoid failure. This is done in order to ensure that the service is not interrupted. The intermediate scheduling module and the memory database module are what make up the middle layer [16]. The information about the request that was communicated by the user is processed based on the intermediate scheduling module, and the data that was attached is transferred in a manner that is both efficient and rapid based on the memory database. On the basis of enhancing the, it is essential to adopt the monolingual encoder to progressively pretrain according to the level, then to train the bilingual encoder, and finally to balance all linkages via the joint training.

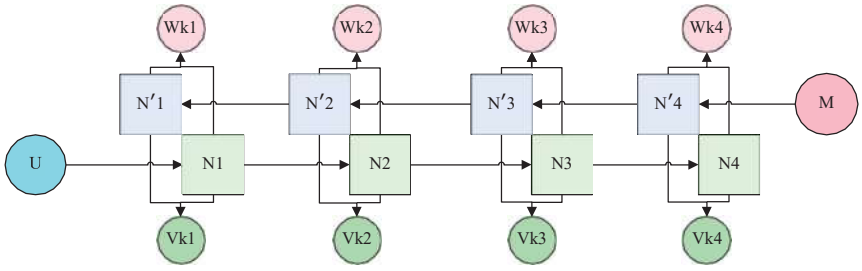

Figure3: Network structure diagram [1].

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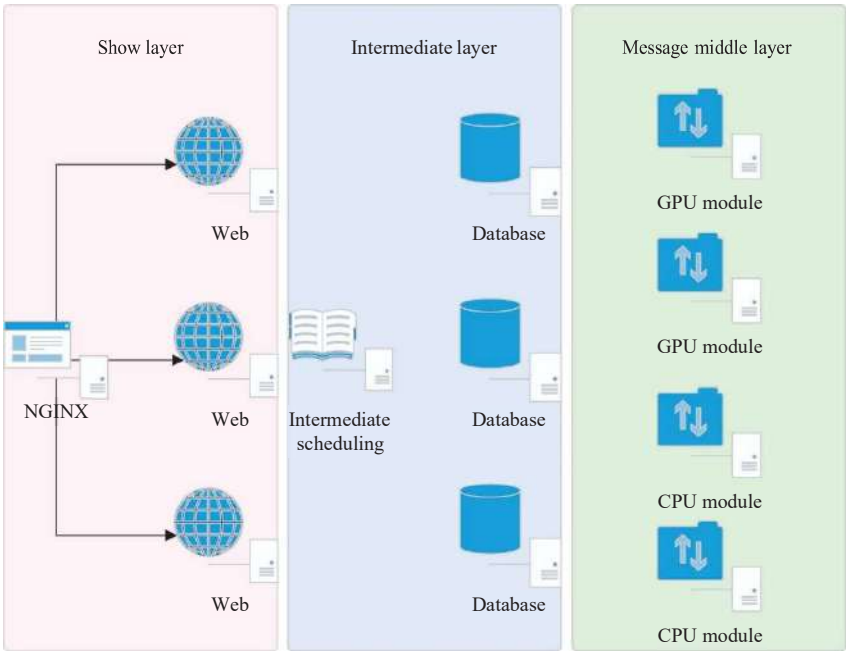

Figure 4: machine learning model framework [1].

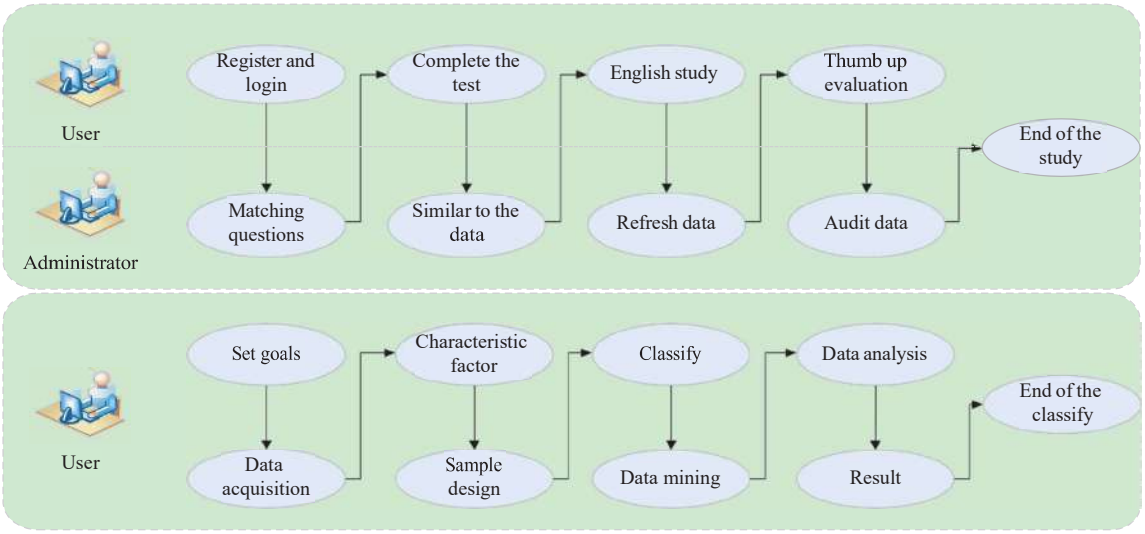

Figure 5: Analysis model of learning ability.[1]

5.1. Deep Learning Style Clustering. A learner's cognitive components, sensory components, and physiological components make up the bulk of their unique learning style. It is a cognitive, sensory, and physiological property of learners that is rather consistent during the process of interactive perception with the learning environment [20]. The following is a list of the three fundamental features of various learning styles: Learners have different tendencies when it comes to their learning styles, and these tendencies are relatively

stable and long-lasting; the formation of a learner's learning style is influenced not only by internal physiological and psychological factors, but also by external education, family, society, and culture factors; and learners who have different learning styles show differences in learning behaviors such as information processing habits, attitudes, and strategies.

5.2. **Deep Learning style can be divided into four dimensions:** The term "learning concept" is used to describe the mentality and level of comprehension that students bring to the learning process. (2) The term "learning motivation" refers to the reasons why students learn, which includes the learners' objectives, intents, motivations, and expectations for their learning. (3) The term "processing strategy" refers to the many strategies of cognitive processing that are used by learners throughout the process of learning. Some students, for instance, have a natural talent for connecting words with their respective roots and affixes, whereas others prefer to remember them by iteratively repeating and secretly reading them over and over again. (4) The term "adjustment strategy" refers to the method in which students organize, regulate, and manage the activities that make up their educational experience.

6. A Review on Machine Learning and Neural Network Algorithms

In this part, we briefly describe the ideas of machine learning and neural networks, and then we show the MLNN algorithms that this article focuses on. Early work in artificial intelligence (AI) focused on using formal languages with hard-coded propositions that a computer could then use to automatically reason about using logical inference rules (this is known as a "knowledge base approach"). Humans have difficulty explaining all the tacit information required to do complicated jobs, hence this method has its limits. To get beyond these constraints, we use machine learning. Using what it has learned from prior calculations and by identifying patterns from large-size datasets, it may aid decision-making. In order to perform cognitive tasks like object detection automatically, it seeks to automate the process of creating analytic models to use. Applying MLNN algorithms that learn from problem-specific training data enables computers to uncover latent insights and intricate patterns without being explicitly instructed to do so. Regressions models, instance-based algorithms, decision trees, Bayesian approaches, and Neural networks are only few of the MLNN algorithms available, each of which comes in numerous specifications and variations depending on the learning job [20]. Here, we introduce the MLNN algorithms that this research investigates and evaluates.

5.1. K-Nearest Neighbors (KNN)

One of the most basic machine learning techniques is the KNN algorithm. This is a slow learning algorithm, which does not generalize well. In n-dimensional space, KNN retains all occurrences that map to training data. Classification of fresh data is based on the votes of each point's k closest neighbors. In other words, we use previously stored information and measures of similarity, such the Euclidean distance function, to assign meaning to each new data point. The search for the best possible neighboring nodes is a major obstacle in KNN. Classification and regression may both benefit from this technique [21].

5.2. Decision Tree (DT) and Random Forest (RF)

DT is a popular choice for both classification and regression problems since it is a non-parametric supervised learning technique. A tree is built by assigning various constraints to its limbs. In the realm of DT algorithms, the Iterative Dichotomiser 3 (ID3), C4.5, and Classification and Regression Trees (CART) [18,21] stand out as

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three of the most popular options. It has been suggested that RF classifier is an ensemble classification method [21]. Breiman first put out the idea in 2001. RF is a team effort that relies on a close-by search for its results. In order to boost performance, RF employs the tried-and-true method of "divide and conquer" [22]. Both the DT and RF algorithms have many commonalities. In reality, the RF is made up of several separate DTs, with conditional features being set in a variety of ways across the various trees. Once a sample is received at a root node, it is distributed to all of the child nodes, each of which makes a prediction about the sample's class label. At last, that sample is classified according to the predominant group's demographics [18].

5.3. Support Vector Machines (SVMs)

Support Vector Machines (SVMs) are used in order to achieve classification and grouping goals by mapping data points to vectors in high-dimensional spaces. When working with data points in an n-dimensional space, it is possible to use a (n-1)-dimensional hyperplane as a classifier, as stated in reference [23].

5.4. Categorical Naive Bayes (CNB)

Using the Bayes theorem as its foundation, CNB is a straightforward probabilistic algorithm. It erroneously thinks the features may be considered separate entities. Supervised learning makes their training relatively fast, although they are often less accurate than more involved methods [23,24].

5.5. Single Layer Perceptron (SLP)

SLP, also known as Perceptron, is a two-class classifier. It multiplies each Perceptron input by its associated weight before summing the results. The (final) label is decided by comparing the outcome to some kind of threshold [23].

5.6. Multilayer Perceptron (MLP)

Multi-layer Perceptron (MLP) is a Perceptron-based system with an input layer, a hidden layer(s), and an output layer(s). Adding more and more hidden layers makes the model more complicated. Extreme potency and sophistication are possible in the MLPs [23,25].

5.7. Long Short-Term Memory (LSTM)

In the realm of artificial intelligence, LSTM is classified as a kind of recurrent neural network (RNN). It has been presented as a solution to traditional RNNs' disappearing and exploding gradient issues. In the original design of LSTMs, the recurrent hidden layer had specialized units called memory blocks. A memory cell in each memory block keeps track of the network's past and present states using specific multiplicative units (gates) and self-connections. The activations entering the memory cell are routed via an input gate, while those leaving the cell are routed through an output gate [26].

5.8. Ensemble Learning (Voting Classifier)

To improve prediction accuracy over using individual learning models, researchers have turned to ensemble learning methods. Using the provided data, it trains several models. Once the models have been trained, the testing data is fed into them so that they may make predictions about the samples' class labels. Each sample forecast is then put to a vote. Hard voting and soft voting are the two voting methods. When a majority vote is reached, the sample is automatically categorized into that category. To choose which class to assign a sample to, the soft voting method takes an average of the probabilities of all possible outcomes (in this case, the class labels) [18].

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CONCLUSION

In this study, a recursive neural network and machine learning model framework is built based on the associated theories and methods of machine learning neural network theory. Eigenvector extraction and a normalization algorithm are employed in order to match the requirements of the neural network model. The neural network model is analyzed, then the feature vectors of the users' Deep learning styles are obtained, and lastly, the clustering method is used to separate the data points with similar features into unified groups in order to produce numerous learning styles. Selection set automatically evaluates the score, makes the personalized learning plan automatically, and pushes the Deep learning guidance system of relevant words and sentences regularly and quantitatively. This is done in order to further expand the scope of their learning and lay the foundation for the improvement of the effectiveness of intelligent learning. It helps users in professional language learning, rapid expansion of vocabulary, good vocabulary aggregation, and Deep learning relevant practical vocabulary. Some of the problems that traditional learning users face in reciting words include an outdated corpus, low precision of personalized recommended words, and traditional reciting words. thesaurus that was chosen for this study is based on the public free thesaurus that already exists, and the extent of the optional thesaurus still needs to be enlarged and investigated. The number of specific data points used in this investigation is just a few thousand, which is unquestionably a relatively low number when compared to the "big data" used in machine learning. In light of upcoming studies, the thesaurus will be augmented.

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