

Artificial Neural Network Learning Techniques: A Survey

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ABSTRACT: In next few years, the gravitating world will embrace Artificial Neural Networks for their drastic development in most of the sectors. The conception behind ANN is human brain with numerous neurons are rational form of computers with high intelligence. Artificial Neural Network is a computation based model hinged on the framework and functions of neural networks. Transmission of information through neural networks affects the framework because the changing or learning processes are done in accordance with the input and output. Neural networks acts as the root components of Artificial Intelligence. This paper is a survey on types of learning techniques and the research issues prevailing in these techniques of artificial neural networks.

KEYWORDS : Artificial Neural Networks, learning techniques,

I. INTRODUCTION

Artificial Neural Network works on two phases: 1.Training phase and 2.Learning phase. Techniques such as Supervised learning, Unsupervised learning and Reinforcement learning. As the name advocates it is a human-propelled systems which are deliberated to replicate the humans. Neural networks comprises of three layers such as input layer, output layer and hidden layer. It is used to recognize patterns that are more complex that even humans cannot recognize them. The ANN uses algorithms which involves the understanding of frameworks. Three basic insights of the ANN algorithms are:

1. It helps us grasp the brunt of the dataset which is increasing / decreasing or vice-versa during the computational time.
2. The best fit of the model in the cases involved could be clearly inferred.
3. It aids us in better understanding of models compatibility in various cases or situations.

Representation of a simple neural network

The inputs are given through data sets. The pixel brightness is analysed through the input layer of the network. The edges in the images are identified through the hidden layer. The textures and structure are analysed through the hidden layer.

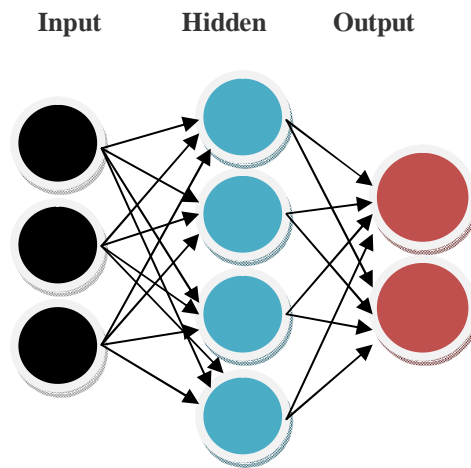
International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 8, Issue 3, March 2019

The detection of complex features are analysed through the hidden layer. The networks are trained as such the labels are given to the output. Here, Backpropagation is used to recover the mistakes done. The classification is done without any human source.



II. LEARNING TECHNIQUES

THREE TYPES OF LEARNING TECHNIQUES

1. Supervised Learning
2. Unsupervised Learning
3. Reinforcement Learning

SUPERVISED LEARNING

As the name specified, this type is dependent on supervision. It is dependent. The output is already known in the case of supervised learning algorithms. The system is fed with the output of the algorithms. The student-instructor relationship is a best example of supervised learning. The algorithm's processing is done in such a way that the output is already fed. The algorithms utilise training data sets which are used to train the system. If the system is misled, the output would be abrupt. The datasets set the right path and guides the system. The output is generated using the algorithm's input.

STEPS INVOLVED IN ALGORITHM

Step 1: Actuate the datasets. The datasets types should be chosen.

Step 2: Gather the datasets that is needed to train the systems. The inputs and the corresponding outputs are also gathered.

Step 3: Determine the input's representation of the features. The output purely depends on the input representation features.

Step 4: Determine the structure to using suitable algorithms.

Step 5: Run the algorithms as per the steps. Certain parameters listed could be optimized by cross-validation.

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 8, Issue 3, March 2019

Step 6: Evaluation of the accuracy in the learned function. The test set is used to measure the performance of the given datasets.

III. LEARNING ALGORITHMS

ALGORITHMS IN SUPERVISED LEARNING

✓ Support-vector machines

A model is being built for the prediction of new classes. Two new classes: 1.Linear SVM 2.Non-linear SVM. It is used to detect classification in facial expression, recognition of speech, guides in identification of digits handwritten, categorization of texts. The massive features could be classified using SVM quite easily. The selection of kernel should support the machine, the incorrect choice of kernel will lead to increased error percentage.

✓ K-nearest neighbours

The labels are conjectured using the nearest neighbours for achieving the target class. Classification tasks and recognition of patterns are done using k-nearest neighbours. Implementation is easy for small set of training data sets. Memory and time consumption is more in the case of KNN.

✓ Linear Discriminant Analysis

The logistic regression's limitation lead to the way of foundation to LDA. Simplified assumptions could be made using this analysis as it is a straight forward representation of data. The prediction of model is aided using Naive Bayes theorem. Known for its simplicity and portability. Prediction is done better in other algorithms.

✓ Naive-bayes algorithm

This algorithm classifies the model using probabilistic machine learning algorithms. The features of the model are independent. Types of Naive-bayes algorithm: 1. Bernoulli Naive Bayes 2. Multinomial Naive Bayes 3. Gaussian Naive Bayes. Implementation is easy and less complexity. Variable dependency is unavailable in this algorithm.

✓ Logistic Regression

This algorithm is used for classifying quest. This acts as the building block of neural networks. It is used for predicting outcome for continuous classes. Algorithm could be classified into binary, multinomial, ordinal regressions. The resources used for computation is comparatively low in this case. The model predicted is over-fitted in some outcomes.

ADVANTAGES OF SUPERVISED LEARNING

- ✚ The accuracy of the algorithms is sustained by being specific in the classification of classes.
- ✚ The classes divided could be determined specifically for further to be trained.
- ✚ Mapping the input data into the output data is done in supervised learning.
- ✚ Since the classes used are known, the output is predicted easily.
- ✚ The data given as input is labelled.

DISADVANTAGES OF SUPERVISED LEARNING

- ✚ When compared with unsupervised learning, it is a bit complex.

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Vol. 8, Issue 3, March 2019

- ✚ It doesn't occur in real time as unsupervised learning.
- ✚ The time consumed for computing the data is more.
- ✚ If the data growth rate is drastic then the label prediction becomes complex.

UNSUPERVISED LEARNING

The following are the task accomplished by unsupervised learning:

1. Clustering
2. Representation
3. Estimation of output

The innate structure of the data is provided without labels. The algorithm directly passes down to the data without any counsel. The unstructured information is sectioned into groups according to the similarities and differences figured out using the tasks listed above. Unsupervised learning is often said to be associated with generative learning models. The system is administered with unlabeled data without any antecedent training. The system cultured with Artificial Intelligence is often tested with unsupervised learning. Complexity is managed by unsupervised than supervised learning.

Two categories of algorithms

1. **Clustering:** The objects gathered are grouped into clusters based on their similarities and characteristics.
2. **Association:** The data is syndicated among them according to the rule of association. Amongst large databases, the interestingness is measured.

ALGORITHMS USED IN UNSUPERVISED LEARNING

✓ K-means clustering

K is the target cluster to be mined out. The centroids chosen are used for iterative process to get the target cluster. Unlabeled data are used. Image feature representation is learned using k-means. The best output is generated using an iterative processes using the clusters. The output efficiency of the algorithm is measured using the cluster's density. It is used in various search engines for grouping the similarity between various categories to provide swift results. The large volume of variables supports clustering in computation. The prediction of k value is a bit complex.

✓ Dimensionality reduction

This algorithm is involved in removing redundancy in data sets and features. It is accomplished using a principle variable. The features are selected and extracted using various techniques involved in their process to achieve the target. Data is being compressed and computation time is also minimized. If the dimension of the data is reduced to 2D or 3D, the visualization and plotting is precisely performed. The performance is increased by maintaining multi-collinearity. Data loss may occur during reduction and the predicted mean and covariance may not define the data sets at times.

✓ Hierarchical clustering

The cluster formed is build according to the hierarchy. Two types of hierarchical clustering: 1. Agglomerative and 2. Divisive clustering. The outcome is best in this algorithm. The changes made could not be unmade. Time complexity should be considered in hierarchical clustering.

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 8, Issue 3, March 2019

✓ Principal Component Analysis

The data set's dimensionality is reduced using PCA. The data is normalized and calculation of covariance, eigen vectors and values are intended for analysing the principal component. No pre requisite information is needed about the data. It is too expensive to be implemented in some applications.

ADVANTAGES OF UNSUPERVISED LEARNING

- ✚ Complexity is less when compared with supervised learning.
- ✚ Learning and sorting of data is done and happens in real time.
- ✚ It is less complex when comes to gain unlabeled data.
- ✚ Though the data lacks in sufficient details, unsupervised learning can be used.

DISADVANTAGES OF UNSUPERVISED LEARNING

- ✚ The output and stored data are not specific.
- ✚ Reliability is less due to the less accuracy in the output.
- ✚ The certainty of the result is less because the number of classes are left unknown.
- ✚ There is no preceding information about the given input data.

REINFORCEMENT LEARNING

The system is obliged with trial and error method. The usage of reinforcement learning is possible when the inputs given are with high dimensions. The performance of the system is maximized by optimizing the input to produce the output efficiently. The current state of the problem decides the action to be taken by the system. The feedback is taken into account for the system to proceed further. The system does not rely on any external guidelines, the decisions are made according to the environmental situation. Markov decision process is the framework used in reinforcement learning to produce long term goals.

ALGORITHMS USED IN REINFORCEMENT LEARNING

✓ Q-learning

The decision to be made out in given circumstances is goal of this algorithm. The value is the quality of the action taken in accordance with the states. The value is maximized over the consecutive steps. The quality of the reward in each step is progressed. The optimized solutions are provided using the Q-value. Complexity occurs at times in optimizing Q-value.

✓ Deep Q Network(DQN)

Frames are produced as inputs and Q-values are produced as output vectors. The greatest Q-value is considered for the best action to be taken in DQN. Vast data is required for best outcomes.

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Vol. 8, Issue 3, March 2019

ADVANTAGES OF REINFORCEMENT LEARNING

- ✚ The performance is maximized.
- ✚ The changes are sustained for a long term.
- ✚ The behaviour is increased.
- ✚ Defiant towards the least standard of performance.

DISADVANTAGES OF REINFORCEMENT LEARNING

- ✚ Overloading the states may lead to vanishing of results.
- ✚ Only the minimal behaviour is met by reinforcement learning.

IV. RESEARCH ISSUES

Computational complexity

The complexity in computation is vast. When it comes to massive input datasets, there occurs complexity in computation. Computational complexity occurs in creation of classifiers, updation in classifiers, classifying newly created instances.

Comprehensibility

The classifier adoption of the user is measured by the comprehensibility criterion. In case of medical sector , the machine needs to determine the output with high accuracy with the help of comprehensibility.

Scalability to large datasets

If the data is massive the training dataset has issues with time and memory.

Parameters / modes	Supervised Learning	Unsupervised Learning	Reinforcement Learning
Supervision	Dependent on supervision.	Independent on supervision.	Trial and error.
Prediction	The output is predicted using the input data.	The patterns hidden are found from the unlabeled input.	The task is predicted with the current state of the data.
Complexity	More complex	Less complex	Complexity is less as it works according to the environment.
Accuracy	More accuracy	Lesser accuracy	Depends on the environmental observations.
Platform	Interactive in various software.	Interactive in marketing segmentation, etc.	Interactive when it comes to human interaction is pervasive.
Algorithms	Many algorithms are used.	Algorithms are used.	Neither supervised nor unsupervised learning algorithms are used.

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Vol. 8, Issue 3, March 2019

V. CONCLUSION

Artificial Intelligence is the drastically growing sector in the technologies prevailing all around the world. Neural network is the vein of AI, in our survey, we have given a clear vision of the three types of learning techniques in Artificial Neural Networks along with its rising pros and cons. Though the learning techniques vary in its principles, it is being still used in most of the domain research.

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