

# A Comparative analysis to detect stroke using deep neural network, Recurrent neural network and KNN

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## ABSTRACT

Stroke is the second leading cause of death, and stroke may be a long-lasting crippling illness. Stroke is a total mental failure exacerbated by a disruption in blood supply to the brain, or by blocking of blood flow to the head. According to the World Health Organisation, the mortality risk will begin to rise throughout the next year's stroke. Much research has been conducted on stroke disease identification. An artificial intelligence solution to stroke and its forms by in-depth education. Forms include Ischemical stroke, Hemorrhagic stroke, Acute Ischemic Attack. Databases from the research organization include obtained through our study. The system of preprocessing expels copied data, details lacking and inconsistent records. The key feature research technique is the estimation is used to decrease predictions and the application of deep learning measures whether or not the individual has chronic illness. In order to anticipate the stroke, classification by deep learning is revised. Once data are submitted, it tests on a qualified model and the predictions of multiple forms of stroke. This study focused primarily on a reliable means of forecasting stroke and specific styles of stroke.

## Keywords

Deep Neural Network, Heart Attack, Machine Learning, RNN and KNN.

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## Introduction

Health care is highly complex requiring integration of multiple information technology systems. Due to the diversity in the standards of similar or the same systems, extreme inefficiency, waste and errors in healthcare information and delivery management are commonplace events. As a result, an individual's health information can become trapped in legacy systems unable to be shared with healthcare professionals. This paper addresses several of the many explanations why it is necessary to standardize knowledge through healthcare facilities.

Stroke is the third biggest killer and the overall long-term goal. Stroke is a medical intervention and sometimes blood coagulation or blood cell separation can occur. When the World Health Organization (WHO) declares a pandemic, the situation will escalate within the next year, and urgent care will be available as soon as possible. Some over a million people have a stroke every year. Impairment involves distortion of the hearing, gestures impairments, and speech impairments. A stroke is a major illness affecting the brain and can affect the heart, resulting in the heart attack. It does not provide enough blood and nutrients to nourish the brain's cells. The stroke

can cause mobility loss, sudden pain in the throat, speechlessness, lack of focus and restricted thinking, blurry or blurred vision and lack of coordination. Stroke affects all age groups. Factors which can be controlled by monitoring and which can be adjusted are important. The study indicates that the most common mistake arises from shortages of pharmaceutical supplies for the incorrect patient.

Stroke for the most part three composers:

- Ischemic stroke
- Hemorrhagic stroke
- Transient ischemic stroke

### A. Ischemic stroke

Ischemic stroke is a generalized form of stroke where there is impaired blood flow to the brain. Inside minutes, individual mind cells start to die off. This stroke happened on a proportion of 0.85 of the world. In the US, ischemic stroke is the third leading cause of death. This writing mind stutters and impacts the paper.

### B. Hemorrhagic stroke

Brain hemorrhages are triggered by cerebrum spillage. This case illustrates the adverse impact excess cerebrum may have on the mind. There are two main types of intracranial pressure: intracranial fluid and subarachnoid pressure. The

primary sort is a most common written assignment. It may start in the brain; spread to the surrounding tissue. The second kind of stroke is a rarer sort of hemorrhagic stroke, which has the possibility of entering territory.

### C. Transient Ischemic Attack

A smaller stroke is called a mini-stroke. TIA is not the same as having a stroke. Blood supplies to the brain, so it is blocked for less than 10 minutes, and not longer than that. This type of stroke will trigger the serious kind in a year and the more common kind in 3 months. The detection and care of stroke will diminish the effects of stroke.

A heart attack happens when a clot in a section of the heart triggers low blood flow. Heart attack is a broad concept that includes all forms of heart diseases. Heart disorder refers to heart problems[2]. Heart disease is an acute disease which needs proper diagnosis and analysis of patient data. It is not possible for a human brain to analyze so much of data; obvious solution is support system for doctor working in the field of heart disease. Earlier time decision support system is based on predicate logic[1] and first expert system called as Dendril is used to find blood related disease in human. Later with advancement of computer processing power, machine learning came into existence[3] which does not need reprogram itself; machine learning put its all focus on dataset and its manipulation. All major algorithms like RNN, KNN, Decision Tree, neural network are used to build support system for predicting chance of heart attack in human. Each method has its own merits and demerits. It has been observed after literature survey that there is a scope of work, regarding much aspect such as lack of accuracy, lack of data independency, better generalized scope and automated pre-processing stage.

Deep learning is an approach where multiple hidden layers are used to reveal the secret inside the data. Deep learning is used for prediction of other diseases[4]. According to our knowledge it is the first time heart attack is predicted using deep neural network. Approach uses fully automated data pre-processing stage and since it is based on deep neural network, it is obvious that accuracy achieved would be much higher than any other machine learning technique for evaluation of this method. Multiple data sets have been taken.

### Existing System

Clinical assessments are mostly taken dependent on the instincts and expertise of practitioners rather than on the valuable knowledge contained in the database. Such behavior creates unintended partialities, accidents and unnecessary medical expenses that impact the level of care offered to patients. Heart disorder therapies are postponed owing to a variety of unconscious signs. Monitoring the condition of health using the data collected from various services facilitates the estimation of patients' wellbeing and the implementation of effective steps. Health care confronts the challenge of illness prevention and treatment.

### Disadvantages

- Further human effort.
- More room for decision-making.

### Detection of stroke using DNN, RNN and KNN DEEP LEARNING

Deep learning uses artificial neural network having more hidden layers. Neural Network is arranged in the cascading pattern to process non-linear data set, i.e. cascading layers of non-linear processing units.

Deep Learning was developed with the idea of enhancing accuracy of the existing machine learning algorithm. It can be seen through Fig 1, in initial phase when data set is small older algorithm underperforms the Deep learning techniques but with increase in size of data set, Deep Learning method started gaining momentum and accuracy gets significant edge over all other older machine learning algorithms.

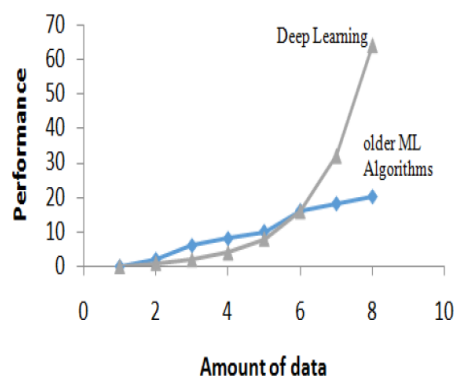


Fig. 1: Comparative graph explaining about nature of Deep Learning algorithms and older Machine Learning Algorithms on the parameter of number of data set

Inception of Deep Learning method starts with origin of recurrent neural network in the year 1973, recurrent network works well with the temporal data where input data set and output dataset is not fixed [5]. It is suitable for the field of language processing and NLP data set. Due to implementation complexities need for the Deep learning method is felt which is fulfilled by the convolutional Network was proposed in year 1978, it works on the fixed data set with fixed output. It is obvious that this method best suitable for the image processing [6].

It is based on the fundamental of breaking complex global weight matrix into change of convolution kernel. Gaussian kernel is used to smooth the data set, edge can be seen with the help of canny kernel and to obtain gradient feature Gabor kernel is used. It is clear that single kernel is not used in the implementation of Convolutional network instead of that it follows the data specific kernel. This model is designed for the very specific task, all major image recognition model are based on it. Other than this application it is hardly applicable for any other application. Auto encoder is simple technique based on the simple fundamental of feedback effect. Model is called encoding because of its architecture which is explained in the Fig.2.

Input layer (visible layer) is connected to hidden layer where number of neurons is much less than the visible layer but each neuron is connected backward to its input neuron, due to less neuron model follows encoding mechanism. Finally at the outer layer decoding is done to preserve all the content of the input layer, keeping this goal in this mind number of the neuron is equivalent to the outer layer.

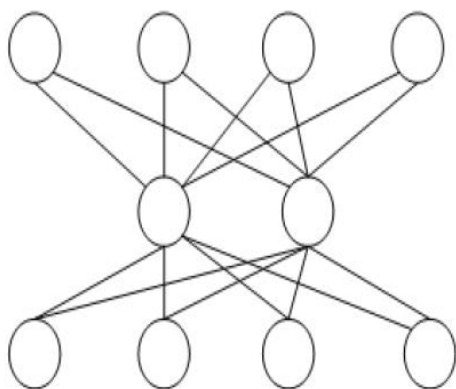


Fig. 2: An overview of the architecture for Auto-Encoder model

Other than these models there exists numerous other variations of the algorithms such as LSTM (Long short term memory) which is considered to be better than Recurrent neural network because it can remember information to long time, this due to the reason LSTM uses special memory unit to remember other than standard memory unit[7]. A set of memory gate is used for controlling entered information, output and forgotten information.

On the other side, the loss function knowledge decreases exponentially as the time goes by, also known as the vanishing gradients problem.

LSTM is much more complex architecture due to this a simpler version of LSTM has been proposed called as Gated Neural unit. It uses set of gates to control flow of information and also instead of using separate memory cell, it uses fewer gates.

### Deep Neural Network

Neural network uses clustered layers of neurons. The brain has many processing layers and each layer has several neurons. A node may be attach its potential to its weight to magnify the importance of input passing through the node. Functioning splits by how far the pulse can bring. In deep neural network, each layer may be on or off. The performance of one layer determines what operation the next layer can do. Deep neural network consists of more than one hidden layer [9] while artificial neural network consists of one input and one output layer and includes several hidden layers [10] [8].

Each neuron in the network obtained unique feedback from the previous layer and is now conditioned based on this. The further layers in the neural network, the stronger at identifying and remembering features. It often recognizes more difficult or varying characteristics.

This is called automated linear feature extraction where the next layer integrates and presents the most abstract and complex performance which possesses the ability to work on high dimensional non-linear datasets.

### K-means algorithm

K-means clustering is one of the fastest clustering algorithms, and is often used to do unsupervised learning. The approach is an easy way to organize a given data set into various clusters centered on a predetermined number of categories. The key concept is to describe k centers are not just one,

but two as well. The centers are better organized in a cohesive manner regardless of the variations in the position they occupy. So, the easiest way to organize these things is to keep them as far apart as possible. The next stage is locating the centres of each point and identifying the closest centre. When a time is not set, the first move is taken and a pre-assigned party is settled on. A new collection of centroids has to be determined as the centroids of and cluster are not exactly the same size. After we have determined the  $k$  new centroids, we need to replicate the above procedure again to find the closest point to and centroid. A loop has been created, as a part of this loop it is note that the  $k$  centers adjust their position step by step before no further adjustments are made or in other words centers do not shift any more.

#### *RNN Classification*

In general, RNN(Recurrent Neural Network) is decision tree-based neural network are an ensemble learning for classification, regression and other tasks, that operate by constructing a multitude of decision trees at training time and outputting the class that is the mode of the classes (classification) or mean prediction (regression) of the individual trees. Regularization functions are utilized to compensate for decision trees' habit of overfitting to their training results.

RNN is a grouping algorithm that groups points based on related characteristics. When the data collection is wide and/or there are a number of variables, it becomes complicated to cluster the data since not all variables can be taken into account, so the clustering algorithm cannot be confident if a data point belongs in a certain category This is how the groupings exist. The algorithm organizes and classes the data indicating steps 1, 2, 3, 4. If you can draw lines between data points within a community, and link these data points to other groups you would see how the framework is like a tree. This is a tree. At and split or node in this tree, variables are selected arbitrarily depending on how strongly connected they are.

The software splits the tree into several logs. Each tree is different due to the random variables that are selected for each break. Then the residual data set (not the training set) is used to decide which tree classifies the data points (the actual classifications are known).The most predictive tree is seen as performance by the algorithm.RNN

Classifier algorithms are hierarchical heuristic techniques. The RNN Classifier is tested to decide the best strategy. The framework used RNN Classifiers for estimating breast cancer tumors. The framework combines decision trees, artificial neural networks and logistic regression. They used 699 outlets from the University of Wisconsin to gather the results. They used nine separate independent variables, and one contingent variable for their inquiry. The researchers say the RNN Classifier provided a prediction accuracy of 99%. Wang, Chu, et al suggested utilizing gene expression to detect cancer. They noticed the lowest possible gene frequency. Two separate methods, gene selection and gene rating, were addressed. Dependent on the rating ratings, the estimated risk of lung cancer for the diabetics is determined. They have used the t test and the F-test. A semi-supervised ellipsoid classification system was proposed to classify the type of cancer. Attributes are numbered so identical ones can be grouped and recognized. The techniques for analyzing knowledge involved artificial modeling of the testing environments. This will have the power of under examining the majority class and over examining the minority class or by consolidated the over and under sampling structures in an organized manner. A statistically equivalent distribution is preserved. The oversampling technique is used to prevent data replication. To solve the class imbalance dilemma, the binary function collection is used. The standard deviation between two groups is calculated to achieve the correct numeric results. The function values are broken into tiny binary groups to goal. There can be continuous function collection in managing machine learning algorithms. To calculate the usefulness of these metrics, we used Pearson correlation coefficient, function evaluation by sliding thresholds, Equal and signal to noise correlation coefficient. These approaches are structured to operate on continuous data, which ensures they analyze the data themselves before performing any research. The studies also used MATLAB to perform the research. Xiao and colleagues explore the distinguishing characteristics of differential expressed genes and high-throughput gene expression prediction, by considering the criteria of importance and biological relevance. The paper centered on how to boost gene ranking using Gene Collection Enrichment Review . (GSEA). The



collection of genetic knowledge via gene expression profiling may be useful in bioinformatics, if properly employed. They may be employed to promote gene prediction. Several gene expression strategies do not work at the same stage as data mining methods. One of the primary difficulties in characterizing the expression of genes is that the number of genes in the human genome is hard to count. It is not obvious which characteristics are needed and which can be devoid of meaning without undermining the classification improvement. An number of different analyses have been used to evaluate microarray results.

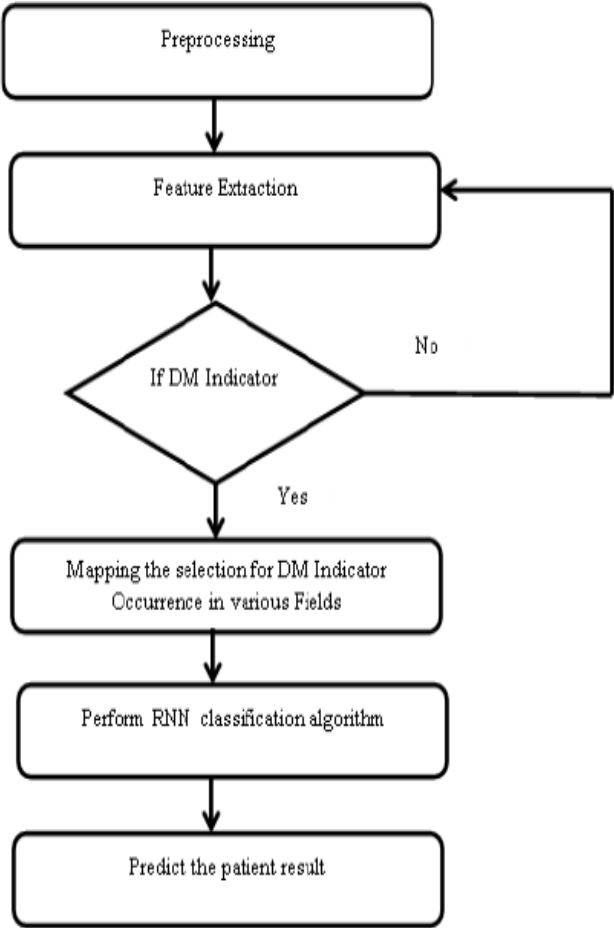


Fig 3.RNN Algorithm

The characterization of the reported examples may be used to discriminate between diverse forms of unsafe tissue, as in, where different kinds of leukemia are differentiated, or to recognize hazardous tissue from normal tissue, as in, where tumor and typical colon tissues are examined. RNN-based detection of cardiac failure as seen in Figure 3.

Result Analysis

Prediction of different types of strokes using ANN and SVM Algorithm

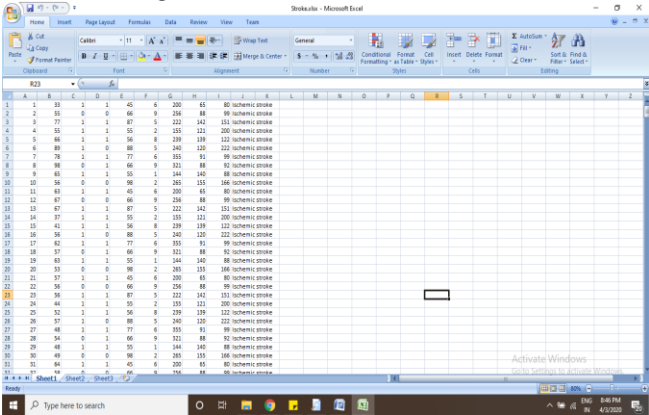


Fig 4: Dataset

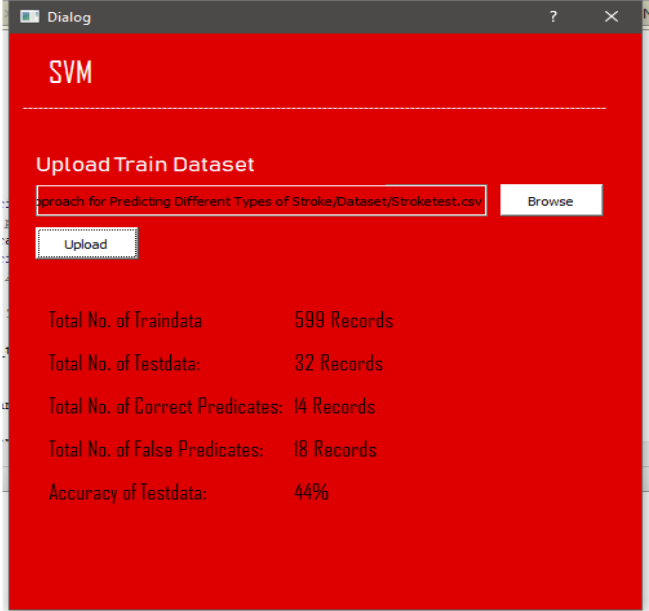


Fig 5: SVM Algorithm Classification

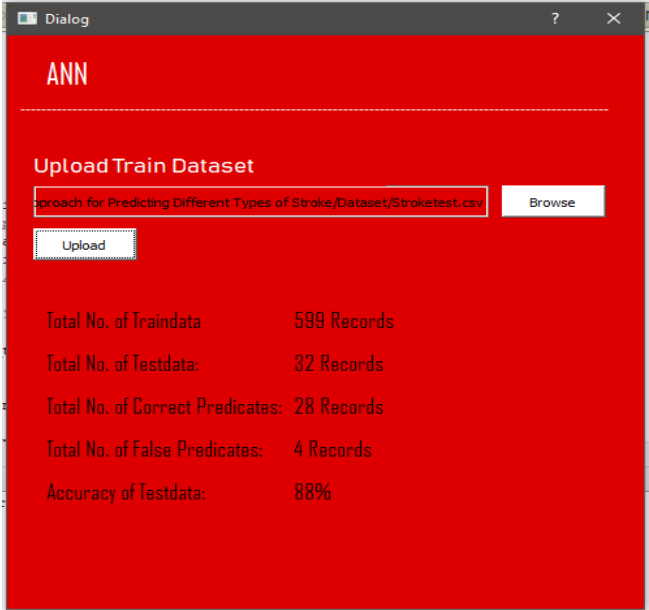


Fig 6: ANN Algorithm classification



Fig 7: Prediction of strokes using ANN and SVM classification algorithms

Comparison Analysis

They stress the significance of the secret layers of the deep neural network, and the weight assigned to them. It is shown in figure 8 that different activation values are assigned to each neuron with the separate weight parameters for each activation value. The activation functions and weight values are modified to prevent over-fitting the data during training of the model. An in-depth study was performed to test the proposed work about its precision and mean square error in each parameter. Until assessing the outcome of the examination, the skewness of the data is examined.

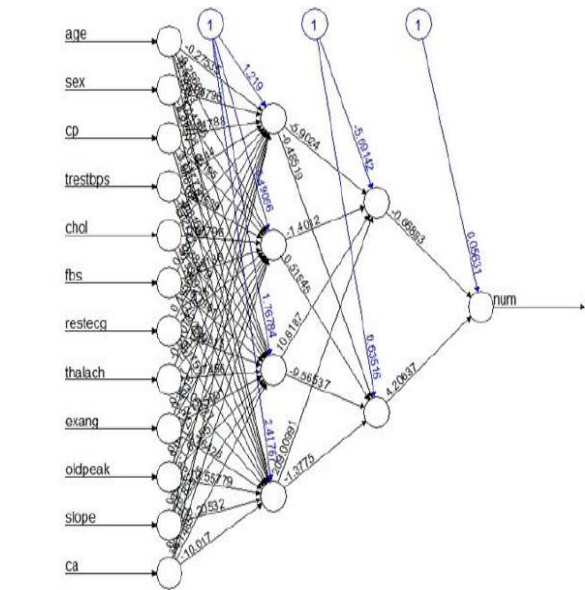


Fig. 8: Deep Neural Network with weights allocated to each neuron and Activation Function at each level

Evaluation in the dataset is done to know the biasness of the dataset. According to biasness of data further processing of the model has been done like predicating the optimal value for epochs, weight and activation function value, biasness of the considered data is shown in the Fig. 9.

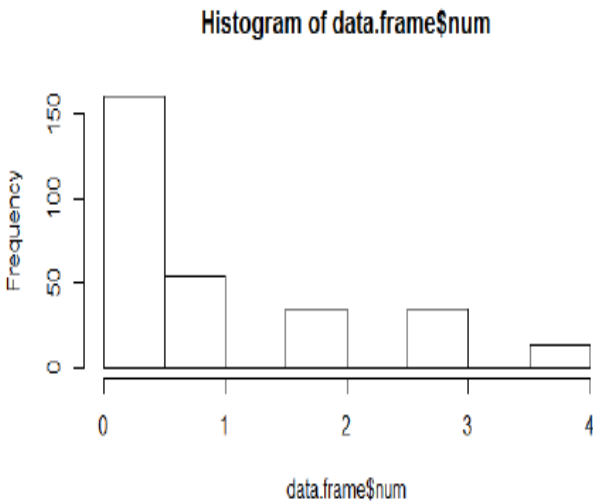


Fig. 9: Represents skewness in the data set

1. Evaluation of Mean Square Error and Accuracy:

Mean square error is defined as array deviation of present value and estimated value. It is obtained in the present experimental setup that in the initial phase of the output when training is done on less number of instances, mean square error achieved is very low, even on increasing the number of epochs the accuracy did not cross the value of the 0.36.

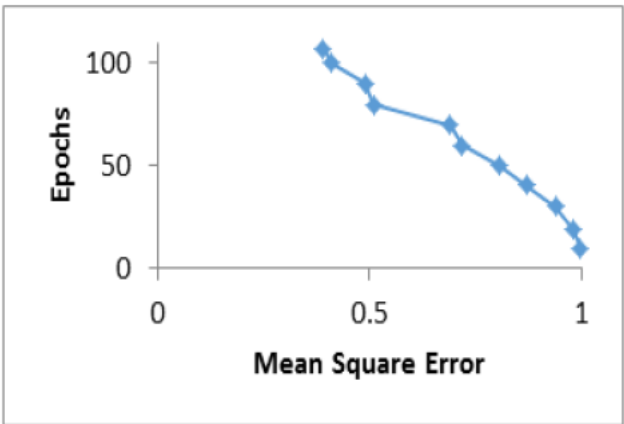


Fig. 10 Fixed error rate after certain epochs keeping number of Instance Constant

In the Fig.10, it can be seen that after 107 epochs mean square error remains constant keeping

number of instance increased to 298 then the mean square error is reduced to 0.15 with the number of epochs equal to the 1237 after increasing number of epochs, value of error remain the same. In the final evaluation of the experiment entire dataset with 512 rows (instances) is feed to the network after 1717 epochs mean square error reduced to the value of 0.0567 with certain variation in the weight factor of neuron and activation function at each level the error value reduced to the level of 0.0413. Modulation of weight factor is kept around the value 1.217 to -5.87 from input layer to the hidden.

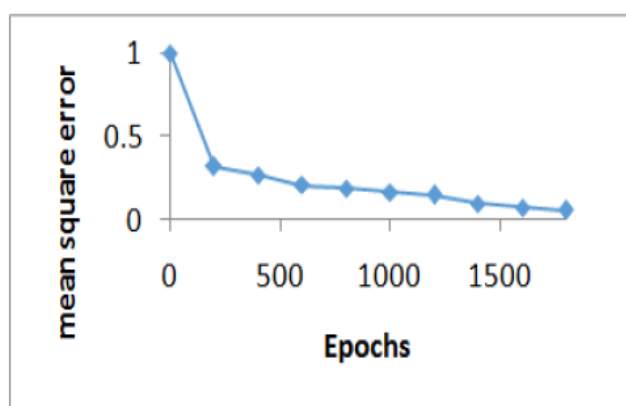


Fig 11: Mean square error on entire data set

Layer, between two hidden layer the weigh is in the range of -5.804 to -1.379 and the final layer one weight factor is -0.65 and another is 4.207. activation function values at level one different for each neuron which is in the range of 1 to 2.5, at level two value are -5.69142 and 0.635 and final layer it 0.631.

## 2. Comparison with Other Algorithms

Deep neural network is most feasible algorithm when compared with other algorithms of machine learning. It can be evaluated the accuracy achieved by the deep neural network is for ahead of its entire contemporary machine learning algorithms. Comparison is done using accuracy as a parameter with both supervised and on supervised learning algorithms. It could be seen from the Table 1 only algorithm whose accuracy is better than deep neural network is the recurrence neural networks (RNN). Other algorithm such as KNN does not show promising results.

In Table 1, the precision of DNN, RNN and KNN algorithms are shared for reference. Recurrent Neural Network differentiates more consistency than DNN and KNN.

Table 1: Accuracy Table

METHOD	ACCURACY
DNN	0.95%
RNN	0.98%
KNN	0.88%

## Conclusion

Heart attack prediction with help of machine learning and deep learning algorithm has a bright feature ahead recently lot of research work has been diverted to the medical dataset. Data mining has played an important role in several different sectors owing to its statistical capability. Detection of strokes has become important recently, hence in this work we have defined the categories of strokes using ANN and SVM classification algorithms. Finally we have compared the accuracy of DNN, RNN and KNN algorithms in the prediction of heart diseases. In the future further work will be performed in this area, because to increase the treatments and the longevity of the patient by proactively preserving and reviewing the health sector data for better forecasts is to maximize the results utilizing hybrid models.

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