Implementation and Analysis of Deep Neural Network

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***Abstract*—Neural networks are a set of algorithms that are modelled and designed to recognise patterns. A Neural network with two or more hidden layers is termed as a Deep Neural Network. In Deep Neural Networks, each hidden layer of nodes trains on a distinct set of features based on the previous layers output. In this report, we have implented Deep Neural Network for classification on the MNIST database. The results and accuracy that we have achieved on various combinations of the Deep Neural Network model for this particular MNIST dataset are shown in the end. We have used the Tensorflow library for generating these results as it provides a very comprehensive and a well-maintained API by Google.**

I. Introduction And Theory

A. What is a Neural Network?

The term "Neural Network" and its model is adapted from the core structure of the Human Brain. Similar to how Neurons process information by signalling neighbouring neurons via it's axon and transmitting information from the synapse while storing information to itself, a neuron or node transmits the output of it's Activation Function at its rear end which is ultimately received by the set of connected neurons on the next hidden layer.

B. How Neural Network works ?

Neural networks are typically organized in layers. Layers are made up of a number of interconnected nodes which contain an activation function. Neural network takes inputs from the input layer, which communicates to one or more hidden layers. All layers are interconnected via links and each link is associated with its weight. The actual processing is done via this weighted connections. Neural network contain some form of learning rule which modifies the weights of the connection according to the input patterns. The delta rule, which is a type of a neural network, is often utilized by the most common class of Artificial Neural Networks called backpropgational neural network. In backpropagational neural network, when a neural network initially presented with the input, it makes a random guess for the output and associate some weights to the links. Then, it sees how far the guess was from the actual output and makes an appropriate adjustment to the weights. A single backpropagation is called an epoch, which completes the a cycle of feed forward + back propagation. The error or the cost associated with each layer is reduced and thus heavily optimizes the model at a specific number of epochs.

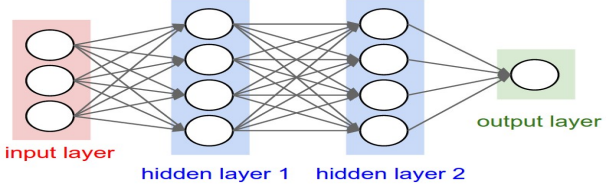

Figure 1.1: Deep neural network

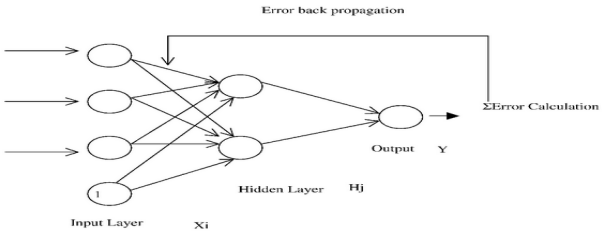

Figure 1.2: Back propagation neural network

II. Heuristics and Results

Classification Accuracy comparison chart on different changing parameters such as No. of neurons, epochs and batch size while keeping others constant on 2 to 5 hidden layers of Neural Network.

No. of Neurons	2-Hidden Layers	3-Hidden Layers	4-Hidden Layers	5-Hidden Layers
100	91.78%	90.05%	88.05%	87.19%
500	94.82%	95.00%	95.01%	95.14%
1000	96.04%	95.52%	96.32%	95.96%

Table 1:Accuracy Comparison with different no. of neurons

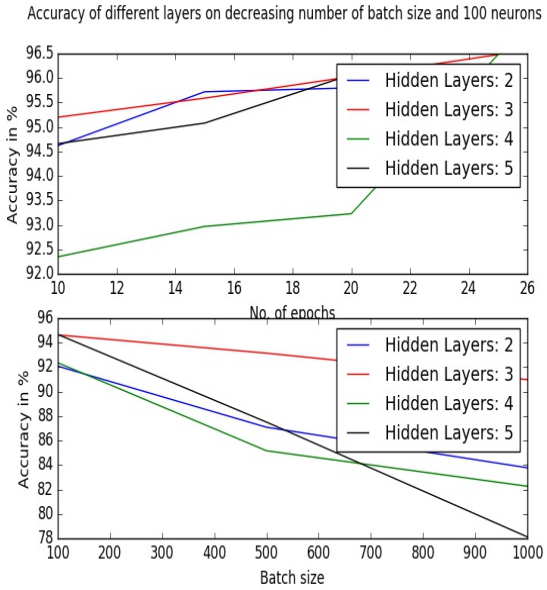

Figure 1.3: Accuracy Comparision on Different of Epochs, Batch Size and Hidden Layers

References

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[2] Tipping, M. E., & Bishop, C. M. (1999). Probabilistic principal component analysis. Journal of the Royal Statistical Society: Series B (Statistical Methodology), 61(3), 611-622.