Hand written digits recognition

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***Abstract*—'Artificial neural networks' are a type of computing system, inspired by the biological neural structures of the brain. A range of neural networks has been in use across the disciplines due to their ability to model real-life nonlinear processes. Specifically, a neural network that can recognize handwritten digits is discussed here. Comparing with today's advanced 'Deep learning' and 'Artificial intelligence', we find it as of primary level modelling but then also, had provided a key start to the field. (*Abstract*)**

I. Introduction (*Heading 1*)

Machines are now featured with intelligence. 'Artificial intelligence (AI)' and 'machine learning (ML)' are no more futuristic technology, we are surrounded by their applications in day-to-day life. From searching for a music video through voice instruction to recommendations on a shopping site. And the future is even surprising. But these all was started from very basic, and then evolved. Due to advancements in computing power, all these mathematical models can able to make a logical choice after thousands of, or even bigger, computations. 'Neural network' is one such model.

"The main difference between human and machine intelligence comes from the fact that humans perceive everything as a pattern, whereas for a machine everything is data [Greenberger, 1962]." [1]

Consist of 'nodes', 'weights' and 'biases', an 'artificial neural network (ANN)' is a layered structure and can model nonlinear systems, like digit recognition. For a particular combination of all these parameters, the network returns the specific output. By changing the weights and biases we can change the output. And if we use 'pre-labelled data' or set of both questions and their desired answers, and then fed to the machine which then adjusts the values of parameters accordingly to match the desired output. The process is called
'Backpropagation' and the theory is called 'supervised learning.' And as stated, "Much of the interest surrounding neural networks has centered on their ability to learn [2]." All this is done by representing data as a matrix and applying a set of linear transformations. 'Matrix multiplication and addition' and applying function like 'sigmoid' or 'ReLU' are two main steps to determine the value of a node.

II. Background

In the early 1940's neurophysiologist Warren McCulloch and mathematician Walter Pitts, discovered the fine working and collaboration in how neurons of the brain might work. As computing evolved, Nathanial Rochester from the IBM research laboratories proposed and hypothetical model of neural network. A layered structure of a mathematical model can give logical choice to the machine. Now, neural networks are becoming tempting to develop 'silicon compliers' which are optimized for applications of neural networks.

III. Motivation

How does mobile read handwriting? Or how does an OCR enable us to extract texts from scanned photos? These questions are interesting to answer, as they drive deep to the basics of computing and implementation of a task as mathematical models. This was motivation.

IV. Literature Survey

Transcribed digits acknowledgment can be carried out with filtering the advanced pictures pixels and extricating the components utilizing a neural organization as classifiers for transcribed digits acknowledgment.

Transcribed digits acknowledgment is turning into a more prominent interest as one of the PC vision methods.

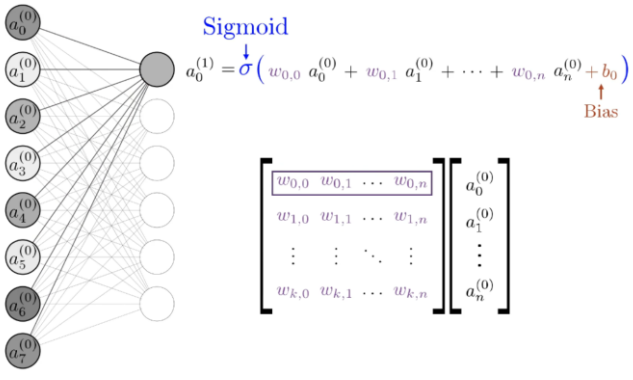
In their review, the writer's utilized MNIST dataset for transcribed digits acknowledgment, the dataset was prepared with angle plunge back-spread calculation and the confirmed with the feed-forward calculation.

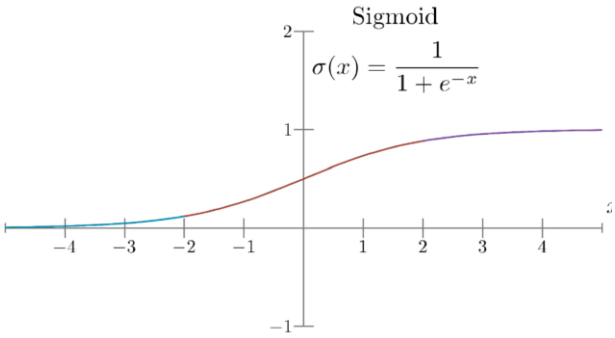
A Decision tree order is one of the least difficult AI model utilized in transcribed digits acknowledgment and a relative report performed on choice tree order and irregular timberlands.

V. Contribution

Vimoksh Bhavsar - Literature survey, Background.
Ruchit Ghodasara - Motivation, Reproduce work
Dhruvam Bhalodiya - Literature survey, plan of action.

VI. Mathematical model





VII. Numerical Results

Our model predicts digits with around 95% accuracy. Accuracy depends on the network we chose, number of hidden layers and number of nodes. Higher the hidden layers higher the computation and higher the accuracy. Also, it is a function of epoch, a term to refer number of iterations our network takes while learning. Higher the epoch higher the computation but not simply higher the accuracy.

References

[1] Yegnanarayana, B. (2009c). ARTIFICIAL NEURAL NETWORKS. PHI Learning.

[2]Pawlicki, Dan-Shyang Lee, Hull and Srihari, "Neural network models and their application to handwritten digit recognition," IEEE 1988 International Conference on Neural Networks, 1988, pp. 63-70 vol.2, doi: 10.1109/ICNN.1988.23913.

YouTube references:

1. https://youtube.com/playlist?list=PLZHQObOWTQDNU6R1_67000Dx_ZCJB-3pi
2. https://youtu.be/ER2It2mIagI

Websites:

Neural Networks - History (stanford.edu)