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Handwritten Character Recognition for Hindi language

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Abstract -- The aim of this paper is to recognize handwritten characters for Hindi language, which is done using neural networks. Although image processing is a major part of a character recognition system, the primary focus of the paper will be on the functioning of the neural network. We discuss the various types of problems in character recognition and the effectiveness of neural networks. The paper also discusses the pros and cons of neural networks.

Keywords -- Machine learning, Neural networks, Activation function, Training set, Regularization

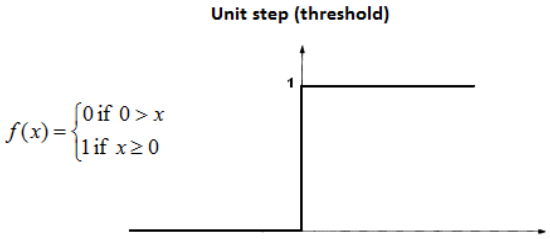
I. Introduction

We start by mentioning some of the parameters that govern the functioning of a neural network. Neural network recognizers learn from an initial image training set. The trained network then makes the character identifications. Each neural network uniquely learns the properties that differentiate training images. It then looks for similar properties in the target image to be identified. Neural networks are quick to set up; however, they can be inaccurate if they learn properties that are not important in the target data. A neural network is dependent on several parameters, the most important of which are as follows:

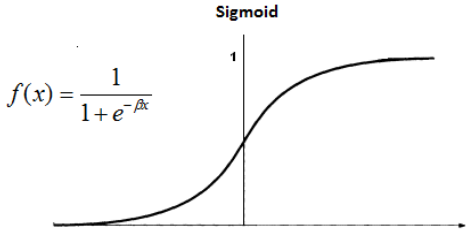
- Number of layers
- Number of units in each layer
- Number of training examples
- Initialization of weights
- Regularization parameter
- Activation function
- Training algorithm
- Learning rate

An activation function maps a set of inputs to an output. Conceptually, it governs the behavior of the neural network. Mathematically, it gives the relationship between set of inputs, weights and set of outputs. There are several types of activation functions:

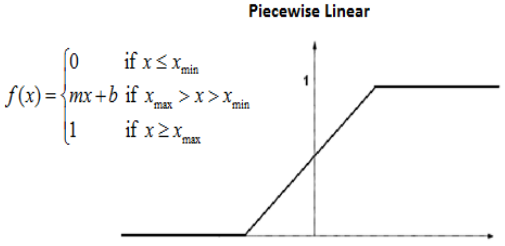
○ Unit step (threshold): The output is set at one of two levels, depending on whether the total input is greater than or less than threshold value.



○ Sigmoid: The sigmoid function consists of 2 functions, logistic and tangential. The values of logistic function range from 0 and 1 and -1 to +1 for tangential function.



○ Piecewise Linear: The output of the function proportional to the total weighted output.



The above list is in no way an exhaustive list of activation functions. Another very popular transfer function (activation function) is the hyperbolic tangent function. This paper focuses on a neural network that employs the logistic function.

II. Image Preprocessing

The character prediction accuracy of a neural network depends on how the neural net is trained as well image processing. The purpose of this paper is to determine how powerful neural networks are without image processing. Hence, image processing has been minimal, consisting of only binarization.

III. Procedure for Hindi Character Recognition

The dataset has been divided into two parts:

- Training set
- Cross validation set

The neural network is fed the training set upon which gradient descent algorithm and back-propagation algorithm are applied. The logistic function gives the output as probability and the highest probability for each image is considered. The probable character is then compared to the actual value and training accuracy is determined. The neural network weights are then saved in a.mat file. These weights are then used on the cross validation set to predict characters.

IV. Result and Conclusion

Given that there is minimal image processing involved, the most important parameter that affects accuracy of neural networks is called regularization parameter. For a small regularization parameter, the accuracy of our system shoots up to even 100 percent. This problem is often referred to as over-fitting, which we verified using the system as cross validation accuracy for small regularization parameter was fickle and often very low. As regularization parameter increased, the cross validation accuracy increased but the training accuracy decreased. Keeping the gradient descent iterations as a constant, we found the optimal value of regularization parameter to maximize both training and cross validation set accuracy. To conclude, image processing affects cross validation accuracy. The neural network can achieve high degree of training accuracy even without image processing. This is because to achieve high accuracy for cross validation, the images in the set must be as close as possible to the training set which can be done by image processing.

V. References

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