**ML ASSIGNMENT-2**

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***Building a Basic Neural Network for Image Classification***

Introduction:

Artificial Neural Network (ANN) is a type of machine learning model that mimics the way the human brain works. In this report, we will discuss the implementation of ANN for Handwritten Digit Recognition in Python.

Dataset:

We have used the MNIST dataset, which consists of 60,000 training images and 10,000 testing images of handwritten digits. The images are grayscale and 28x28 pixels in size.

Pre-processing:

We first converted the images into a 1D array of 784 pixels and normalized the pixel values between 0 and 1. We also one-hot encoded the target variable (digit label) for both training and testing datasets.

Model Architecture:

We implemented a neural network with two or three hidden layers each of them having either 100 or 150 neurons depending on the artificial neural network classifier, followed by a SoftMax output layer of 10 neurons (one for each digit class). We have used Tan-Hyperbolic (tanh), Sigmoid, and Rectified Linear Unit (ReLu) activation function in their respective artificial neural network classifier for the hidden layers and the SoftMax activation function for the output layer. We trained the model using the sparse-categorical cross-entropy loss function and the Adam optimizer.

Training and Validation:

We trained all the distinct artificial neural network classifiers of the developed model for 3 epochs using the x\_train and y\_train (testing) datasets (NumPy arrays). We have also used 10 random training and testing splits of data to feed into the model (the respective artificial neural network classifier). After compiling and evaluating the model (for the respective artificial neural network classifier) using the testing data, the distinct artificial neural network classifiers together achieved an average accuracy of 93.87% and a variance of 0.045 on the testing dataset. Also, the tanh model is the one which has the highest accuracy (occurs most number of times among all runs).

Conclusion:

In this report, we implemented an ANN model for handwritten digit recognition using Python and the MNIST dataset. The model achieved a high accuracy on the testing dataset, demonstrating the effectiveness of ANN in image classification tasks.