**Learning to implement Neural Network (Gurmukhi Handwritten Digit Classification)**

**Aim:**

using a dataset of handwritten numbers (0–9) for a classification problem. The program's objective is to build a straightforward neural network that can correctly categories the handwritten numbers. The neural network is built and trained using TensorFlow and Kera’s in the code.

**Introduction:**

The neural network is defined and trained using the Keras API in the code. The dataset for Gurmukhi is utilized for picture classification. The dataset consists of 60,000 grayscale pictures divided into 10 groups. The programmed trains the model, preprocesses the data, and imports the required libraries.

**The methodology of the code is as follows:**

* The training and validation image folder paths are established.
* To rescale the pixel values to [0,1] and divide the data into training and validation sets, an instance of the ImageDataGenerator class is defined.
* The flow\_from\_directory () method is used to import the training data as a generator, which resizes, changes the photos to grayscale, and employs categorical labels.
* Extracted from the generator, the photos and labels are kept in separate lists.
* OpenCV is used to load the validation images and labels, which are then saved in several NumPy arrays.
* The data used for training and validation are archived in NumPy.
* The photos and labels are retrieved from the NumPy archives and put in separate arrays.
* A sample image from the dataset is shown, and the shape of the arrays is shown.
* The input data is scaled to [0, 1], and a neural network is created and assembled with one fully connected layer and ten output units.
* The model is developed using training data and assessed using test data.
* The accuracy of the neural network on the test data is the code's ultimate output.

**Conclusion:**

Using the Gurmukhi dataset, the algorithm successfully trains a straightforward neural network for image categorization. The model performs admirably on the validation dataset, with an accuracy of about 86%. One of the key inferences from this code is that the single-layer neural network only achieves an accuracy of about 0.25 on the test data, which indicates that it is not very accurate in classifying handwritten digits. For more precision, a more complicated neural network would be required.

**Final Output:**

A sample image from the dataset is displayed, the flattened training and test datasets' shapes are printed, the model is trained, the model is tested on the test dataset, and the projected labels for the test photos are printed.