

# Digit Summation

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## 1 Problem Statement

Given a set of images with 4 digits rotated and mixed, make a model to predict the sum.

## 2 Intermediate evaluation

- Since the max sum of 4 single digits can be 36, I used a model with 2 hidden layers of size 128 and 256 respectively, with activation function as RELU.
- The output layer was of size 37, with softmax as activation function
- The model did not perform very well, and gave an accuracy of 36 %.

## 3 Algorithm Implementation

- The digits are rotated and twisted in some manner, plus some of them are attached together, so digit segmentation becomes a bit difficult.
- The algorithm that was employed was deterministic, rather than training a model to do the same.

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**Algorithm 1:** Algorithm to compute sum of digits from MNIST

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Import data from `data0`, `data1`, `data2.npy`

Convolve a  $28 * 28$  filter, but instead of multiplying it with a matrix, pass the  $28 * 28$  matrix to a pre-trained model which has been trained on MNIST dataset.

$stride_x \leftarrow 18$

$stride_y \leftarrow 1$

$Output_{Shape} \leftarrow ((40 - 28)/1 + 1, (168 - 28)/18 + 1)$

$Output_{Shape} \leftarrow (13, 8, 10)$

The output shape has 1 vector of size 10 for each  $28 * 28$  image that was convolved through the MNIST dataset

Now, since there are no images that are on top of each other, we can take the max along the 1st axis

This mathematically means that for every image's prediction, we are estimating the max probability of every digit on each image in the row wise convolution.

After, the  $13 * 10$  vector is sorted column wise, and the last 4 columns were taken, effectively resulting in a  $4 * 10$  vector

Find the maximum 4 digits which have highest probabilities, (they could be same or different), and the sum of these digits is the prediction.

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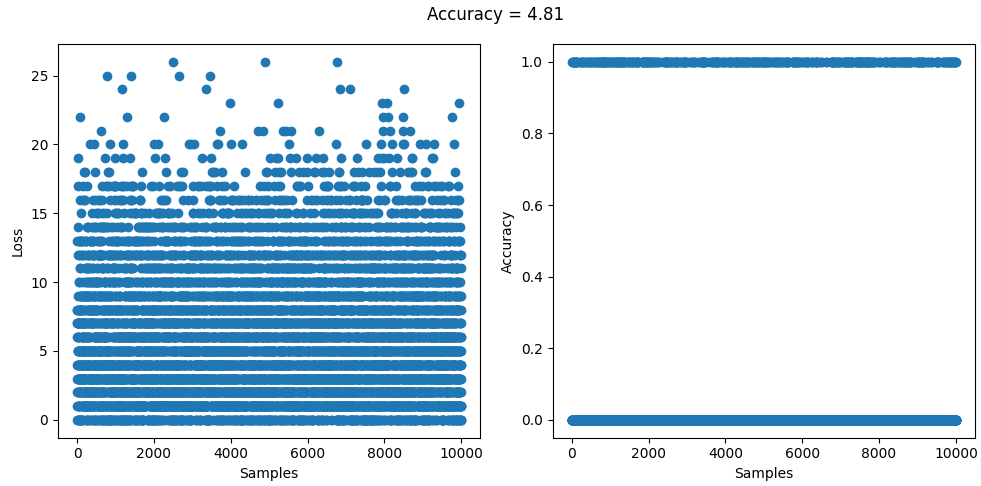


Figure 1: data0.npy

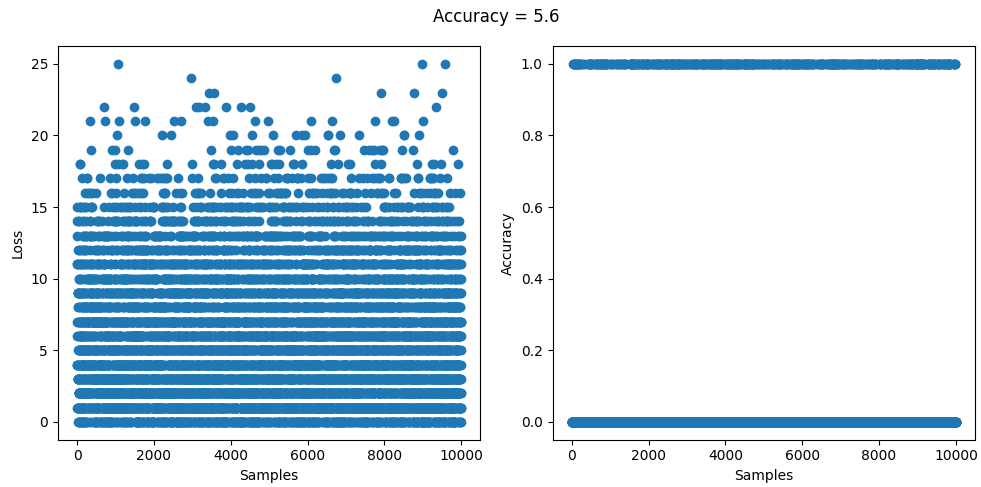


Figure 2: data1.npy

## 4 Computational Results

The notebook contains plots for only a select few images. An sbatch script was run and the results can be seen in Figure 1, 2, and 3 for how to include figures in your document.

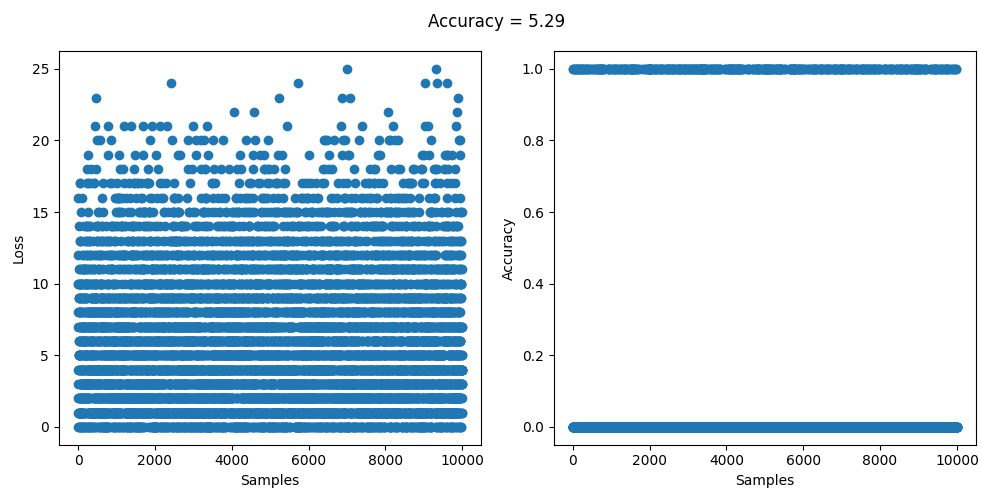


Figure 3: data2.npy