

# E0 270-O: Assignment 2

Due date: March 28, 2024

## Data

Consider the MNIST dataset consisting of images of handwritten digits. The task is to classify the given image as one of 10 possible digits. Each data point is an  $28 \times 28$  image, whose features are the individual pixel values ranging from 0-255 (scaled down between  $-1$  and  $1$ ).

## Task: Single and Multi-class Logistic Regression

There are ten classes, corresponding to ten digits, and the task is to classify a given image as containing a digit, based on the assumption that the features are conditionally independent given the class label.

You are given a folder containing three python files: `main.py`, `model.py`, `train_utils.py`, and `utils.py`.

1. Fill in the incomplete methods in `model.py`, `utils.py` and `train_utils.py` that are marked clearly to be filled in. Do not change any other line of code.
2. Run the code and note down the obtained train and test metrics.

## Deliverables

- Completed code for implementing the Linear and Softmax Regression without using any libraries except `numpy` in the given incomplete code snippets.
- Output of run:  

```
python main.py --mode logistic  
--num_iters <your choice> --lr <your choice> --batch_size <your choice>  
--l2_lambda <your choice> --grad_norm_clipping <your choice>
```

  
and adjust the hyper-parameters to get the best training, validation and test performance for the binary classification task.
- Output of run:  

```
python main.py --mode softmax  
--num_iters <your choice> --lr <your choice> --batch_size <your choice>  
--l2_lambda <your choice> --grad_norm_clipping <your choice>
```

  
and adjust the hyper-parameters to get the best training, validation and test performance for the multi-class classification task.
- A report containing the complete details of the algorithm and your implementation, along with justification for any extra assumptions made if necessary. Since the data classes are balanced, just mentioning the accuracies (as metrics) should be sufficient.

## Submission

Attach a **single zip file** named in the format `Asst2.FirstName.LastName.5DigitsOfSRNo.zip` to the assignment in Teams, before the due date. The zip file should contain the following files: `main.py`, `utils.py`, `model.py`, `train_utils.py`, `report.pdf`. Please note that the dataset must **not** be included in the submission. Also provide the loss and accuracy plots