PA6: Neural Networks

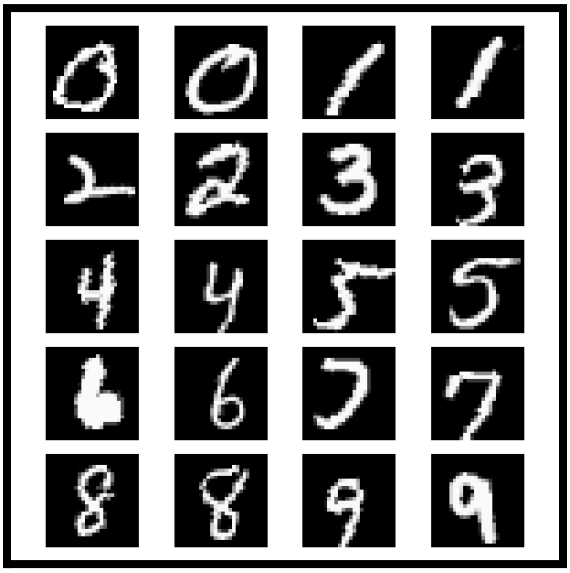
Colab Link: PA6_B22CS090.ipynb

Task 0

- MNIST dataset is downloaded using **torchvision**.
- Training and test set have been loaded separately, and the validation set will be using a fraction of the training set.
  Training set size = 54000
  Validation set size = 6000
  Test set size = 10000
- Transformations have been applied using **torchvision.transforms** and incorporated into a pipeline using the '**compose**' function.
  Transformations done:
  - ➔ **Random Crop** to size of **26 x 26**. (MNIST is originally of 28 x 28)
  - ➔ **Random Rotation** of maximum **15 degrees**.
  - ➔ Converting to **torch tensor**.
  - ➔ Normalising the tensor to **mean = 0.5, standard deviation = 0.5**.

Task 1

- Dataloader has been created, which randomly selects 256 images in a batch.
  Batch size for both the training and test set is 256.
- Dataloaders for training, validation and test sets are present. Validation set uses 6000 images from the original 60000 images set of the training set.
- Displaying few transformed images:



Task 2

- Class **ThreeLayeredMLP** consists of the 3 linear layered neural network, created using the torch.nn module.
- The number of input, hidden, and output features are as follows:

Layer	Number of input features	Number of output features
1	26 x 26 = 676	256
2 (hidden)	256	64
3	64	10 (number of classes)

- **ReLU** activation function has been used for the first 2 layers.
- Number of trainable parameters: **190410**

Task 3

- **Number of epochs:** 5
- **Optimizer:** Adam - combines the benefits of both AdaGrad and RMSProp by using momentum and adaptive learning rates.
- **Loss function:** Cross Entropy Loss
- Losses and accuracies have been found out for both training and validation set, after every epoch.
- **train_epoch()** aids in performing training for an epoch.
- **calc_loss_accuracy()** calculates loss and accuracy for a given dataset.
- **compute_accuracy()** calculates accuracy, given the predictions and actual labels.

Observations:

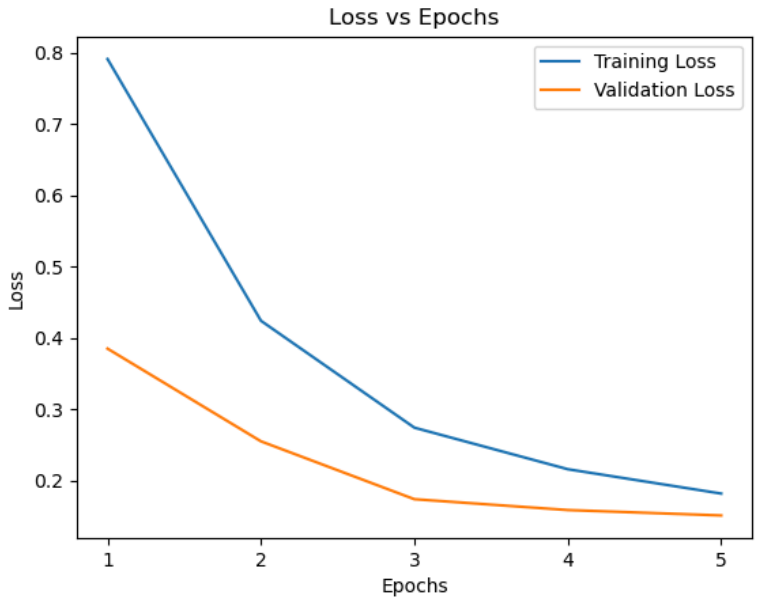
Epoch	Training Loss	Validation Loss	Training Accuracy	Validation Accuracy
1	0.7909	0.3848	0.7598	0.8888
2	0.4239	0.2549	0.8730	0.9278
3	0.2740	0.1737	0.9180	0.9473
4	0.2158	0.1585	0.9346	0.9520
5	0.1816	0.1509	0.9444	0.9587

Note: Accuracies are in fraction

Test Set Loss: 0.1280
Test Set Accuracy: 0.9585

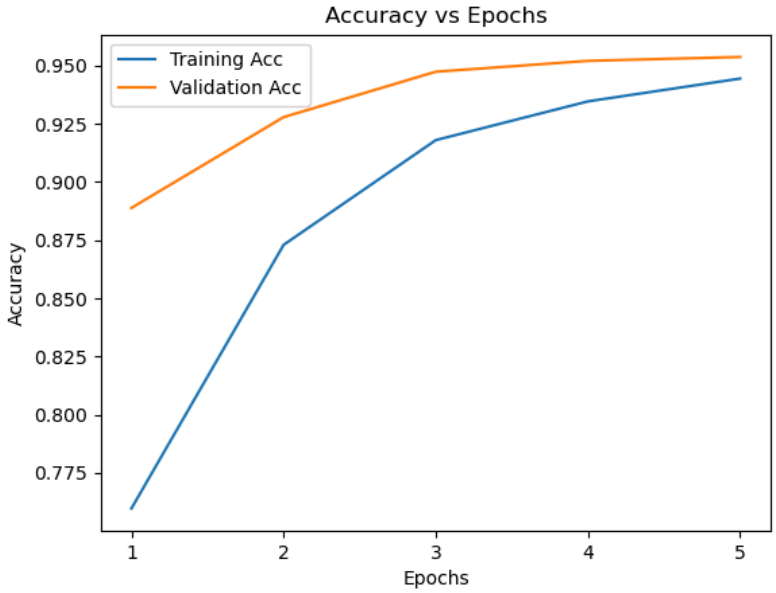
Task 4

- **Loss-epoch graph:**



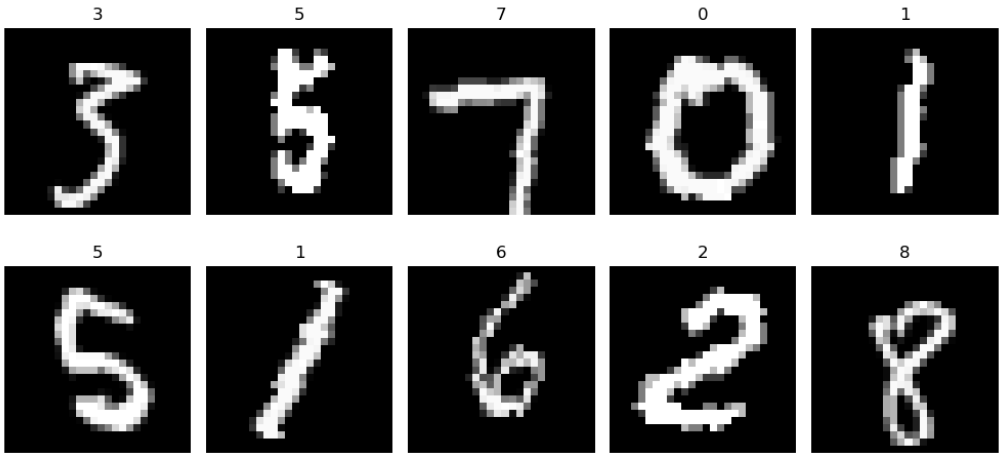
Loss decreases with increase in epochs. The losses tend to converge here.

- **Accuracy-epochs graph:**

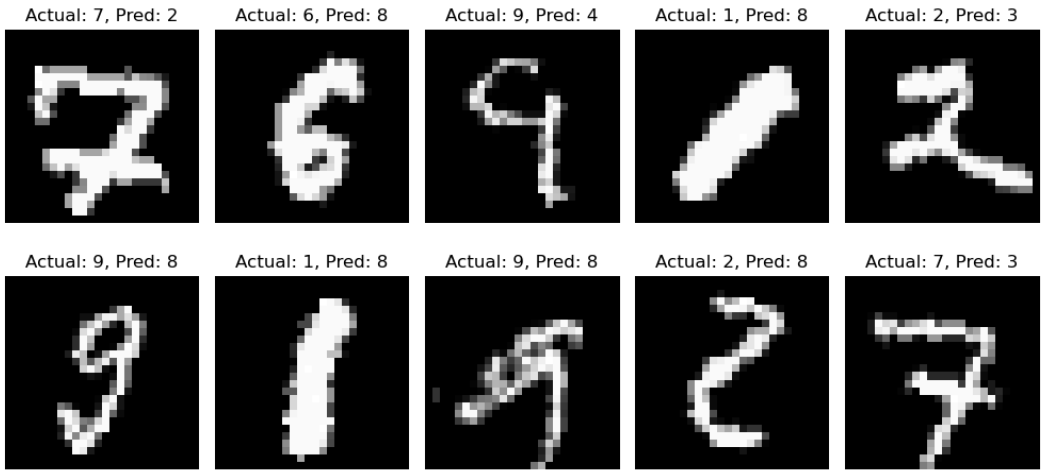


Accuracies increase with more training. They tend to converge here.

- Visualising some correctly classified images in the test set:



- Visualising some misclassified images in the test set:



Misclassifications can happen due to different handwritings. For example, it can be hard to tell that the 3rd image in the 2nd row is a 9.