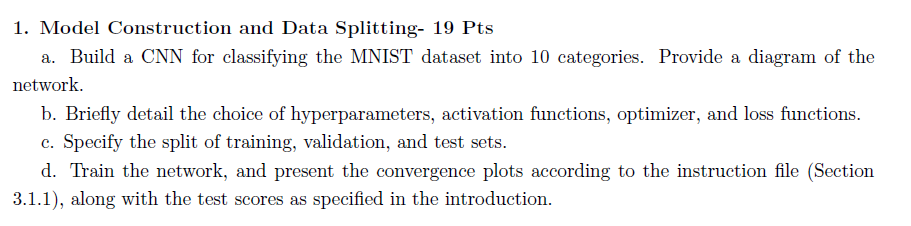
Home Work Assignment 1

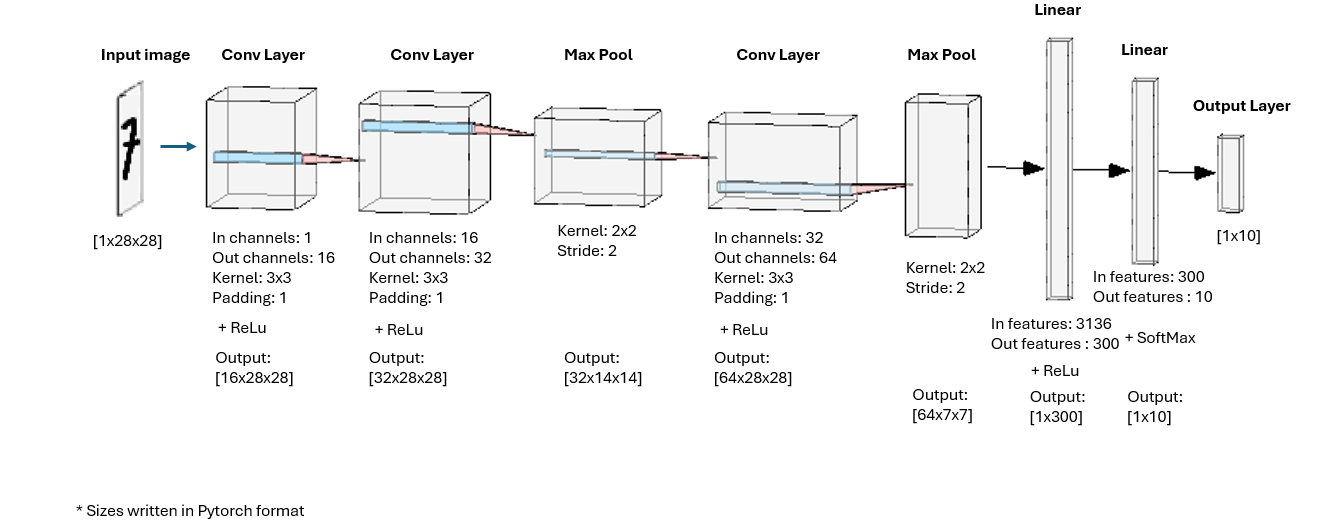
Alon Zeltser -

Nadav Amir - 308339860

**Question 1**



**Answer**



1. We followed a basic CNN structure. ReLU was used as the activation function to introduce non-linearity and minimize vanishing gradients phenomena, while SoftMax was applied at the output layer for probabilistic multi-class predictions[[1]](#footnote-1). A mini-batch size of 264 provided a balance between computational efficiency and convergence stability. We chose a learning rate of 0.001 for steady training and ran for 20 epochs to ensure sufficient learning without overfitting. Adam Optimizer was selected for its adaptive learning capability. Cross-entropy loss was used, as it is suitable for multi-class classification problems.
2. Train: 48,000 images (68.57%), Validation: 12,000 images (17.14%), Test: 10,000 images (14.28%)
3. See the next page:

A graph of a train

AI-generated content may be incorrect.

Figure 1 – Training vs. Validation Loss Progress Graph

A graph showing a number of numbers

AI-generated content may be incorrect.

Figure 2 – Test Set Confusion Matrix

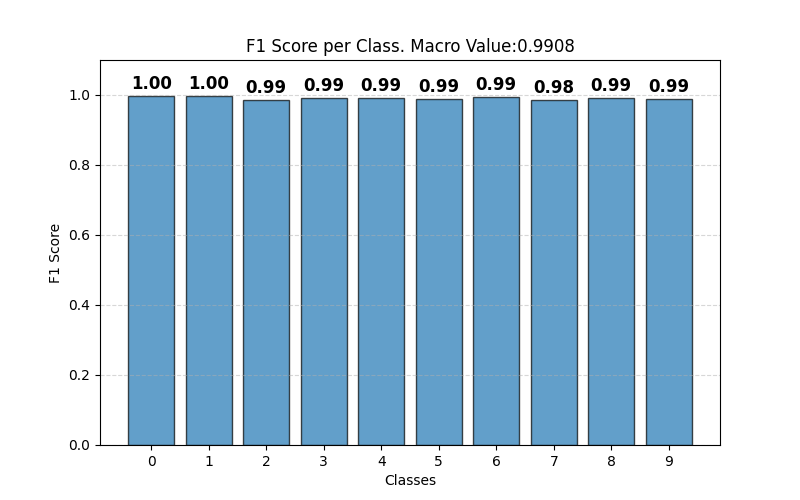
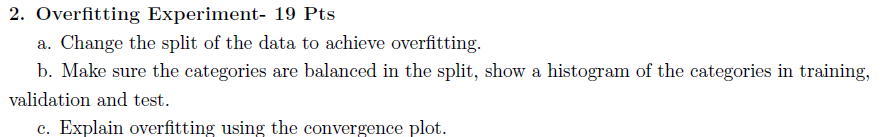


Figure 3 – Test Set F1 Score for each category + Macro (Average) Value

**Question 2**



**Answer**

1. We changed the split to be - Train 120 images (0.17 %), Validation 59880 images (85.54%), Test 10,000 images (14.28%)
2. We used StratifiedShuddleSplit to make sure that the data is balanced:

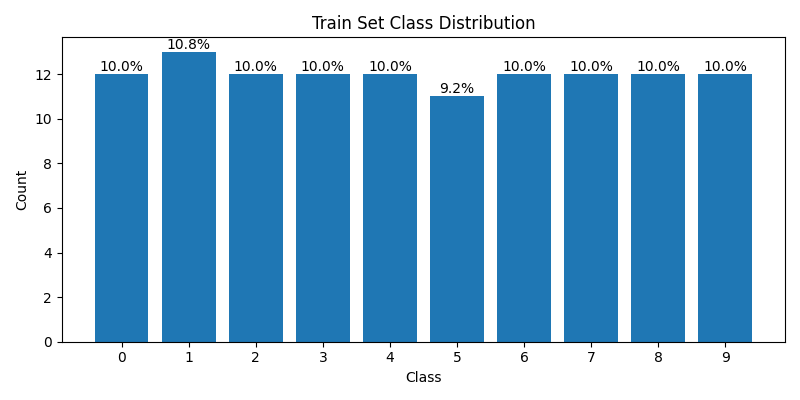
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Figure 4 – Train Set Class Distribution  
  
A graph of a number of blue bars

AI-generated content may be incorrect.

Figure 5 – Validation Set Class Distribution

A bar graph with numbers and text

AI-generated content may be incorrect.

Figure 6 – Test Set Class Distribution

1. According to Fig 7, around epoch 11 the validation loss stops decreasing and begins to rise slightly, while the training loss continues converging toward zero. This suggests the model is starting to "memorize" the training set rather than generalizing.

A graph of a train vs. validation loss

AI-generated content may be incorrect.

Figure 7 – Training vs. Validation Loss Progress Graph – Over Fitting Experiment

1. Although softmax is implied for multi-class classification, we did not apply it explicitly, as PyTorch’s CrossEntropyLoss includes it internally. [↑](#footnote-ref-1)