

**Department of Computer Science and Engineering,  
Delhi Technological University**

**AI509: Artificial Neural Networks  
Assignment 2**

**Max Marks:** 100

**Due Date:** 11:59PM Nov 10, 2024

**Instructions:**

- Keep collaborations among teams at high level discussions.
- Copying/Plagiarism will be dealt with strictly.

**Submission Instructions:** Submissions will be through Google classroom. Create a single folder ANN\_A2\_GroupXX.zip containing a report ANN\_A2\_GroupXX.pdf and the code files. The report must contain the google drive link of the folder where you upload the plots, output images, saved model etc. Report all your solutions, results and outputs in ANN\_A2\_GroupXX.pdf. (XX denotes your group number)

Only PyTorch can be used as a DL library. In case of any doubt, initiate a discussion on Google classroom or drop an email to [anurag@dtu.ac.in](mailto:anurag@dtu.ac.in) with subject line ANN Doubt Assignment 2.

**Q1. (Convolutional Neural Networks)**

For the **dataset** build a CNN architecture (use inbuilt PyTorch functions) of the following specifications: The architecture of the convolutional layers are [block1:  $[3*3*16]*2$ ], [block2:  $[3*3*32]*2$ ], [block3:  $[3*3*64]*2$ ] (pooling is an optional layer, use according to your requirement). Perform the following tasks to analyze the CNN architecture:

- (1) Implement a CNN architecture with block1 followed by FCs (Fully Connected), block 1, block2 followed by FCs, and block 1,2,3, followed by FCs layers and a softmax layer. For all the three architectures apply the Tanh or ReLU activation function on all layers.
- (2) Implement Dropout and use i) After convolutional layers, ii) Between FC layers

***Deliverables:***

- (1) Visualize 10 random images from each class of the dataset. [10 marks]
- (2) Analyze the accuracy and loss while adding block 1, block 2 and block 3 (with mentioned non-linearities) [35 marks]
- (3) Analyze the accuracy and loss while changing the dropout probability. (Try atleast three Dropout probabilities e.g. [0.2, 0.5, 0.8]) [15 marks]
- (4) Initialize the neural network weights by following: Zero initialization, Random Initialization and He initialization. Which initialization approach is best and why? [15 marks]
- (5) In the end, report the best accuracy with model architecture and detail analysis of choosing specific hyperparameters and any augmentation or pre-processing if done. [15 marks]
- (6) Analyze the results of the best model when all the activation functions are removed. Justify the performance drop. [10 marks]

**Dataset Description:** Data file is given in raw format (pickle) containing 10000 samples. Take first 8000 samples for training and remaining 2000 for validation for all your experiments. Each row of the array stores a  $32*32$  colour image.

**Labels -** The train key contains a list of 10000 numbers in the range 0-9. The number at index  $i$  indicates the label of the  $i^{\text{th}}$  image in the array data.