University of Rajshahi
Faculty of Engineering
Department of Computer Science and Engineering
AI Lab Assignments

1. Manually draw a Fully Connected Feed-forward Neural Network (FCFNN) having 8 neurons in the input layer, 10 neurons in the output layer, and three hidden layers having 4, 8, 4 neurons, respectively.

2. Write a report in pdf format using any Latex system after:
   - drawing a Fully Connected Feed-forward Neural Network (FCFNN) according to your preferences.
   - implementing it using Tensforflow.Keras.

3. Write a report in pdf format using any Latex system after:
   - building FCFNNs for solving the following equations:
     i. $y = 5x + 10$
     ii. $y = 3x^2 + 5x + 10$
     iii. $y = 4x^3 + 3x^2 + 5x + 10$
   - preparing a training set, a validation set and a test set for the above equations.
   - training and testing FCFNNs using your prepared data.
   - plotting original y and 'predicted y'.
   - explaining the effect of "power of an independent variable" on the architecture of your FCFNN and the amount of training data.

4. Write a report in pdf format using any Latex system after:
   - building an FCFNN based classifier according to your preferences about the number of hidden layers and neurons in the hidden layers.
   - training and testing your FCFNN based classifier using the:
     - Fashion MNIST dataset.
     - MNIST English dataset.
     - CIFAR-10 dataset.

5. Write a report in pdf format using any Latex system after:
   - building a Convolutional Neural Network (CNN) based 10 class classifier
   - training and testing the classifier by using the the:
     - Fashion MNIST dataset.
     - MNIST English dataset.
     - CIFAR-10 dataset.

6. Write a report in pdf format using any Latex system after:
   - Prepare an English handwritten digit dataset by collecting hand written data and splitting into the training set and test.

- Retrain FCFNN using your training set with the training set of the MNIST English digit dataset.
- Evaluate your FCFNN using your test set along with the test set of the MNIST English dataset.

7. Write a report in pdf format using any Latex system after:
   - training and testing a CNN based classifier using images captured by you and your group mates using mobile phones.
   - mentioning total training time, testing time per sample, amount-of-data vs performance, epoch vs performance, model size (i.e., number of parameters) vs performance and some other observations that you think are interesting and informative.

8. Build a CNN based classifier having architecture similar to the classical VGG16.

9. Write a report on how feature maps of different convolutional layers look when you pass your favourite image through your three favourite pre-trained CNN classifiers..

10. Write a report in pdf format using any Latex system after:
    - training a binary classifier, based on the pre-trained VGG16, by transfer learning and fine tuning.
    - showing the effect of fine-tuning:
      i. whole pre-trained VGG16
      ii. partial pre-trained VGG16

11. Discuss the feature extraction power of your favorite CNN pretrained by the ImageNet dataset before and after transfer learning by the MNIST digit dataset after plotting high dimensional feature vectors on 2D plane using the following two dimension reduction techniques:
    - Principal Component Analysis (PCA)
    - t-distributed Stochastic Neighbor Embedding (t-SNE)

12. Write a report by discussing the effect of different data augmentation techniques on your CNN based classifiers.

13. Show the effect of dropout layer, data augmentation techniques on overfitting issues of your CNN based classifier.

14. Write a report by discussing the effect of the following issues on the classifier's performance:
    - different activation functions in hidden layers
    - different loss functions

15. Write a report by describing how different callback functions can make your training process better.

16. Write a report describing how monitoring performance curves for both the training set and the validation set based on the target metric (e.g., ‘accuracy’) and ‘loss’ metric can improve your hyperparameter training.