Statistical Machine Learning
Winter 2022
Assignment - 4 Rubric
Deadline : $14^{th} May, 11:59 PM$

April 2022

1 Instructions

- You are free to use either python or MATLAB for this assignment.
- You can use inbuilt libraries for Math, plotting, and handling the data (eg. NumPy, Pandas, Matplotlib).
- Usage instructions for other libraries can be found in the question.
- Only (*.py) and (*.m) files should be submitted for code.
- Create a (*.pdf) report explaining your assumptions, approach, results, and any further detail asked in the question.
- You should be able to replicate your results if required.

2 Question:1 [4 Marks]

Use MNISTdataset and follow below instructions to solve this question.
Create Gradient Boosting Classifier from scratch with following instructions.

- As a base model, use DecisionTreeRegression(max_depth = 1) from sklearn.
- Use **Number of Itertaions M = 5**[0.6 marks for each iterations= 3 marks] and **learning rate = 0.1**
- Plot iteration-wise training and testing accuracy1 marks
- Report all the assumptions that you made, and report final testing accuracy.

3 Question:2 [4 Marks]

Use FMNIST(Fashion MNIST)dataset and follow below instructions to solve this question.
Crate a feed forward Neural Network from with following instructions.
NOTE : You are allowed use **PyTorch** or **TensorFlow** and take advantage of all the functionality of these DL frameworks to implement this architecture. Do not need to implement anything from scratch.

- Input layer must have **784** nodes and output layer have appropriate number of nodes. 0.5 marks
- use any number of hidden layers with any number of neurons depend on your computation power availability.0.5 marks
- Use **Multiclass Cross Entropy loss** function, **Stochastic Gradient descent(SGD)** optimizer and **random weight initialization** techniques to train the model.0.5 marks
- Report all the **hyperparameters** that you have assumed like batch size , learning rate etc.0.5 marks
- Plot epoch wise training loss[1 Marks].Report testing accuracy[0.5 marks] and classwise testing accuracy[0.5 Marks].

4 Question:3 [4 Marks]

Use MNISTdataset and follow below instructions to solve this question.
NOTE : To solve this question you are allowed to use any python packages or DL framework.

- Create a AutoEncoder with following instructions:[2 marks]
  - Create feed forward Neural Network as follows:[1 Marks]
    - **Input layer** : (input = 784, output = 512,activation = ReLU)
    - **Hidden layer** : (input = 512, output = 128, activation = ReLU)
    - **Latent Space** : (input = 128,output = 64, activation = ReLU)
    - **Hidden layer** : (input = 64, output = 128,activation = ReLU)
    - **Hidden layer** :(input = 128,output = 512,activation = ReLU)
    - **Output layer** : (input = 512, output = ?,activation = ReLU)
  - Use appropriate loss function, and state why you used this loss function.
  - Use Adam optimizer to optimize the loss function with proper learning rate.

  - Use training data to train the autoencoder and plot epoch-wise loss.[1 Marks]
  - After Training autoEncoder remove the decoder from the autoEncoder architecture.

- Create Classifcation Model called **MNIST Classifcation Model** with following configuration.[2 Marks]

- Use the encoder and then argument it with the following.[1 Marks]

  - **Input Layer** :(input = 64 , output = 32 , activation = ReLU)
  - **output Layer** : (input = 32 , output = ? , activation = Softmax)

- Use **MultiClass Cross Entropy loss** function and **Adam** optimizer to optimize the loss function with appropriate learning rate.

- Train **MNIST Classifcation Model** using training dataset.Plot epoch-wise training loss.

- Test using testing dataset and report accuracy and classwise accuracy.[1 Marks]

5 Question : 4[4 Marks]

Use MNISTdataset and below instructions to solve this question.
NOTE: Use of any bagging libraries are not allowed.

- Create a Bagging or Bootstrap model where the **bag size = 3** and the **base model = DecisionTreeClassifier**.[1 marks]

- Use **Majority voting** techniques for final prediction.[1 marks]

- Report accuracy [1 marks and classwise accuracy [1 marks on the testing dataset.