ASSIGNMENT 3

CS5691 Pattern Recognition and Machine Learning

CS5691 Assignment 3

Team Members:

BE17B007	N Sowmya Manojna
PH17B010	Thakkar Riya Anandbhai
PH17B011	Chaithanya Krishna Moorthy

Indian Institute of Technology, Madras

Contents

1 Dataset 1A

1.1 Perceptron

1.2 MLFFNN

The classification accuracies on the training and validation datasets are as follows:

| # Neurons	Activation	Solver	Batch Size	α	Learning Rate	Accuracy	Validation Accuracy
5	tanh	lbfgs	200	0.0001	adaptive	100.0	100.0
5	tanh	lbfgs	200	0.0001	constant	100.0	100.0
5	tanh	lbfgs	200	0.0	invscaling	100.0	100.0
5	tanh	lbfgs	200	0.0	adaptive	100.0	100.0
5	tanh	lbfgs	200	0.0	constant	100.0	100.0
5	tanh	lbfgs	100	0.0	adaptive	100.0	100.0
5	tanh	lbfgs	100	0.0001	invscaling	100.0	100.0
5	relu	lbfgs	200	0.0	constant	100.0	100.0
5	relu	lbfgs	100	0.0001	invscaling	100.0	100.0
5	relu	lbfgs	200	0.0	adaptive	100.0	100.0

Table 2: Best 10 Train and Validation Accuracies obtained after performing a `GridSearch` on 432 parameter combinations.

In addition, the parameter combination were sorted based on minimum fitting time (least fitting time - first) and the model that gave the best accuracy the fastest was chosen. Hence the best parameter combination chosen is:

- hidden_layer_sizes: 5
- activation: tanh
- solver: lbfgs
- batch_size: 200
- alpha: 0.0001
- learning_rate: adaptive

The classification accuracy of the best model on the testing data is: 100%. The confusion matrices obtained are as follows:
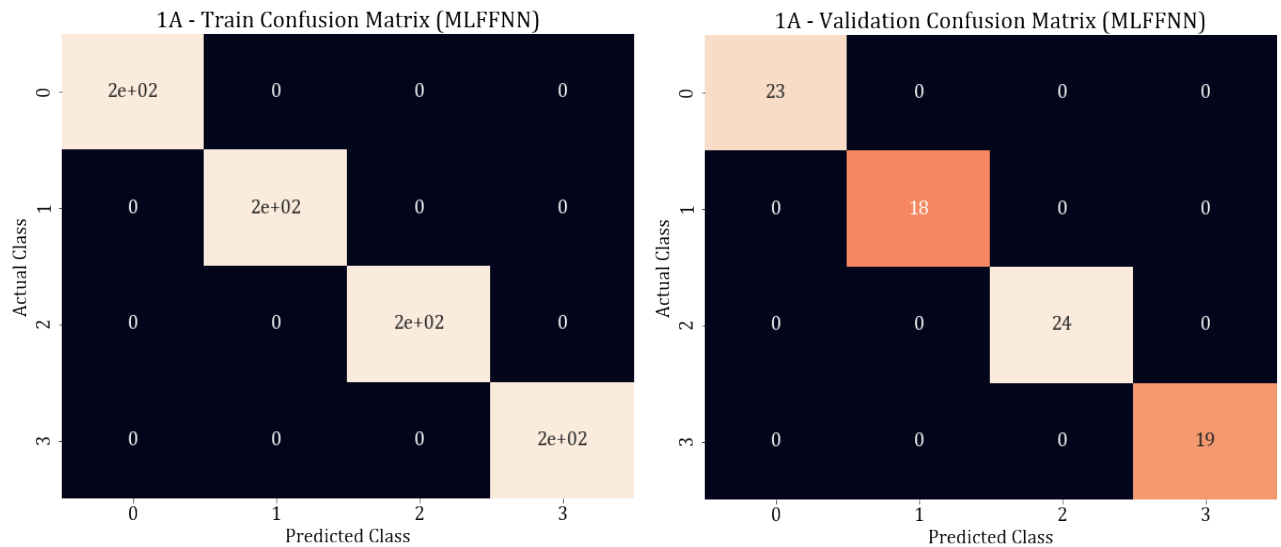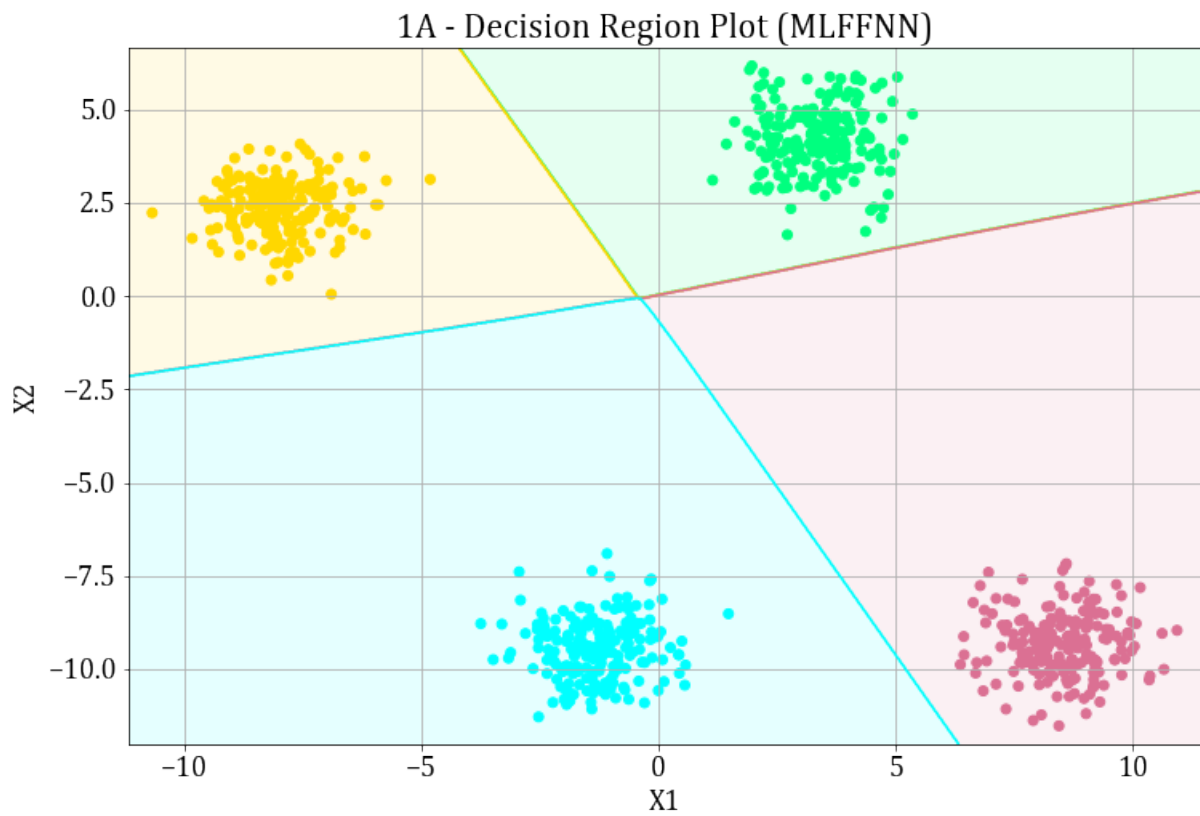

Figure 1: Training and Validation confusion matrices obtained for the best parameter combination, on the left and right respectively.
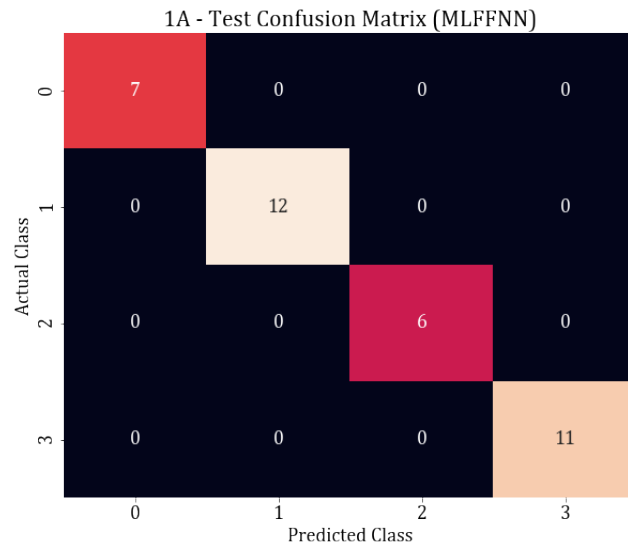
Figure 2: Testing confusion matrices obtained for the best parameter combination.

The decision region plots obtained is as follows:

Figure 3: Decision Region Plot obtained for the best parameter combination.

1.3 Linear SVM

2 Dataset 1B

2.1 MLFFNN

The classification accuracies on the training and validation datasets are as follows:

# Neurons	Activation	Batch Size	Early Stopping	Learning Rate	α	Accuracy	Validation Accuracy
(8, 8)	relu	50	False	adaptive	0.01	99.33	98.41
(8, 8)	relu	50	False	constant	0.001	99.33	98.41
(8, 8)	relu	50	False	invscaling	0.01	99.33	98.41
(8, 8)	relu	50	False	adaptive	0.001	99.33	98.41
(8, 8)	relu	50	False	invscaling	0.001	99.33	98.41
(8, 8)	relu	50	False	constant	0.01	99.33	98.41
(10, 10)	relu	50	False	adaptive	0.01	99.0	98.41
(10, 10)	relu	50	False	constant	0.01	99.0	98.41
(10, 10)	relu	50	False	invscaling	0.01	99.0	98.41
(10, 10)	relu	50	False	constant	0.001	99.0	96.82

Table 3: Best 10 Train and Validation Accuracies obtained after performing a `GridSearch` on 432 parameter combinations.

In addition, the parameter combination were sorted based on minimum fitting time (least fitting time - first) and the model that gave the best accuracy the fastest was chosen. Hence the best parameter combination chosen is:

- hidden_layer_sizes: (8, 8)
- activation: relu
- batch_size: 50
- early_stopping: False
- learning_rate: adaptive
- alpha: 0.01

The classification accuracy of the best model on the testing data is: 96.296%. The confusion matrices obtained are as follows:
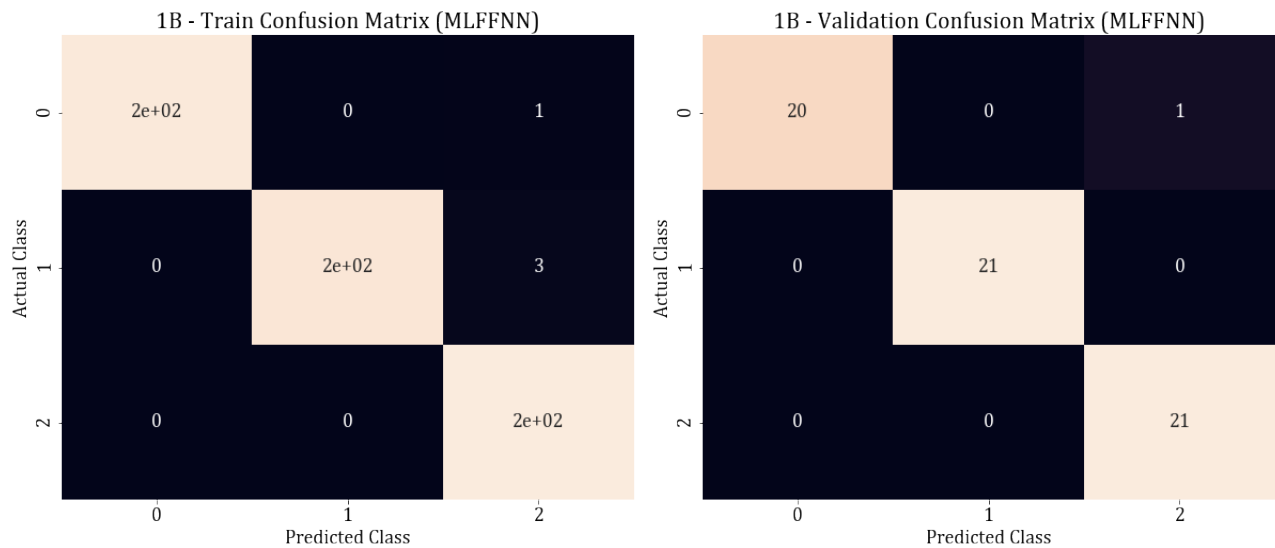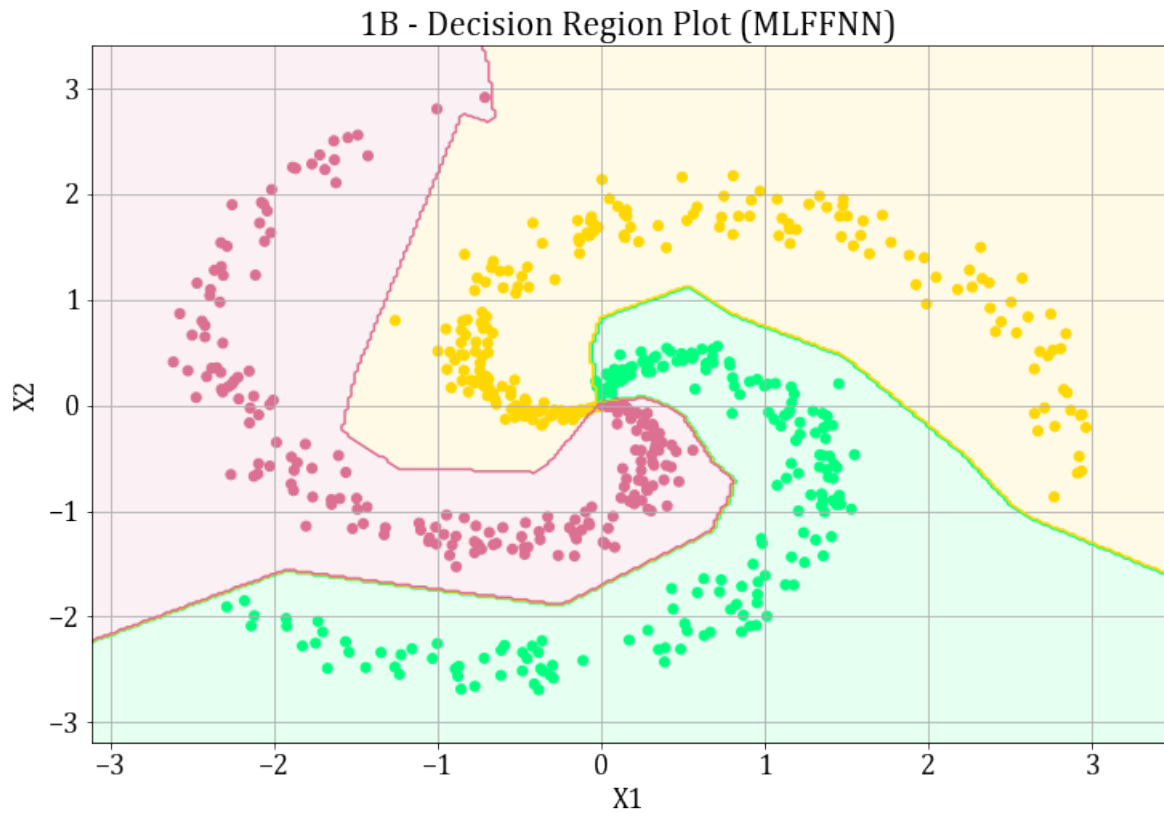

Figure 4: Training and Validation confusion matrices obtained for the best parameter combination, on the left and right respectively.
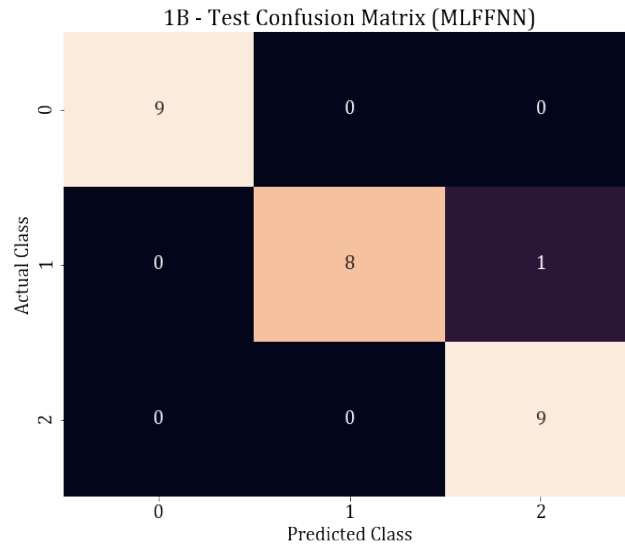
Figure 5: Testing confusion matrices obtained for the best parameter combination.

The decision region plots obtained is as follows:

Figure 6: Decision Region Plot obtained for the best parameter combination.

2.2   Non-Linear SVM

3 Dataset 2A

3.1 MLFFNN

3.2 Gaussian-kernel SVM