

Jupytermain_show

December 12, 2020

```
[1]: #from A1 import A1_extract_landmarks as A1_extract
from A1 import A1_functions_all as A1_functions
```

Using TensorFlow backend.

```
[2]: TaskA1_opt_models_dict, TaskA1_res_dict = A1_functions.get_A1_results()
```

-----Reading Task A1 dataset-----

-----Task A1: Grid searching on Logistic
regression-----

Logistic Regression Grid search CV on Dataset A:

Training scores:

```
0.500 (+/-0.004) for {'C': 0.0001, 'penalty': 'l1', 'solver': 'saga'}
0.834 (+/-0.005) for {'C': 0.0001, 'penalty': 'l2', 'solver': 'saga'}
0.501 (+/-0.003) for {'C': 0.001, 'penalty': 'l1', 'solver': 'saga'}
0.873 (+/-0.008) for {'C': 0.001, 'penalty': 'l2', 'solver': 'saga'}
0.855 (+/-0.009) for {'C': 0.01, 'penalty': 'l1', 'solver': 'saga'}
0.903 (+/-0.006) for {'C': 0.01, 'penalty': 'l2', 'solver': 'saga'}
0.916 (+/-0.005) for {'C': 0.1, 'penalty': 'l1', 'solver': 'saga'}
0.922 (+/-0.005) for {'C': 0.1, 'penalty': 'l2', 'solver': 'saga'}
0.928 (+/-0.009) for {'C': 1, 'penalty': 'l1', 'solver': 'saga'}
0.928 (+/-0.009) for {'C': 1, 'penalty': 'l2', 'solver': 'saga'}
0.929 (+/-0.010) for {'C': 10, 'penalty': 'l1', 'solver': 'saga'}
0.929 (+/-0.010) for {'C': 10, 'penalty': 'l2', 'solver': 'saga'}
```

Validation scores:

```
0.499 (+/-0.004) for {'C': 0.0001, 'penalty': 'l1', 'solver': 'saga'}
0.834 (+/-0.029) for {'C': 0.0001, 'penalty': 'l2', 'solver': 'saga'}
0.501 (+/-0.003) for {'C': 0.001, 'penalty': 'l1', 'solver': 'saga'}
0.871 (+/-0.042) for {'C': 0.001, 'penalty': 'l2', 'solver': 'saga'}
0.854 (+/-0.031) for {'C': 0.01, 'penalty': 'l1', 'solver': 'saga'}
```

0.897 (+/-0.032) for {'C': 0.01, 'penalty': 'l2', 'solver': 'saga'}
 0.910 (+/-0.016) for {'C': 0.1, 'penalty': 'l1', 'solver': 'saga'}
 0.914 (+/-0.021) for {'C': 0.1, 'penalty': 'l2', 'solver': 'saga'}
 0.917 (+/-0.018) for {'C': 1, 'penalty': 'l1', 'solver': 'saga'}
 0.918 (+/-0.021) for {'C': 1, 'penalty': 'l2', 'solver': 'saga'}
 0.918 (+/-0.018) for {'C': 10, 'penalty': 'l1', 'solver': 'saga'}
 0.918 (+/-0.018) for {'C': 10, 'penalty': 'l2', 'solver': 'saga'}

Prediction on a pseudo test set (split from Dataset A):

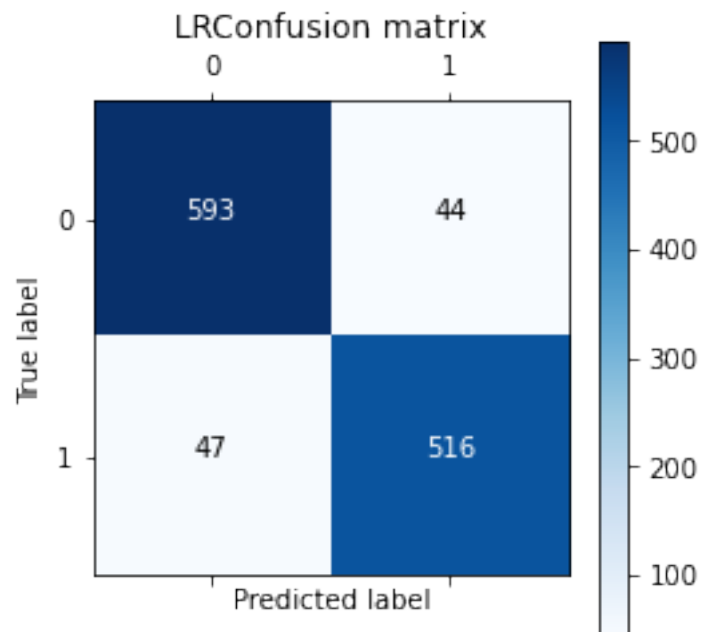
	precision	recall	f1-score	support
0.0	0.93	0.93	0.93	637
1.0	0.92	0.92	0.92	563
accuracy			0.92	1200
macro avg	0.92	0.92	0.92	1200
weighted avg	0.92	0.92	0.92	1200

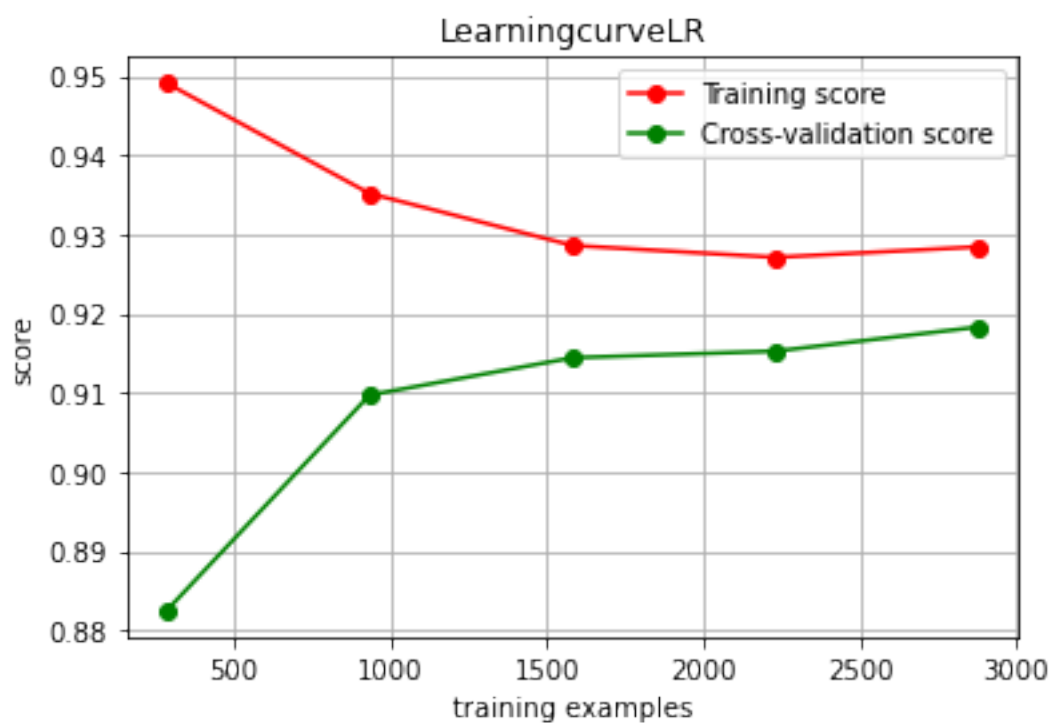
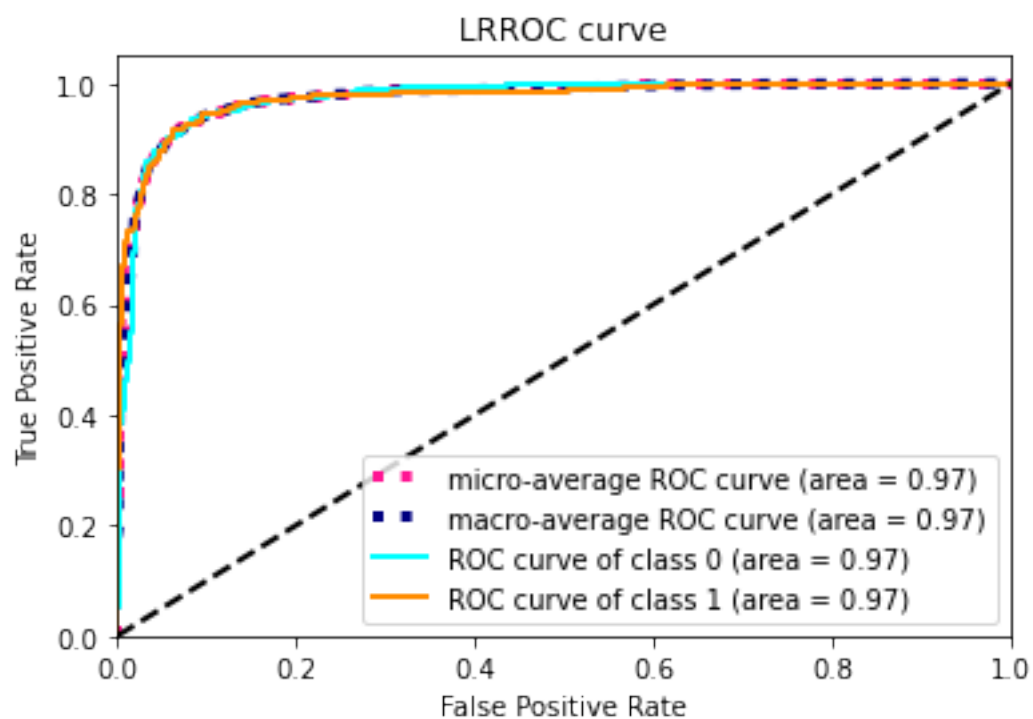
Accuracy: 0.9241666666666667

Best parameters found on Dataset A:

{'C': 1, 'penalty': 'l2', 'solver': 'saga'}

Average runtime per test instance: 6.55055046081543e-07





-----Task A1: Grid searching on
SVM-----

SVM Grid search CV on Dataset A:

Training scores:

0.502 (+/-0.000) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'rbf'}
0.891 (+/-0.010) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'linear'}
0.502 (+/-0.000) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'sigmoid'}
0.502 (+/-0.000) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'rbf'}
0.891 (+/-0.010) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'linear'}
0.502 (+/-0.000) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'sigmoid'}
0.502 (+/-0.000) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'rbf'}
0.891 (+/-0.010) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'linear'}
0.502 (+/-0.000) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'sigmoid'}
0.502 (+/-0.000) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'rbf'}
0.891 (+/-0.010) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'linear'}
0.661 (+/-0.041) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'sigmoid'}
0.502 (+/-0.000) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'rbf'}
0.917 (+/-0.005) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'linear'}
0.502 (+/-0.000) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'sigmoid'}
0.502 (+/-0.000) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'rbf'}
0.917 (+/-0.005) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'linear'}
0.502 (+/-0.000) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'sigmoid'}
0.801 (+/-0.008) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'rbf'}
0.917 (+/-0.005) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'linear'}
0.822 (+/-0.007) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'sigmoid'}
0.502 (+/-0.000) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'rbf'}
0.917 (+/-0.005) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'linear'}
0.633 (+/-0.012) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'sigmoid'}
0.504 (+/-0.002) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'rbf'}
0.932 (+/-0.005) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'linear'}
0.502 (+/-0.000) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
0.856 (+/-0.007) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'rbf'}
0.932 (+/-0.005) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'linear'}
0.840 (+/-0.006) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'sigmoid'}
0.886 (+/-0.008) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'rbf'}
0.932 (+/-0.005) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'linear'}
0.752 (+/-0.010) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'sigmoid'}
0.521 (+/-0.004) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}
0.932 (+/-0.005) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'linear'}

0.602 (+/-0.032) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.860 (+/-0.005) for {'C': 1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.939 (+/-0.005) for {'C': 1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.841 (+/-0.006) for {'C': 1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.904 (+/-0.006) for {'C': 1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.939 (+/-0.005) for {'C': 1, 'gamma': 0.001, 'kernel': 'linear'}
 0.891 (+/-0.009) for {'C': 1, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.950 (+/-0.004) for {'C': 1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.939 (+/-0.005) for {'C': 1, 'gamma': 0.01, 'kernel': 'linear'}
 0.695 (+/-0.013) for {'C': 1, 'gamma': 0.01, 'kernel': 'sigmoid'}
 1.000 (+/-0.000) for {'C': 1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.939 (+/-0.005) for {'C': 1, 'gamma': 0.1, 'kernel': 'linear'}
 0.597 (+/-0.035) for {'C': 1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.901 (+/-0.009) for {'C': 10, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.942 (+/-0.003) for {'C': 10, 'gamma': 0.0001, 'kernel': 'linear'}
 0.889 (+/-0.007) for {'C': 10, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.937 (+/-0.004) for {'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}
 0.942 (+/-0.003) for {'C': 10, 'gamma': 0.001, 'kernel': 'linear'}
 0.881 (+/-0.018) for {'C': 10, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.992 (+/-0.002) for {'C': 10, 'gamma': 0.01, 'kernel': 'rbf'}
 0.942 (+/-0.003) for {'C': 10, 'gamma': 0.01, 'kernel': 'linear'}
 0.689 (+/-0.011) for {'C': 10, 'gamma': 0.01, 'kernel': 'sigmoid'}
 1.000 (+/-0.000) for {'C': 10, 'gamma': 0.1, 'kernel': 'rbf'}
 0.942 (+/-0.003) for {'C': 10, 'gamma': 0.1, 'kernel': 'linear'}
 0.598 (+/-0.035) for {'C': 10, 'gamma': 0.1, 'kernel': 'sigmoid'}

Validation scores:

0.502 (+/-0.001) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.889 (+/-0.039) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'linear'}
 0.502 (+/-0.001) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.502 (+/-0.001) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'rbf'}
 0.889 (+/-0.039) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'linear'}
 0.502 (+/-0.001) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.502 (+/-0.001) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'rbf'}
 0.889 (+/-0.039) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'linear'}
 0.502 (+/-0.001) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.502 (+/-0.001) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'rbf'}
 0.889 (+/-0.039) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'linear'}
 0.665 (+/-0.050) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.502 (+/-0.001) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.911 (+/-0.023) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'linear'}
 0.502 (+/-0.001) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.502 (+/-0.001) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'rbf'}
 0.911 (+/-0.023) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'linear'}
 0.502 (+/-0.001) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.797 (+/-0.026) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'rbf'}
 0.911 (+/-0.023) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'linear'}

0.821 (+/-0.021) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.502 (+/-0.001) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'rbf'}
 0.911 (+/-0.023) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'linear'}
 0.632 (+/-0.028) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.504 (+/-0.003) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.917 (+/-0.025) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.502 (+/-0.001) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.854 (+/-0.031) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.917 (+/-0.025) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'linear'}
 0.842 (+/-0.023) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.869 (+/-0.026) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.917 (+/-0.025) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'linear'}
 0.753 (+/-0.035) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.512 (+/-0.006) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.917 (+/-0.025) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'linear'}
 0.593 (+/-0.043) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.860 (+/-0.026) for {'C': 1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.916 (+/-0.021) for {'C': 1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.842 (+/-0.021) for {'C': 1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.897 (+/-0.033) for {'C': 1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.916 (+/-0.021) for {'C': 1, 'gamma': 0.001, 'kernel': 'linear'}
 0.887 (+/-0.035) for {'C': 1, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.901 (+/-0.021) for {'C': 1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.916 (+/-0.021) for {'C': 1, 'gamma': 0.01, 'kernel': 'linear'}
 0.696 (+/-0.043) for {'C': 1, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.813 (+/-0.025) for {'C': 1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.916 (+/-0.021) for {'C': 1, 'gamma': 0.1, 'kernel': 'linear'}
 0.591 (+/-0.043) for {'C': 1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.897 (+/-0.033) for {'C': 10, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.914 (+/-0.011) for {'C': 10, 'gamma': 0.0001, 'kernel': 'linear'}
 0.890 (+/-0.032) for {'C': 10, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.914 (+/-0.030) for {'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}
 0.914 (+/-0.011) for {'C': 10, 'gamma': 0.001, 'kernel': 'linear'}
 0.874 (+/-0.043) for {'C': 10, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.903 (+/-0.018) for {'C': 10, 'gamma': 0.01, 'kernel': 'rbf'}
 0.914 (+/-0.011) for {'C': 10, 'gamma': 0.01, 'kernel': 'linear'}
 0.688 (+/-0.045) for {'C': 10, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.818 (+/-0.029) for {'C': 10, 'gamma': 0.1, 'kernel': 'rbf'}
 0.914 (+/-0.011) for {'C': 10, 'gamma': 0.1, 'kernel': 'linear'}
 0.591 (+/-0.045) for {'C': 10, 'gamma': 0.1, 'kernel': 'sigmoid'}

Prediction on a pseudo test set (split from Dataset A):

	precision	recall	f1-score	support
0.0	0.93	0.93	0.93	637
1.0	0.92	0.92	0.92	563
accuracy			0.93	1200

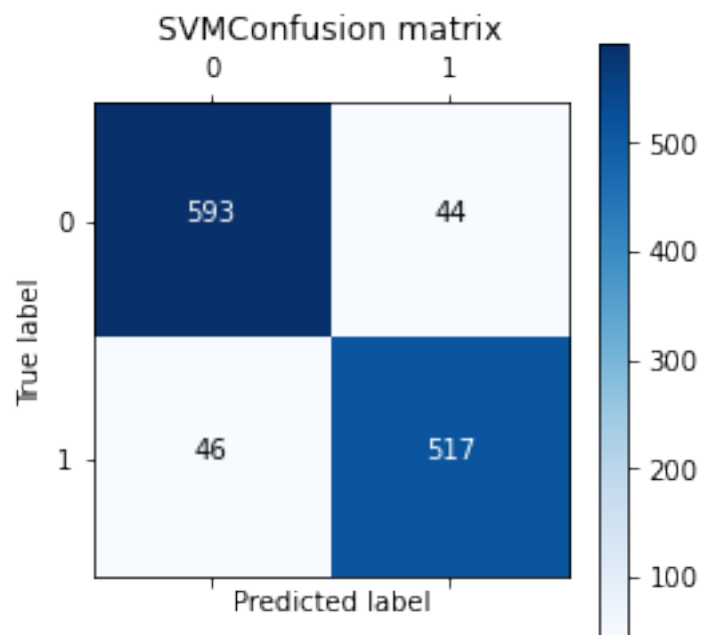
macro avg	0.92	0.92	0.92	1200
weighted avg	0.93	0.93	0.93	1200

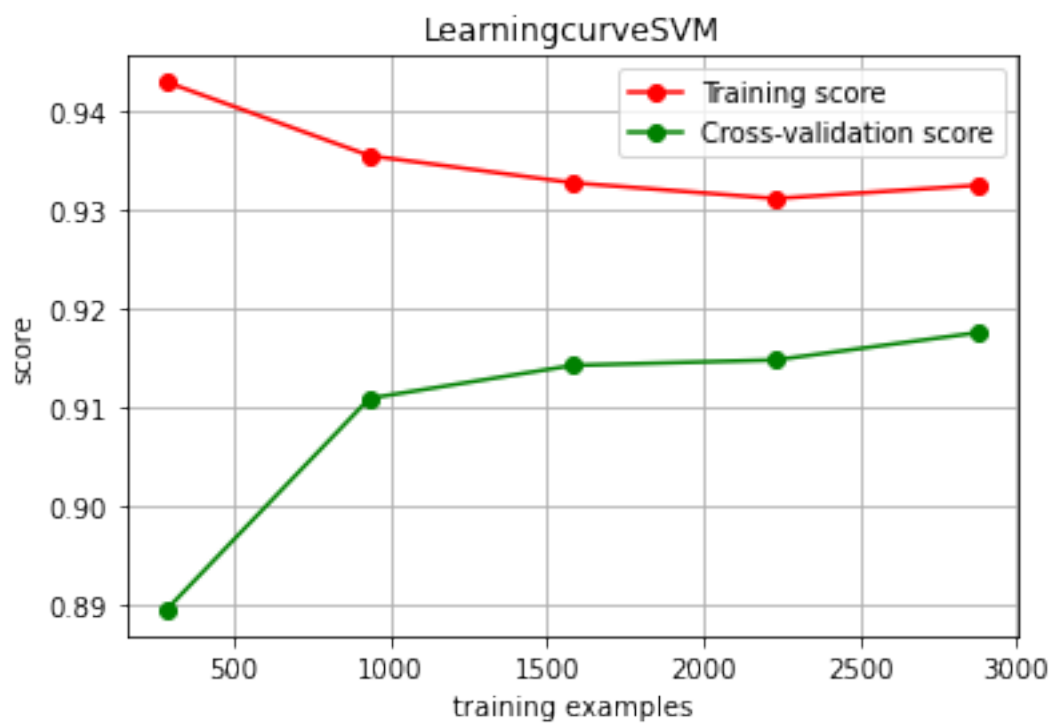
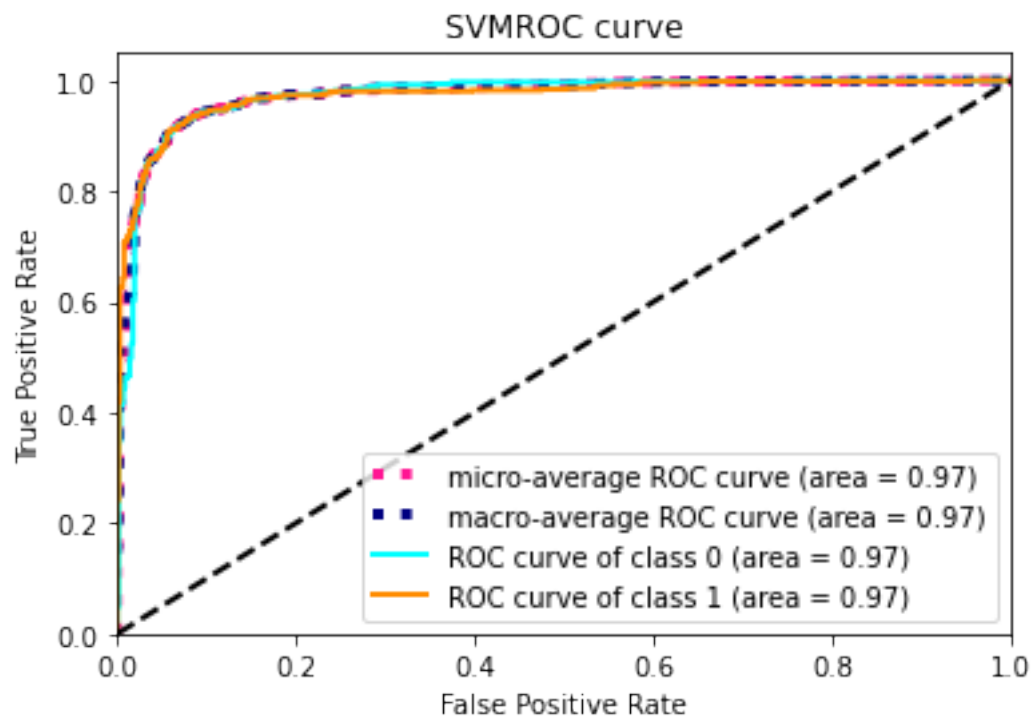
Accuracy: 0.925

Best parameters found on Dataset A:

`{'C': 0.1, 'gamma': 0.0001, 'kernel': 'linear'}`

Average runtime per test instance: 0.0001966351270675659





-----Task A1: Grid searching on Rando
Forest-----

RF Grid search CV on Dataset A:

Training scores:

1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 1024}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 1024}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 1024}
1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 1024}
1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 1024}

Validation scores:

0.862 (+/-0.017) for {'max_depth': 64, 'n_estimators': 64}
0.864 (+/-0.026) for {'max_depth': 64, 'n_estimators': 128}
0.864 (+/-0.035) for {'max_depth': 64, 'n_estimators': 256}
0.864 (+/-0.024) for {'max_depth': 64, 'n_estimators': 512}
0.865 (+/-0.024) for {'max_depth': 64, 'n_estimators': 1024}
0.858 (+/-0.019) for {'max_depth': 128, 'n_estimators': 64}
0.861 (+/-0.032) for {'max_depth': 128, 'n_estimators': 128}
0.864 (+/-0.023) for {'max_depth': 128, 'n_estimators': 256}
0.866 (+/-0.034) for {'max_depth': 128, 'n_estimators': 512}
0.868 (+/-0.028) for {'max_depth': 128, 'n_estimators': 1024}

0.859 (+/-0.027) for {'max_depth': 256, 'n_estimators': 64}
 0.865 (+/-0.025) for {'max_depth': 256, 'n_estimators': 128}
 0.866 (+/-0.027) for {'max_depth': 256, 'n_estimators': 256}
 0.867 (+/-0.024) for {'max_depth': 256, 'n_estimators': 512}
 0.864 (+/-0.028) for {'max_depth': 256, 'n_estimators': 1024}
 0.863 (+/-0.026) for {'max_depth': 512, 'n_estimators': 64}
 0.861 (+/-0.019) for {'max_depth': 512, 'n_estimators': 128}
 0.865 (+/-0.032) for {'max_depth': 512, 'n_estimators': 256}
 0.866 (+/-0.024) for {'max_depth': 512, 'n_estimators': 512}
 0.867 (+/-0.027) for {'max_depth': 512, 'n_estimators': 1024}
 0.862 (+/-0.019) for {'max_depth': 1024, 'n_estimators': 64}
 0.863 (+/-0.028) for {'max_depth': 1024, 'n_estimators': 128}
 0.864 (+/-0.023) for {'max_depth': 1024, 'n_estimators': 256}
 0.863 (+/-0.029) for {'max_depth': 1024, 'n_estimators': 512}
 0.867 (+/-0.024) for {'max_depth': 1024, 'n_estimators': 1024}

Prediction on a pseudo test set (split from Dataset A):

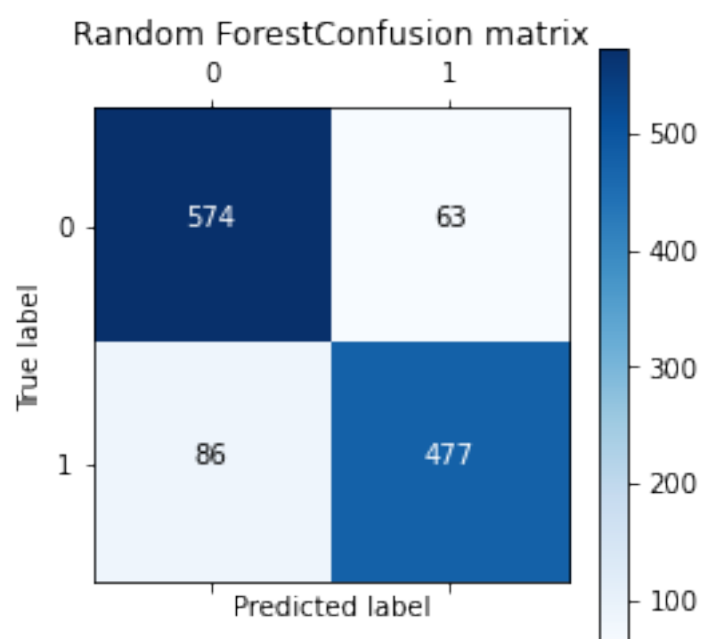
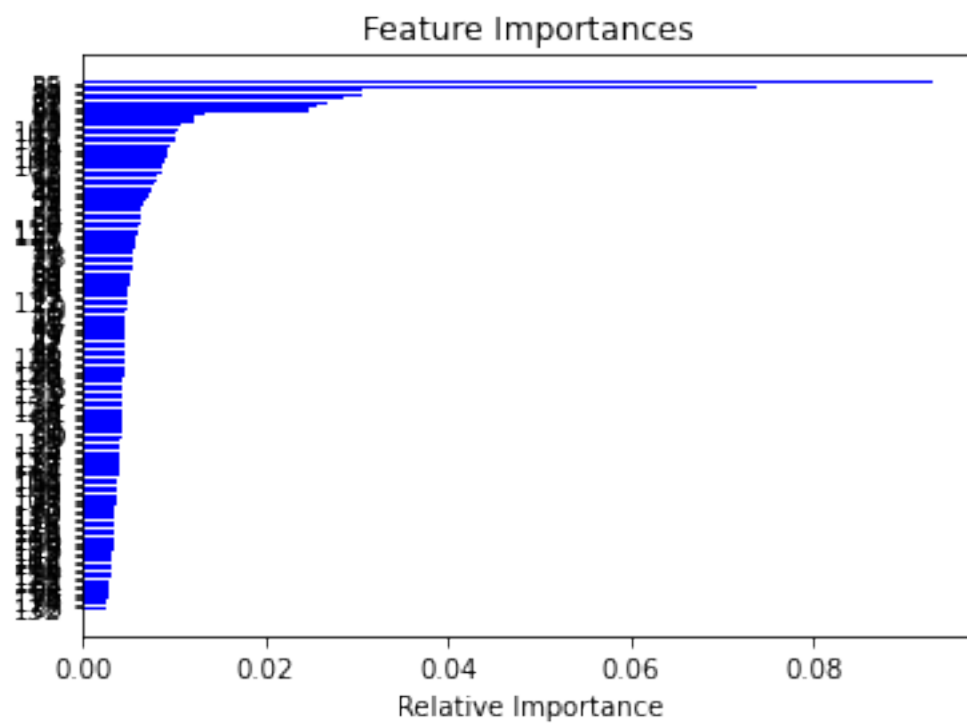
	precision	recall	f1-score	support
0.0	0.87	0.90	0.89	637
1.0	0.88	0.85	0.86	563
accuracy			0.88	1200
macro avg	0.88	0.87	0.88	1200
weighted avg	0.88	0.88	0.88	1200

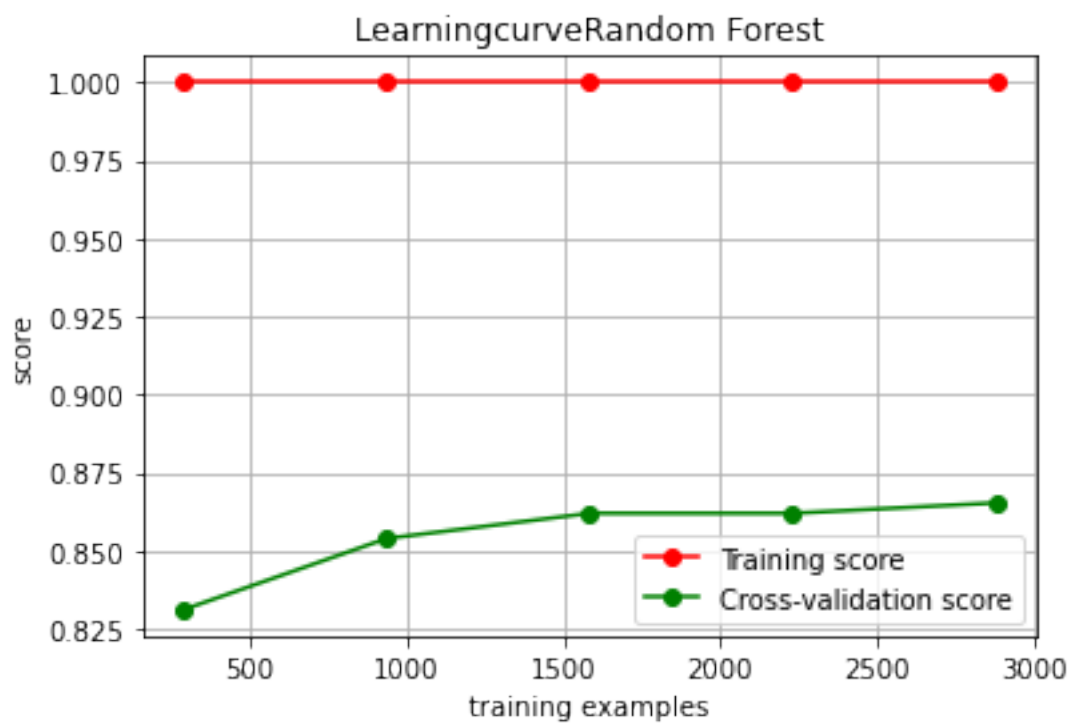
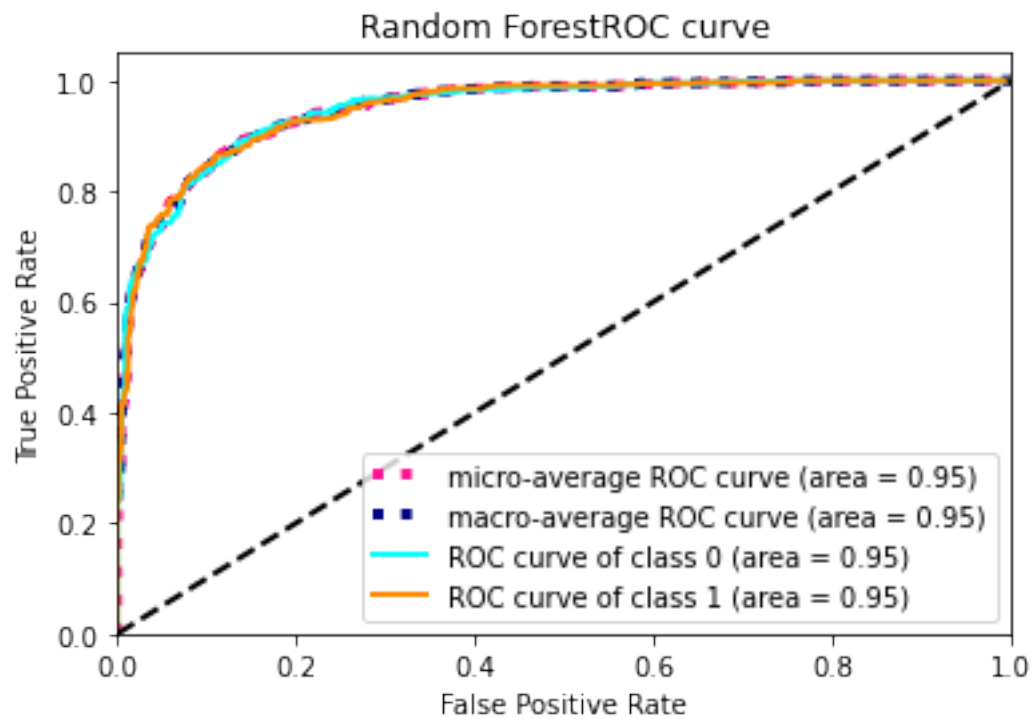
Accuracy: 0.8758333333333334

Best parameters found on Dataset A:

{'max_depth': 128, 'n_estimators': 1024}

Average runtime per test instance: 0.000469089945157369





-----Task A1: Grid searching on
KNN-----

KNN Grid search CV on Dataset A:

Training scores:

0.840 (+/-0.007) for {'n_neighbors': 8}
0.836 (+/-0.009) for {'n_neighbors': 16}
0.830 (+/-0.009) for {'n_neighbors': 32}
0.820 (+/-0.007) for {'n_neighbors': 64}
0.815 (+/-0.005) for {'n_neighbors': 128}

Validation scores:

0.799 (+/-0.021) for {'n_neighbors': 8}
0.808 (+/-0.010) for {'n_neighbors': 16}
0.812 (+/-0.022) for {'n_neighbors': 32}
0.812 (+/-0.019) for {'n_neighbors': 64}
0.809 (+/-0.009) for {'n_neighbors': 128}

Prediction on a pseudo test set (split from Dataset A):

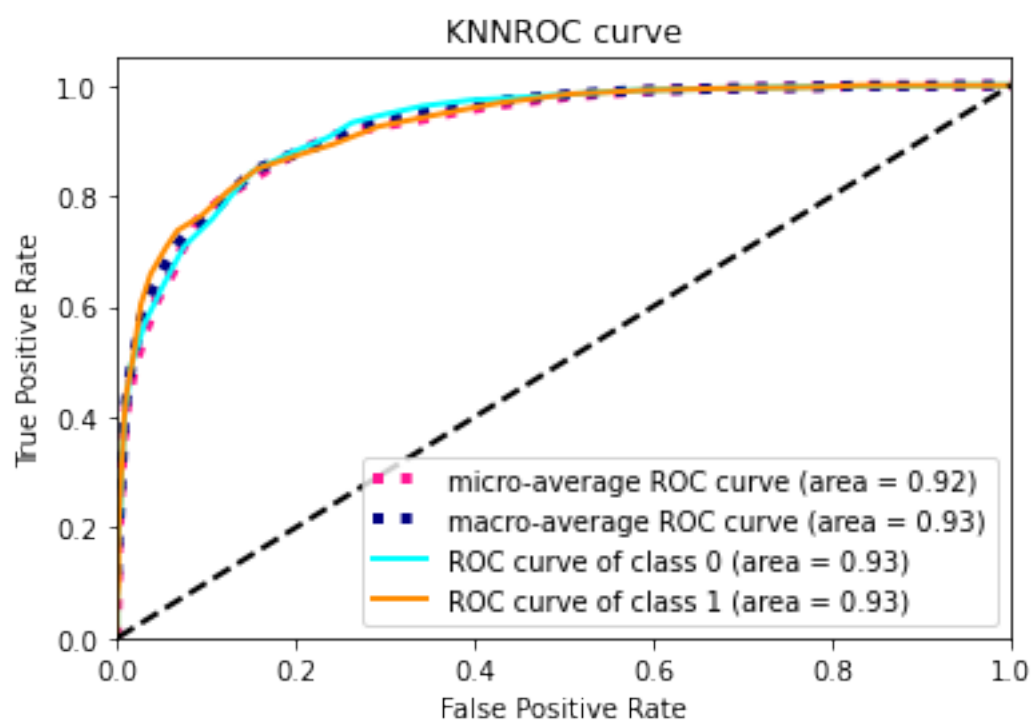
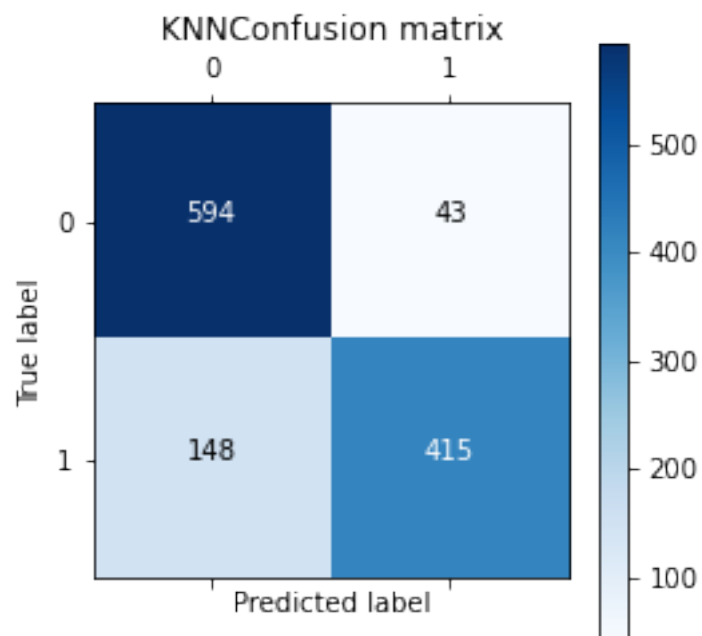
	precision	recall	f1-score	support
0.0	0.80	0.93	0.86	637
1.0	0.91	0.74	0.81	563
accuracy			0.84	1200
macro avg	0.85	0.83	0.84	1200
weighted avg	0.85	0.84	0.84	1200

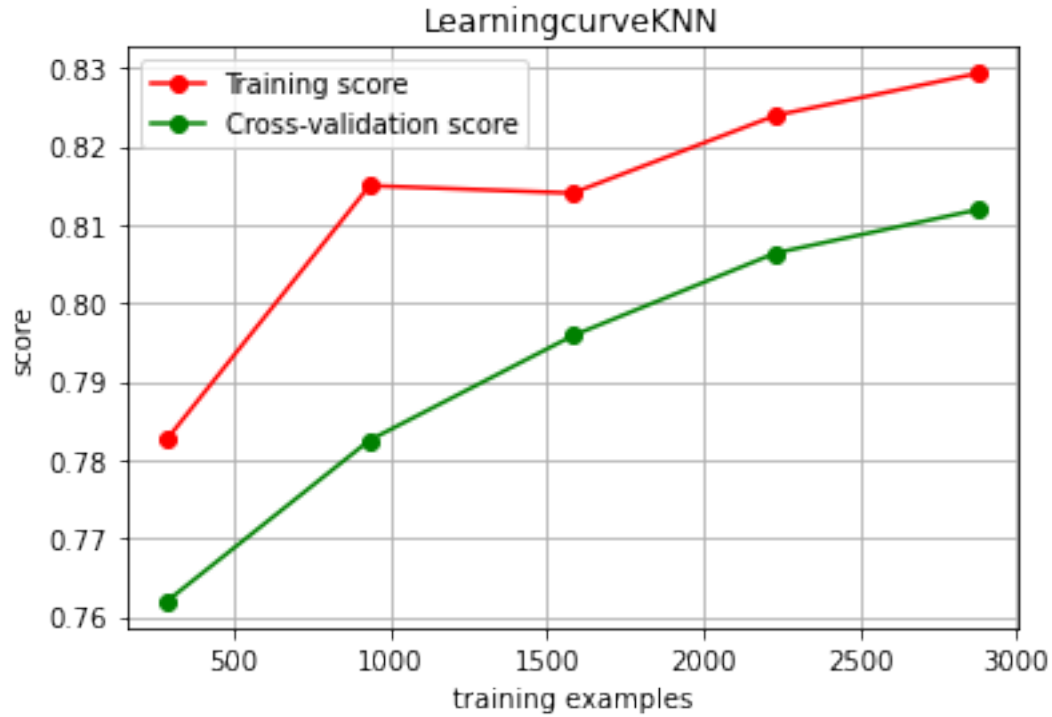
Accuracy: 0.8408333333333333

Best parameters found on Dataset A:

{'n_neighbors': 32}

Average runtime per test instance: 0.0046141950289408365





-----Task A1: Gird searching on
MLP-----

#####

Sequential with Kfold CV:

Training for fold 1 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_1"

Layer (type)	Output Shape	Param #
dense_1 (Dense)	(None, 2176)	298112
dense_2 (Dense)	(None, 1088)	2368576
dropout_1 (Dropout)	(None, 1088)	0
dense_3 (Dense)	(None, 544)	592416

dropout_2 (Dropout)	(None, 544)	0

dense_4 (Dense)	(None, 272)	148240

dropout_3 (Dropout)	(None, 272)	0

dense_5 (Dense)	(None, 2)	546
=====		

Total params: 3,407,890

Trainable params: 3,407,890

Non-trainable params: 0

WARNING:tensorflow:From /Users/apple/opt/anaconda3/envs/AMLS/lib/python3.6/site-packages/keras/backend/tensorflow_backend.py:422: The name tf.global_variables is deprecated. Please use tf.compat.v1.global_variables instead.

Train on 2880 samples, validate on 720 samples

Epoch 1/50

2880/2880 [=====] - 8s 3ms/step - loss: 1.7760 - accuracy: 0.5507 - val_loss: 0.5097 - val_accuracy: 0.7500

Epoch 2/50

2880/2880 [=====] - 2s 818us/step - loss: 0.4809 - accuracy: 0.7830 - val_loss: 0.3649 - val_accuracy: 0.8389

Epoch 3/50

2880/2880 [=====] - 2s 686us/step - loss: 0.3193 - accuracy: 0.8653 - val_loss: 0.3237 - val_accuracy: 0.8528

Epoch 4/50

2880/2880 [=====] - 3s 880us/step - loss: 0.3329 - accuracy: 0.8618 - val_loss: 0.2598 - val_accuracy: 0.8972

Epoch 5/50

2880/2880 [=====] - 3s 884us/step - loss: 0.2962 - accuracy: 0.8806 - val_loss: 0.3196 - val_accuracy: 0.8611

Epoch 6/50

2880/2880 [=====] - 2s 867us/step - loss: 0.2727 - accuracy: 0.8899 - val_loss: 0.2622 - val_accuracy: 0.8792

Epoch 7/50

2880/2880 [=====] - 3s 883us/step - loss: 0.2528 - accuracy: 0.8993 - val_loss: 0.2832 - val_accuracy: 0.8861

Epoch 8/50

2880/2880 [=====] - 3s 881us/step - loss: 0.2608 - accuracy: 0.8899 - val_loss: 0.2523 - val_accuracy: 0.9111

Epoch 9/50

2880/2880 [=====] - 3s 882us/step - loss: 0.2550 - accuracy: 0.8941 - val_loss: 0.2370 - val_accuracy: 0.9111

Epoch 10/50

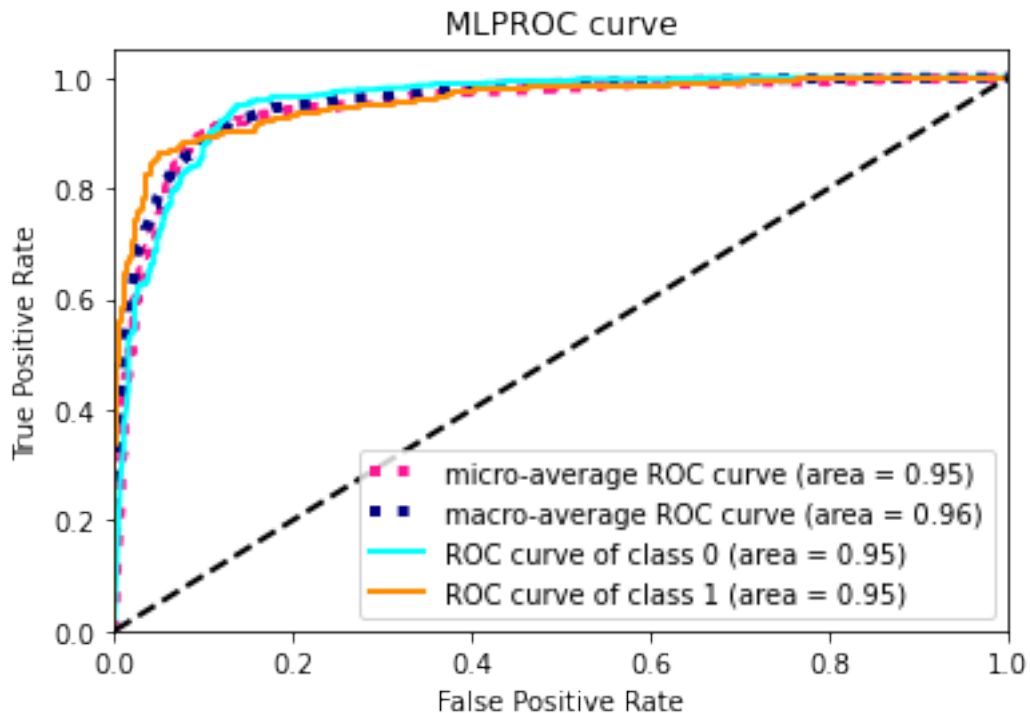
2880/2880 [=====] - 3s 885us/step - loss: 0.2144 - accuracy: 0.9142 - val_loss: 0.2486 - val_accuracy: 0.9069

Epoch 11/50

2880/2880 [=====] - 3s 880us/step - loss: 0.2312 - accuracy: 0.9080 - val_loss: 0.2402 - val_accuracy: 0.9000
Epoch 12/50
2880/2880 [=====] - 2s 854us/step - loss: 0.2066 - accuracy: 0.9139 - val_loss: 0.2729 - val_accuracy: 0.8736
Epoch 13/50
2880/2880 [=====] - 3s 887us/step - loss: 0.2057 - accuracy: 0.9167 - val_loss: 0.4767 - val_accuracy: 0.8236
Epoch 14/50
2880/2880 [=====] - 2s 868us/step - loss: 0.2402 - accuracy: 0.9017 - val_loss: 0.2382 - val_accuracy: 0.9111
Epoch 15/50
2880/2880 [=====] - 3s 873us/step - loss: 0.1966 - accuracy: 0.9139 - val_loss: 0.2550 - val_accuracy: 0.9056
Epoch 16/50
2880/2880 [=====] - 3s 879us/step - loss: 0.1745 - accuracy: 0.9271 - val_loss: 0.3941 - val_accuracy: 0.8625
Epoch 17/50
2880/2880 [=====] - 3s 872us/step - loss: 0.2009 - accuracy: 0.9174 - val_loss: 0.2450 - val_accuracy: 0.9153
Epoch 18/50
2880/2880 [=====] - 3s 880us/step - loss: 0.1792 - accuracy: 0.9271 - val_loss: 0.2545 - val_accuracy: 0.9014
Epoch 19/50
2880/2880 [=====] - 3s 870us/step - loss: 0.1948 - accuracy: 0.9243 - val_loss: 0.3225 - val_accuracy: 0.8861
Epoch 20/50
2880/2880 [=====] - 2s 862us/step - loss: 0.1818 - accuracy: 0.9243 - val_loss: 0.2759 - val_accuracy: 0.8972
Epoch 21/50
2880/2880 [=====] - 3s 887us/step - loss: 0.1562 - accuracy: 0.9354 - val_loss: 0.2606 - val_accuracy: 0.9181
Epoch 22/50
2880/2880 [=====] - 3s 876us/step - loss: 0.1750 - accuracy: 0.9198 - val_loss: 0.2838 - val_accuracy: 0.8611
Epoch 23/50
2880/2880 [=====] - 3s 880us/step - loss: 0.1516 - accuracy: 0.9354 - val_loss: 0.2892 - val_accuracy: 0.8917
Epoch 24/50
2880/2880 [=====] - 3s 901us/step - loss: 0.1655 - accuracy: 0.9236 - val_loss: 0.2235 - val_accuracy: 0.9250
Epoch 25/50
2880/2880 [=====] - 3s 887us/step - loss: 0.1354 - accuracy: 0.9413 - val_loss: 0.2775 - val_accuracy: 0.9208
Epoch 26/50
2880/2880 [=====] - 3s 887us/step - loss: 0.1333 - accuracy: 0.9413 - val_loss: 0.3202 - val_accuracy: 0.9056
Epoch 27/50

2880/2880 [=====] - 3s 890us/step - loss: 0.1439 -
accuracy: 0.9413 - val_loss: 0.2804 - val_accuracy: 0.8806
Epoch 28/50
2880/2880 [=====] - 3s 930us/step - loss: 0.1648 -
accuracy: 0.9285 - val_loss: 0.2332 - val_accuracy: 0.9181
Epoch 29/50
2880/2880 [=====] - 3s 1ms/step - loss: 0.1330 -
accuracy: 0.9451 - val_loss: 0.2763 - val_accuracy: 0.9264
Epoch 30/50
2880/2880 [=====] - 3s 1000us/step - loss: 0.1380 -
accuracy: 0.9469 - val_loss: 0.2570 - val_accuracy: 0.9139
Epoch 31/50
2880/2880 [=====] - 3s 900us/step - loss: 0.1188 -
accuracy: 0.9493 - val_loss: 0.3567 - val_accuracy: 0.9042
Epoch 32/50
2880/2880 [=====] - 3s 896us/step - loss: 0.1458 -
accuracy: 0.9431 - val_loss: 0.2766 - val_accuracy: 0.8972
Epoch 33/50
2880/2880 [=====] - 3s 918us/step - loss: 0.1171 -
accuracy: 0.9524 - val_loss: 0.3100 - val_accuracy: 0.9056
Epoch 34/50
2880/2880 [=====] - 3s 890us/step - loss: 0.1314 -
accuracy: 0.9479 - val_loss: 0.3310 - val_accuracy: 0.9028
Epoch 35/50
2880/2880 [=====] - 3s 893us/step - loss: 0.1063 -
accuracy: 0.9552 - val_loss: 0.3036 - val_accuracy: 0.9181
Epoch 36/50
2880/2880 [=====] - 3s 893us/step - loss: 0.1192 -
accuracy: 0.9538 - val_loss: 0.2530 - val_accuracy: 0.9319
Epoch 37/50
2880/2880 [=====] - 3s 892us/step - loss: 0.1098 -
accuracy: 0.9576 - val_loss: 0.2738 - val_accuracy: 0.9222
Epoch 38/50
2880/2880 [=====] - 3s 904us/step - loss: 0.0863 -
accuracy: 0.9646 - val_loss: 0.3780 - val_accuracy: 0.9056
Epoch 39/50
2880/2880 [=====] - 3s 889us/step - loss: 0.1110 -
accuracy: 0.9545 - val_loss: 0.3042 - val_accuracy: 0.9292
Epoch 40/50
2880/2880 [=====] - 3s 894us/step - loss: 0.1281 -
accuracy: 0.9451 - val_loss: 0.2534 - val_accuracy: 0.9139
Epoch 41/50
2880/2880 [=====] - 3s 922us/step - loss: 0.0776 -
accuracy: 0.9681 - val_loss: 0.3789 - val_accuracy: 0.9069
Epoch 42/50
2880/2880 [=====] - 3s 910us/step - loss: 0.1437 -
accuracy: 0.9399 - val_loss: 0.3091 - val_accuracy: 0.9222
Epoch 43/50

2880/2880 [=====] - 3s 887us/step - loss: 0.0927 -
accuracy: 0.9646 - val_loss: 0.3102 - val_accuracy: 0.9194
Epoch 44/50
2880/2880 [=====] - 3s 869us/step - loss: 0.1175 -
accuracy: 0.9597 - val_loss: 0.2746 - val_accuracy: 0.9222
Epoch 45/50
2880/2880 [=====] - 3s 880us/step - loss: 0.0745 -
accuracy: 0.9708 - val_loss: 0.4392 - val_accuracy: 0.8806
Epoch 46/50
2880/2880 [=====] - 3s 881us/step - loss: 0.1065 -
accuracy: 0.9535 - val_loss: 0.3760 - val_accuracy: 0.9069
Epoch 47/50
2880/2880 [=====] - 3s 882us/step - loss: 0.1001 -
accuracy: 0.9632 - val_loss: 0.3186 - val_accuracy: 0.9139
Epoch 48/50
2880/2880 [=====] - 3s 875us/step - loss: 0.0964 -
accuracy: 0.9656 - val_loss: 0.2979 - val_accuracy: 0.9208
Epoch 49/50
2880/2880 [=====] - 3s 883us/step - loss: 0.0875 -
accuracy: 0.9646 - val_loss: 0.2685 - val_accuracy: 0.9083
Epoch 50/50
2880/2880 [=====] - 3s 894us/step - loss: 0.0611 -
accuracy: 0.9792 - val_loss: 0.5453 - val_accuracy: 0.9000
1200/1200 [=====] - 1s 562us/step



Sequential with Kfold CV:

Training for fold 2 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_2"

Layer (type)	Output Shape	Param #
dense_6 (Dense)	(None, 2176)	298112
dense_7 (Dense)	(None, 1088)	2368576
dropout_4 (Dropout)	(None, 1088)	0
dense_8 (Dense)	(None, 544)	592416
dropout_5 (Dropout)	(None, 544)	0
dense_9 (Dense)	(None, 272)	148240
dropout_6 (Dropout)	(None, 272)	0
dense_10 (Dense)	(None, 2)	546

Total params: 3,407,890

Trainable params: 3,407,890

Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50

2880/2880 [=====] - 8s 3ms/step - loss: 1.5425 -
accuracy: 0.5771 - val_loss: 0.4574 - val_accuracy: 0.7903

Epoch 2/50

2880/2880 [=====] - 3s 883us/step - loss: 0.4389 -
accuracy: 0.8024 - val_loss: 0.3372 - val_accuracy: 0.8611

Epoch 3/50

2880/2880 [=====] - 3s 881us/step - loss: 0.3690 -
accuracy: 0.8434 - val_loss: 0.3014 - val_accuracy: 0.8736

Epoch 4/50

2880/2880 [=====] - 3s 895us/step - loss: 0.2717 -
accuracy: 0.8896 - val_loss: 0.2941 - val_accuracy: 0.8875

Epoch 5/50

2880/2880 [=====] - 3s 883us/step - loss: 0.3056 -
accuracy: 0.8722 - val_loss: 0.3069 - val_accuracy: 0.8806

Epoch 6/50

2880/2880 [=====] - 3s 892us/step - loss: 0.2445 -

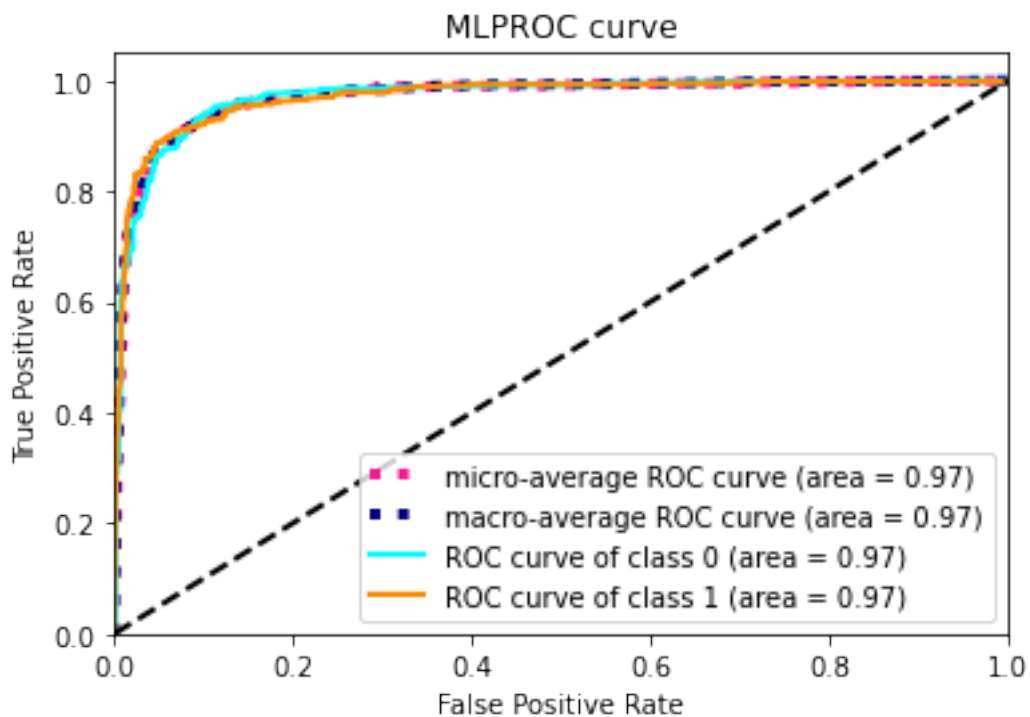
accuracy: 0.8976 - val_loss: 0.3102 - val_accuracy: 0.8861
 Epoch 7/50
 2880/2880 [=====] - 3s 886us/step - loss: 0.2244 -
 accuracy: 0.9083 - val_loss: 0.3877 - val_accuracy: 0.8653
 Epoch 8/50
 2880/2880 [=====] - 3s 879us/step - loss: 0.2834 -
 accuracy: 0.8819 - val_loss: 0.3984 - val_accuracy: 0.8611
 Epoch 9/50
 2880/2880 [=====] - 3s 883us/step - loss: 0.2256 -
 accuracy: 0.9080 - val_loss: 0.2667 - val_accuracy: 0.8944
 Epoch 10/50
 2880/2880 [=====] - 3s 888us/step - loss: 0.2251 -
 accuracy: 0.9059 - val_loss: 0.3212 - val_accuracy: 0.8542
 Epoch 11/50
 2880/2880 [=====] - 3s 876us/step - loss: 0.2231 -
 accuracy: 0.9080 - val_loss: 0.2993 - val_accuracy: 0.9056
 Epoch 12/50
 2880/2880 [=====] - 2s 864us/step - loss: 0.2031 -
 accuracy: 0.9181 - val_loss: 0.3070 - val_accuracy: 0.8764
 Epoch 13/50
 2880/2880 [=====] - 3s 896us/step - loss: 0.2015 -
 accuracy: 0.9233 - val_loss: 0.3007 - val_accuracy: 0.8917
 Epoch 14/50
 2880/2880 [=====] - 3s 887us/step - loss: 0.2091 -
 accuracy: 0.9149 - val_loss: 0.2467 - val_accuracy: 0.8958
 Epoch 15/50
 2880/2880 [=====] - 3s 893us/step - loss: 0.1749 -
 accuracy: 0.9323 - val_loss: 0.2856 - val_accuracy: 0.9014
 Epoch 16/50
 2880/2880 [=====] - 2s 865us/step - loss: 0.2114 -
 accuracy: 0.9108 - val_loss: 0.3120 - val_accuracy: 0.8694
 Epoch 17/50
 2880/2880 [=====] - 3s 886us/step - loss: 0.1698 -
 accuracy: 0.9264 - val_loss: 0.2943 - val_accuracy: 0.8903
 Epoch 18/50
 2880/2880 [=====] - 3s 878us/step - loss: 0.2003 -
 accuracy: 0.9240 - val_loss: 0.2649 - val_accuracy: 0.9000
 Epoch 19/50
 2880/2880 [=====] - 3s 884us/step - loss: 0.1537 -
 accuracy: 0.9375 - val_loss: 0.2767 - val_accuracy: 0.8972
 Epoch 20/50
 2880/2880 [=====] - 3s 898us/step - loss: 0.1651 -
 accuracy: 0.9309 - val_loss: 0.3674 - val_accuracy: 0.8764
 Epoch 21/50
 2880/2880 [=====] - 3s 881us/step - loss: 0.1532 -
 accuracy: 0.9378 - val_loss: 0.3211 - val_accuracy: 0.9056
 Epoch 22/50
 2880/2880 [=====] - 3s 875us/step - loss: 0.1690 -

accuracy: 0.9288 - val_loss: 0.3288 - val_accuracy: 0.8722
 Epoch 23/50
 2880/2880 [=====] - 3s 880us/step - loss: 0.1553 -
 accuracy: 0.9347 - val_loss: 0.3175 - val_accuracy: 0.8819
 Epoch 24/50
 2880/2880 [=====] - 3s 896us/step - loss: 0.1598 -
 accuracy: 0.9347 - val_loss: 0.3071 - val_accuracy: 0.9083
 Epoch 25/50
 2880/2880 [=====] - 3s 878us/step - loss: 0.1572 -
 accuracy: 0.9333 - val_loss: 0.3806 - val_accuracy: 0.8931
 Epoch 26/50
 2880/2880 [=====] - 3s 888us/step - loss: 0.1491 -
 accuracy: 0.9344 - val_loss: 0.3273 - val_accuracy: 0.8931
 Epoch 27/50
 2880/2880 [=====] - 3s 897us/step - loss: 0.1262 -
 accuracy: 0.9444 - val_loss: 0.4130 - val_accuracy: 0.9153
 Epoch 28/50
 2880/2880 [=====] - 2s 864us/step - loss: 0.1872 -
 accuracy: 0.9278 - val_loss: 0.3045 - val_accuracy: 0.9000
 Epoch 29/50
 2880/2880 [=====] - 3s 914us/step - loss: 0.1225 -
 accuracy: 0.9497 - val_loss: 0.3550 - val_accuracy: 0.9042
 Epoch 30/50
 2880/2880 [=====] - 3s 889us/step - loss: 0.1507 -
 accuracy: 0.9347 - val_loss: 0.3379 - val_accuracy: 0.9014
 Epoch 31/50
 2880/2880 [=====] - 3s 885us/step - loss: 0.1158 -
 accuracy: 0.9503 - val_loss: 0.3438 - val_accuracy: 0.8806
 Epoch 32/50
 2880/2880 [=====] - 3s 874us/step - loss: 0.1147 -
 accuracy: 0.9514 - val_loss: 0.4197 - val_accuracy: 0.9042
 Epoch 33/50
 2880/2880 [=====] - 3s 910us/step - loss: 0.1137 -
 accuracy: 0.9542 - val_loss: 0.3728 - val_accuracy: 0.9000
 Epoch 34/50
 2880/2880 [=====] - 3s 890us/step - loss: 0.1274 -
 accuracy: 0.9458 - val_loss: 0.4012 - val_accuracy: 0.8903
 Epoch 35/50
 2880/2880 [=====] - 3s 899us/step - loss: 0.0949 -
 accuracy: 0.9646 - val_loss: 0.4547 - val_accuracy: 0.9181
 Epoch 36/50
 2880/2880 [=====] - 3s 900us/step - loss: 0.1530 -
 accuracy: 0.9410 - val_loss: 0.3124 - val_accuracy: 0.9083
 Epoch 37/50
 2880/2880 [=====] - 3s 891us/step - loss: 0.0786 -
 accuracy: 0.9698 - val_loss: 0.4749 - val_accuracy: 0.8875
 Epoch 38/50
 2880/2880 [=====] - 3s 877us/step - loss: 0.1538 -

```

accuracy: 0.9427 - val_loss: 0.2819 - val_accuracy: 0.9139
Epoch 39/50
2880/2880 [=====] - 3s 889us/step - loss: 0.1122 -
accuracy: 0.9611 - val_loss: 0.2752 - val_accuracy: 0.8958
Epoch 40/50
2880/2880 [=====] - 3s 882us/step - loss: 0.1202 -
accuracy: 0.9552 - val_loss: 0.3065 - val_accuracy: 0.8875
Epoch 41/50
2880/2880 [=====] - 3s 892us/step - loss: 0.0830 -
accuracy: 0.9684 - val_loss: 0.4704 - val_accuracy: 0.9069
Epoch 42/50
2880/2880 [=====] - 3s 888us/step - loss: 0.1159 -
accuracy: 0.9542 - val_loss: 0.4802 - val_accuracy: 0.8736
Epoch 43/50
2880/2880 [=====] - 3s 884us/step - loss: 0.1049 -
accuracy: 0.9601 - val_loss: 0.2950 - val_accuracy: 0.8958
Epoch 44/50
2880/2880 [=====] - 3s 900us/step - loss: 0.0658 -
accuracy: 0.9771 - val_loss: 0.4492 - val_accuracy: 0.9097
Epoch 45/50
2880/2880 [=====] - 3s 887us/step - loss: 0.1034 -
accuracy: 0.9622 - val_loss: 0.5229 - val_accuracy: 0.8806
Epoch 46/50
2880/2880 [=====] - 3s 875us/step - loss: 0.1358 -
accuracy: 0.9521 - val_loss: 0.3935 - val_accuracy: 0.9083
Epoch 47/50
2880/2880 [=====] - 2s 867us/step - loss: 0.0606 -
accuracy: 0.9788 - val_loss: 0.4179 - val_accuracy: 0.9111
Epoch 48/50
2880/2880 [=====] - 3s 892us/step - loss: 0.1037 -
accuracy: 0.9635 - val_loss: 0.3792 - val_accuracy: 0.9056
Epoch 49/50
2880/2880 [=====] - 3s 877us/step - loss: 0.0645 -
accuracy: 0.9715 - val_loss: 0.4508 - val_accuracy: 0.9097
Epoch 50/50
2880/2880 [=====] - 3s 895us/step - loss: 0.0587 -
accuracy: 0.9757 - val_loss: 0.5628 - val_accuracy: 0.8972
1200/1200 [=====] - 1s 543us/step

```



Sequential with Kfold CV:

Training for fold 3 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_3"

Layer (type)	Output Shape	Param #
dense_11 (Dense)	(None, 2176)	298112
dense_12 (Dense)	(None, 1088)	2368576
dropout_7 (Dropout)	(None, 1088)	0
dense_13 (Dense)	(None, 544)	592416
dropout_8 (Dropout)	(None, 544)	0
dense_14 (Dense)	(None, 272)	148240
dropout_9 (Dropout)	(None, 272)	0

```

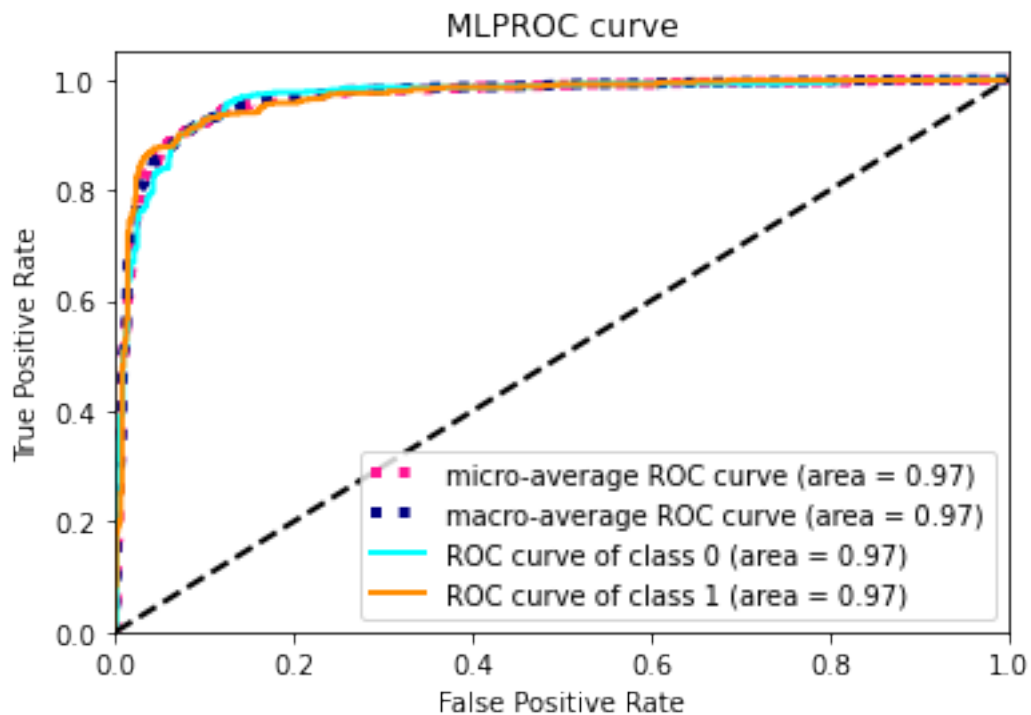
dense_15 (Dense)                (None, 2)                546
=====
Total params: 3,407,890
Trainable params: 3,407,890
Non-trainable params: 0
-----
Train on 2880 samples, validate on 720 samples
Epoch 1/50
2880/2880 [=====] - 8s 3ms/step - loss: 1.4256 -
accuracy: 0.5688 - val_loss: 0.4442 - val_accuracy: 0.8375
Epoch 2/50
2880/2880 [=====] - 3s 878us/step - loss: 0.4584 -
accuracy: 0.7986 - val_loss: 0.3101 - val_accuracy: 0.8569
Epoch 3/50
2880/2880 [=====] - 3s 890us/step - loss: 0.3168 -
accuracy: 0.8701 - val_loss: 0.3495 - val_accuracy: 0.8403
Epoch 4/50
2880/2880 [=====] - 3s 897us/step - loss: 0.2772 -
accuracy: 0.8851 - val_loss: 0.2641 - val_accuracy: 0.8875
Epoch 5/50
2880/2880 [=====] - 3s 891us/step - loss: 0.3389 -
accuracy: 0.8597 - val_loss: 0.2826 - val_accuracy: 0.8875
Epoch 6/50
2880/2880 [=====] - 3s 884us/step - loss: 0.2467 -
accuracy: 0.8990 - val_loss: 0.2603 - val_accuracy: 0.8944
Epoch 7/50
2880/2880 [=====] - 3s 887us/step - loss: 0.2551 -
accuracy: 0.8924 - val_loss: 0.2459 - val_accuracy: 0.8931
Epoch 8/50
2880/2880 [=====] - 3s 886us/step - loss: 0.2334 -
accuracy: 0.9045 - val_loss: 0.3296 - val_accuracy: 0.8542
Epoch 9/50
2880/2880 [=====] - 2s 867us/step - loss: 0.2424 -
accuracy: 0.9010 - val_loss: 0.2624 - val_accuracy: 0.8792
Epoch 10/50
2880/2880 [=====] - 3s 893us/step - loss: 0.2224 -
accuracy: 0.9066 - val_loss: 0.2507 - val_accuracy: 0.8931
Epoch 11/50
2880/2880 [=====] - 2s 829us/step - loss: 0.2404 -
accuracy: 0.9073 - val_loss: 0.2797 - val_accuracy: 0.9014
Epoch 12/50
2880/2880 [=====] - 2s 678us/step - loss: 0.2244 -
accuracy: 0.9167 - val_loss: 0.2389 - val_accuracy: 0.9097
Epoch 13/50
2880/2880 [=====] - 2s 805us/step - loss: 0.2019 -
accuracy: 0.9135 - val_loss: 0.2751 - val_accuracy: 0.8903
Epoch 14/50
2880/2880 [=====] - 3s 1ms/step - loss: 0.1949 -

```

accuracy: 0.9229 - val_loss: 0.2159 - val_accuracy: 0.9111
 Epoch 15/50
 2880/2880 [=====] - 3s 1ms/step - loss: 0.1878 -
 accuracy: 0.9243 - val_loss: 0.2228 - val_accuracy: 0.9194
 Epoch 16/50
 2880/2880 [=====] - 3s 1ms/step - loss: 0.1813 -
 accuracy: 0.9271 - val_loss: 0.2916 - val_accuracy: 0.9056
 Epoch 17/50
 2880/2880 [=====] - 3s 1ms/step - loss: 0.2017 -
 accuracy: 0.9240 - val_loss: 0.2434 - val_accuracy: 0.8958
 Epoch 18/50
 2880/2880 [=====] - 3s 1ms/step - loss: 0.1751 -
 accuracy: 0.9295 - val_loss: 0.2641 - val_accuracy: 0.8958
 Epoch 19/50
 2880/2880 [=====] - 3s 874us/step - loss: 0.1734 -
 accuracy: 0.9361 - val_loss: 0.2997 - val_accuracy: 0.8944
 Epoch 20/50
 2880/2880 [=====] - 3s 891us/step - loss: 0.1643 -
 accuracy: 0.9375 - val_loss: 0.3842 - val_accuracy: 0.8375
 Epoch 21/50
 2880/2880 [=====] - 3s 873us/step - loss: 0.1769 -
 accuracy: 0.9271 - val_loss: 0.2215 - val_accuracy: 0.9194
 Epoch 22/50
 2880/2880 [=====] - 3s 886us/step - loss: 0.1734 -
 accuracy: 0.9347 - val_loss: 0.2614 - val_accuracy: 0.8986
 Epoch 23/50
 2880/2880 [=====] - 3s 919us/step - loss: 0.1570 -
 accuracy: 0.9399 - val_loss: 0.2498 - val_accuracy: 0.8917
 Epoch 24/50
 2880/2880 [=====] - 3s 878us/step - loss: 0.1181 -
 accuracy: 0.9542 - val_loss: 0.2741 - val_accuracy: 0.9194
 Epoch 25/50
 2880/2880 [=====] - 3s 937us/step - loss: 0.1978 -
 accuracy: 0.9312 - val_loss: 0.3120 - val_accuracy: 0.8833
 Epoch 26/50
 2880/2880 [=====] - 3s 875us/step - loss: 0.1508 -
 accuracy: 0.9455 - val_loss: 0.2504 - val_accuracy: 0.9069
 Epoch 27/50
 2880/2880 [=====] - 3s 885us/step - loss: 0.1338 -
 accuracy: 0.9462 - val_loss: 0.2984 - val_accuracy: 0.9097
 Epoch 28/50
 2880/2880 [=====] - 3s 889us/step - loss: 0.1428 -
 accuracy: 0.9431 - val_loss: 0.2729 - val_accuracy: 0.9139
 Epoch 29/50
 2880/2880 [=====] - 3s 887us/step - loss: 0.1329 -
 accuracy: 0.9493 - val_loss: 0.3580 - val_accuracy: 0.8958
 Epoch 30/50
 2880/2880 [=====] - 3s 890us/step - loss: 0.1279 -

accuracy: 0.9507 - val_loss: 0.3876 - val_accuracy: 0.8208
 Epoch 31/50
 2880/2880 [=====] - 2s 867us/step - loss: 0.1612 -
 accuracy: 0.9434 - val_loss: 0.2538 - val_accuracy: 0.8931
 Epoch 32/50
 2880/2880 [=====] - 3s 898us/step - loss: 0.1047 -
 accuracy: 0.9604 - val_loss: 0.3140 - val_accuracy: 0.9125
 Epoch 33/50
 2880/2880 [=====] - 3s 880us/step - loss: 0.1492 -
 accuracy: 0.9417 - val_loss: 0.2438 - val_accuracy: 0.9222
 Epoch 34/50
 2880/2880 [=====] - 3s 885us/step - loss: 0.1327 -
 accuracy: 0.9524 - val_loss: 0.2782 - val_accuracy: 0.9097
 Epoch 35/50
 2880/2880 [=====] - 3s 882us/step - loss: 0.1332 -
 accuracy: 0.9472 - val_loss: 0.3154 - val_accuracy: 0.9111
 Epoch 36/50
 2880/2880 [=====] - 3s 869us/step - loss: 0.0884 -
 accuracy: 0.9694 - val_loss: 0.3910 - val_accuracy: 0.8847
 Epoch 37/50
 2880/2880 [=====] - 3s 905us/step - loss: 0.1514 -
 accuracy: 0.9417 - val_loss: 0.3238 - val_accuracy: 0.8847
 Epoch 38/50
 2880/2880 [=====] - 3s 885us/step - loss: 0.1040 -
 accuracy: 0.9583 - val_loss: 0.3120 - val_accuracy: 0.9014
 Epoch 39/50
 2880/2880 [=====] - 3s 898us/step - loss: 0.0904 -
 accuracy: 0.9635 - val_loss: 0.3731 - val_accuracy: 0.8931
 Epoch 40/50
 2880/2880 [=====] - 3s 907us/step - loss: 0.1342 -
 accuracy: 0.9552 - val_loss: 0.3141 - val_accuracy: 0.9097
 Epoch 41/50
 2880/2880 [=====] - 3s 875us/step - loss: 0.1032 -
 accuracy: 0.9569 - val_loss: 0.3707 - val_accuracy: 0.9153
 Epoch 42/50
 2880/2880 [=====] - 3s 874us/step - loss: 0.1036 -
 accuracy: 0.9611 - val_loss: 0.3167 - val_accuracy: 0.9153
 Epoch 43/50
 2880/2880 [=====] - 3s 873us/step - loss: 0.1005 -
 accuracy: 0.9611 - val_loss: 0.3514 - val_accuracy: 0.9097
 Epoch 44/50
 2880/2880 [=====] - 3s 873us/step - loss: 0.0804 -
 accuracy: 0.9701 - val_loss: 0.3933 - val_accuracy: 0.9042
 Epoch 45/50
 2880/2880 [=====] - 3s 884us/step - loss: 0.1022 -
 accuracy: 0.9608 - val_loss: 0.3542 - val_accuracy: 0.8958
 Epoch 46/50
 2880/2880 [=====] - 3s 882us/step - loss: 0.0712 -

accuracy: 0.9701 - val_loss: 0.4223 - val_accuracy: 0.9111
Epoch 47/50
2880/2880 [=====] - 3s 897us/step - loss: 0.1010 -
accuracy: 0.9622 - val_loss: 0.3751 - val_accuracy: 0.9111
Epoch 48/50
2880/2880 [=====] - 3s 897us/step - loss: 0.0710 -
accuracy: 0.9757 - val_loss: 0.3500 - val_accuracy: 0.8958
Epoch 49/50
2880/2880 [=====] - 3s 900us/step - loss: 0.0756 -
accuracy: 0.9677 - val_loss: 0.4730 - val_accuracy: 0.8750
Epoch 50/50
2880/2880 [=====] - 2s 864us/step - loss: 0.1191 -
accuracy: 0.9611 - val_loss: 0.3039 - val_accuracy: 0.9167
1200/1200 [=====] - 1s 603us/step



Sequential with Kfold CV:
Training for fold 4 ...
Adding layer 1:
Adding layer 2:
Adding layer 3:
Model: "sequential_4"

Layer (type)	Output Shape	Param #
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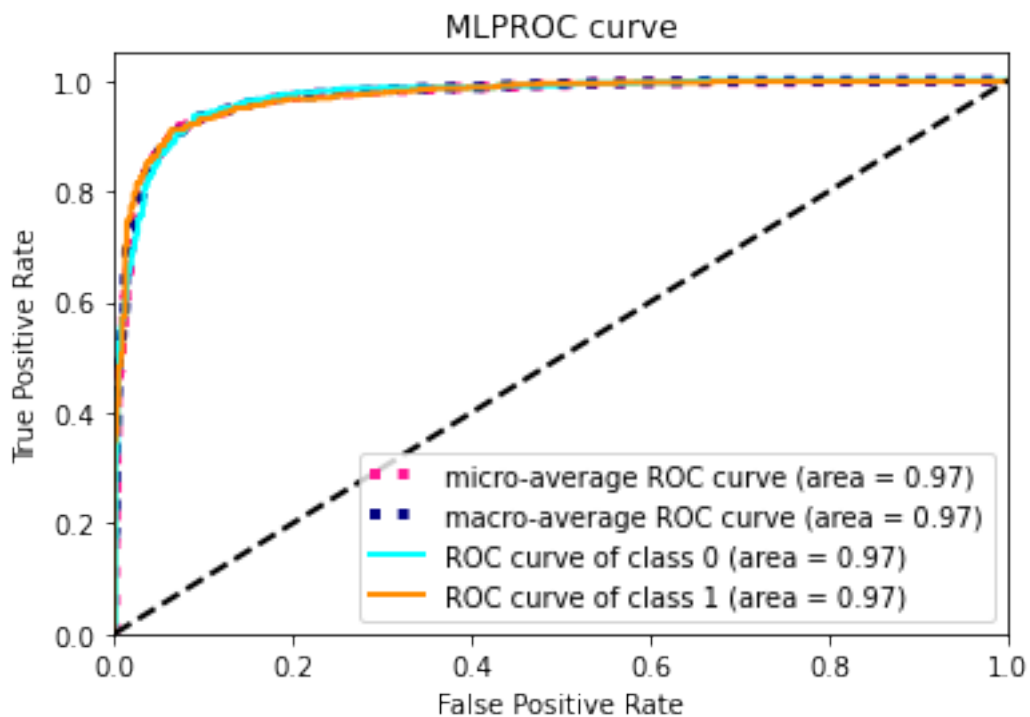
=====
dense_16 (Dense)                (None, 2176)                298112
-----
dense_17 (Dense)                (None, 1088)                2368576
-----
dropout_10 (Dropout)           (None, 1088)                0
-----
dense_18 (Dense)                (None, 544)                 592416
-----
dropout_11 (Dropout)           (None, 544)                 0
-----
dense_19 (Dense)                (None, 272)                 148240
-----
dropout_12 (Dropout)           (None, 272)                 0
-----
dense_20 (Dense)                (None, 2)                   546
=====
Total params: 3,407,890
Trainable params: 3,407,890
Non-trainable params: 0
-----
Train on 2880 samples, validate on 720 samples
Epoch 1/50
2880/2880 [=====] - 8s 3ms/step - loss: 1.5821 -
accuracy: 0.5767 - val_loss: 0.5356 - val_accuracy: 0.7319
Epoch 2/50
2880/2880 [=====] - 3s 880us/step - loss: 0.4606 -
accuracy: 0.7913 - val_loss: 0.3222 - val_accuracy: 0.8556
Epoch 3/50
2880/2880 [=====] - 3s 891us/step - loss: 0.3276 -
accuracy: 0.8604 - val_loss: 0.3422 - val_accuracy: 0.8514
Epoch 4/50
2880/2880 [=====] - 3s 890us/step - loss: 0.3044 -
accuracy: 0.8729 - val_loss: 0.2594 - val_accuracy: 0.9000
Epoch 5/50
2880/2880 [=====] - 3s 872us/step - loss: 0.2996 -
accuracy: 0.8736 - val_loss: 0.3465 - val_accuracy: 0.8403
Epoch 6/50
2880/2880 [=====] - 3s 888us/step - loss: 0.2718 -
accuracy: 0.8889 - val_loss: 0.2598 - val_accuracy: 0.9042
Epoch 7/50
2880/2880 [=====] - 3s 897us/step - loss: 0.2476 -
accuracy: 0.9021 - val_loss: 0.2503 - val_accuracy: 0.9056
Epoch 8/50
2880/2880 [=====] - 3s 902us/step - loss: 0.2435 -
accuracy: 0.9035 - val_loss: 0.2437 - val_accuracy: 0.9069
Epoch 9/50
2880/2880 [=====] - 3s 896us/step - loss: 0.2216 -

```

accuracy: 0.9080 - val_loss: 0.2328 - val_accuracy: 0.9139
 Epoch 10/50
 2880/2880 [=====] - 3s 881us/step - loss: 0.2387 -
 accuracy: 0.9118 - val_loss: 0.2679 - val_accuracy: 0.8958
 Epoch 11/50
 2880/2880 [=====] - 3s 891us/step - loss: 0.2015 -
 accuracy: 0.9198 - val_loss: 0.2734 - val_accuracy: 0.9000
 Epoch 12/50
 2880/2880 [=====] - 3s 896us/step - loss: 0.2245 -
 accuracy: 0.9056 - val_loss: 0.2635 - val_accuracy: 0.8986
 Epoch 13/50
 2880/2880 [=====] - 3s 884us/step - loss: 0.2187 -
 accuracy: 0.9090 - val_loss: 0.2510 - val_accuracy: 0.9153
 Epoch 14/50
 2880/2880 [=====] - 3s 899us/step - loss: 0.2099 -
 accuracy: 0.9222 - val_loss: 0.2916 - val_accuracy: 0.8917
 Epoch 15/50
 2880/2880 [=====] - 3s 889us/step - loss: 0.1989 -
 accuracy: 0.9219 - val_loss: 0.2533 - val_accuracy: 0.9028
 Epoch 16/50
 2880/2880 [=====] - 3s 904us/step - loss: 0.1799 -
 accuracy: 0.9278 - val_loss: 0.2699 - val_accuracy: 0.9069
 Epoch 17/50
 2880/2880 [=====] - 3s 924us/step - loss: 0.1728 -
 accuracy: 0.9292 - val_loss: 0.2685 - val_accuracy: 0.8833
 Epoch 18/50
 2880/2880 [=====] - 3s 922us/step - loss: 0.1899 -
 accuracy: 0.9163 - val_loss: 0.2814 - val_accuracy: 0.8986
 Epoch 19/50
 2880/2880 [=====] - 3s 897us/step - loss: 0.1681 -
 accuracy: 0.9333 - val_loss: 0.2704 - val_accuracy: 0.9028
 Epoch 20/50
 2880/2880 [=====] - 3s 912us/step - loss: 0.1711 -
 accuracy: 0.9368 - val_loss: 0.3308 - val_accuracy: 0.9125
 Epoch 21/50
 2880/2880 [=====] - 3s 878us/step - loss: 0.1978 -
 accuracy: 0.9267 - val_loss: 0.2581 - val_accuracy: 0.9111
 Epoch 22/50
 2880/2880 [=====] - 3s 893us/step - loss: 0.1586 -
 accuracy: 0.9361 - val_loss: 0.2617 - val_accuracy: 0.8819
 Epoch 23/50
 2880/2880 [=====] - 3s 894us/step - loss: 0.1517 -
 accuracy: 0.9385 - val_loss: 0.3048 - val_accuracy: 0.9042
 Epoch 24/50
 2880/2880 [=====] - 3s 882us/step - loss: 0.1537 -
 accuracy: 0.9375 - val_loss: 0.2428 - val_accuracy: 0.9056
 Epoch 25/50
 2880/2880 [=====] - 3s 896us/step - loss: 0.1267 -

accuracy: 0.9458 - val_loss: 0.2993 - val_accuracy: 0.8944
 Epoch 26/50
 2880/2880 [=====] - 3s 872us/step - loss: 0.1638 -
 accuracy: 0.9344 - val_loss: 0.2676 - val_accuracy: 0.9125
 Epoch 27/50
 2880/2880 [=====] - 3s 891us/step - loss: 0.1437 -
 accuracy: 0.9413 - val_loss: 0.3484 - val_accuracy: 0.8722
 Epoch 28/50
 2880/2880 [=====] - 3s 903us/step - loss: 0.1404 -
 accuracy: 0.9378 - val_loss: 0.3396 - val_accuracy: 0.8944
 Epoch 29/50
 2880/2880 [=====] - 3s 880us/step - loss: 0.1479 -
 accuracy: 0.9372 - val_loss: 0.2867 - val_accuracy: 0.8875
 Epoch 30/50
 2880/2880 [=====] - 3s 889us/step - loss: 0.1356 -
 accuracy: 0.9420 - val_loss: 0.3211 - val_accuracy: 0.9167
 Epoch 31/50
 2880/2880 [=====] - 3s 884us/step - loss: 0.1070 -
 accuracy: 0.9542 - val_loss: 0.4485 - val_accuracy: 0.9014
 Epoch 32/50
 2880/2880 [=====] - 3s 899us/step - loss: 0.1396 -
 accuracy: 0.9465 - val_loss: 0.3373 - val_accuracy: 0.8958
 Epoch 33/50
 2880/2880 [=====] - 3s 881us/step - loss: 0.1287 -
 accuracy: 0.9476 - val_loss: 0.4457 - val_accuracy: 0.8778
 Epoch 34/50
 2880/2880 [=====] - 3s 886us/step - loss: 0.1434 -
 accuracy: 0.9358 - val_loss: 0.3041 - val_accuracy: 0.9139
 Epoch 35/50
 2880/2880 [=====] - 3s 909us/step - loss: 0.1118 -
 accuracy: 0.9514 - val_loss: 0.3517 - val_accuracy: 0.8917
 Epoch 36/50
 2880/2880 [=====] - 2s 863us/step - loss: 0.1013 -
 accuracy: 0.9538 - val_loss: 0.4641 - val_accuracy: 0.8972
 Epoch 37/50
 2880/2880 [=====] - 3s 892us/step - loss: 0.1361 -
 accuracy: 0.9479 - val_loss: 0.3464 - val_accuracy: 0.8583
 Epoch 38/50
 2880/2880 [=====] - 3s 890us/step - loss: 0.1328 -
 accuracy: 0.9476 - val_loss: 0.3508 - val_accuracy: 0.8708
 Epoch 39/50
 2880/2880 [=====] - 3s 890us/step - loss: 0.1101 -
 accuracy: 0.9542 - val_loss: 0.3373 - val_accuracy: 0.8944
 Epoch 40/50
 2880/2880 [=====] - 3s 873us/step - loss: 0.1037 -
 accuracy: 0.9517 - val_loss: 0.3233 - val_accuracy: 0.8819
 Epoch 41/50
 2880/2880 [=====] - 3s 888us/step - loss: 0.1021 -

accuracy: 0.9587 - val_loss: 0.5991 - val_accuracy: 0.8653
Epoch 42/50
2880/2880 [=====] - 3s 879us/step - loss: 0.1273 -
accuracy: 0.9566 - val_loss: 0.3580 - val_accuracy: 0.9028
Epoch 43/50
2880/2880 [=====] - 3s 901us/step - loss: 0.1138 -
accuracy: 0.9531 - val_loss: 0.3530 - val_accuracy: 0.9069
Epoch 44/50
2880/2880 [=====] - 3s 897us/step - loss: 0.1067 -
accuracy: 0.9628 - val_loss: 0.3820 - val_accuracy: 0.8986
Epoch 45/50
2880/2880 [=====] - 3s 893us/step - loss: 0.0709 -
accuracy: 0.9688 - val_loss: 0.5421 - val_accuracy: 0.8639
Epoch 46/50
2880/2880 [=====] - 3s 893us/step - loss: 0.1240 -
accuracy: 0.9476 - val_loss: 0.3126 - val_accuracy: 0.9028
Epoch 47/50
2880/2880 [=====] - 3s 903us/step - loss: 0.0712 -
accuracy: 0.9740 - val_loss: 0.4670 - val_accuracy: 0.9111
Epoch 48/50
2880/2880 [=====] - 3s 873us/step - loss: 0.1220 -
accuracy: 0.9524 - val_loss: 0.3788 - val_accuracy: 0.9083
Epoch 49/50
2880/2880 [=====] - 3s 908us/step - loss: 0.1202 -
accuracy: 0.9569 - val_loss: 0.2964 - val_accuracy: 0.8958
Epoch 50/50
2880/2880 [=====] - 3s 875us/step - loss: 0.0704 -
accuracy: 0.9719 - val_loss: 0.3623 - val_accuracy: 0.9125
1200/1200 [=====] - 1s 621us/step



Sequential with Kfold CV:

Training for fold 5 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_5"

Layer (type)	Output Shape	Param #
dense_21 (Dense)	(None, 2176)	298112
dense_22 (Dense)	(None, 1088)	2368576
dropout_13 (Dropout)	(None, 1088)	0
dense_23 (Dense)	(None, 544)	592416
dropout_14 (Dropout)	(None, 544)	0
dense_24 (Dense)	(None, 272)	148240
dropout_15 (Dropout)	(None, 272)	0

```

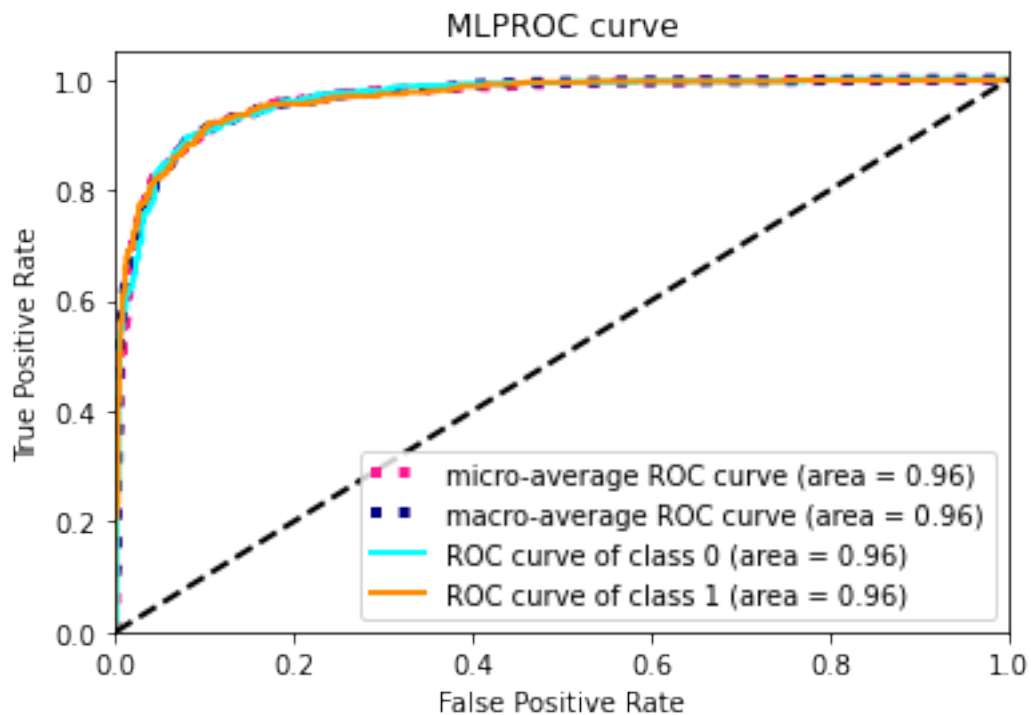
dense_25 (Dense)                (None, 2)                546
=====
Total params: 3,407,890
Trainable params: 3,407,890
Non-trainable params: 0
-----
Train on 2880 samples, validate on 720 samples
Epoch 1/50
2880/2880 [=====] - 8s 3ms/step - loss: 1.6835 -
accuracy: 0.5670 - val_loss: 0.5837 - val_accuracy: 0.7500
Epoch 2/50
2880/2880 [=====] - 2s 865us/step - loss: 0.5222 -
accuracy: 0.7646 - val_loss: 0.2951 - val_accuracy: 0.8819
Epoch 3/50
2880/2880 [=====] - 3s 897us/step - loss: 0.3301 -
accuracy: 0.8660 - val_loss: 0.3842 - val_accuracy: 0.8250
Epoch 4/50
2880/2880 [=====] - 3s 899us/step - loss: 0.3271 -
accuracy: 0.8615 - val_loss: 0.2828 - val_accuracy: 0.8694
Epoch 5/50
2880/2880 [=====] - 3s 880us/step - loss: 0.2929 -
accuracy: 0.8861 - val_loss: 0.2721 - val_accuracy: 0.8861
Epoch 6/50
2880/2880 [=====] - 3s 901us/step - loss: 0.2757 -
accuracy: 0.8885 - val_loss: 0.3153 - val_accuracy: 0.8792
Epoch 7/50
2880/2880 [=====] - 3s 892us/step - loss: 0.2644 -
accuracy: 0.8924 - val_loss: 0.2587 - val_accuracy: 0.8903
Epoch 8/50
2880/2880 [=====] - 3s 896us/step - loss: 0.2451 -
accuracy: 0.9059 - val_loss: 0.2595 - val_accuracy: 0.8972
Epoch 9/50
2880/2880 [=====] - 3s 912us/step - loss: 0.2587 -
accuracy: 0.9000 - val_loss: 0.2544 - val_accuracy: 0.9042
Epoch 10/50
2880/2880 [=====] - 3s 902us/step - loss: 0.2349 -
accuracy: 0.9066 - val_loss: 0.2349 - val_accuracy: 0.8972
Epoch 11/50
2880/2880 [=====] - 3s 885us/step - loss: 0.2151 -
accuracy: 0.9153 - val_loss: 0.2845 - val_accuracy: 0.9042
Epoch 12/50
2880/2880 [=====] - 3s 883us/step - loss: 0.2436 -
accuracy: 0.9059 - val_loss: 0.2430 - val_accuracy: 0.9069
Epoch 13/50
2880/2880 [=====] - 3s 879us/step - loss: 0.1900 -
accuracy: 0.9222 - val_loss: 0.3116 - val_accuracy: 0.8958
Epoch 14/50
2880/2880 [=====] - 3s 880us/step - loss: 0.2246 -

```

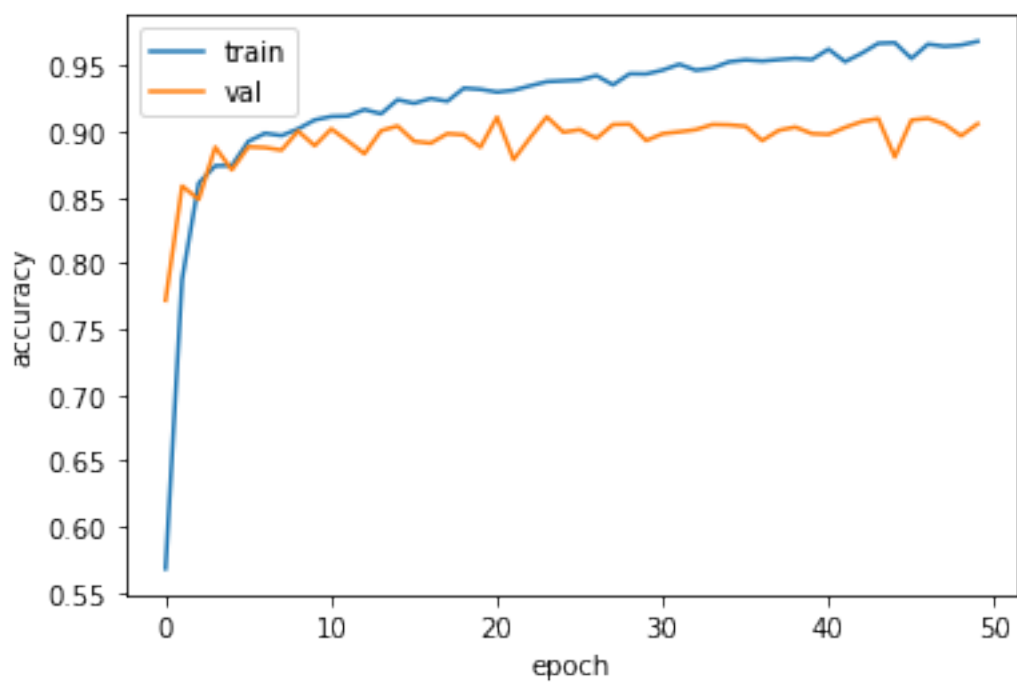
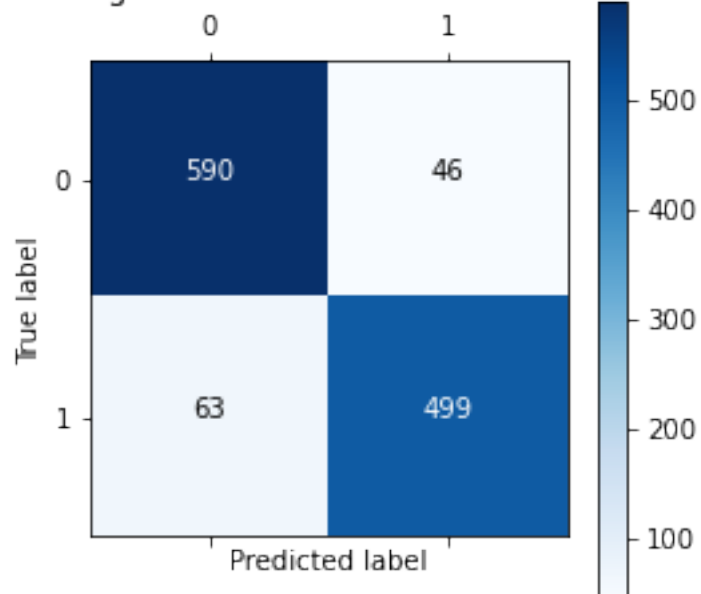
accuracy: 0.9066 - val_loss: 0.2443 - val_accuracy: 0.8944
 Epoch 15/50
 2880/2880 [=====] - 3s 887us/step - loss: 0.1721 -
 accuracy: 0.9295 - val_loss: 0.2610 - val_accuracy: 0.8931
 Epoch 16/50
 2880/2880 [=====] - 3s 884us/step - loss: 0.2222 -
 accuracy: 0.9156 - val_loss: 0.2489 - val_accuracy: 0.9194
 Epoch 17/50
 2880/2880 [=====] - 3s 873us/step - loss: 0.1715 -
 accuracy: 0.9299 - val_loss: 0.3150 - val_accuracy: 0.8722
 Epoch 18/50
 2880/2880 [=====] - 2s 848us/step - loss: 0.1864 -
 accuracy: 0.9191 - val_loss: 0.2662 - val_accuracy: 0.8972
 Epoch 19/50
 2880/2880 [=====] - 2s 754us/step - loss: 0.1734 -
 accuracy: 0.9347 - val_loss: 0.2711 - val_accuracy: 0.9083
 Epoch 20/50
 2880/2880 [=====] - 2s 823us/step - loss: 0.1822 -
 accuracy: 0.9319 - val_loss: 0.2474 - val_accuracy: 0.9181
 Epoch 21/50
 2880/2880 [=====] - 3s 879us/step - loss: 0.1787 -
 accuracy: 0.9240 - val_loss: 0.2594 - val_accuracy: 0.9014
 Epoch 22/50
 2880/2880 [=====] - 3s 875us/step - loss: 0.1500 -
 accuracy: 0.9385 - val_loss: 0.3720 - val_accuracy: 0.8806
 Epoch 23/50
 2880/2880 [=====] - 3s 869us/step - loss: 0.1916 -
 accuracy: 0.9260 - val_loss: 0.2837 - val_accuracy: 0.9083
 Epoch 24/50
 2880/2880 [=====] - 3s 889us/step - loss: 0.1499 -
 accuracy: 0.9406 - val_loss: 0.2953 - val_accuracy: 0.8986
 Epoch 25/50
 2880/2880 [=====] - 3s 880us/step - loss: 0.1451 -
 accuracy: 0.9420 - val_loss: 0.2410 - val_accuracy: 0.9069
 Epoch 26/50
 2880/2880 [=====] - 3s 901us/step - loss: 0.1481 -
 accuracy: 0.9413 - val_loss: 0.3099 - val_accuracy: 0.8903
 Epoch 27/50
 2880/2880 [=====] - 3s 874us/step - loss: 0.1420 -
 accuracy: 0.9403 - val_loss: 0.3623 - val_accuracy: 0.8972
 Epoch 28/50
 2880/2880 [=====] - 3s 893us/step - loss: 0.1680 -
 accuracy: 0.9413 - val_loss: 0.2777 - val_accuracy: 0.9014
 Epoch 29/50
 2880/2880 [=====] - 3s 869us/step - loss: 0.1455 -
 accuracy: 0.9392 - val_loss: 0.3060 - val_accuracy: 0.9153
 Epoch 30/50
 2880/2880 [=====] - 3s 907us/step - loss: 0.1297 -

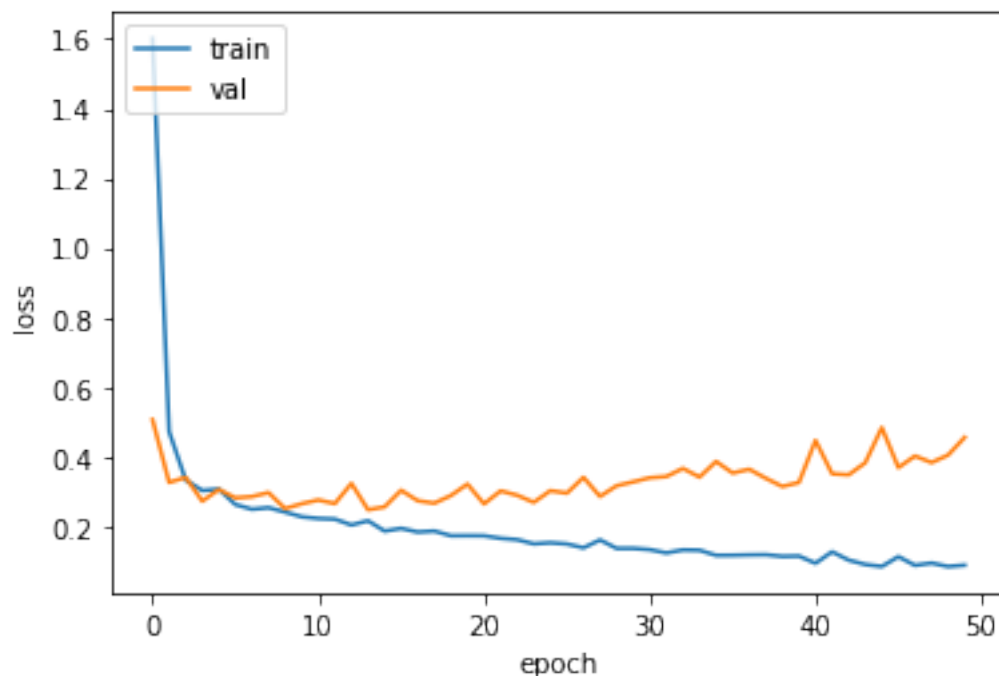
accuracy: 0.9455 - val_loss: 0.3341 - val_accuracy: 0.9139
 Epoch 31/50
 2880/2880 [=====] - 2s 865us/step - loss: 0.1613 -
 accuracy: 0.9375 - val_loss: 0.2934 - val_accuracy: 0.9139
 Epoch 32/50
 2880/2880 [=====] - 3s 896us/step - loss: 0.1116 -
 accuracy: 0.9552 - val_loss: 0.3662 - val_accuracy: 0.8903
 Epoch 33/50
 2880/2880 [=====] - 3s 871us/step - loss: 0.1508 -
 accuracy: 0.9382 - val_loss: 0.4586 - val_accuracy: 0.9028
 Epoch 34/50
 2880/2880 [=====] - 3s 882us/step - loss: 0.1199 -
 accuracy: 0.9601 - val_loss: 0.3912 - val_accuracy: 0.9111
 Epoch 35/50
 2880/2880 [=====] - 3s 895us/step - loss: 0.1353 -
 accuracy: 0.9476 - val_loss: 0.5052 - val_accuracy: 0.8875
 Epoch 36/50
 2880/2880 [=====] - 3s 885us/step - loss: 0.1207 -
 accuracy: 0.9552 - val_loss: 0.3438 - val_accuracy: 0.8986
 Epoch 37/50
 2880/2880 [=====] - 3s 896us/step - loss: 0.1120 -
 accuracy: 0.9517 - val_loss: 0.3998 - val_accuracy: 0.9139
 Epoch 38/50
 2880/2880 [=====] - 3s 870us/step - loss: 0.1134 -
 accuracy: 0.9611 - val_loss: 0.3662 - val_accuracy: 0.9139
 Epoch 39/50
 2880/2880 [=====] - 3s 945us/step - loss: 0.1432 -
 accuracy: 0.9458 - val_loss: 0.2814 - val_accuracy: 0.9056
 Epoch 40/50
 2880/2880 [=====] - 3s 880us/step - loss: 0.0851 -
 accuracy: 0.9674 - val_loss: 0.4307 - val_accuracy: 0.9000
 Epoch 41/50
 2880/2880 [=====] - 3s 884us/step - loss: 0.1015 -
 accuracy: 0.9618 - val_loss: 0.4137 - val_accuracy: 0.8958
 Epoch 42/50
 2880/2880 [=====] - 3s 907us/step - loss: 0.1426 -
 accuracy: 0.9545 - val_loss: 0.2893 - val_accuracy: 0.9028
 Epoch 43/50
 2880/2880 [=====] - 3s 910us/step - loss: 0.1012 -
 accuracy: 0.9594 - val_loss: 0.4294 - val_accuracy: 0.9069
 Epoch 44/50
 2880/2880 [=====] - 3s 887us/step - loss: 0.0799 -
 accuracy: 0.9663 - val_loss: 0.4129 - val_accuracy: 0.9153
 Epoch 45/50
 2880/2880 [=====] - 3s 880us/step - loss: 0.0705 -
 accuracy: 0.9760 - val_loss: 0.5586 - val_accuracy: 0.8833
 Epoch 46/50
 2880/2880 [=====] - 3s 890us/step - loss: 0.1258 -

accuracy: 0.9556 - val_loss: 0.3380 - val_accuracy: 0.9153
Epoch 47/50
2880/2880 [=====] - 3s 894us/step - loss: 0.1050 -
accuracy: 0.9549 - val_loss: 0.4307 - val_accuracy: 0.9042
Epoch 48/50
2880/2880 [=====] - 2s 865us/step - loss: 0.0774 -
accuracy: 0.9674 - val_loss: 0.5091 - val_accuracy: 0.8986
Epoch 49/50
2880/2880 [=====] - 3s 875us/step - loss: 0.0732 -
accuracy: 0.9688 - val_loss: 0.5339 - val_accuracy: 0.8958
Epoch 50/50
2880/2880 [=====] - 3s 876us/step - loss: 0.1311 -
accuracy: 0.9559 - val_loss: 0.5033 - val_accuracy: 0.9042
1200/1200 [=====] - 1s 581us/step



MLP Avg Confusion matrix across all folds





Average scores for pseudo test set across all folds:
 > Accuracy: 0.9080000042915344 (+- 0.008259694488400967)
 > Loss: 0.43945329840729636
 > Avg runtime per test instance: 0.0015766371488571168

 #####

Sequential with Kfold CV:

Training for fold 1 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_6"

Layer (type)	Output Shape	Param #
dense_26 (Dense)	(None, 4352)	596224
dense_27 (Dense)	(None, 2176)	9472128
dropout_16 (Dropout)	(None, 2176)	0

dense_28 (Dense)	(None, 1088)	2368576
dropout_17 (Dropout)	(None, 1088)	0
dense_29 (Dense)	(None, 544)	592416
dropout_18 (Dropout)	(None, 544)	0
dense_30 (Dense)	(None, 272)	148240
dropout_19 (Dropout)	(None, 272)	0
dense_31 (Dense)	(None, 2)	546

Total params: 13,178,130

Trainable params: 13,178,130

Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50

2880/2880 [=====] - 15s 5ms/step - loss: 3.0720 - accuracy: 0.5059 - val_loss: 0.6910 - val_accuracy: 0.5431

Epoch 2/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.7191 - accuracy: 0.5146 - val_loss: 0.6581 - val_accuracy: 0.7667

Epoch 3/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.7065 - accuracy: 0.5719 - val_loss: 0.5130 - val_accuracy: 0.7806

Epoch 4/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.6830 - accuracy: 0.6983 - val_loss: 0.4873 - val_accuracy: 0.8361

Epoch 5/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.4322 - accuracy: 0.8434 - val_loss: 0.3770 - val_accuracy: 0.8625

Epoch 6/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.3452 - accuracy: 0.8694 - val_loss: 0.4953 - val_accuracy: 0.8347

Epoch 7/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.3215 - accuracy: 0.8788 - val_loss: 0.3334 - val_accuracy: 0.8958

Epoch 8/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.3341 - accuracy: 0.8806 - val_loss: 0.2946 - val_accuracy: 0.9028

Epoch 9/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.3258 - accuracy: 0.8712 - val_loss: 0.2786 - val_accuracy: 0.8931

Epoch 10/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.2665 -

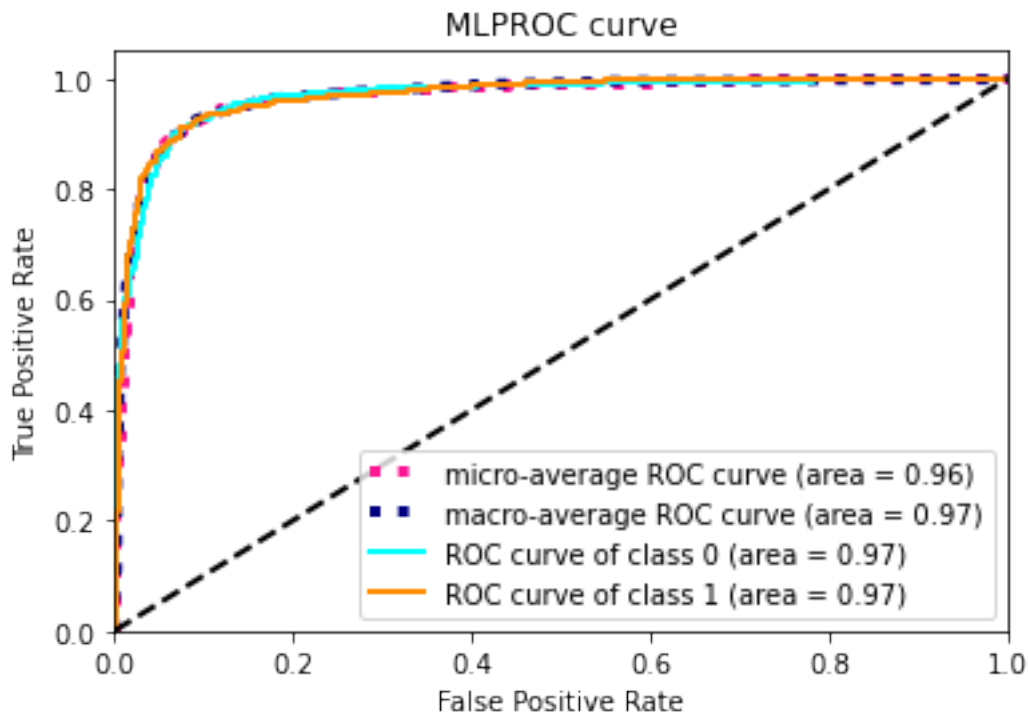

```

accuracy: 0.8934 - val_loss: 0.3713 - val_accuracy: 0.8264
Epoch 11/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2707 -
accuracy: 0.8938 - val_loss: 0.2490 - val_accuracy: 0.9097
Epoch 12/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2627 -
accuracy: 0.8951 - val_loss: 0.2985 - val_accuracy: 0.8944
Epoch 13/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2321 -
accuracy: 0.9097 - val_loss: 0.2747 - val_accuracy: 0.9153
Epoch 14/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2680 -
accuracy: 0.8885 - val_loss: 0.2635 - val_accuracy: 0.8972
Epoch 15/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2254 -
accuracy: 0.9153 - val_loss: 0.2405 - val_accuracy: 0.9083
Epoch 16/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2586 -
accuracy: 0.8951 - val_loss: 0.2673 - val_accuracy: 0.8944
Epoch 17/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2075 -
accuracy: 0.9167 - val_loss: 0.2351 - val_accuracy: 0.9139
Epoch 18/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2339 -
accuracy: 0.9052 - val_loss: 0.2534 - val_accuracy: 0.9042
Epoch 19/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1939 -
accuracy: 0.9212 - val_loss: 0.2568 - val_accuracy: 0.9069
Epoch 20/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2547 -
accuracy: 0.9090 - val_loss: 0.2550 - val_accuracy: 0.9153
Epoch 21/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1938 -
accuracy: 0.9260 - val_loss: 0.2389 - val_accuracy: 0.9042
Epoch 22/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2119 -
accuracy: 0.9087 - val_loss: 0.2753 - val_accuracy: 0.9069
Epoch 23/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2032 -
accuracy: 0.9219 - val_loss: 0.2401 - val_accuracy: 0.9125
Epoch 24/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1703 -
accuracy: 0.9292 - val_loss: 0.2701 - val_accuracy: 0.8819
Epoch 25/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2415 -
accuracy: 0.9066 - val_loss: 0.2336 - val_accuracy: 0.9139
Epoch 26/50
2880/2880 [=====] - 7s 3ms/step - loss: 0.1889 -

```

accuracy: 0.9229 - val_loss: 0.2186 - val_accuracy: 0.9181
 Epoch 27/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.1679 -
 accuracy: 0.9253 - val_loss: 0.2568 - val_accuracy: 0.9111
 Epoch 28/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2204 -
 accuracy: 0.9108 - val_loss: 0.2126 - val_accuracy: 0.9222
 Epoch 29/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1565 -
 accuracy: 0.9413 - val_loss: 0.2748 - val_accuracy: 0.9042
 Epoch 30/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1879 -
 accuracy: 0.9208 - val_loss: 0.2939 - val_accuracy: 0.9042
 Epoch 31/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1854 -
 accuracy: 0.9302 - val_loss: 0.2714 - val_accuracy: 0.8972
 Epoch 32/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1670 -
 accuracy: 0.9340 - val_loss: 0.2679 - val_accuracy: 0.9153
 Epoch 33/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1866 -
 accuracy: 0.9292 - val_loss: 0.2551 - val_accuracy: 0.9042
 Epoch 34/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1625 -
 accuracy: 0.9330 - val_loss: 0.2901 - val_accuracy: 0.9167
 Epoch 35/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1659 -
 accuracy: 0.9392 - val_loss: 0.2756 - val_accuracy: 0.9014
 Epoch 36/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1717 -
 accuracy: 0.9333 - val_loss: 0.2793 - val_accuracy: 0.9236
 Epoch 37/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1626 -
 accuracy: 0.9306 - val_loss: 0.2230 - val_accuracy: 0.9194
 Epoch 38/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1653 -
 accuracy: 0.9323 - val_loss: 0.2481 - val_accuracy: 0.9167
 Epoch 39/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1434 -
 accuracy: 0.9410 - val_loss: 0.2714 - val_accuracy: 0.8986
 Epoch 40/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1859 -
 accuracy: 0.9240 - val_loss: 0.3051 - val_accuracy: 0.9208
 Epoch 41/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1548 -
 accuracy: 0.9375 - val_loss: 0.3298 - val_accuracy: 0.9194
 Epoch 42/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1685 -

accuracy: 0.9316 - val_loss: 0.2908 - val_accuracy: 0.8667
Epoch 43/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1454 -
accuracy: 0.9375 - val_loss: 0.2691 - val_accuracy: 0.9292
Epoch 44/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1466 -
accuracy: 0.9385 - val_loss: 0.3034 - val_accuracy: 0.8875
Epoch 45/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1682 -
accuracy: 0.9285 - val_loss: 0.2985 - val_accuracy: 0.9056
Epoch 46/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1542 -
accuracy: 0.9420 - val_loss: 0.2363 - val_accuracy: 0.9167
Epoch 47/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1315 -
accuracy: 0.9434 - val_loss: 0.2403 - val_accuracy: 0.9208
Epoch 48/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1418 -
accuracy: 0.9451 - val_loss: 0.2638 - val_accuracy: 0.9056
Epoch 49/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1523 -
accuracy: 0.9392 - val_loss: 0.2371 - val_accuracy: 0.9264
Epoch 50/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1295 -
accuracy: 0.9476 - val_loss: 0.2290 - val_accuracy: 0.9347
1200/1200 [=====] - 2s 1ms/step



Sequential with Kfold CV:

Training for fold 2 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_7"

Layer (type)	Output Shape	Param #
dense_32 (Dense)	(None, 4352)	596224
dense_33 (Dense)	(None, 2176)	9472128
dropout_20 (Dropout)	(None, 2176)	0
dense_34 (Dense)	(None, 1088)	2368576
dropout_21 (Dropout)	(None, 1088)	0
dense_35 (Dense)	(None, 544)	592416
dropout_22 (Dropout)	(None, 544)	0
dense_36 (Dense)	(None, 272)	148240
dropout_23 (Dropout)	(None, 272)	0
dense_37 (Dense)	(None, 2)	546

Total params: 13,178,130

Trainable params: 13,178,130

Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50

2880/2880 [=====] - 14s 5ms/step - loss: 2.8035 -
accuracy: 0.5139 - val_loss: 0.6995 - val_accuracy: 0.4819

Epoch 2/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.7215 -
accuracy: 0.5080 - val_loss: 0.6919 - val_accuracy: 0.4819

Epoch 3/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.7352 -
accuracy: 0.5267 - val_loss: 0.5771 - val_accuracy: 0.8000

Epoch 4/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.6833 -
accuracy: 0.6524 - val_loss: 0.4606 - val_accuracy: 0.7958
Epoch 5/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.4368 -
accuracy: 0.8347 - val_loss: 0.3443 - val_accuracy: 0.8639
Epoch 6/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3805 -
accuracy: 0.8566 - val_loss: 0.3386 - val_accuracy: 0.8708
Epoch 7/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3696 -
accuracy: 0.8552 - val_loss: 0.3256 - val_accuracy: 0.8736
Epoch 8/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2600 -
accuracy: 0.8979 - val_loss: 0.3141 - val_accuracy: 0.8792
Epoch 9/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3207 -
accuracy: 0.8792 - val_loss: 0.3049 - val_accuracy: 0.8833
Epoch 10/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2406 -
accuracy: 0.9042 - val_loss: 0.2975 - val_accuracy: 0.8944
Epoch 11/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3191 -
accuracy: 0.8795 - val_loss: 0.2883 - val_accuracy: 0.8917
Epoch 12/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2290 -
accuracy: 0.9097 - val_loss: 0.2885 - val_accuracy: 0.8833
Epoch 13/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2518 -
accuracy: 0.9062 - val_loss: 0.3758 - val_accuracy: 0.8569
Epoch 14/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2141 -
accuracy: 0.9187 - val_loss: 0.3444 - val_accuracy: 0.8569
Epoch 15/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2419 -
accuracy: 0.9028 - val_loss: 0.2828 - val_accuracy: 0.9000
Epoch 16/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2074 -
accuracy: 0.9201 - val_loss: 0.3488 - val_accuracy: 0.9014
Epoch 17/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2364 -
accuracy: 0.9045 - val_loss: 0.3299 - val_accuracy: 0.8986
Epoch 18/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1858 -
accuracy: 0.9264 - val_loss: 0.2716 - val_accuracy: 0.9056
Epoch 19/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2519 -
accuracy: 0.9021 - val_loss: 0.3182 - val_accuracy: 0.8750

Epoch 20/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1891 -
accuracy: 0.9281 - val_loss: 0.2825 - val_accuracy: 0.8944
Epoch 21/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2088 -
accuracy: 0.9201 - val_loss: 0.3359 - val_accuracy: 0.8917
Epoch 22/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1670 -
accuracy: 0.9312 - val_loss: 0.3306 - val_accuracy: 0.8944
Epoch 23/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2195 -
accuracy: 0.9059 - val_loss: 0.3332 - val_accuracy: 0.8542
Epoch 24/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1858 -
accuracy: 0.9250 - val_loss: 0.3470 - val_accuracy: 0.8889
Epoch 25/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1957 -
accuracy: 0.9240 - val_loss: 0.3159 - val_accuracy: 0.8667
Epoch 26/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1737 -
accuracy: 0.9274 - val_loss: 0.3747 - val_accuracy: 0.8611
Epoch 27/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1998 -
accuracy: 0.9167 - val_loss: 0.3360 - val_accuracy: 0.9042
Epoch 28/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1527 -
accuracy: 0.9392 - val_loss: 0.3798 - val_accuracy: 0.8917
Epoch 29/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1836 -
accuracy: 0.9250 - val_loss: 0.3560 - val_accuracy: 0.8931
Epoch 30/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1458 -
accuracy: 0.9399 - val_loss: 0.4579 - val_accuracy: 0.8194
Epoch 31/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1817 -
accuracy: 0.9229 - val_loss: 0.3380 - val_accuracy: 0.9083
Epoch 32/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1714 -
accuracy: 0.9271 - val_loss: 0.4290 - val_accuracy: 0.8778
Epoch 33/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1401 -
accuracy: 0.9427 - val_loss: 0.3813 - val_accuracy: 0.9069
Epoch 34/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1711 -
accuracy: 0.9372 - val_loss: 0.3591 - val_accuracy: 0.8778
Epoch 35/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1453 -
accuracy: 0.9434 - val_loss: 0.2892 - val_accuracy: 0.9014

Epoch 36/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1496 -
accuracy: 0.9417 - val_loss: 0.3803 - val_accuracy: 0.8944

Epoch 37/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1433 -
accuracy: 0.9451 - val_loss: 0.3592 - val_accuracy: 0.8931

Epoch 38/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1588 -
accuracy: 0.9323 - val_loss: 0.5134 - val_accuracy: 0.8750

Epoch 39/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1375 -
accuracy: 0.9434 - val_loss: 0.3619 - val_accuracy: 0.8944

Epoch 40/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1637 -
accuracy: 0.9323 - val_loss: 0.3242 - val_accuracy: 0.8875

Epoch 41/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1772 -
accuracy: 0.9278 - val_loss: 0.3959 - val_accuracy: 0.8958

Epoch 42/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1092 -
accuracy: 0.9573 - val_loss: 0.4685 - val_accuracy: 0.8806

Epoch 43/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1368 -
accuracy: 0.9420 - val_loss: 0.3459 - val_accuracy: 0.9042

Epoch 44/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1749 -
accuracy: 0.9306 - val_loss: 0.3688 - val_accuracy: 0.8653

Epoch 45/50
2880/2880 [=====] - 7s 2ms/step - loss: 0.1328 -
accuracy: 0.9462 - val_loss: 0.3683 - val_accuracy: 0.8889

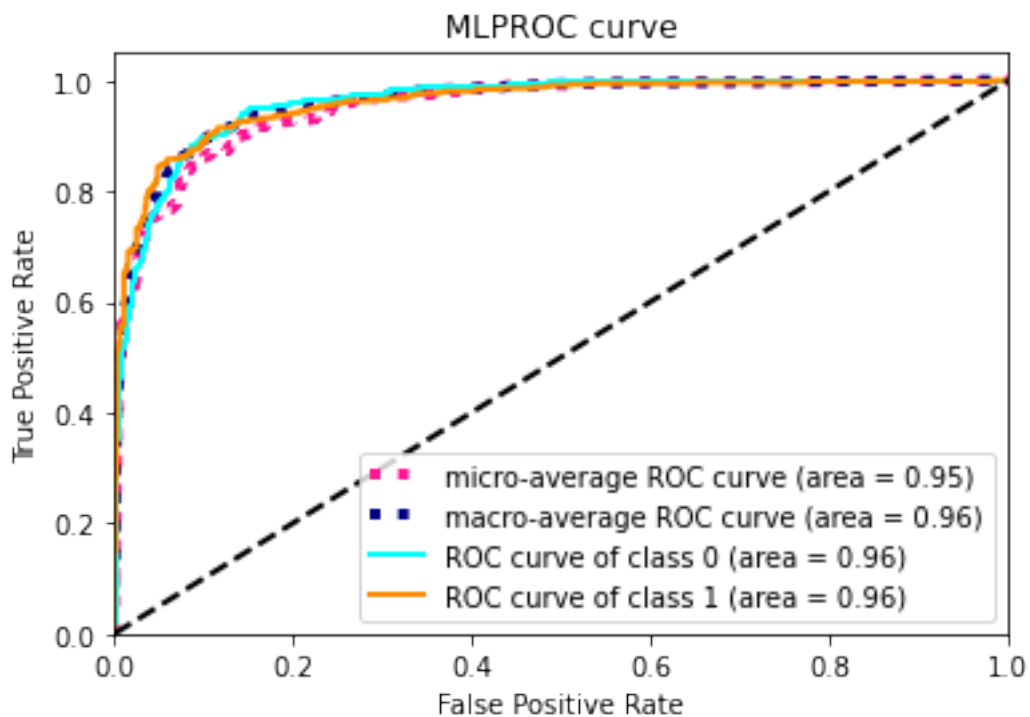
Epoch 46/50
2880/2880 [=====] - 7s 2ms/step - loss: 0.1222 -
accuracy: 0.9493 - val_loss: 0.3405 - val_accuracy: 0.8792

Epoch 47/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1303 -
accuracy: 0.9451 - val_loss: 0.5053 - val_accuracy: 0.8764

Epoch 48/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1419 -
accuracy: 0.9448 - val_loss: 0.4397 - val_accuracy: 0.8750

Epoch 49/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1140 -
accuracy: 0.9566 - val_loss: 0.4230 - val_accuracy: 0.8903

Epoch 50/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1405 -
accuracy: 0.9441 - val_loss: 0.3749 - val_accuracy: 0.8569
1200/1200 [=====] - 1s 524us/step



Sequential with Kfold CV:

Training for fold 3 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_8"

Layer (type)	Output Shape	Param #
dense_38 (Dense)	(None, 4352)	596224
dense_39 (Dense)	(None, 2176)	9472128
dropout_24 (Dropout)	(None, 2176)	0
dense_40 (Dense)	(None, 1088)	2368576
dropout_25 (Dropout)	(None, 1088)	0
dense_41 (Dense)	(None, 544)	592416
dropout_26 (Dropout)	(None, 544)	0

dense_42 (Dense)	(None, 272)	148240
dropout_27 (Dropout)	(None, 272)	0
dense_43 (Dense)	(None, 2)	546

Total params: 13,178,130
 Trainable params: 13,178,130
 Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50

2880/2880 [=====] - 7s 2ms/step - loss: 2.8543 - accuracy: 0.4948 - val_loss: 0.6870 - val_accuracy: 0.4931

Epoch 2/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.7508 - accuracy: 0.5170 - val_loss: 0.6461 - val_accuracy: 0.6972

Epoch 3/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.6925 - accuracy: 0.6174 - val_loss: 0.4841 - val_accuracy: 0.7958

Epoch 4/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.5024 - accuracy: 0.8035 - val_loss: 0.4358 - val_accuracy: 0.8458

Epoch 5/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.3487 - accuracy: 0.8708 - val_loss: 0.3361 - val_accuracy: 0.8750

Epoch 6/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.3976 - accuracy: 0.8465 - val_loss: 0.3491 - val_accuracy: 0.8708

Epoch 7/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2934 - accuracy: 0.8872 - val_loss: 0.2678 - val_accuracy: 0.8778

Epoch 8/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2974 - accuracy: 0.8826 - val_loss: 0.3797 - val_accuracy: 0.8583

Epoch 9/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2682 - accuracy: 0.8962 - val_loss: 0.2401 - val_accuracy: 0.8944

Epoch 10/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2732 - accuracy: 0.8944 - val_loss: 0.2348 - val_accuracy: 0.9097

Epoch 11/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2588 - accuracy: 0.9003 - val_loss: 0.2526 - val_accuracy: 0.9083

Epoch 12/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2817 - accuracy: 0.8941 - val_loss: 0.2239 - val_accuracy: 0.9125

Epoch 13/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2386 - accuracy: 0.8986 - val_loss: 0.4471 - val_accuracy: 0.7917

Epoch 14/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2497 - accuracy: 0.9035 - val_loss: 0.2345 - val_accuracy: 0.9125

Epoch 15/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2399 - accuracy: 0.9010 - val_loss: 0.2720 - val_accuracy: 0.9014

Epoch 16/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2278 - accuracy: 0.9160 - val_loss: 0.2211 - val_accuracy: 0.9153

Epoch 17/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2236 - accuracy: 0.9097 - val_loss: 0.2363 - val_accuracy: 0.9236

Epoch 18/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2011 - accuracy: 0.9198 - val_loss: 0.5242 - val_accuracy: 0.8278

Epoch 19/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2252 - accuracy: 0.9167 - val_loss: 0.2188 - val_accuracy: 0.9194

Epoch 20/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1977 - accuracy: 0.9267 - val_loss: 0.2406 - val_accuracy: 0.9069

Epoch 21/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2464 - accuracy: 0.9035 - val_loss: 0.2226 - val_accuracy: 0.9097

Epoch 22/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1871 - accuracy: 0.9316 - val_loss: 0.2522 - val_accuracy: 0.8972

Epoch 23/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1717 - accuracy: 0.9333 - val_loss: 0.2637 - val_accuracy: 0.9167

Epoch 24/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1972 - accuracy: 0.9240 - val_loss: 0.3051 - val_accuracy: 0.8958

Epoch 25/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2220 - accuracy: 0.9142 - val_loss: 0.2362 - val_accuracy: 0.9139

Epoch 26/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1903 - accuracy: 0.9302 - val_loss: 0.2350 - val_accuracy: 0.9306

Epoch 27/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1913 - accuracy: 0.9264 - val_loss: 0.2235 - val_accuracy: 0.9181

Epoch 28/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2000 - accuracy: 0.9156 - val_loss: 0.2161 - val_accuracy: 0.9139

Epoch 29/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1742 - accuracy: 0.9309 - val_loss: 0.2483 - val_accuracy: 0.8986

Epoch 30/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1777 - accuracy: 0.9281 - val_loss: 0.2568 - val_accuracy: 0.9111

Epoch 31/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1582 - accuracy: 0.9347 - val_loss: 0.2389 - val_accuracy: 0.9153

Epoch 32/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2105 - accuracy: 0.9170 - val_loss: 0.2350 - val_accuracy: 0.9069

Epoch 33/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1622 - accuracy: 0.9295 - val_loss: 0.2759 - val_accuracy: 0.9194

Epoch 34/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1570 - accuracy: 0.9354 - val_loss: 0.3078 - val_accuracy: 0.8958

Epoch 35/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1916 - accuracy: 0.9285 - val_loss: 0.2619 - val_accuracy: 0.9153

Epoch 36/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1568 - accuracy: 0.9382 - val_loss: 0.2523 - val_accuracy: 0.9042

Epoch 37/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1826 - accuracy: 0.9240 - val_loss: 0.2555 - val_accuracy: 0.9139

Epoch 38/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1424 - accuracy: 0.9431 - val_loss: 0.3166 - val_accuracy: 0.9278

Epoch 39/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1884 - accuracy: 0.9365 - val_loss: 0.2354 - val_accuracy: 0.9125

Epoch 40/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1667 - accuracy: 0.9378 - val_loss: 0.2361 - val_accuracy: 0.9264

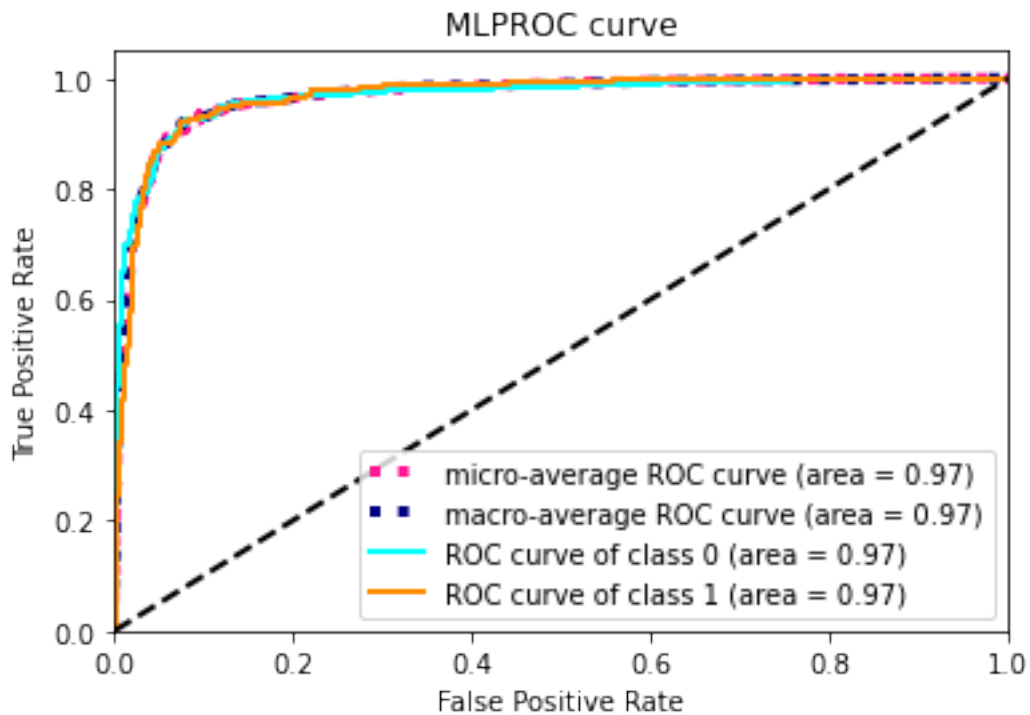
Epoch 41/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1652 - accuracy: 0.9378 - val_loss: 0.2895 - val_accuracy: 0.8917

Epoch 42/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1457 - accuracy: 0.9465 - val_loss: 0.2838 - val_accuracy: 0.9153

Epoch 43/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1525 - accuracy: 0.9403 - val_loss: 0.2299 - val_accuracy: 0.9236

Epoch 44/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1648 - accuracy: 0.9417 - val_loss: 0.2242 - val_accuracy: 0.9333

Epoch 45/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1446 - accuracy: 0.9427 - val_loss: 0.2398 - val_accuracy: 0.9222
 Epoch 46/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1172 - accuracy: 0.9556 - val_loss: 0.2465 - val_accuracy: 0.9319
 Epoch 47/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1654 - accuracy: 0.9378 - val_loss: 0.2821 - val_accuracy: 0.9222
 Epoch 48/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1747 - accuracy: 0.9354 - val_loss: 0.2583 - val_accuracy: 0.9194
 Epoch 49/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1388 - accuracy: 0.9486 - val_loss: 0.2353 - val_accuracy: 0.9167
 Epoch 50/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1405 - accuracy: 0.9444 - val_loss: 0.2524 - val_accuracy: 0.9194
 1200/1200 [=====] - 1s 498us/step



Sequential with Kfold CV:
 Training for fold 4 ...
 Adding layer 1:

Adding layer 2:
 Adding layer 3:
 Adding layer 4:
 Model: "sequential_9"

Layer (type)	Output Shape	Param #
dense_44 (Dense)	(None, 4352)	596224
dense_45 (Dense)	(None, 2176)	9472128
dropout_28 (Dropout)	(None, 2176)	0
dense_46 (Dense)	(None, 1088)	2368576
dropout_29 (Dropout)	(None, 1088)	0
dense_47 (Dense)	(None, 544)	592416
dropout_30 (Dropout)	(None, 544)	0
dense_48 (Dense)	(None, 272)	148240
dropout_31 (Dropout)	(None, 272)	0
dense_49 (Dense)	(None, 2)	546

Total params: 13,178,130
 Trainable params: 13,178,130
 Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50

2880/2880 [=====] - 8s 3ms/step - loss: 2.8803 - accuracy: 0.5299 - val_loss: 0.7284 - val_accuracy: 0.5125

Epoch 2/50

2880/2880 [=====] - 6s 2ms/step - loss: 0.7414 - accuracy: 0.4938 - val_loss: 0.6927 - val_accuracy: 0.4875

Epoch 3/50

2880/2880 [=====] - 7s 2ms/step - loss: 0.7232 - accuracy: 0.5108 - val_loss: 0.8221 - val_accuracy: 0.4875

Epoch 4/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.7454 - accuracy: 0.6094 - val_loss: 0.3991 - val_accuracy: 0.8556

Epoch 5/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.4375 - accuracy: 0.8330 - val_loss: 0.3029 - val_accuracy: 0.8764

Epoch 6/50

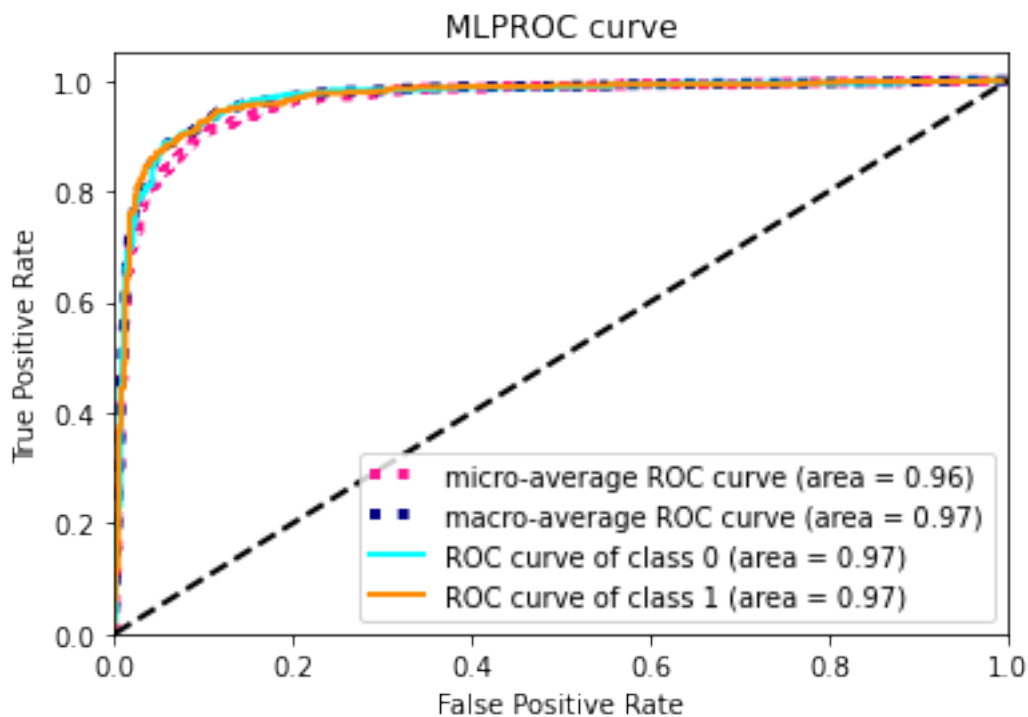
2880/2880 [=====] - 5s 2ms/step - loss: 0.3413 -
accuracy: 0.8760 - val_loss: 0.3790 - val_accuracy: 0.8347
Epoch 7/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.3324 -
accuracy: 0.8674 - val_loss: 0.2750 - val_accuracy: 0.8792
Epoch 8/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.3613 -
accuracy: 0.8552 - val_loss: 0.2665 - val_accuracy: 0.8889
Epoch 9/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2670 -
accuracy: 0.9031 - val_loss: 0.2914 - val_accuracy: 0.8875
Epoch 10/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.3275 -
accuracy: 0.8701 - val_loss: 0.2721 - val_accuracy: 0.9000
Epoch 11/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2564 -
accuracy: 0.8944 - val_loss: 0.2361 - val_accuracy: 0.9097
Epoch 12/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2227 -
accuracy: 0.9146 - val_loss: 0.3855 - val_accuracy: 0.8431
Epoch 13/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2970 -
accuracy: 0.8736 - val_loss: 0.2446 - val_accuracy: 0.9125
Epoch 14/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2174 -
accuracy: 0.9181 - val_loss: 0.2697 - val_accuracy: 0.8958
Epoch 15/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2897 -
accuracy: 0.8920 - val_loss: 0.2492 - val_accuracy: 0.8944
Epoch 16/50
2880/2880 [=====] - 7s 2ms/step - loss: 0.2018 -
accuracy: 0.9240 - val_loss: 0.2294 - val_accuracy: 0.9083
Epoch 17/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2334 -
accuracy: 0.9087 - val_loss: 0.3403 - val_accuracy: 0.8597
Epoch 18/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2194 -
accuracy: 0.9135 - val_loss: 0.2487 - val_accuracy: 0.9236
Epoch 19/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2024 -
accuracy: 0.9177 - val_loss: 0.3175 - val_accuracy: 0.8944
Epoch 20/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2496 -
accuracy: 0.9017 - val_loss: 0.2198 - val_accuracy: 0.9153
Epoch 21/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1898 -
accuracy: 0.9253 - val_loss: 0.2600 - val_accuracy: 0.8931
Epoch 22/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2003 -
accuracy: 0.9212 - val_loss: 0.2701 - val_accuracy: 0.9097
Epoch 23/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2198 -
accuracy: 0.9177 - val_loss: 0.2555 - val_accuracy: 0.9069
Epoch 24/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1884 -
accuracy: 0.9281 - val_loss: 0.3606 - val_accuracy: 0.9056
Epoch 25/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1757 -
accuracy: 0.9323 - val_loss: 0.2506 - val_accuracy: 0.9042
Epoch 26/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2147 -
accuracy: 0.9038 - val_loss: 0.2752 - val_accuracy: 0.9097
Epoch 27/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1675 -
accuracy: 0.9351 - val_loss: 0.2382 - val_accuracy: 0.9181
Epoch 28/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1885 -
accuracy: 0.9240 - val_loss: 0.3213 - val_accuracy: 0.8861
Epoch 29/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1772 -
accuracy: 0.9271 - val_loss: 0.2737 - val_accuracy: 0.9194
Epoch 30/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1603 -
accuracy: 0.9333 - val_loss: 0.3226 - val_accuracy: 0.9097
Epoch 31/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1960 -
accuracy: 0.9222 - val_loss: 0.2813 - val_accuracy: 0.9111
Epoch 32/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2082 -
accuracy: 0.9226 - val_loss: 0.2332 - val_accuracy: 0.9153
Epoch 33/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1522 -
accuracy: 0.9396 - val_loss: 0.2986 - val_accuracy: 0.9056
Epoch 34/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1808 -
accuracy: 0.9233 - val_loss: 0.2648 - val_accuracy: 0.8917
Epoch 35/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1813 -
accuracy: 0.9319 - val_loss: 0.2622 - val_accuracy: 0.9181
Epoch 36/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1515 -
accuracy: 0.9410 - val_loss: 0.2820 - val_accuracy: 0.9125
Epoch 37/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1450 -
accuracy: 0.9448 - val_loss: 0.2997 - val_accuracy: 0.9083
Epoch 38/50

```

2880/2880 [=====] - 5s 2ms/step - loss: 0.1690 -
accuracy: 0.9385 - val_loss: 0.3219 - val_accuracy: 0.9111
Epoch 39/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1383 -
accuracy: 0.9427 - val_loss: 0.3304 - val_accuracy: 0.8972
Epoch 40/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1716 -
accuracy: 0.9365 - val_loss: 0.2649 - val_accuracy: 0.9153
Epoch 41/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1499 -
accuracy: 0.9424 - val_loss: 0.3913 - val_accuracy: 0.8944
Epoch 42/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1635 -
accuracy: 0.9368 - val_loss: 0.2505 - val_accuracy: 0.9153
Epoch 43/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1178 -
accuracy: 0.9573 - val_loss: 0.3642 - val_accuracy: 0.9194
Epoch 44/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1665 -
accuracy: 0.9323 - val_loss: 0.3341 - val_accuracy: 0.9069
Epoch 45/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1265 -
accuracy: 0.9503 - val_loss: 0.3841 - val_accuracy: 0.9139
Epoch 46/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1882 -
accuracy: 0.9299 - val_loss: 0.3265 - val_accuracy: 0.8875
Epoch 47/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1396 -
accuracy: 0.9451 - val_loss: 0.4016 - val_accuracy: 0.8889
Epoch 48/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1529 -
accuracy: 0.9378 - val_loss: 0.3519 - val_accuracy: 0.9056
Epoch 49/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1391 -
accuracy: 0.9438 - val_loss: 0.4898 - val_accuracy: 0.8556
Epoch 50/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1666 -
accuracy: 0.9354 - val_loss: 0.2672 - val_accuracy: 0.8958
1200/1200 [=====] - 1s 457us/step

```

Sequential with Kfold CV:

Training for fold 5 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_10"

Layer (type)	Output Shape	Param #
dense_50 (Dense)	(None, 4352)	596224
dense_51 (Dense)	(None, 2176)	9472128
dropout_32 (Dropout)	(None, 2176)	0
dense_52 (Dense)	(None, 1088)	2368576
dropout_33 (Dropout)	(None, 1088)	0
dense_53 (Dense)	(None, 544)	592416
dropout_34 (Dropout)	(None, 544)	0

dense_54 (Dense)	(None, 272)	148240
dropout_35 (Dropout)	(None, 272)	0
dense_55 (Dense)	(None, 2)	546

Total params: 13,178,130
 Trainable params: 13,178,130
 Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50

2880/2880 [=====] - 7s 2ms/step - loss: 2.1300 - accuracy: 0.5198 - val_loss: 0.6921 - val_accuracy: 0.5264

Epoch 2/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.7234 - accuracy: 0.5142 - val_loss: 0.6847 - val_accuracy: 0.5625

Epoch 3/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.7475 - accuracy: 0.5295 - val_loss: 0.6567 - val_accuracy: 0.6389

Epoch 4/50

2880/2880 [=====] - 6s 2ms/step - loss: 0.6220 - accuracy: 0.7010 - val_loss: 0.4485 - val_accuracy: 0.8444

Epoch 5/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.4005 - accuracy: 0.8538 - val_loss: 0.5102 - val_accuracy: 0.8403

Epoch 6/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.4025 - accuracy: 0.8465 - val_loss: 0.3151 - val_accuracy: 0.8833

Epoch 7/50

2880/2880 [=====] - 6s 2ms/step - loss: 0.3155 - accuracy: 0.8847 - val_loss: 0.3092 - val_accuracy: 0.8889

Epoch 8/50

2880/2880 [=====] - 6s 2ms/step - loss: 0.3339 - accuracy: 0.8750 - val_loss: 0.3001 - val_accuracy: 0.8972

Epoch 9/50

2880/2880 [=====] - 6s 2ms/step - loss: 0.2861 - accuracy: 0.8997 - val_loss: 0.2657 - val_accuracy: 0.8931

Epoch 10/50

2880/2880 [=====] - 6s 2ms/step - loss: 0.2588 - accuracy: 0.8931 - val_loss: 0.2634 - val_accuracy: 0.8986

Epoch 11/50

2880/2880 [=====] - 7s 2ms/step - loss: 0.3065 - accuracy: 0.8844 - val_loss: 0.2599 - val_accuracy: 0.8917

Epoch 12/50

2880/2880 [=====] - 6s 2ms/step - loss: 0.2221 - accuracy: 0.9167 - val_loss: 0.3947 - val_accuracy: 0.8708

Epoch 13/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2740 -
accuracy: 0.8941 - val_loss: 0.2548 - val_accuracy: 0.9014
Epoch 14/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2444 -
accuracy: 0.9090 - val_loss: 0.2824 - val_accuracy: 0.8958
Epoch 15/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2513 -
accuracy: 0.9056 - val_loss: 0.3036 - val_accuracy: 0.8889
Epoch 16/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2351 -
accuracy: 0.9191 - val_loss: 0.2676 - val_accuracy: 0.8944
Epoch 17/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2098 -
accuracy: 0.9215 - val_loss: 0.2540 - val_accuracy: 0.8931
Epoch 18/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2313 -
accuracy: 0.9135 - val_loss: 0.3376 - val_accuracy: 0.8917
Epoch 19/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2303 -
accuracy: 0.9181 - val_loss: 0.2426 - val_accuracy: 0.9014
Epoch 20/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1838 -
accuracy: 0.9337 - val_loss: 0.3096 - val_accuracy: 0.8875
Epoch 21/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2186 -
accuracy: 0.9215 - val_loss: 0.2753 - val_accuracy: 0.9069
Epoch 22/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2162 -
accuracy: 0.9115 - val_loss: 0.3017 - val_accuracy: 0.9028
Epoch 23/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1929 -
accuracy: 0.9233 - val_loss: 0.2901 - val_accuracy: 0.9000
Epoch 24/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2057 -
accuracy: 0.9253 - val_loss: 0.3471 - val_accuracy: 0.8931
Epoch 25/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1814 -
accuracy: 0.9306 - val_loss: 0.2631 - val_accuracy: 0.9042
Epoch 26/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2095 -
accuracy: 0.9215 - val_loss: 0.3057 - val_accuracy: 0.9028
Epoch 27/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1529 -
accuracy: 0.9469 - val_loss: 0.2765 - val_accuracy: 0.9097
Epoch 28/50
2880/2880 [=====] - 7s 2ms/step - loss: 0.2141 -
accuracy: 0.9094 - val_loss: 0.3254 - val_accuracy: 0.8903

Epoch 29/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1768 -
accuracy: 0.9312 - val_loss: 0.4522 - val_accuracy: 0.8361

Epoch 30/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1944 -
accuracy: 0.9219 - val_loss: 0.2449 - val_accuracy: 0.9069

Epoch 31/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1764 -
accuracy: 0.9292 - val_loss: 0.3152 - val_accuracy: 0.8903

Epoch 32/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1792 -
accuracy: 0.9271 - val_loss: 0.3937 - val_accuracy: 0.8653

Epoch 33/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1672 -
accuracy: 0.9358 - val_loss: 0.3032 - val_accuracy: 0.8833

Epoch 34/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1600 -
accuracy: 0.9420 - val_loss: 0.3113 - val_accuracy: 0.9069

Epoch 35/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1699 -
accuracy: 0.9319 - val_loss: 0.2950 - val_accuracy: 0.8653

Epoch 36/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1874 -
accuracy: 0.9309 - val_loss: 0.2645 - val_accuracy: 0.8958

Epoch 37/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1435 -
accuracy: 0.9465 - val_loss: 0.4558 - val_accuracy: 0.8583

Epoch 38/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1823 -
accuracy: 0.9274 - val_loss: 0.2927 - val_accuracy: 0.9056

Epoch 39/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1431 -
accuracy: 0.9434 - val_loss: 0.2538 - val_accuracy: 0.9125

Epoch 40/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1550 -
accuracy: 0.9434 - val_loss: 0.3835 - val_accuracy: 0.9014

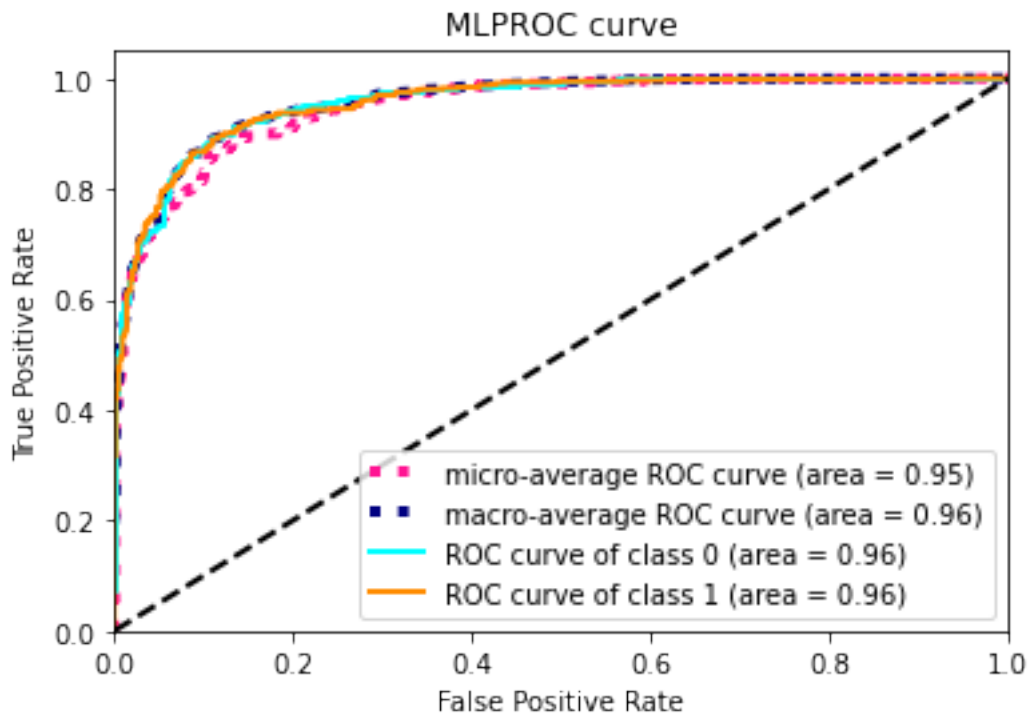
Epoch 41/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2076 -
accuracy: 0.9319 - val_loss: 0.2715 - val_accuracy: 0.9111

Epoch 42/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1330 -
accuracy: 0.9507 - val_loss: 0.3197 - val_accuracy: 0.8931

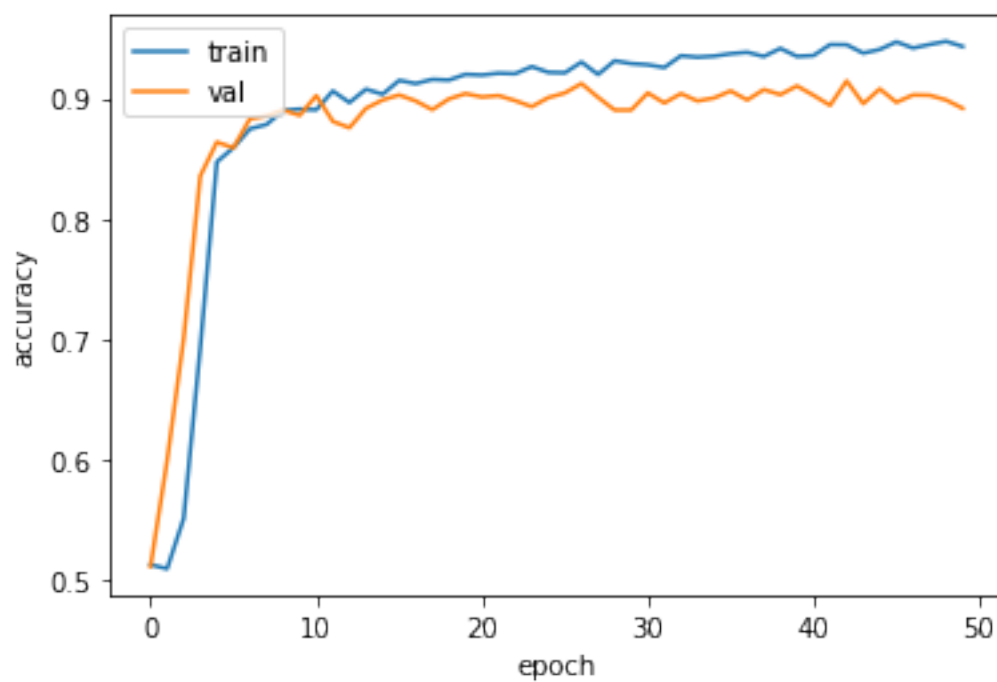
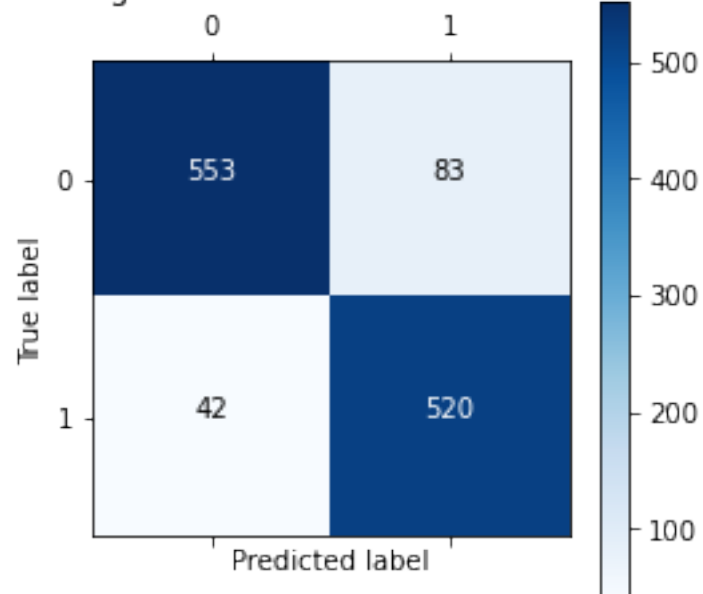
Epoch 43/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1365 -
accuracy: 0.9451 - val_loss: 0.2613 - val_accuracy: 0.8958

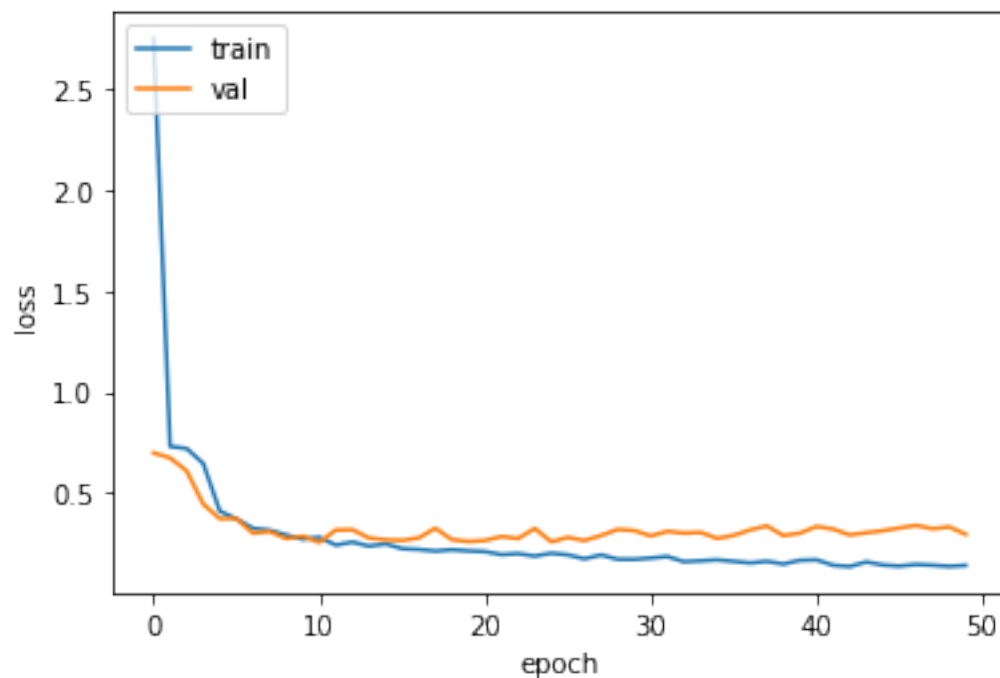
Epoch 44/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1494 -
accuracy: 0.9444 - val_loss: 0.2935 - val_accuracy: 0.8847

Epoch 45/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1551 - accuracy: 0.9351 - val_loss: 0.2830 - val_accuracy: 0.9083
 Epoch 46/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1184 - accuracy: 0.9576 - val_loss: 0.4911 - val_accuracy: 0.8681
 Epoch 47/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1725 - accuracy: 0.9372 - val_loss: 0.2769 - val_accuracy: 0.9056
 Epoch 48/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1100 - accuracy: 0.9601 - val_loss: 0.3091 - val_accuracy: 0.9069
 Epoch 49/50
 2880/2880 [=====] - 6s 2ms/step - loss: 0.1492 - accuracy: 0.9483 - val_loss: 0.2839 - val_accuracy: 0.9042
 Epoch 50/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1401 - accuracy: 0.9434 - val_loss: 0.3615 - val_accuracy: 0.8514
 1200/1200 [=====] - 1s 672us/step



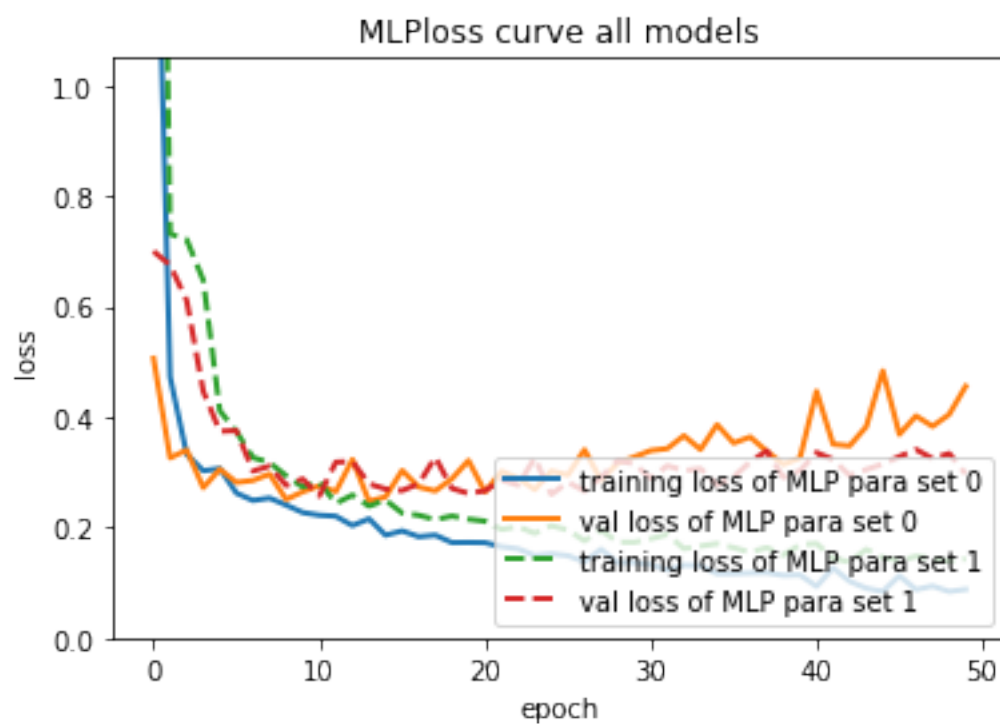
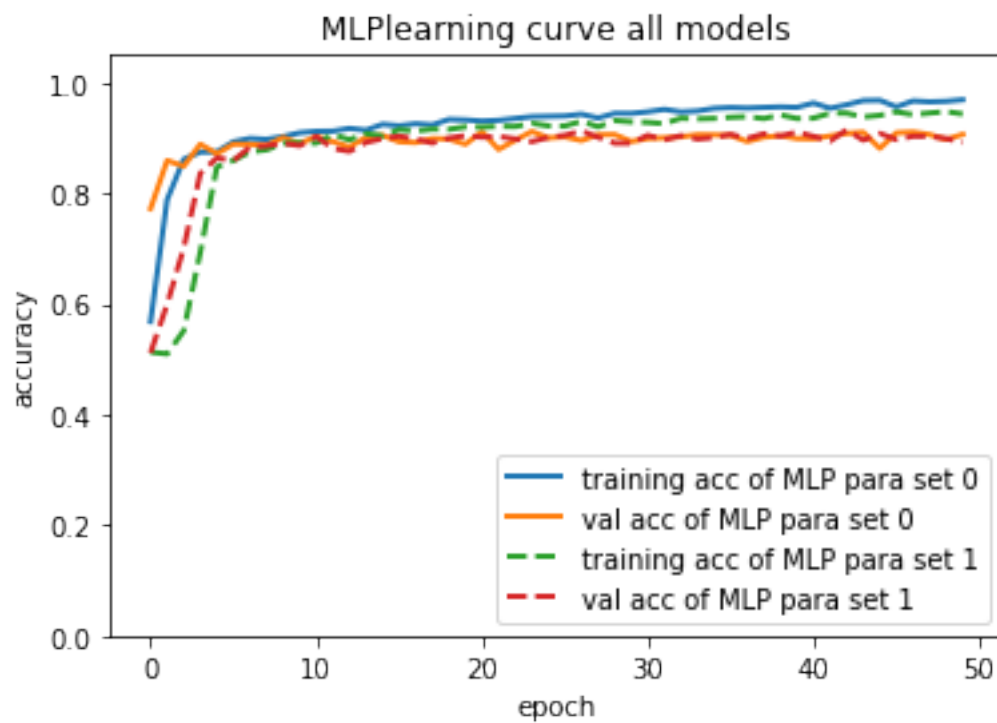
MLP Avg Confusion matrix across all folds





Average scores for pseudo test set across all folds:
 > Accuracy: 0.8950000047683716 (+- 0.018461679153953428)
 > Loss: 0.29445346718033155
 > Avg runtime per test instance: 0.0018388656377792355

 #####



Opt model parameter found on the pseudo test set:

```
{'num_hidden_layer': 3, 'hidden_layer_activation': ['relu', 'tanh', 'relu'],  
'dropout': [0.5, 0.25, 0.125], 'last_activation': 'softmax'}
```

Best average pseudo test set accuracy score with the opt model:

0.9080000042915344

Average runtime per test instance: 0.0015766371488571168

```
[5]: from A2 import A2_functions_all as A2_functions
```

```
[7]: TaskA2_opt_models_dict, TaskA2_res_dict = A2_functions.get_A2_results()
```

-----Reading Task A2 dataset-----

-----Task A2: Grid searching on Logistic
regression-----

Logistic Regression Grid search CV on Dataset A:

Training scores:

```
0.514 (+/-0.000) for {'C': 0.0001, 'penalty': 'l1', 'solver': 'saga'}  
0.881 (+/-0.008) for {'C': 0.0001, 'penalty': 'l2', 'solver': 'saga'}  
0.545 (+/-0.076) for {'C': 0.001, 'penalty': 'l1', 'solver': 'saga'}  
0.889 (+/-0.005) for {'C': 0.001, 'penalty': 'l2', 'solver': 'saga'}  
0.878 (+/-0.005) for {'C': 0.01, 'penalty': 'l1', 'solver': 'saga'}  
0.898 (+/-0.002) for {'C': 0.01, 'penalty': 'l2', 'solver': 'saga'}  
0.899 (+/-0.005) for {'C': 0.1, 'penalty': 'l1', 'solver': 'saga'}  
0.903 (+/-0.004) for {'C': 0.1, 'penalty': 'l2', 'solver': 'saga'}  
0.905 (+/-0.004) for {'C': 1, 'penalty': 'l1', 'solver': 'saga'}  
0.906 (+/-0.005) for {'C': 1, 'penalty': 'l2', 'solver': 'saga'}  
0.907 (+/-0.008) for {'C': 10, 'penalty': 'l1', 'solver': 'saga'}  
0.907 (+/-0.008) for {'C': 10, 'penalty': 'l2', 'solver': 'saga'}
```

Validation scores:

```
0.514 (+/-0.001) for {'C': 0.0001, 'penalty': 'l1', 'solver': 'saga'}  
0.880 (+/-0.018) for {'C': 0.0001, 'penalty': 'l2', 'solver': 'saga'}  
0.545 (+/-0.072) for {'C': 0.001, 'penalty': 'l1', 'solver': 'saga'}  
0.886 (+/-0.012) for {'C': 0.001, 'penalty': 'l2', 'solver': 'saga'}  
0.876 (+/-0.013) for {'C': 0.01, 'penalty': 'l1', 'solver': 'saga'}  
0.898 (+/-0.009) for {'C': 0.01, 'penalty': 'l2', 'solver': 'saga'}  
0.895 (+/-0.012) for {'C': 0.1, 'penalty': 'l1', 'solver': 'saga'}  
0.896 (+/-0.009) for {'C': 0.1, 'penalty': 'l2', 'solver': 'saga'}
```

0.895 (+/-0.015) for {'C': 1, 'penalty': 'l1', 'solver': 'saga'}
 0.892 (+/-0.020) for {'C': 1, 'penalty': 'l2', 'solver': 'saga'}
 0.890 (+/-0.023) for {'C': 10, 'penalty': 'l1', 'solver': 'saga'}
 0.891 (+/-0.022) for {'C': 10, 'penalty': 'l2', 'solver': 'saga'}

Prediction on a pseudo test set (split from Dataset A):

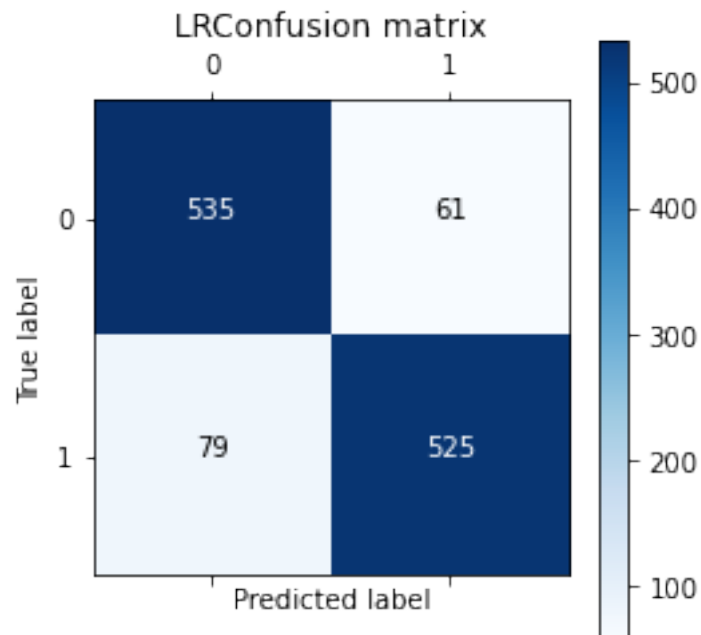
	precision	recall	f1-score	support
0.0	0.87	0.90	0.88	596
1.0	0.90	0.87	0.88	604
accuracy			0.88	1200
macro avg	0.88	0.88	0.88	1200
weighted avg	0.88	0.88	0.88	1200

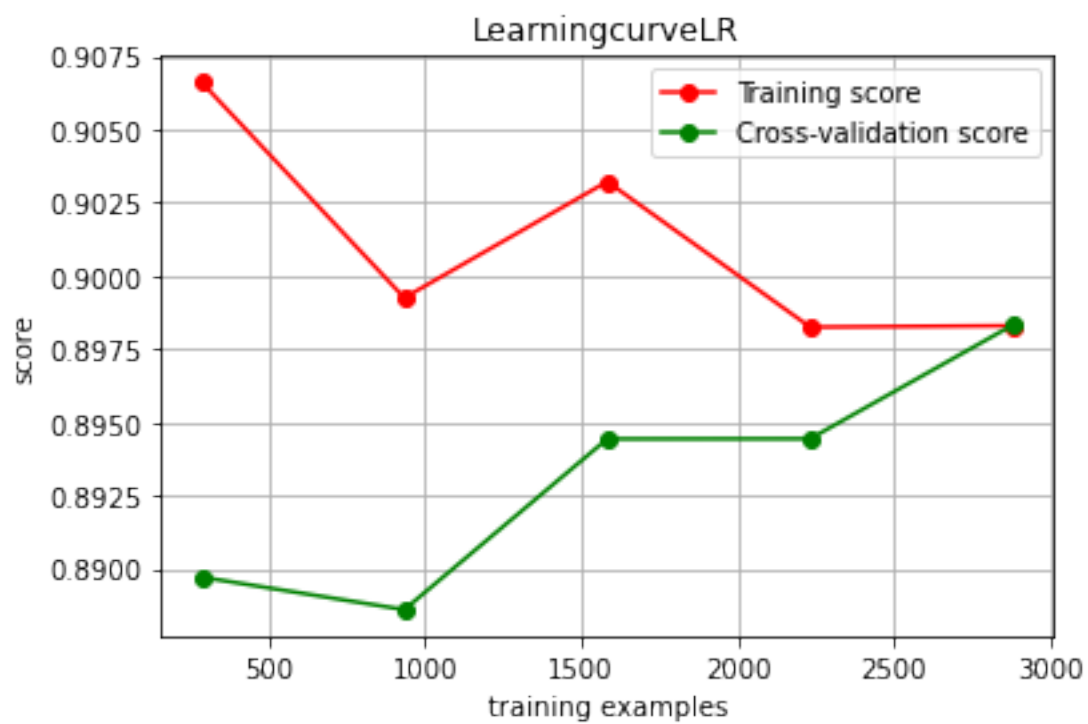
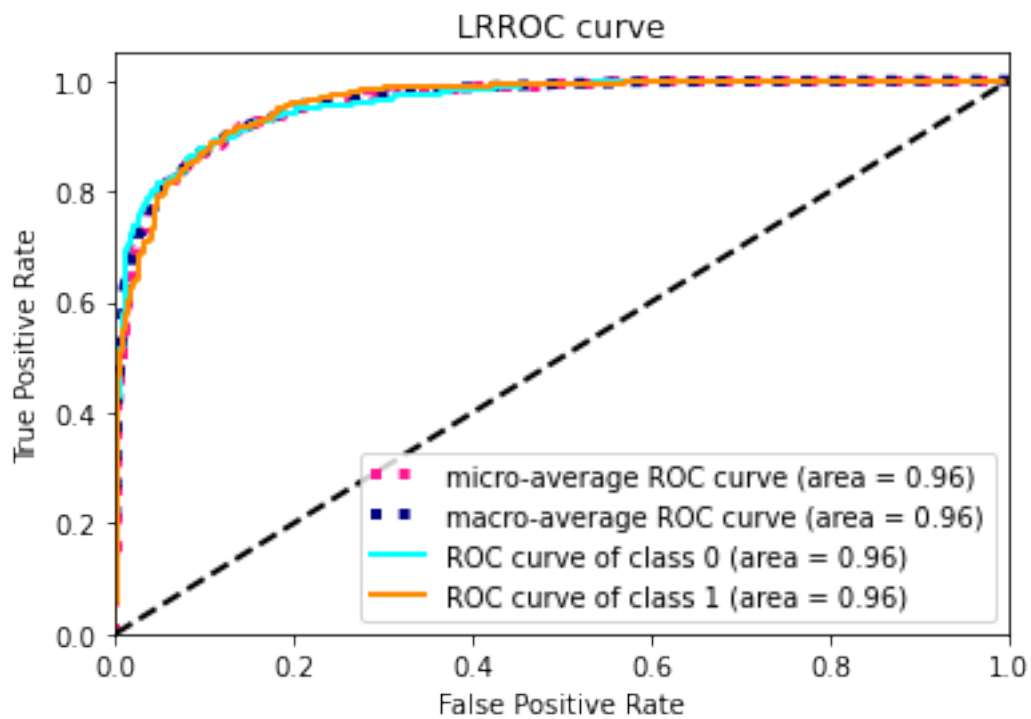
Accuracy: 0.8833333333333333

Best parameters found on Dataset A:

{'C': 0.01, 'penalty': 'l2', 'solver': 'saga'}

Average runtime per test instance: 1.5525023142496745e-06





-----Task A2: Grid searching on
SVM-----

SVM Grid search CV on Dataset A:

Training scores:

0.514 (+/-0.000) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'rbf'}
0.894 (+/-0.003) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'linear'}
0.514 (+/-0.000) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'sigmoid'}
0.514 (+/-0.000) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'rbf'}
0.894 (+/-0.003) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'linear'}
0.514 (+/-0.000) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'sigmoid'}
0.514 (+/-0.000) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'rbf'}
0.894 (+/-0.003) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'linear'}
0.678 (+/-0.008) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'sigmoid'}
0.514 (+/-0.000) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'rbf'}
0.894 (+/-0.003) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'linear'}
0.862 (+/-0.008) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'sigmoid'}
0.514 (+/-0.000) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'rbf'}
0.904 (+/-0.003) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'linear'}
0.515 (+/-0.000) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'sigmoid'}
0.877 (+/-0.004) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'rbf'}
0.904 (+/-0.003) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'linear'}
0.795 (+/-0.009) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'sigmoid'}
0.865 (+/-0.006) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'rbf'}
0.904 (+/-0.003) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'linear'}
0.880 (+/-0.005) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'sigmoid'}
0.514 (+/-0.000) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'rbf'}
0.904 (+/-0.003) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'linear'}
0.771 (+/-0.009) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'sigmoid'}
0.875 (+/-0.003) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'rbf'}
0.907 (+/-0.004) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'linear'}
0.796 (+/-0.008) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
0.887 (+/-0.005) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'rbf'}
0.907 (+/-0.004) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'linear'}
0.881 (+/-0.004) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'sigmoid'}
0.897 (+/-0.003) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'rbf'}
0.907 (+/-0.004) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'linear'}
0.834 (+/-0.002) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'sigmoid'}
0.540 (+/-0.007) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}
0.907 (+/-0.004) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'linear'}
0.725 (+/-0.005) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'sigmoid'}
0.886 (+/-0.004) for {'C': 1, 'gamma': 0.0001, 'kernel': 'rbf'}
0.913 (+/-0.004) for {'C': 1, 'gamma': 0.0001, 'kernel': 'linear'}

0.881 (+/-0.004) for {'C': 1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.902 (+/-0.003) for {'C': 1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.913 (+/-0.004) for {'C': 1, 'gamma': 0.001, 'kernel': 'linear'}
 0.893 (+/-0.004) for {'C': 1, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.928 (+/-0.003) for {'C': 1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.913 (+/-0.004) for {'C': 1, 'gamma': 0.01, 'kernel': 'linear'}
 0.795 (+/-0.005) for {'C': 1, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.998 (+/-0.001) for {'C': 1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.913 (+/-0.004) for {'C': 1, 'gamma': 0.1, 'kernel': 'linear'}
 0.723 (+/-0.006) for {'C': 1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.900 (+/-0.005) for {'C': 10, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.913 (+/-0.007) for {'C': 10, 'gamma': 0.0001, 'kernel': 'linear'}
 0.894 (+/-0.003) for {'C': 10, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.915 (+/-0.005) for {'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}
 0.913 (+/-0.007) for {'C': 10, 'gamma': 0.001, 'kernel': 'linear'}
 0.875 (+/-0.021) for {'C': 10, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.977 (+/-0.002) for {'C': 10, 'gamma': 0.01, 'kernel': 'rbf'}
 0.913 (+/-0.007) for {'C': 10, 'gamma': 0.01, 'kernel': 'linear'}
 0.791 (+/-0.006) for {'C': 10, 'gamma': 0.01, 'kernel': 'sigmoid'}
 1.000 (+/-0.000) for {'C': 10, 'gamma': 0.1, 'kernel': 'rbf'}
 0.913 (+/-0.007) for {'C': 10, 'gamma': 0.1, 'kernel': 'linear'}
 0.723 (+/-0.006) for {'C': 10, 'gamma': 0.1, 'kernel': 'sigmoid'}

Validation scores:

0.514 (+/-0.001) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.892 (+/-0.014) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'linear'}
 0.514 (+/-0.001) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.514 (+/-0.001) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'rbf'}
 0.892 (+/-0.014) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'linear'}
 0.514 (+/-0.001) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.514 (+/-0.001) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'rbf'}
 0.892 (+/-0.014) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'linear'}
 0.678 (+/-0.024) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.514 (+/-0.001) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'rbf'}
 0.892 (+/-0.014) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'linear'}
 0.859 (+/-0.022) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.514 (+/-0.001) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.897 (+/-0.006) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'linear'}
 0.515 (+/-0.001) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.877 (+/-0.021) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'rbf'}
 0.897 (+/-0.006) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'linear'}
 0.793 (+/-0.019) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.863 (+/-0.025) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'rbf'}
 0.897 (+/-0.006) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'linear'}
 0.880 (+/-0.014) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.514 (+/-0.001) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'rbf'}
 0.897 (+/-0.006) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'linear'}

0.770 (+/-0.020) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.876 (+/-0.017) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.894 (+/-0.017) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.794 (+/-0.018) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.887 (+/-0.012) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.894 (+/-0.017) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'linear'}
 0.881 (+/-0.016) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.888 (+/-0.020) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.894 (+/-0.017) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'linear'}
 0.829 (+/-0.008) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.529 (+/-0.007) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.894 (+/-0.017) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'linear'}
 0.727 (+/-0.016) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.885 (+/-0.012) for {'C': 1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.890 (+/-0.020) for {'C': 1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.881 (+/-0.015) for {'C': 1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.899 (+/-0.017) for {'C': 1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.890 (+/-0.020) for {'C': 1, 'gamma': 0.001, 'kernel': 'linear'}
 0.894 (+/-0.012) for {'C': 1, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.890 (+/-0.017) for {'C': 1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.890 (+/-0.020) for {'C': 1, 'gamma': 0.01, 'kernel': 'linear'}
 0.787 (+/-0.016) for {'C': 1, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.865 (+/-0.029) for {'C': 1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.890 (+/-0.020) for {'C': 1, 'gamma': 0.1, 'kernel': 'linear'}
 0.728 (+/-0.011) for {'C': 1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.897 (+/-0.012) for {'C': 10, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.889 (+/-0.021) for {'C': 10, 'gamma': 0.0001, 'kernel': 'linear'}
 0.892 (+/-0.014) for {'C': 10, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.900 (+/-0.019) for {'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}
 0.889 (+/-0.021) for {'C': 10, 'gamma': 0.001, 'kernel': 'linear'}
 0.876 (+/-0.023) for {'C': 10, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.878 (+/-0.019) for {'C': 10, 'gamma': 0.01, 'kernel': 'rbf'}
 0.889 (+/-0.021) for {'C': 10, 'gamma': 0.01, 'kernel': 'linear'}
 0.786 (+/-0.019) for {'C': 10, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.861 (+/-0.024) for {'C': 10, 'gamma': 0.1, 'kernel': 'rbf'}
 0.889 (+/-0.021) for {'C': 10, 'gamma': 0.1, 'kernel': 'linear'}
 0.727 (+/-0.011) for {'C': 10, 'gamma': 0.1, 'kernel': 'sigmoid'}

Prediction on a pseudo test set (split from Dataset A):

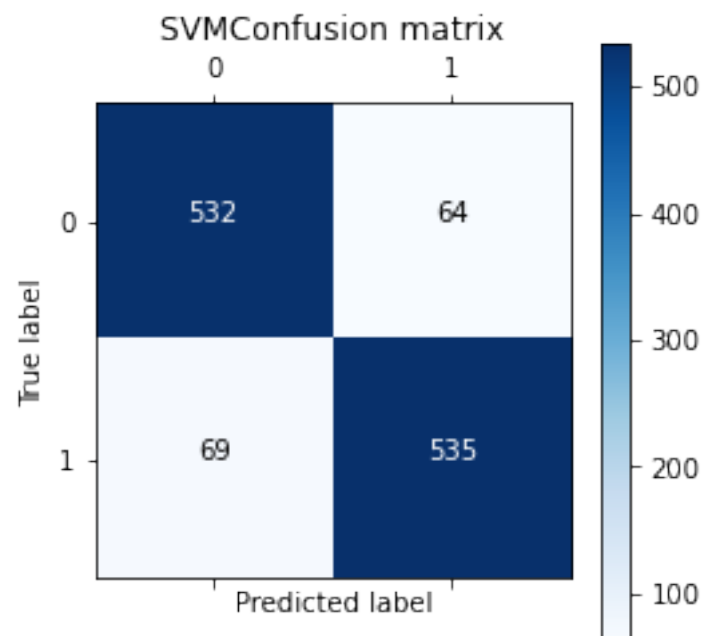
	precision	recall	f1-score	support
0.0	0.89	0.89	0.89	596
1.0	0.89	0.89	0.89	604
accuracy			0.89	1200
macro avg	0.89	0.89	0.89	1200
weighted avg	0.89	0.89	0.89	1200

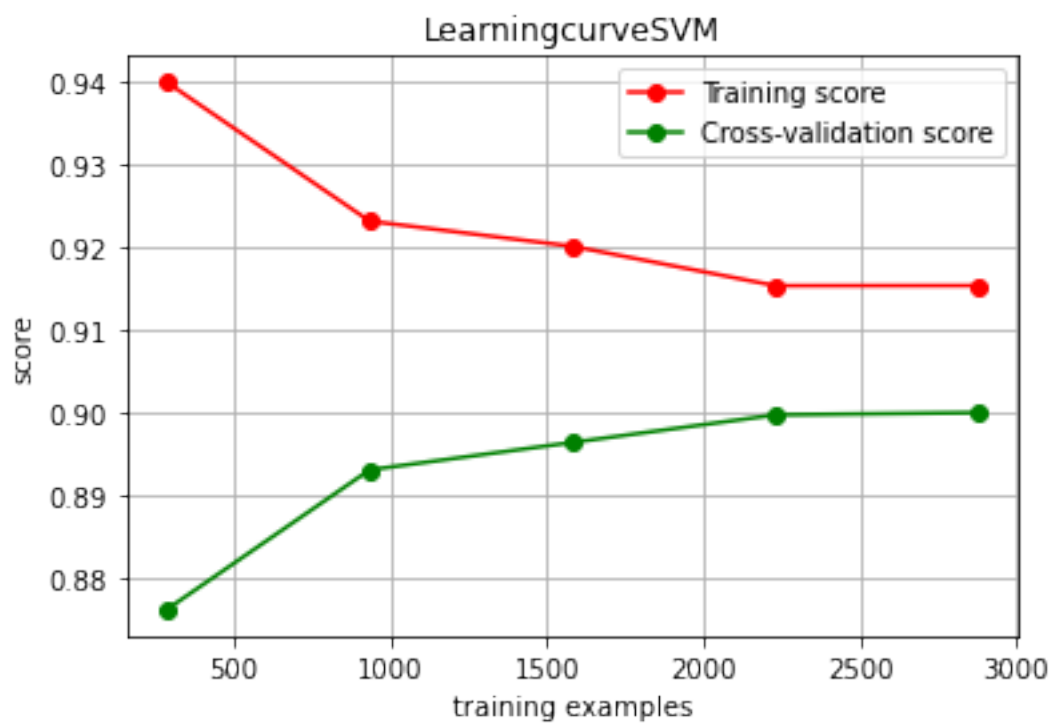
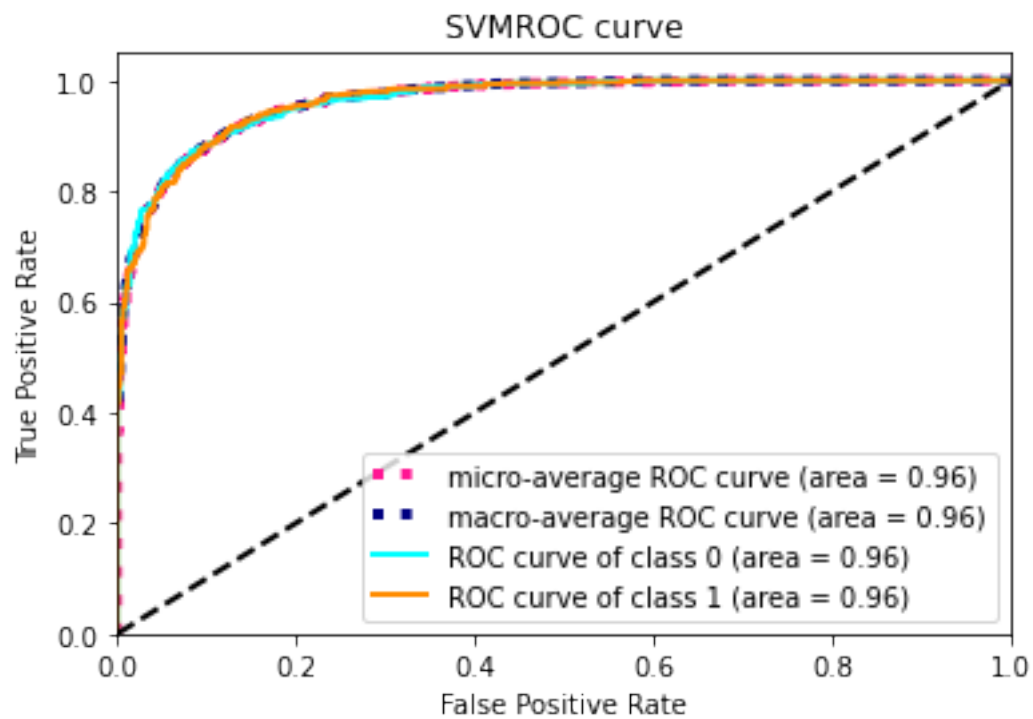
Accuracy: 0.8891666666666667

Best parameters found on Dataset A:

`{'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}`

Average runtime per test instance: 0.00027517338593800863





-----Task A2: Grid searching on Rando
Forest-----

RF Grid search CV on Dataset A:

Training scores:

1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 1024}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 1024}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 1024}
1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 1024}
1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 1024}

Validation scores:

0.889 (+/-0.008) for {'max_depth': 64, 'n_estimators': 64}
0.892 (+/-0.019) for {'max_depth': 64, 'n_estimators': 128}
0.890 (+/-0.013) for {'max_depth': 64, 'n_estimators': 256}
0.892 (+/-0.015) for {'max_depth': 64, 'n_estimators': 512}
0.893 (+/-0.009) for {'max_depth': 64, 'n_estimators': 1024}
0.889 (+/-0.012) for {'max_depth': 128, 'n_estimators': 64}
0.887 (+/-0.018) for {'max_depth': 128, 'n_estimators': 128}
0.892 (+/-0.013) for {'max_depth': 128, 'n_estimators': 256}
0.890 (+/-0.009) for {'max_depth': 128, 'n_estimators': 512}
0.892 (+/-0.016) for {'max_depth': 128, 'n_estimators': 1024}

0.894 (+/-0.023) for {'max_depth': 256, 'n_estimators': 64}
 0.894 (+/-0.011) for {'max_depth': 256, 'n_estimators': 128}
 0.892 (+/-0.015) for {'max_depth': 256, 'n_estimators': 256}
 0.893 (+/-0.008) for {'max_depth': 256, 'n_estimators': 512}
 0.892 (+/-0.014) for {'max_depth': 256, 'n_estimators': 1024}
 0.887 (+/-0.020) for {'max_depth': 512, 'n_estimators': 64}
 0.887 (+/-0.011) for {'max_depth': 512, 'n_estimators': 128}
 0.891 (+/-0.011) for {'max_depth': 512, 'n_estimators': 256}
 0.891 (+/-0.012) for {'max_depth': 512, 'n_estimators': 512}
 0.893 (+/-0.011) for {'max_depth': 512, 'n_estimators': 1024}
 0.887 (+/-0.007) for {'max_depth': 1024, 'n_estimators': 64}
 0.885 (+/-0.016) for {'max_depth': 1024, 'n_estimators': 128}
 0.892 (+/-0.009) for {'max_depth': 1024, 'n_estimators': 256}
 0.892 (+/-0.015) for {'max_depth': 1024, 'n_estimators': 512}
 0.891 (+/-0.013) for {'max_depth': 1024, 'n_estimators': 1024}

Prediction on a pseudo test set (split from Dataset A):

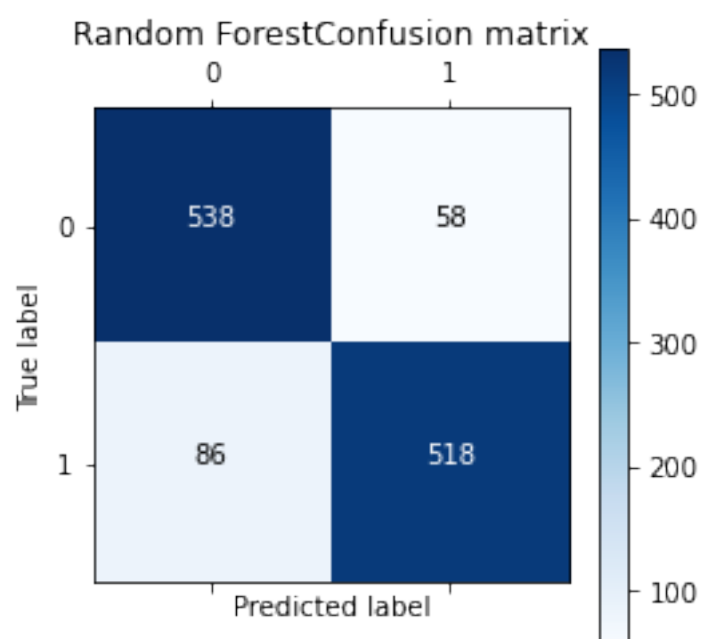
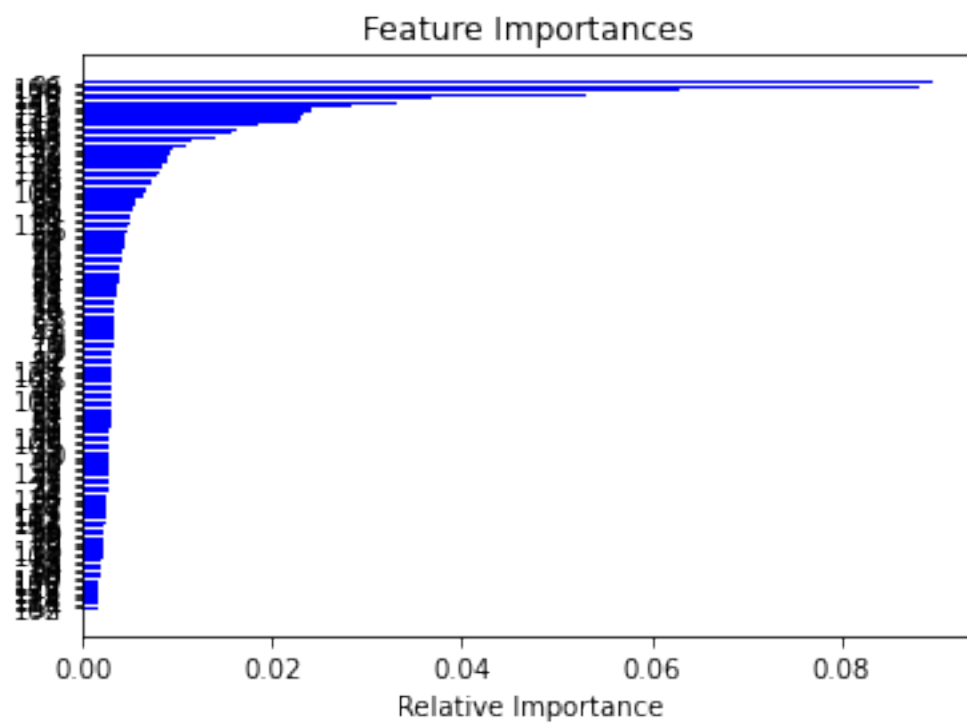
	precision	recall	f1-score	support
0.0	0.86	0.90	0.88	596
1.0	0.90	0.86	0.88	604
accuracy			0.88	1200
macro avg	0.88	0.88	0.88	1200
weighted avg	0.88	0.88	0.88	1200

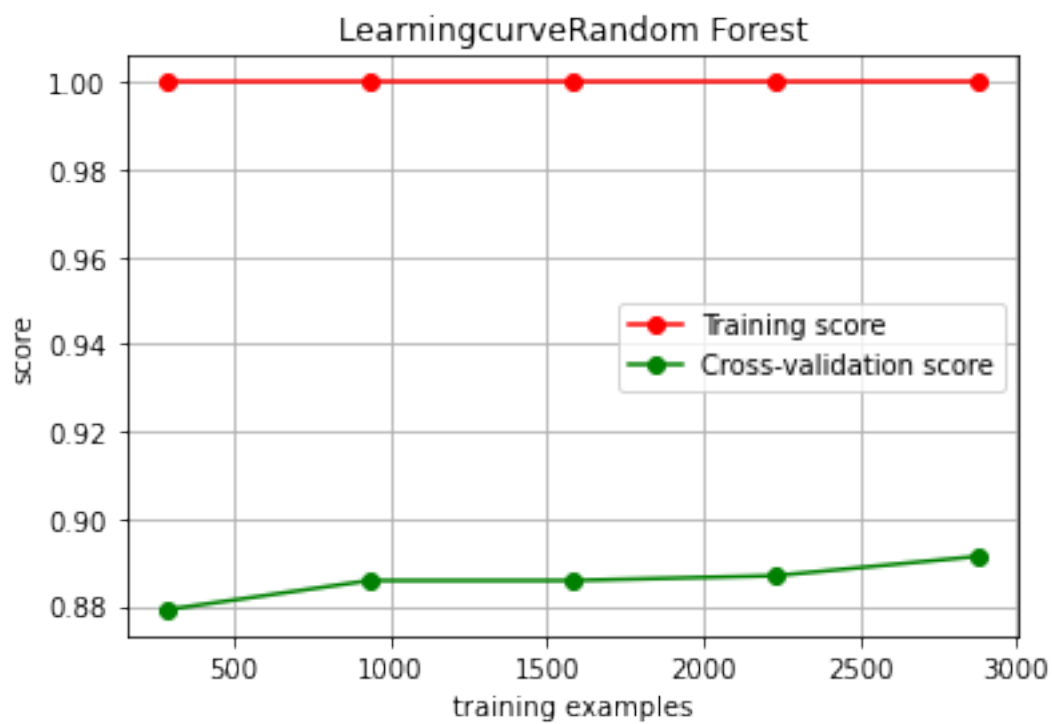
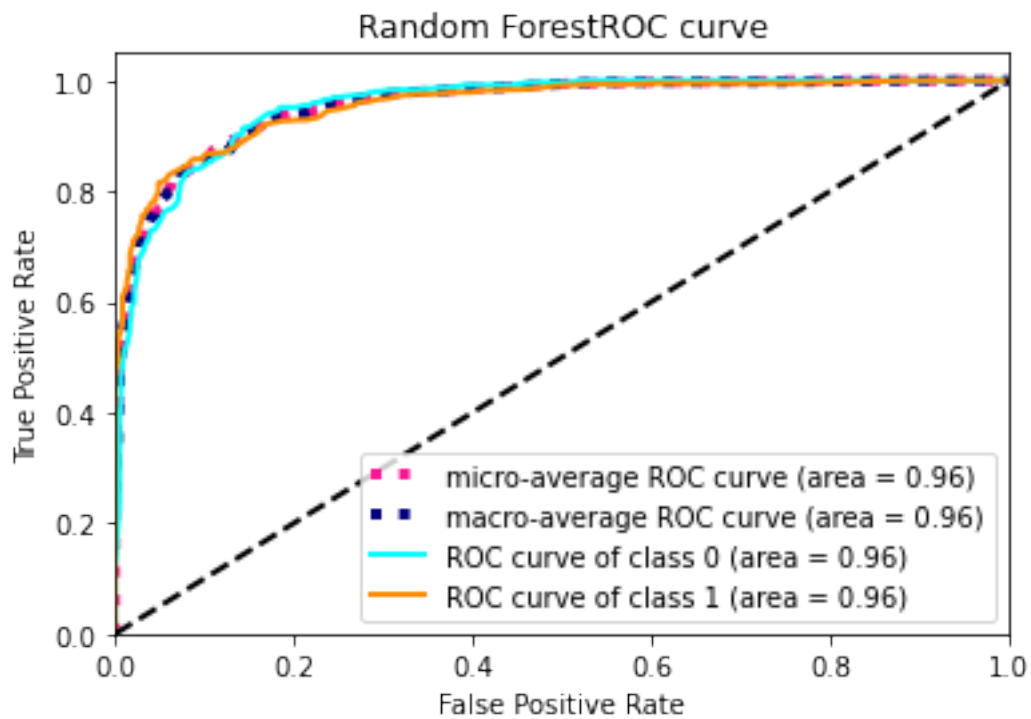
Accuracy: 0.88

Best parameters found on Dataset A:

{ 'max_depth': 256, 'n_estimators': 128 }

Average runtime per test instance: 5.51903247833252e-05





-----Task A2: Grid searching on
KNN-----

KNN Grid search CV on Dataset A:

Training scores:

0.894 (+/-0.009) for {'n_neighbors': 8}
0.885 (+/-0.007) for {'n_neighbors': 16}
0.884 (+/-0.005) for {'n_neighbors': 32}
0.884 (+/-0.006) for {'n_neighbors': 64}
0.885 (+/-0.005) for {'n_neighbors': 128}

Validation scores:

0.870 (+/-0.016) for {'n_neighbors': 8}
0.876 (+/-0.022) for {'n_neighbors': 16}
0.877 (+/-0.020) for {'n_neighbors': 32}
0.881 (+/-0.015) for {'n_neighbors': 64}
0.882 (+/-0.014) for {'n_neighbors': 128}

Prediction on a pseudo test set (split from Dataset A):

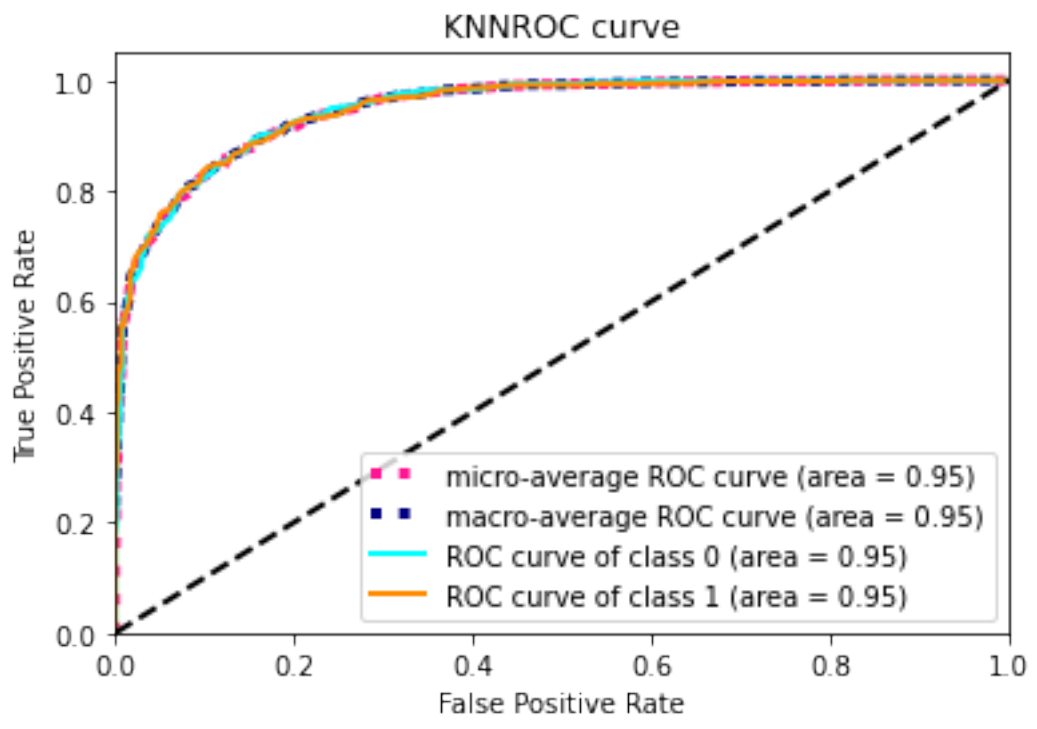
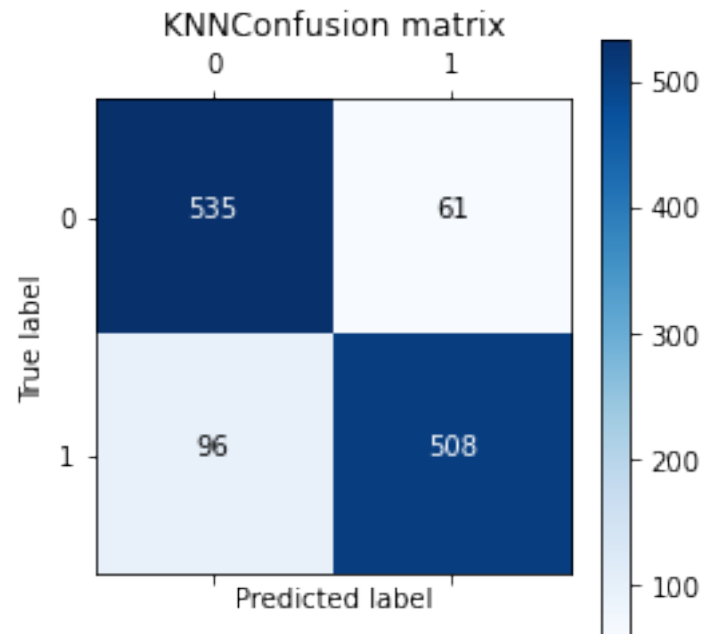
	precision	recall	f1-score	support
0.0	0.85	0.90	0.87	596
1.0	0.89	0.84	0.87	604
accuracy			0.87	1200
macro avg	0.87	0.87	0.87	1200
weighted avg	0.87	0.87	0.87	1200

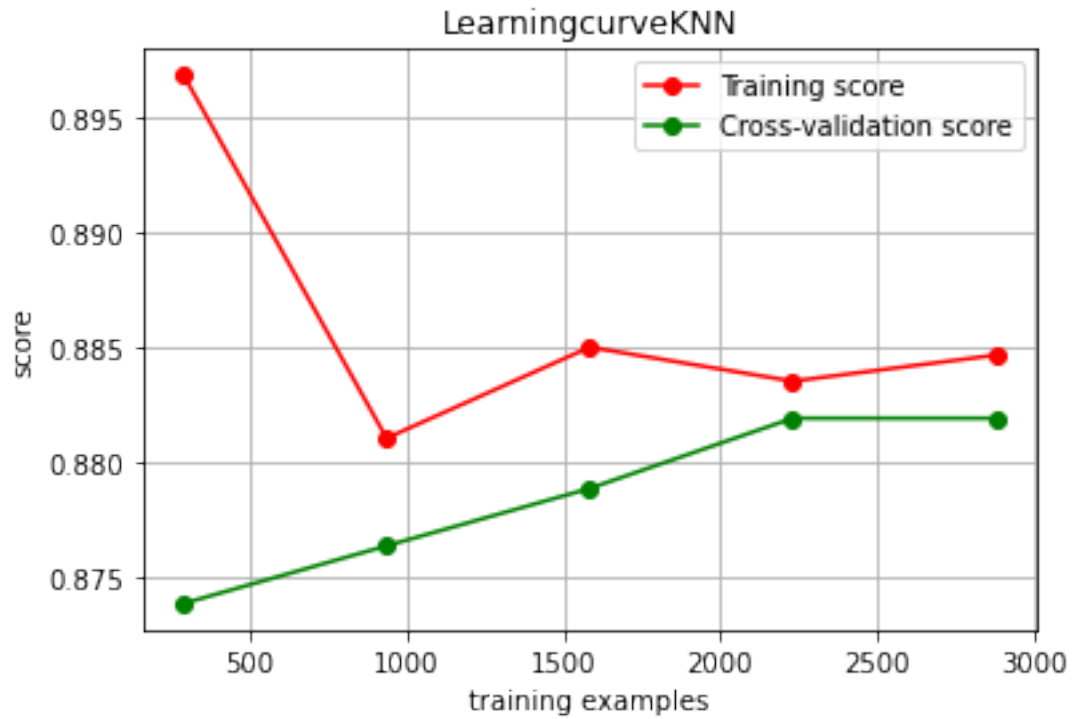
Accuracy: 0.8691666666666666

Best parameters found on Dataset A:

{'n_neighbors': 128}

Average runtime per test instance: 0.001910872459411621





-----Task A2: Gird searching on
MLP-----

#####

Sequential with Kfold CV:

Training for fold 1 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_11"

Layer (type)	Output Shape	Param #
dense_56 (Dense)	(None, 2176)	298112
dense_57 (Dense)	(None, 1088)	2368576
dropout_36 (Dropout)	(None, 1088)	0
dense_58 (Dense)	(None, 544)	592416

dropout_37 (Dropout)	(None, 544)	0

dense_59 (Dense)	(None, 272)	148240

dropout_38 (Dropout)	(None, 272)	0

dense_60 (Dense)	(None, 2)	546
=====		
Total params: 3,407,890		
Trainable params: 3,407,890		
Non-trainable params: 0		

Train on 2880 samples, validate on 720 samples		
Epoch 1/50		
2880/2880 [=====] - 4s 1ms/step - loss: 1.3769 -		
accuracy: 0.6167 - val_loss: 0.3165 - val_accuracy: 0.8653		
Epoch 2/50		
2880/2880 [=====] - 2s 672us/step - loss: 0.2700 -		
accuracy: 0.8903 - val_loss: 0.3231 - val_accuracy: 0.8694		
Epoch 3/50		
2880/2880 [=====] - 2s 702us/step - loss: 0.2882 -		
accuracy: 0.8792 - val_loss: 0.2612 - val_accuracy: 0.8792		
Epoch 4/50		
2880/2880 [=====] - 2s 674us/step - loss: 0.2582 -		
accuracy: 0.8913 - val_loss: 0.2821 - val_accuracy: 0.8736		
Epoch 5/50		
2880/2880 [=====] - 2s 672us/step - loss: 0.2543 -		
accuracy: 0.8885 - val_loss: 0.2681 - val_accuracy: 0.8806		
Epoch 6/50		
2880/2880 [=====] - 2s 691us/step - loss: 0.2585 -		
accuracy: 0.8962 - val_loss: 0.3080 - val_accuracy: 0.8847		
Epoch 7/50		
2880/2880 [=====] - 2s 689us/step - loss: 0.2407 -		
accuracy: 0.9000 - val_loss: 0.2841 - val_accuracy: 0.8792		
Epoch 8/50		
2880/2880 [=====] - 2s 666us/step - loss: 0.2281 -		
accuracy: 0.9073 - val_loss: 0.2870 - val_accuracy: 0.8806		
Epoch 9/50		
2880/2880 [=====] - 2s 663us/step - loss: 0.2517 -		
accuracy: 0.9010 - val_loss: 0.2802 - val_accuracy: 0.8833		
Epoch 10/50		
2880/2880 [=====] - 2s 666us/step - loss: 0.2047 -		
accuracy: 0.9122 - val_loss: 0.3538 - val_accuracy: 0.8792		
Epoch 11/50		
2880/2880 [=====] - 2s 671us/step - loss: 0.2580 -		
accuracy: 0.9000 - val_loss: 0.2873 - val_accuracy: 0.8917		
Epoch 12/50		
2880/2880 [=====] - 2s 674us/step - loss: 0.2213 -		

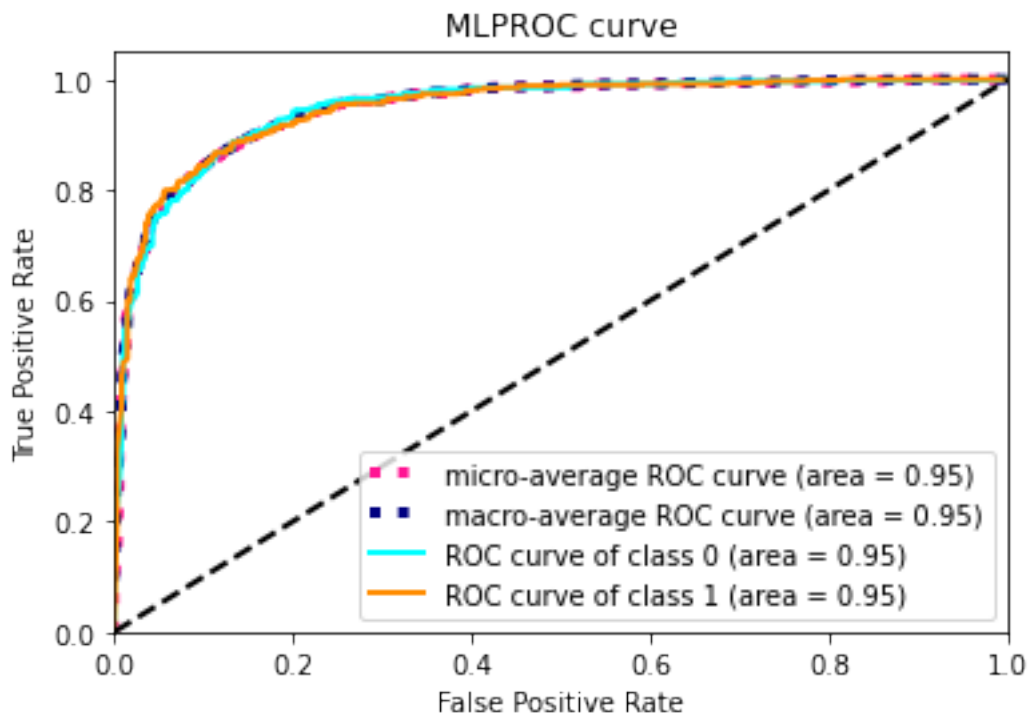
accuracy: 0.9104 - val_loss: 0.2687 - val_accuracy: 0.8861
 Epoch 13/50
 2880/2880 [=====] - 2s 686us/step - loss: 0.2123 -
 accuracy: 0.9090 - val_loss: 0.2995 - val_accuracy: 0.8889
 Epoch 14/50
 2880/2880 [=====] - 2s 689us/step - loss: 0.2207 -
 accuracy: 0.9083 - val_loss: 0.3242 - val_accuracy: 0.8847
 Epoch 15/50
 2880/2880 [=====] - 2s 685us/step - loss: 0.1927 -
 accuracy: 0.9198 - val_loss: 0.3176 - val_accuracy: 0.8986
 Epoch 16/50
 2880/2880 [=====] - 2s 685us/step - loss: 0.2008 -
 accuracy: 0.9135 - val_loss: 0.2907 - val_accuracy: 0.8847
 Epoch 17/50
 2880/2880 [=====] - 2s 677us/step - loss: 0.1743 -
 accuracy: 0.9253 - val_loss: 0.3448 - val_accuracy: 0.8944
 Epoch 18/50
 2880/2880 [=====] - 2s 681us/step - loss: 0.1808 -
 accuracy: 0.9215 - val_loss: 0.3586 - val_accuracy: 0.8931
 Epoch 19/50
 2880/2880 [=====] - 2s 669us/step - loss: 0.1972 -
 accuracy: 0.9198 - val_loss: 0.3965 - val_accuracy: 0.8736
 Epoch 20/50
 2880/2880 [=====] - 2s 683us/step - loss: 0.1609 -
 accuracy: 0.9295 - val_loss: 0.3853 - val_accuracy: 0.8778
 Epoch 21/50
 2880/2880 [=====] - 2s 678us/step - loss: 0.1725 -
 accuracy: 0.9253 - val_loss: 0.3580 - val_accuracy: 0.8764
 Epoch 22/50
 2880/2880 [=====] - 2s 665us/step - loss: 0.1564 -
 accuracy: 0.9312 - val_loss: 0.3916 - val_accuracy: 0.8847
 Epoch 23/50
 2880/2880 [=====] - 2s 684us/step - loss: 0.1840 -
 accuracy: 0.9212 - val_loss: 0.4411 - val_accuracy: 0.8764
 Epoch 24/50
 2880/2880 [=====] - 2s 677us/step - loss: 0.1474 -
 accuracy: 0.9385 - val_loss: 0.4424 - val_accuracy: 0.8514
 Epoch 25/50
 2880/2880 [=====] - 2s 685us/step - loss: 0.1583 -
 accuracy: 0.9323 - val_loss: 0.4163 - val_accuracy: 0.8847
 Epoch 26/50
 2880/2880 [=====] - 2s 661us/step - loss: 0.1509 -
 accuracy: 0.9382 - val_loss: 0.5442 - val_accuracy: 0.8653
 Epoch 27/50
 2880/2880 [=====] - 2s 676us/step - loss: 0.1348 -
 accuracy: 0.9458 - val_loss: 0.4648 - val_accuracy: 0.8819
 Epoch 28/50
 2880/2880 [=====] - 2s 676us/step - loss: 0.1443 -

accuracy: 0.9385 - val_loss: 0.5526 - val_accuracy: 0.8736
 Epoch 29/50
 2880/2880 [=====] - 2s 671us/step - loss: 0.1136 -
 accuracy: 0.9514 - val_loss: 0.6664 - val_accuracy: 0.8861
 Epoch 30/50
 2880/2880 [=====] - 2s 669us/step - loss: 0.1539 -
 accuracy: 0.9444 - val_loss: 0.4499 - val_accuracy: 0.8847
 Epoch 31/50
 2880/2880 [=====] - 2s 688us/step - loss: 0.1130 -
 accuracy: 0.9514 - val_loss: 0.5451 - val_accuracy: 0.8736
 Epoch 32/50
 2880/2880 [=====] - 2s 681us/step - loss: 0.1221 -
 accuracy: 0.9497 - val_loss: 0.5304 - val_accuracy: 0.8847
 Epoch 33/50
 2880/2880 [=====] - 2s 677us/step - loss: 0.1298 -
 accuracy: 0.9563 - val_loss: 0.4849 - val_accuracy: 0.8861
 Epoch 34/50
 2880/2880 [=====] - 2s 667us/step - loss: 0.1030 -
 accuracy: 0.9604 - val_loss: 0.9952 - val_accuracy: 0.8653
 Epoch 35/50
 2880/2880 [=====] - 2s 681us/step - loss: 0.1211 -
 accuracy: 0.9580 - val_loss: 0.5980 - val_accuracy: 0.8778
 Epoch 36/50
 2880/2880 [=====] - 2s 678us/step - loss: 0.1242 -
 accuracy: 0.9580 - val_loss: 0.4105 - val_accuracy: 0.8667
 Epoch 37/50
 2880/2880 [=====] - 2s 666us/step - loss: 0.0998 -
 accuracy: 0.9622 - val_loss: 0.5587 - val_accuracy: 0.8792
 Epoch 38/50
 2880/2880 [=====] - 2s 680us/step - loss: 0.0841 -
 accuracy: 0.9694 - val_loss: 0.5210 - val_accuracy: 0.8681
 Epoch 39/50
 2880/2880 [=====] - 2s 665us/step - loss: 0.0963 -
 accuracy: 0.9625 - val_loss: 0.4570 - val_accuracy: 0.8417
 Epoch 40/50
 2880/2880 [=====] - 2s 674us/step - loss: 0.0779 -
 accuracy: 0.9681 - val_loss: 0.6022 - val_accuracy: 0.8806
 Epoch 41/50
 2880/2880 [=====] - 2s 676us/step - loss: 0.1728 -
 accuracy: 0.9451 - val_loss: 0.4350 - val_accuracy: 0.8806
 Epoch 42/50
 2880/2880 [=====] - 2s 667us/step - loss: 0.0524 -
 accuracy: 0.9847 - val_loss: 0.5793 - val_accuracy: 0.8819
 Epoch 43/50
 2880/2880 [=====] - 2s 661us/step - loss: 0.0817 -
 accuracy: 0.9743 - val_loss: 0.5997 - val_accuracy: 0.8278
 Epoch 44/50
 2880/2880 [=====] - 2s 658us/step - loss: 0.0727 -

```

accuracy: 0.9722 - val_loss: 0.6618 - val_accuracy: 0.8806
Epoch 45/50
2880/2880 [=====] - 2s 665us/step - loss: 0.1183 -
accuracy: 0.9625 - val_loss: 0.5416 - val_accuracy: 0.8681
Epoch 46/50
2880/2880 [=====] - 2s 656us/step - loss: 0.0485 -
accuracy: 0.9830 - val_loss: 0.8821 - val_accuracy: 0.8806
Epoch 47/50
2880/2880 [=====] - 2s 649us/step - loss: 0.0933 -
accuracy: 0.9622 - val_loss: 0.6086 - val_accuracy: 0.8792
Epoch 48/50
2880/2880 [=====] - 2s 665us/step - loss: 0.0271 -
accuracy: 0.9885 - val_loss: 0.9270 - val_accuracy: 0.8722
Epoch 49/50
2880/2880 [=====] - 2s 656us/step - loss: 0.0687 -
accuracy: 0.9743 - val_loss: 0.7302 - val_accuracy: 0.8528
Epoch 50/50
2880/2880 [=====] - 2s 676us/step - loss: 0.0610 -
accuracy: 0.9729 - val_loss: 0.7779 - val_accuracy: 0.8819
1200/1200 [=====] - 0s 255us/step

```



Sequential with Kfold CV:
Training for fold 2 ...

Adding layer 1:
 Adding layer 2:
 Adding layer 3:
 Model: "sequential_12"

Layer (type)	Output Shape	Param #
dense_61 (Dense)	(None, 2176)	298112
dense_62 (Dense)	(None, 1088)	2368576
dropout_39 (Dropout)	(None, 1088)	0
dense_63 (Dense)	(None, 544)	592416
dropout_40 (Dropout)	(None, 544)	0
dense_64 (Dense)	(None, 272)	148240
dropout_41 (Dropout)	(None, 272)	0
dense_65 (Dense)	(None, 2)	546

Total params: 3,407,890
 Trainable params: 3,407,890
 Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50
 2880/2880 [=====] - 4s 1ms/step - loss: 1.3433 - accuracy: 0.6757 - val_loss: 0.2952 - val_accuracy: 0.8736

Epoch 2/50
 2880/2880 [=====] - 2s 665us/step - loss: 0.2618 - accuracy: 0.8882 - val_loss: 0.2830 - val_accuracy: 0.8861

Epoch 3/50
 2880/2880 [=====] - 2s 660us/step - loss: 0.2525 - accuracy: 0.8913 - val_loss: 0.2799 - val_accuracy: 0.8875

Epoch 4/50
 2880/2880 [=====] - 2s 664us/step - loss: 0.2599 - accuracy: 0.8892 - val_loss: 0.3768 - val_accuracy: 0.8306

Epoch 5/50
 2880/2880 [=====] - 2s 670us/step - loss: 0.2570 - accuracy: 0.8941 - val_loss: 0.3314 - val_accuracy: 0.8722

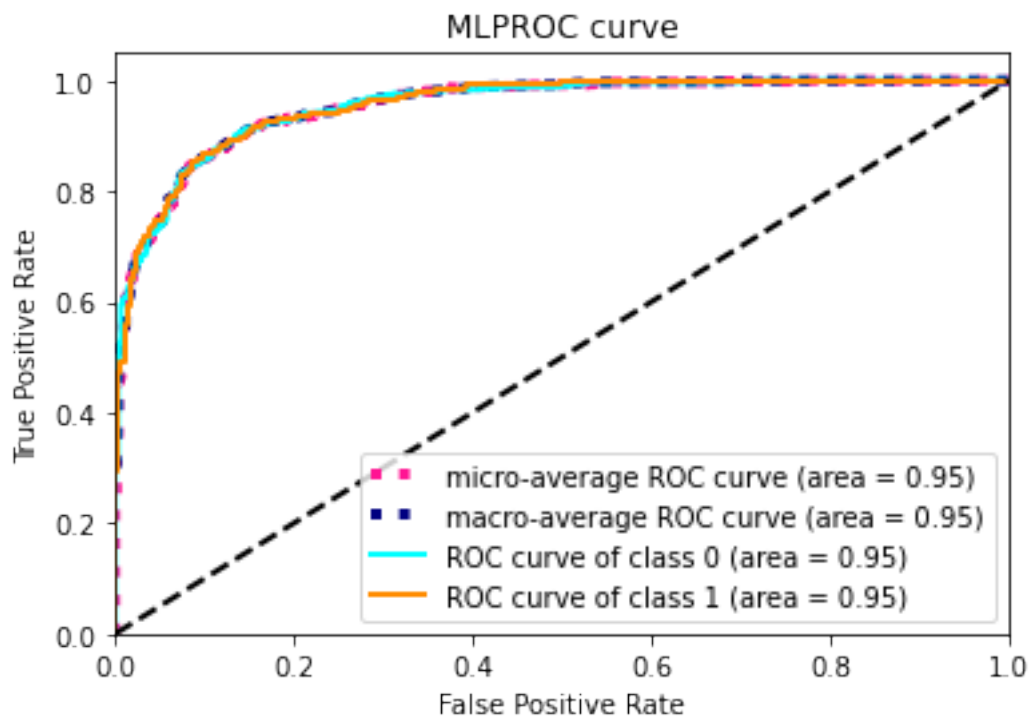
Epoch 6/50
 2880/2880 [=====] - 2s 665us/step - loss: 0.2506 - accuracy: 0.8948 - val_loss: 0.2947 - val_accuracy: 0.8875

Epoch 7/50
 2880/2880 [=====] - 2s 657us/step - loss: 0.2468 -

accuracy: 0.8969 - val_loss: 0.2823 - val_accuracy: 0.8792
 Epoch 8/50
 2880/2880 [=====] - 2s 667us/step - loss: 0.2686 -
 accuracy: 0.8847 - val_loss: 0.2747 - val_accuracy: 0.8847
 Epoch 9/50
 2880/2880 [=====] - 2s 682us/step - loss: 0.2421 -
 accuracy: 0.8979 - val_loss: 0.2894 - val_accuracy: 0.8944
 Epoch 10/50
 2880/2880 [=====] - 2s 665us/step - loss: 0.2132 -
 accuracy: 0.9087 - val_loss: 0.3696 - val_accuracy: 0.8597
 Epoch 11/50
 2880/2880 [=====] - 2s 664us/step - loss: 0.2355 -
 accuracy: 0.8983 - val_loss: 0.2920 - val_accuracy: 0.8944
 Epoch 12/50
 2880/2880 [=====] - 2s 668us/step - loss: 0.2141 -
 accuracy: 0.9101 - val_loss: 0.2996 - val_accuracy: 0.8722
 Epoch 13/50
 2880/2880 [=====] - 2s 664us/step - loss: 0.2117 -
 accuracy: 0.9090 - val_loss: 0.2941 - val_accuracy: 0.8722
 Epoch 14/50
 2880/2880 [=====] - 2s 707us/step - loss: 0.2062 -
 accuracy: 0.9104 - val_loss: 0.3328 - val_accuracy: 0.8875
 Epoch 15/50
 2880/2880 [=====] - 2s 678us/step - loss: 0.1993 -
 accuracy: 0.9083 - val_loss: 0.3467 - val_accuracy: 0.8875
 Epoch 16/50
 2880/2880 [=====] - 2s 683us/step - loss: 0.2052 -
 accuracy: 0.9094 - val_loss: 0.3267 - val_accuracy: 0.8819
 Epoch 17/50
 2880/2880 [=====] - 2s 653us/step - loss: 0.1883 -
 accuracy: 0.9125 - val_loss: 0.3544 - val_accuracy: 0.8500
 Epoch 18/50
 2880/2880 [=====] - 2s 678us/step - loss: 0.1966 -
 accuracy: 0.9094 - val_loss: 0.3522 - val_accuracy: 0.8917
 Epoch 19/50
 2880/2880 [=====] - 2s 674us/step - loss: 0.1664 -
 accuracy: 0.9250 - val_loss: 0.3418 - val_accuracy: 0.8778
 Epoch 20/50
 2880/2880 [=====] - 2s 686us/step - loss: 0.1750 -
 accuracy: 0.9243 - val_loss: 0.3963 - val_accuracy: 0.8764
 Epoch 21/50
 2880/2880 [=====] - 2s 671us/step - loss: 0.1693 -
 accuracy: 0.9201 - val_loss: 0.3540 - val_accuracy: 0.8611
 Epoch 22/50
 2880/2880 [=====] - 2s 664us/step - loss: 0.1826 -
 accuracy: 0.9184 - val_loss: 0.3446 - val_accuracy: 0.8653
 Epoch 23/50
 2880/2880 [=====] - 2s 662us/step - loss: 0.1399 -

accuracy: 0.9326 - val_loss: 0.4212 - val_accuracy: 0.8750
 Epoch 24/50
 2880/2880 [=====] - 2s 673us/step - loss: 0.1711 -
 accuracy: 0.9267 - val_loss: 0.3707 - val_accuracy: 0.8722
 Epoch 25/50
 2880/2880 [=====] - 2s 681us/step - loss: 0.1653 -
 accuracy: 0.9278 - val_loss: 0.3757 - val_accuracy: 0.8736
 Epoch 26/50
 2880/2880 [=====] - 2s 681us/step - loss: 0.1633 -
 accuracy: 0.9274 - val_loss: 0.3681 - val_accuracy: 0.8972
 Epoch 27/50
 2880/2880 [=====] - 2s 648us/step - loss: 0.1287 -
 accuracy: 0.9420 - val_loss: 0.4437 - val_accuracy: 0.8875
 Epoch 28/50
 2880/2880 [=====] - 2s 677us/step - loss: 0.1706 -
 accuracy: 0.9233 - val_loss: 0.3896 - val_accuracy: 0.8931
 Epoch 29/50
 2880/2880 [=====] - 2s 664us/step - loss: 0.1069 -
 accuracy: 0.9535 - val_loss: 0.4315 - val_accuracy: 0.8833
 Epoch 30/50
 2880/2880 [=====] - 2s 661us/step - loss: 0.1467 -
 accuracy: 0.9368 - val_loss: 0.4741 - val_accuracy: 0.8806
 Epoch 31/50
 2880/2880 [=====] - 2s 669us/step - loss: 0.1285 -
 accuracy: 0.9507 - val_loss: 0.4199 - val_accuracy: 0.8764
 Epoch 32/50
 2880/2880 [=====] - 2s 666us/step - loss: 0.0935 -
 accuracy: 0.9604 - val_loss: 0.6921 - val_accuracy: 0.8611
 Epoch 33/50
 2880/2880 [=====] - 2s 654us/step - loss: 0.1166 -
 accuracy: 0.9528 - val_loss: 0.5261 - val_accuracy: 0.8694
 Epoch 34/50
 2880/2880 [=====] - 2s 682us/step - loss: 0.1366 -
 accuracy: 0.9406 - val_loss: 0.4879 - val_accuracy: 0.8903
 Epoch 35/50
 2880/2880 [=====] - 2s 689us/step - loss: 0.1162 -
 accuracy: 0.9510 - val_loss: 0.4976 - val_accuracy: 0.8792
 Epoch 36/50
 2880/2880 [=====] - 2s 680us/step - loss: 0.0747 -
 accuracy: 0.9691 - val_loss: 0.5380 - val_accuracy: 0.8542
 Epoch 37/50
 2880/2880 [=====] - 2s 655us/step - loss: 0.0894 -
 accuracy: 0.9604 - val_loss: 0.6493 - val_accuracy: 0.8708
 Epoch 38/50
 2880/2880 [=====] - 2s 648us/step - loss: 0.1238 -
 accuracy: 0.9507 - val_loss: 0.5079 - val_accuracy: 0.8944
 Epoch 39/50
 2880/2880 [=====] - 2s 676us/step - loss: 0.0946 -

accuracy: 0.9646 - val_loss: 0.5390 - val_accuracy: 0.8778
 Epoch 40/50
 2880/2880 [=====] - 2s 671us/step - loss: 0.0936 -
 accuracy: 0.9601 - val_loss: 0.7018 - val_accuracy: 0.8694
 Epoch 41/50
 2880/2880 [=====] - 2s 679us/step - loss: 0.1003 -
 accuracy: 0.9646 - val_loss: 0.4850 - val_accuracy: 0.8861
 Epoch 42/50
 2880/2880 [=====] - 2s 658us/step - loss: 0.0664 -
 accuracy: 0.9767 - val_loss: 0.5643 - val_accuracy: 0.8833
 Epoch 43/50
 2880/2880 [=====] - 2s 792us/step - loss: 0.0702 -
 accuracy: 0.9712 - val_loss: 0.6564 - val_accuracy: 0.8722
 Epoch 44/50
 2880/2880 [=====] - 2s 867us/step - loss: 0.0853 -
 accuracy: 0.9698 - val_loss: 0.6263 - val_accuracy: 0.8792
 Epoch 45/50
 2880/2880 [=====] - 3s 907us/step - loss: 0.0662 -
 accuracy: 0.9767 - val_loss: 0.5801 - val_accuracy: 0.8764
 Epoch 46/50
 2880/2880 [=====] - 3s 888us/step - loss: 0.0966 -
 accuracy: 0.9628 - val_loss: 0.5319 - val_accuracy: 0.8792
 Epoch 47/50
 2880/2880 [=====] - 3s 914us/step - loss: 0.0420 -
 accuracy: 0.9826 - val_loss: 0.6731 - val_accuracy: 0.8750
 Epoch 48/50
 2880/2880 [=====] - 3s 895us/step - loss: 0.0404 -
 accuracy: 0.9865 - val_loss: 0.9514 - val_accuracy: 0.8750
 Epoch 49/50
 2880/2880 [=====] - 3s 912us/step - loss: 0.0662 -
 accuracy: 0.9788 - val_loss: 0.6868 - val_accuracy: 0.8833
 Epoch 50/50
 2880/2880 [=====] - 3s 908us/step - loss: 0.1418 -
 accuracy: 0.9590 - val_loss: 0.3868 - val_accuracy: 0.8833
 1200/1200 [=====] - 1s 522us/step



Sequential with Kfold CV:

Training for fold 3 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_13"

Layer (type)	Output Shape	Param #
dense_66 (Dense)	(None, 2176)	298112
dense_67 (Dense)	(None, 1088)	2368576
dropout_42 (Dropout)	(None, 1088)	0
dense_68 (Dense)	(None, 544)	592416
dropout_43 (Dropout)	(None, 544)	0
dense_69 (Dense)	(None, 272)	148240
dropout_44 (Dropout)	(None, 272)	0

```

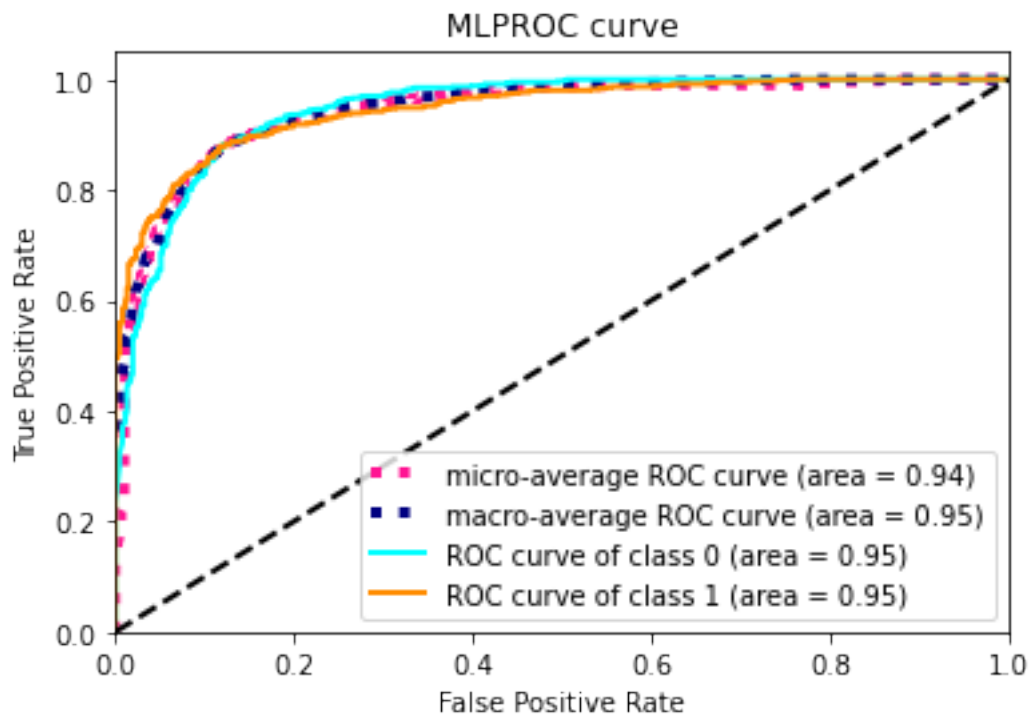
dense_70 (Dense)                (None, 2)                546
=====
Total params: 3,407,890
Trainable params: 3,407,890
Non-trainable params: 0
-----
Train on 2880 samples, validate on 720 samples
Epoch 1/50
2880/2880 [=====] - 8s 3ms/step - loss: 1.5005 -
accuracy: 0.6687 - val_loss: 0.2822 - val_accuracy: 0.8819
Epoch 2/50
2880/2880 [=====] - 3s 878us/step - loss: 0.2601 -
accuracy: 0.8951 - val_loss: 0.2621 - val_accuracy: 0.8764
Epoch 3/50
2880/2880 [=====] - 3s 894us/step - loss: 0.2513 -
accuracy: 0.8951 - val_loss: 0.2804 - val_accuracy: 0.8889
Epoch 4/50
2880/2880 [=====] - 3s 876us/step - loss: 0.2802 -
accuracy: 0.8875 - val_loss: 0.2570 - val_accuracy: 0.8861
Epoch 5/50
2880/2880 [=====] - 3s 925us/step - loss: 0.2441 -
accuracy: 0.9000 - val_loss: 0.2606 - val_accuracy: 0.8875
Epoch 6/50
2880/2880 [=====] - 3s 924us/step - loss: 0.2276 -
accuracy: 0.9031 - val_loss: 0.2806 - val_accuracy: 0.8903
Epoch 7/50
2880/2880 [=====] - 3s 915us/step - loss: 0.2865 -
accuracy: 0.8774 - val_loss: 0.2724 - val_accuracy: 0.8833
Epoch 8/50
2880/2880 [=====] - 3s 904us/step - loss: 0.2381 -
accuracy: 0.9028 - val_loss: 0.2676 - val_accuracy: 0.8819
Epoch 9/50
2880/2880 [=====] - 3s 908us/step - loss: 0.2231 -
accuracy: 0.9014 - val_loss: 0.3284 - val_accuracy: 0.8722
Epoch 10/50
2880/2880 [=====] - 3s 910us/step - loss: 0.2361 -
accuracy: 0.9031 - val_loss: 0.3256 - val_accuracy: 0.8847
Epoch 11/50
2880/2880 [=====] - 3s 917us/step - loss: 0.2430 -
accuracy: 0.9042 - val_loss: 0.2893 - val_accuracy: 0.8889
Epoch 12/50
2880/2880 [=====] - 3s 987us/step - loss: 0.2147 -
accuracy: 0.9073 - val_loss: 0.3055 - val_accuracy: 0.8875
Epoch 13/50
2880/2880 [=====] - 3s 928us/step - loss: 0.2168 -
accuracy: 0.9083 - val_loss: 0.3062 - val_accuracy: 0.8889
Epoch 14/50
2880/2880 [=====] - 3s 907us/step - loss: 0.2059 -

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accuracy: 0.9174 - val_loss: 0.3462 - val_accuracy: 0.8736
 Epoch 15/50
 2880/2880 [=====] - 3s 900us/step - loss: 0.1875 -
 accuracy: 0.9194 - val_loss: 0.2985 - val_accuracy: 0.8875
 Epoch 16/50
 2880/2880 [=====] - 2s 854us/step - loss: 0.2043 -
 accuracy: 0.9167 - val_loss: 0.2989 - val_accuracy: 0.8833
 Epoch 17/50
 2880/2880 [=====] - 2s 679us/step - loss: 0.1843 -
 accuracy: 0.9229 - val_loss: 0.3003 - val_accuracy: 0.8917
 Epoch 18/50
 2880/2880 [=====] - 3s 938us/step - loss: 0.1808 -
 accuracy: 0.9240 - val_loss: 0.2795 - val_accuracy: 0.8889
 Epoch 19/50
 2880/2880 [=====] - 3s 894us/step - loss: 0.1701 -
 accuracy: 0.9267 - val_loss: 0.3941 - val_accuracy: 0.8875
 Epoch 20/50
 2880/2880 [=====] - 3s 904us/step - loss: 0.1989 -
 accuracy: 0.9139 - val_loss: 0.3566 - val_accuracy: 0.8861
 Epoch 21/50
 2880/2880 [=====] - 3s 869us/step - loss: 0.1734 -
 accuracy: 0.9253 - val_loss: 0.3401 - val_accuracy: 0.8889
 Epoch 22/50
 2880/2880 [=====] - 3s 892us/step - loss: 0.2281 -
 accuracy: 0.9146 - val_loss: 0.2824 - val_accuracy: 0.8931
 Epoch 23/50
 2880/2880 [=====] - 3s 893us/step - loss: 0.1418 -
 accuracy: 0.9424 - val_loss: 0.4321 - val_accuracy: 0.8889
 Epoch 24/50
 2880/2880 [=====] - 3s 916us/step - loss: 0.1578 -
 accuracy: 0.9330 - val_loss: 0.3554 - val_accuracy: 0.8847
 Epoch 25/50
 2880/2880 [=====] - 3s 888us/step - loss: 0.1542 -
 accuracy: 0.9368 - val_loss: 0.4161 - val_accuracy: 0.8986
 Epoch 26/50
 2880/2880 [=====] - 3s 883us/step - loss: 0.1265 -
 accuracy: 0.9413 - val_loss: 0.4374 - val_accuracy: 0.8639
 Epoch 27/50
 2880/2880 [=====] - 3s 920us/step - loss: 0.1697 -
 accuracy: 0.9288 - val_loss: 0.3318 - val_accuracy: 0.8889
 Epoch 28/50
 2880/2880 [=====] - 3s 893us/step - loss: 0.1299 -
 accuracy: 0.9438 - val_loss: 0.3369 - val_accuracy: 0.8861
 Epoch 29/50
 2880/2880 [=====] - 3s 891us/step - loss: 0.1138 -
 accuracy: 0.9545 - val_loss: 0.6935 - val_accuracy: 0.8639
 Epoch 30/50
 2880/2880 [=====] - 3s 904us/step - loss: 0.1377 -

accuracy: 0.9451 - val_loss: 0.5088 - val_accuracy: 0.8667
 Epoch 31/50
 2880/2880 [=====] - 3s 947us/step - loss: 0.1475 -
 accuracy: 0.9396 - val_loss: 0.4445 - val_accuracy: 0.8958
 Epoch 32/50
 2880/2880 [=====] - 3s 902us/step - loss: 0.1512 -
 accuracy: 0.9441 - val_loss: 0.3933 - val_accuracy: 0.8833
 Epoch 33/50
 2880/2880 [=====] - 3s 887us/step - loss: 0.0969 -
 accuracy: 0.9625 - val_loss: 0.5315 - val_accuracy: 0.8681
 Epoch 34/50
 2880/2880 [=====] - 3s 889us/step - loss: 0.1269 -
 accuracy: 0.9451 - val_loss: 0.4198 - val_accuracy: 0.8958
 Epoch 35/50
 2880/2880 [=====] - 3s 889us/step - loss: 0.0660 -
 accuracy: 0.9743 - val_loss: 0.6070 - val_accuracy: 0.8833
 Epoch 36/50
 2880/2880 [=====] - 3s 912us/step - loss: 0.0995 -
 accuracy: 0.9556 - val_loss: 0.5572 - val_accuracy: 0.8861
 Epoch 37/50
 2880/2880 [=====] - 3s 903us/step - loss: 0.1067 -
 accuracy: 0.9632 - val_loss: 0.5880 - val_accuracy: 0.8153
 Epoch 38/50
 2880/2880 [=====] - 3s 895us/step - loss: 0.1219 -
 accuracy: 0.9465 - val_loss: 0.4858 - val_accuracy: 0.8778
 Epoch 39/50
 2880/2880 [=====] - 3s 897us/step - loss: 0.0843 -
 accuracy: 0.9694 - val_loss: 0.5749 - val_accuracy: 0.8972
 Epoch 40/50
 2880/2880 [=====] - 3s 896us/step - loss: 0.1245 -
 accuracy: 0.9542 - val_loss: 0.4278 - val_accuracy: 0.8458
 Epoch 41/50
 2880/2880 [=====] - 3s 893us/step - loss: 0.0839 -
 accuracy: 0.9674 - val_loss: 0.4948 - val_accuracy: 0.8819
 Epoch 42/50
 2880/2880 [=====] - 3s 991us/step - loss: 0.0744 -
 accuracy: 0.9722 - val_loss: 0.5031 - val_accuracy: 0.8847
 Epoch 43/50
 2880/2880 [=====] - 3s 931us/step - loss: 0.0997 -
 accuracy: 0.9622 - val_loss: 0.4847 - val_accuracy: 0.8639
 Epoch 44/50
 2880/2880 [=====] - 3s 903us/step - loss: 0.0859 -
 accuracy: 0.9705 - val_loss: 0.6577 - val_accuracy: 0.8778
 Epoch 45/50
 2880/2880 [=====] - 3s 878us/step - loss: 0.0651 -
 accuracy: 0.9736 - val_loss: 0.5535 - val_accuracy: 0.8708
 Epoch 46/50
 2880/2880 [=====] - 3s 899us/step - loss: 0.0388 -

accuracy: 0.9875 - val_loss: 0.9342 - val_accuracy: 0.8639
Epoch 47/50
2880/2880 [=====] - 3s 889us/step - loss: 0.1097 -
accuracy: 0.9642 - val_loss: 0.5348 - val_accuracy: 0.8861
Epoch 48/50
2880/2880 [=====] - 3s 884us/step - loss: 0.0805 -
accuracy: 0.9774 - val_loss: 0.6104 - val_accuracy: 0.8625
Epoch 49/50
2880/2880 [=====] - 3s 887us/step - loss: 0.0946 -
accuracy: 0.9698 - val_loss: 0.6704 - val_accuracy: 0.8708
Epoch 50/50
2880/2880 [=====] - 2s 773us/step - loss: 0.0567 -
accuracy: 0.9812 - val_loss: 0.5961 - val_accuracy: 0.8833
1200/1200 [=====] - 0s 251us/step



Sequential with Kfold CV:

Training for fold 4 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_14"

Layer (type)	Output Shape	Param #
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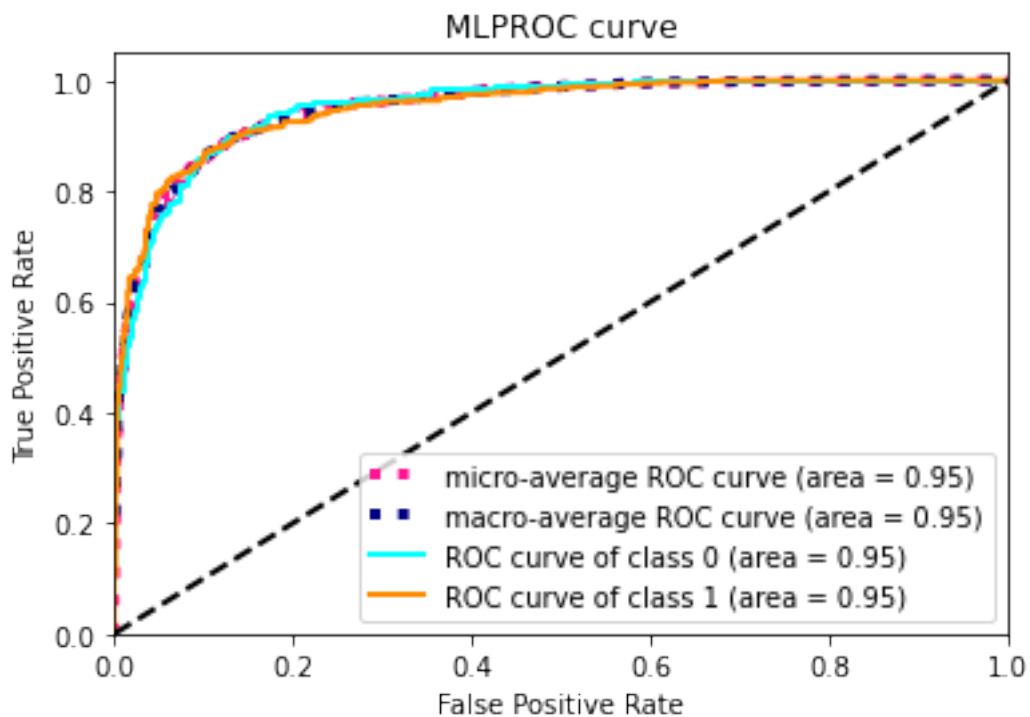
=====
dense_71 (Dense)                (None, 2176)                298112
-----
dense_72 (Dense)                (None, 1088)                2368576
-----
dropout_45 (Dropout)           (None, 1088)                0
-----
dense_73 (Dense)                (None, 544)                 592416
-----
dropout_46 (Dropout)           (None, 544)                 0
-----
dense_74 (Dense)                (None, 272)                 148240
-----
dropout_47 (Dropout)           (None, 272)                 0
-----
dense_75 (Dense)                (None, 2)                   546
=====
Total params: 3,407,890
Trainable params: 3,407,890
Non-trainable params: 0
-----
Train on 2880 samples, validate on 720 samples
Epoch 1/50
2880/2880 [=====] - 8s 3ms/step - loss: 1.4471 -
accuracy: 0.7215 - val_loss: 0.2626 - val_accuracy: 0.9014
Epoch 2/50
2880/2880 [=====] - 3s 889us/step - loss: 0.2779 -
accuracy: 0.8816 - val_loss: 0.2465 - val_accuracy: 0.8944
Epoch 3/50
2880/2880 [=====] - 3s 943us/step - loss: 0.2619 -
accuracy: 0.8872 - val_loss: 0.2581 - val_accuracy: 0.8931
Epoch 4/50
2880/2880 [=====] - 3s 902us/step - loss: 0.3084 -
accuracy: 0.8715 - val_loss: 0.2345 - val_accuracy: 0.9097
Epoch 5/50
2880/2880 [=====] - 3s 906us/step - loss: 0.2573 -
accuracy: 0.8910 - val_loss: 0.2325 - val_accuracy: 0.9069
Epoch 6/50
2880/2880 [=====] - 3s 897us/step - loss: 0.2558 -
accuracy: 0.8910 - val_loss: 0.3424 - val_accuracy: 0.8444
Epoch 7/50
2880/2880 [=====] - 3s 889us/step - loss: 0.2860 -
accuracy: 0.8830 - val_loss: 0.2642 - val_accuracy: 0.8903
Epoch 8/50
2880/2880 [=====] - 3s 911us/step - loss: 0.2487 -
accuracy: 0.8948 - val_loss: 0.2324 - val_accuracy: 0.8986
Epoch 9/50
2880/2880 [=====] - 3s 909us/step - loss: 0.2318 -

```

accuracy: 0.9031 - val_loss: 0.2556 - val_accuracy: 0.9056
 Epoch 10/50
 2880/2880 [=====] - 3s 900us/step - loss: 0.2403 -
 accuracy: 0.9003 - val_loss: 0.2421 - val_accuracy: 0.9125
 Epoch 11/50
 2880/2880 [=====] - 3s 906us/step - loss: 0.2327 -
 accuracy: 0.8962 - val_loss: 0.2378 - val_accuracy: 0.8986
 Epoch 12/50
 2880/2880 [=====] - 3s 902us/step - loss: 0.2399 -
 accuracy: 0.8990 - val_loss: 0.2657 - val_accuracy: 0.9042
 Epoch 13/50
 2880/2880 [=====] - 3s 909us/step - loss: 0.2026 -
 accuracy: 0.9104 - val_loss: 0.2469 - val_accuracy: 0.8972
 Epoch 14/50
 2880/2880 [=====] - 3s 900us/step - loss: 0.2384 -
 accuracy: 0.9090 - val_loss: 0.2553 - val_accuracy: 0.8958
 Epoch 15/50
 2880/2880 [=====] - 3s 890us/step - loss: 0.1885 -
 accuracy: 0.9229 - val_loss: 0.3107 - val_accuracy: 0.8778
 Epoch 16/50
 2880/2880 [=====] - 3s 906us/step - loss: 0.2093 -
 accuracy: 0.9104 - val_loss: 0.2585 - val_accuracy: 0.9014
 Epoch 17/50
 2880/2880 [=====] - 3s 910us/step - loss: 0.1929 -
 accuracy: 0.9191 - val_loss: 0.2882 - val_accuracy: 0.8861
 Epoch 18/50
 2880/2880 [=====] - 3s 900us/step - loss: 0.1856 -
 accuracy: 0.9201 - val_loss: 0.3660 - val_accuracy: 0.8875
 Epoch 19/50
 2880/2880 [=====] - 3s 895us/step - loss: 0.1997 -
 accuracy: 0.9181 - val_loss: 0.2769 - val_accuracy: 0.9000
 Epoch 20/50
 2880/2880 [=====] - 3s 895us/step - loss: 0.1742 -
 accuracy: 0.9253 - val_loss: 0.3008 - val_accuracy: 0.8819
 Epoch 21/50
 2880/2880 [=====] - 3s 887us/step - loss: 0.2014 -
 accuracy: 0.9170 - val_loss: 0.3057 - val_accuracy: 0.8722
 Epoch 22/50
 2880/2880 [=====] - 3s 914us/step - loss: 0.1767 -
 accuracy: 0.9278 - val_loss: 0.3052 - val_accuracy: 0.8889
 Epoch 23/50
 2880/2880 [=====] - 3s 891us/step - loss: 0.1490 -
 accuracy: 0.9326 - val_loss: 0.4810 - val_accuracy: 0.8500
 Epoch 24/50
 2880/2880 [=====] - 3s 872us/step - loss: 0.1648 -
 accuracy: 0.9302 - val_loss: 0.3284 - val_accuracy: 0.8972
 Epoch 25/50
 2880/2880 [=====] - 2s 707us/step - loss: 0.1650 -

accuracy: 0.9285 - val_loss: 0.3273 - val_accuracy: 0.8569
 Epoch 26/50
 2880/2880 [=====] - 3s 900us/step - loss: 0.1588 -
 accuracy: 0.9295 - val_loss: 0.2960 - val_accuracy: 0.8889
 Epoch 27/50
 2880/2880 [=====] - 3s 900us/step - loss: 0.1352 -
 accuracy: 0.9417 - val_loss: 0.3957 - val_accuracy: 0.8708
 Epoch 28/50
 2880/2880 [=====] - 3s 889us/step - loss: 0.1513 -
 accuracy: 0.9337 - val_loss: 0.3651 - val_accuracy: 0.8889
 Epoch 29/50
 2880/2880 [=====] - 3s 889us/step - loss: 0.1405 -
 accuracy: 0.9476 - val_loss: 0.3597 - val_accuracy: 0.8972
 Epoch 30/50
 2880/2880 [=====] - 3s 929us/step - loss: 0.1290 -
 accuracy: 0.9441 - val_loss: 0.3216 - val_accuracy: 0.8736
 Epoch 31/50
 2880/2880 [=====] - 3s 903us/step - loss: 0.1325 -
 accuracy: 0.9448 - val_loss: 0.3807 - val_accuracy: 0.8875
 Epoch 32/50
 2880/2880 [=====] - 3s 894us/step - loss: 0.1140 -
 accuracy: 0.9521 - val_loss: 0.4041 - val_accuracy: 0.8917
 Epoch 33/50
 2880/2880 [=====] - 3s 908us/step - loss: 0.1260 -
 accuracy: 0.9483 - val_loss: 0.5162 - val_accuracy: 0.8847
 Epoch 34/50
 2880/2880 [=====] - 3s 891us/step - loss: 0.1284 -
 accuracy: 0.9524 - val_loss: 0.4059 - val_accuracy: 0.8917
 Epoch 35/50
 2880/2880 [=====] - 3s 907us/step - loss: 0.0944 -
 accuracy: 0.9649 - val_loss: 0.4876 - val_accuracy: 0.8875
 Epoch 36/50
 2880/2880 [=====] - 3s 894us/step - loss: 0.1464 -
 accuracy: 0.9538 - val_loss: 0.2882 - val_accuracy: 0.8847
 Epoch 37/50
 2880/2880 [=====] - 3s 905us/step - loss: 0.1421 -
 accuracy: 0.9521 - val_loss: 0.3105 - val_accuracy: 0.8931
 Epoch 38/50
 2880/2880 [=====] - 3s 903us/step - loss: 0.0831 -
 accuracy: 0.9663 - val_loss: 0.4540 - val_accuracy: 0.8653
 Epoch 39/50
 2880/2880 [=====] - 3s 878us/step - loss: 0.0733 -
 accuracy: 0.9760 - val_loss: 0.6443 - val_accuracy: 0.8611
 Epoch 40/50
 2880/2880 [=====] - 3s 921us/step - loss: 0.1108 -
 accuracy: 0.9566 - val_loss: 0.4913 - val_accuracy: 0.8778
 Epoch 41/50
 2880/2880 [=====] - 3s 898us/step - loss: 0.0812 -

accuracy: 0.9653 - val_loss: 0.5369 - val_accuracy: 0.8819
Epoch 42/50
2880/2880 [=====] - 3s 897us/step - loss: 0.0576 -
accuracy: 0.9778 - val_loss: 0.5726 - val_accuracy: 0.8736
Epoch 43/50
2880/2880 [=====] - 3s 925us/step - loss: 0.1176 -
accuracy: 0.9524 - val_loss: 0.5216 - val_accuracy: 0.8667
Epoch 44/50
2880/2880 [=====] - 3s 897us/step - loss: 0.0825 -
accuracy: 0.9674 - val_loss: 0.6639 - val_accuracy: 0.8778
Epoch 45/50
2880/2880 [=====] - 3s 908us/step - loss: 0.0820 -
accuracy: 0.9701 - val_loss: 0.5551 - val_accuracy: 0.8931
Epoch 46/50
2880/2880 [=====] - 3s 887us/step - loss: 0.1083 -
accuracy: 0.9615 - val_loss: 0.4892 - val_accuracy: 0.8972
Epoch 47/50
2880/2880 [=====] - 3s 908us/step - loss: 0.0931 -
accuracy: 0.9670 - val_loss: 0.4419 - val_accuracy: 0.8958
Epoch 48/50
2880/2880 [=====] - 3s 887us/step - loss: 0.0497 -
accuracy: 0.9823 - val_loss: 0.6675 - val_accuracy: 0.8861
Epoch 49/50
2880/2880 [=====] - 3s 940us/step - loss: 0.0463 -
accuracy: 0.9854 - val_loss: 0.7629 - val_accuracy: 0.8847
Epoch 50/50
2880/2880 [=====] - 3s 903us/step - loss: 0.1593 -
accuracy: 0.9503 - val_loss: 0.3756 - val_accuracy: 0.9014
1200/1200 [=====] - 1s 647us/step



Sequential with Kfold CV:

Training for fold 5 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_15"

Layer (type)	Output Shape	Param #
dense_76 (Dense)	(None, 2176)	298112
dense_77 (Dense)	(None, 1088)	2368576
dropout_48 (Dropout)	(None, 1088)	0
dense_78 (Dense)	(None, 544)	592416
dropout_49 (Dropout)	(None, 544)	0
dense_79 (Dense)	(None, 272)	148240
dropout_50 (Dropout)	(None, 272)	0

```

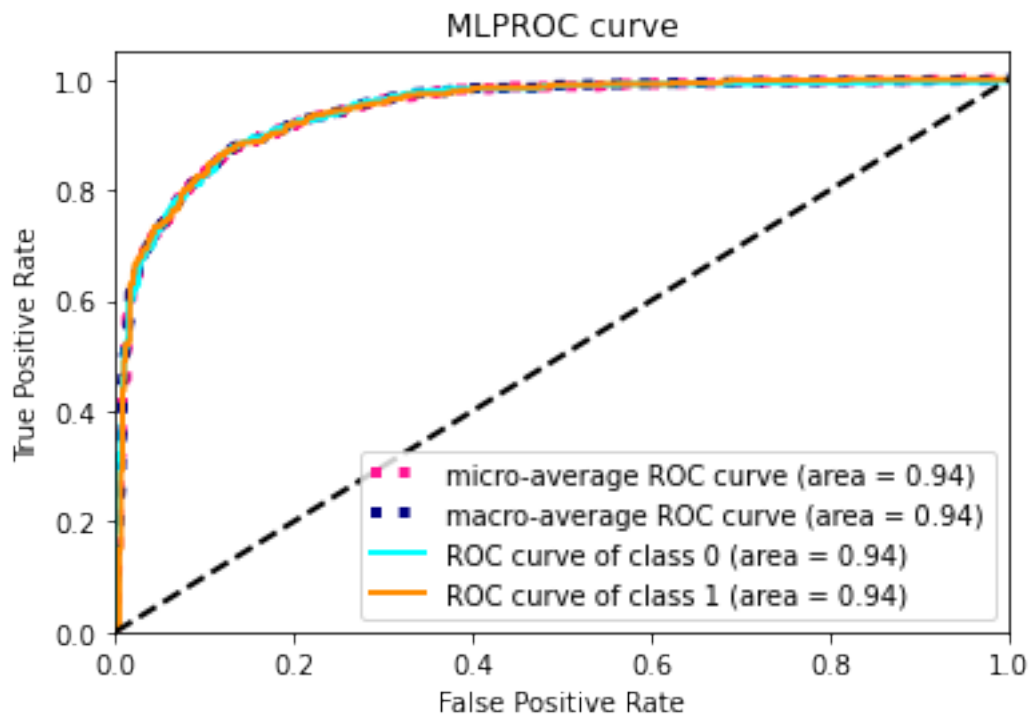
dense_80 (Dense)                (None, 2)                546
=====
Total params: 3,407,890
Trainable params: 3,407,890
Non-trainable params: 0
-----
Train on 2880 samples, validate on 720 samples
Epoch 1/50
2880/2880 [=====] - 6s 2ms/step - loss: 1.6003 -
accuracy: 0.6747 - val_loss: 0.2449 - val_accuracy: 0.9014
Epoch 2/50
2880/2880 [=====] - 3s 879us/step - loss: 0.2779 -
accuracy: 0.8799 - val_loss: 0.2211 - val_accuracy: 0.9139
Epoch 3/50
2880/2880 [=====] - 3s 915us/step - loss: 0.2607 -
accuracy: 0.8840 - val_loss: 0.2233 - val_accuracy: 0.9000
Epoch 4/50
2880/2880 [=====] - 3s 888us/step - loss: 0.3169 -
accuracy: 0.8705 - val_loss: 0.2268 - val_accuracy: 0.9042
Epoch 5/50
2880/2880 [=====] - 3s 902us/step - loss: 0.2500 -
accuracy: 0.8993 - val_loss: 0.2195 - val_accuracy: 0.9000
Epoch 6/50
2880/2880 [=====] - 3s 895us/step - loss: 0.2785 -
accuracy: 0.8819 - val_loss: 0.2205 - val_accuracy: 0.9042
Epoch 7/50
2880/2880 [=====] - 3s 884us/step - loss: 0.2461 -
accuracy: 0.8983 - val_loss: 0.2717 - val_accuracy: 0.9042
Epoch 8/50
2880/2880 [=====] - 3s 908us/step - loss: 0.2613 -
accuracy: 0.8934 - val_loss: 0.2845 - val_accuracy: 0.8792
Epoch 9/50
2880/2880 [=====] - 2s 861us/step - loss: 0.2490 -
accuracy: 0.8986 - val_loss: 0.2208 - val_accuracy: 0.8972
Epoch 10/50
2880/2880 [=====] - 3s 893us/step - loss: 0.2397 -
accuracy: 0.9052 - val_loss: 0.2510 - val_accuracy: 0.9056
Epoch 11/50
2880/2880 [=====] - 3s 900us/step - loss: 0.2241 -
accuracy: 0.9132 - val_loss: 0.2349 - val_accuracy: 0.9069
Epoch 12/50
2880/2880 [=====] - 3s 916us/step - loss: 0.2235 -
accuracy: 0.9073 - val_loss: 0.2274 - val_accuracy: 0.9028
Epoch 13/50
2880/2880 [=====] - 3s 907us/step - loss: 0.2124 -
accuracy: 0.9132 - val_loss: 0.2677 - val_accuracy: 0.8986
Epoch 14/50
2880/2880 [=====] - 3s 901us/step - loss: 0.2202 -

```

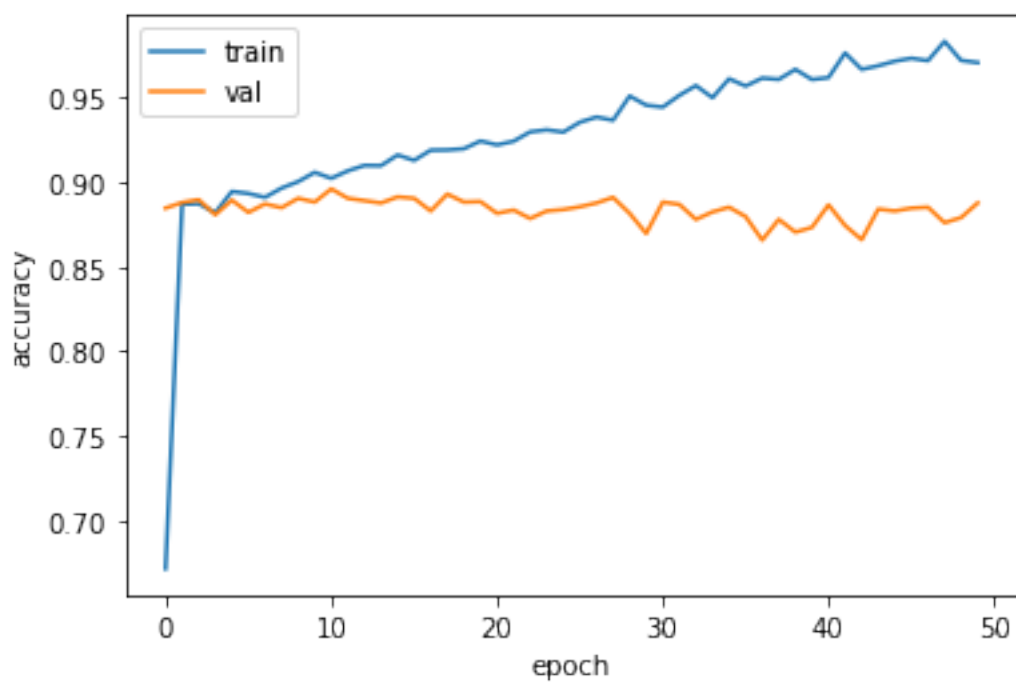
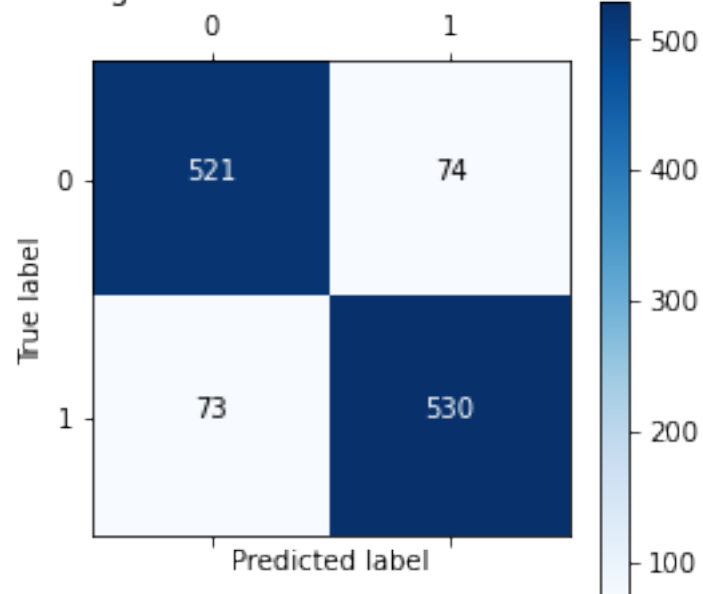
accuracy: 0.9042 - val_loss: 0.2622 - val_accuracy: 0.8972
 Epoch 15/50
 2880/2880 [=====] - 3s 910us/step - loss: 0.2112 -
 accuracy: 0.9104 - val_loss: 0.2339 - val_accuracy: 0.9056
 Epoch 16/50
 2880/2880 [=====] - 3s 906us/step - loss: 0.2079 -
 accuracy: 0.9149 - val_loss: 0.2675 - val_accuracy: 0.9014
 Epoch 17/50
 2880/2880 [=====] - 3s 902us/step - loss: 0.1876 -
 accuracy: 0.9153 - val_loss: 0.2652 - val_accuracy: 0.8931
 Epoch 18/50
 2880/2880 [=====] - 3s 884us/step - loss: 0.1905 -
 accuracy: 0.9208 - val_loss: 0.2535 - val_accuracy: 0.9042
 Epoch 19/50
 2880/2880 [=====] - 3s 892us/step - loss: 0.1995 -
 accuracy: 0.9097 - val_loss: 0.2474 - val_accuracy: 0.9028
 Epoch 20/50
 2880/2880 [=====] - 3s 899us/step - loss: 0.1697 -
 accuracy: 0.9292 - val_loss: 0.2343 - val_accuracy: 0.9208
 Epoch 21/50
 2880/2880 [=====] - 3s 905us/step - loss: 0.1759 -
 accuracy: 0.9229 - val_loss: 0.2388 - val_accuracy: 0.9097
 Epoch 22/50
 2880/2880 [=====] - 3s 891us/step - loss: 0.1592 -
 accuracy: 0.9295 - val_loss: 0.3032 - val_accuracy: 0.8861
 Epoch 23/50
 2880/2880 [=====] - 3s 911us/step - loss: 0.1786 -
 accuracy: 0.9205 - val_loss: 0.2947 - val_accuracy: 0.9028
 Epoch 24/50
 2880/2880 [=====] - 3s 887us/step - loss: 0.1661 -
 accuracy: 0.9267 - val_loss: 0.2978 - val_accuracy: 0.9097
 Epoch 25/50
 2880/2880 [=====] - 3s 908us/step - loss: 0.1977 -
 accuracy: 0.9233 - val_loss: 0.2632 - val_accuracy: 0.9056
 Epoch 26/50
 2880/2880 [=====] - 3s 906us/step - loss: 0.1386 -
 accuracy: 0.9413 - val_loss: 0.3143 - val_accuracy: 0.9125
 Epoch 27/50
 2880/2880 [=====] - 3s 891us/step - loss: 0.1523 -
 accuracy: 0.9347 - val_loss: 0.2954 - val_accuracy: 0.9097
 Epoch 28/50
 2880/2880 [=====] - 3s 1ms/step - loss: 0.1258 -
 accuracy: 0.9444 - val_loss: 0.3254 - val_accuracy: 0.9139
 Epoch 29/50
 2880/2880 [=====] - 3s 904us/step - loss: 0.1259 -
 accuracy: 0.9483 - val_loss: 0.4333 - val_accuracy: 0.8778
 Epoch 30/50
 2880/2880 [=====] - 3s 887us/step - loss: 0.1073 -

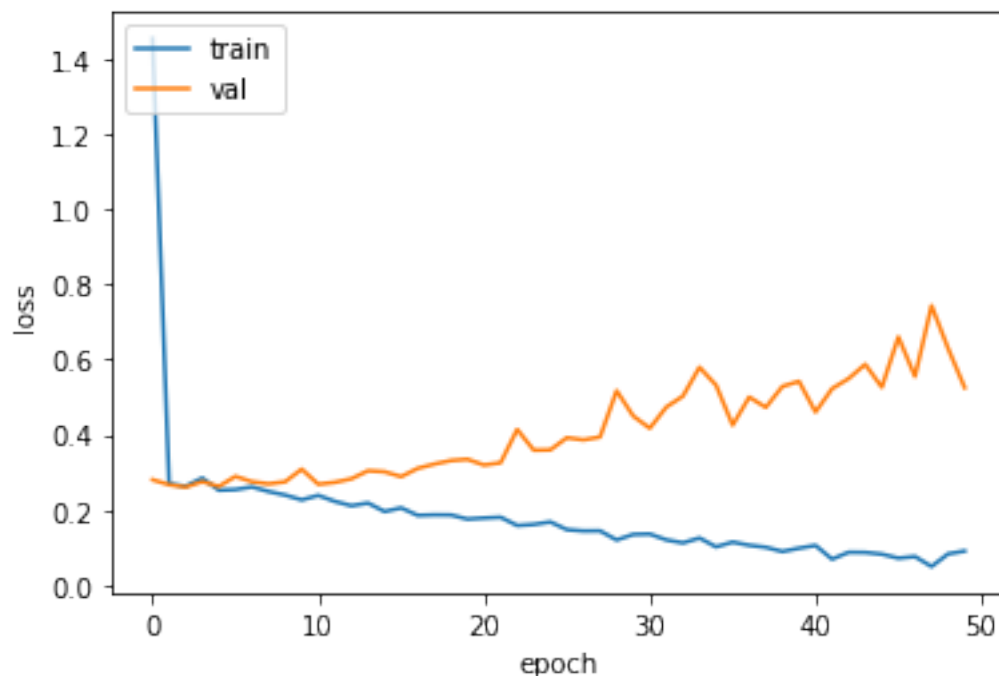
accuracy: 0.9576 - val_loss: 0.4942 - val_accuracy: 0.8431
 Epoch 31/50
 2880/2880 [=====] - 3s 908us/step - loss: 0.1582 -
 accuracy: 0.9361 - val_loss: 0.2955 - val_accuracy: 0.9083
 Epoch 32/50
 2880/2880 [=====] - 2s 828us/step - loss: 0.1215 -
 accuracy: 0.9510 - val_loss: 0.3477 - val_accuracy: 0.9139
 Epoch 33/50
 2880/2880 [=====] - 2s 702us/step - loss: 0.0927 -
 accuracy: 0.9663 - val_loss: 0.4544 - val_accuracy: 0.8819
 Epoch 34/50
 2880/2880 [=====] - 3s 868us/step - loss: 0.1322 -
 accuracy: 0.9517 - val_loss: 0.5877 - val_accuracy: 0.8694
 Epoch 35/50
 2880/2880 [=====] - 3s 910us/step - loss: 0.1116 -
 accuracy: 0.9580 - val_loss: 0.4683 - val_accuracy: 0.8986
 Epoch 36/50
 2880/2880 [=====] - 2s 860us/step - loss: 0.1280 -
 accuracy: 0.9483 - val_loss: 0.3336 - val_accuracy: 0.9069
 Epoch 37/50
 2880/2880 [=====] - 3s 878us/step - loss: 0.0922 -
 accuracy: 0.9705 - val_loss: 0.3938 - val_accuracy: 0.8708
 Epoch 38/50
 2880/2880 [=====] - 3s 881us/step - loss: 0.0907 -
 accuracy: 0.9715 - val_loss: 0.3950 - val_accuracy: 0.8847
 Epoch 39/50
 2880/2880 [=====] - 3s 892us/step - loss: 0.0991 -
 accuracy: 0.9615 - val_loss: 0.4263 - val_accuracy: 0.8750
 Epoch 40/50
 2880/2880 [=====] - 3s 950us/step - loss: 0.0844 -
 accuracy: 0.9653 - val_loss: 0.4864 - val_accuracy: 0.8931
 Epoch 41/50
 2880/2880 [=====] - 3s 976us/step - loss: 0.0899 -
 accuracy: 0.9674 - val_loss: 0.3499 - val_accuracy: 0.9028
 Epoch 42/50
 2880/2880 [=====] - 3s 889us/step - loss: 0.0948 -
 accuracy: 0.9712 - val_loss: 0.3929 - val_accuracy: 0.8486
 Epoch 43/50
 2880/2880 [=====] - 3s 890us/step - loss: 0.0683 -
 accuracy: 0.9740 - val_loss: 0.4843 - val_accuracy: 0.9000
 Epoch 44/50
 2880/2880 [=====] - 3s 893us/step - loss: 0.1088 -
 accuracy: 0.9649 - val_loss: 0.3260 - val_accuracy: 0.9056
 Epoch 45/50
 2880/2880 [=====] - 3s 880us/step - loss: 0.0805 -
 accuracy: 0.9753 - val_loss: 0.4009 - val_accuracy: 0.9069
 Epoch 46/50
 2880/2880 [=====] - 3s 886us/step - loss: 0.0665 -

accuracy: 0.9722 - val_loss: 0.4622 - val_accuracy: 0.9028
Epoch 47/50
2880/2880 [=====] - 3s 901us/step - loss: 0.0426 -
accuracy: 0.9837 - val_loss: 0.5162 - val_accuracy: 0.8903
Epoch 48/50
2880/2880 [=====] - 3s 875us/step - loss: 0.0503 -
accuracy: 0.9823 - val_loss: 0.5594 - val_accuracy: 0.8847
Epoch 49/50
2880/2880 [=====] - 2s 861us/step - loss: 0.1405 -
accuracy: 0.9521 - val_loss: 0.2960 - val_accuracy: 0.9042
Epoch 50/50
2880/2880 [=====] - 3s 871us/step - loss: 0.0351 -
accuracy: 0.9906 - val_loss: 0.4892 - val_accuracy: 0.8889
1200/1200 [=====] - 1s 588us/step



MLP Avg Confusion matrix across all folds





Average scores for pseudo test set across all folds:
 > Accuracy: 0.8764999985694886 (+- 0.002758821595188)
 > Loss: 0.5773166338602701
 > Avg runtime per test instance: 0.0019980326493581136

#####

#####

Sequential with Kfold CV:

Training for fold 1 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_16"

Layer (type)	Output Shape	Param #
dense_81 (Dense)	(None, 4352)	596224
dense_82 (Dense)	(None, 2176)	9472128
dropout_51 (Dropout)	(None, 2176)	0

dense_83 (Dense)	(None, 1088)	2368576
dropout_52 (Dropout)	(None, 1088)	0
dense_84 (Dense)	(None, 544)	592416
dropout_53 (Dropout)	(None, 544)	0
dense_85 (Dense)	(None, 272)	148240
dropout_54 (Dropout)	(None, 272)	0
dense_86 (Dense)	(None, 2)	546

Total params: 13,178,130

Trainable params: 13,178,130

Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50

2880/2880 [=====] - 16s 6ms/step - loss: 2.7476 - accuracy: 0.5122 - val_loss: 0.6232 - val_accuracy: 0.5347

Epoch 2/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.5528 - accuracy: 0.7566 - val_loss: 0.3717 - val_accuracy: 0.8653

Epoch 3/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.3031 - accuracy: 0.8885 - val_loss: 0.2753 - val_accuracy: 0.8889

Epoch 4/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.3167 - accuracy: 0.8802 - val_loss: 0.3042 - val_accuracy: 0.8861

Epoch 5/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.2788 - accuracy: 0.8941 - val_loss: 0.3620 - val_accuracy: 0.8778

Epoch 6/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.3396 - accuracy: 0.8736 - val_loss: 0.2890 - val_accuracy: 0.8833

Epoch 7/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.2850 - accuracy: 0.8889 - val_loss: 0.2756 - val_accuracy: 0.8778

Epoch 8/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.2689 - accuracy: 0.8990 - val_loss: 0.2691 - val_accuracy: 0.8917

Epoch 9/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.2750 - accuracy: 0.8979 - val_loss: 0.3755 - val_accuracy: 0.8569

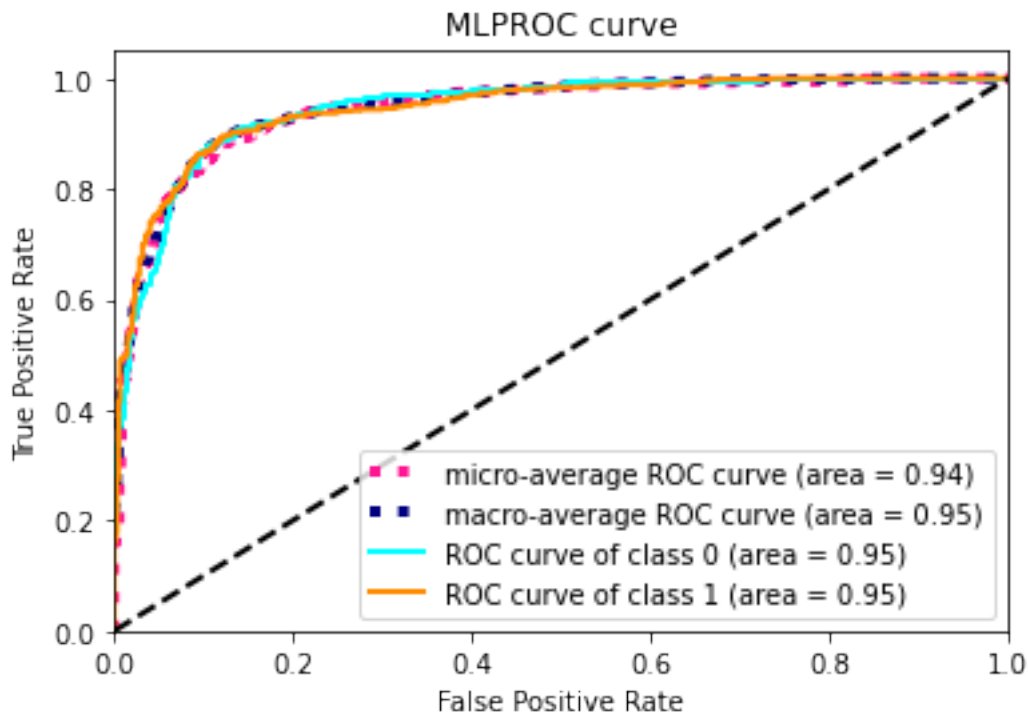
Epoch 10/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.2858 -

accuracy: 0.8875 - val_loss: 0.2740 - val_accuracy: 0.8861
 Epoch 11/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2699 -
 accuracy: 0.8941 - val_loss: 0.3855 - val_accuracy: 0.8625
 Epoch 12/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2558 -
 accuracy: 0.8983 - val_loss: 0.3113 - val_accuracy: 0.8667
 Epoch 13/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2871 -
 accuracy: 0.8816 - val_loss: 0.2865 - val_accuracy: 0.8722
 Epoch 14/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2538 -
 accuracy: 0.8972 - val_loss: 0.4874 - val_accuracy: 0.8042
 Epoch 15/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2502 -
 accuracy: 0.8997 - val_loss: 0.2886 - val_accuracy: 0.8819
 Epoch 16/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2660 -
 accuracy: 0.8920 - val_loss: 0.3222 - val_accuracy: 0.8819
 Epoch 17/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2268 -
 accuracy: 0.9062 - val_loss: 0.2834 - val_accuracy: 0.8778
 Epoch 18/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2110 -
 accuracy: 0.9163 - val_loss: 0.3194 - val_accuracy: 0.8764
 Epoch 19/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2316 -
 accuracy: 0.9052 - val_loss: 0.3430 - val_accuracy: 0.8681
 Epoch 20/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2295 -
 accuracy: 0.9083 - val_loss: 0.3365 - val_accuracy: 0.8597
 Epoch 21/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2412 -
 accuracy: 0.9062 - val_loss: 0.2995 - val_accuracy: 0.8819
 Epoch 22/50
 2880/2880 [=====] - 10s 3ms/step - loss: 0.2058 -
 accuracy: 0.9208 - val_loss: 0.3080 - val_accuracy: 0.8778
 Epoch 23/50
 2880/2880 [=====] - 10s 4ms/step - loss: 0.2289 -
 accuracy: 0.9080 - val_loss: 0.3333 - val_accuracy: 0.8847
 Epoch 24/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.2043 -
 accuracy: 0.9205 - val_loss: 0.3003 - val_accuracy: 0.8847
 Epoch 25/50
 2880/2880 [=====] - 10s 3ms/step - loss: 0.1998 -
 accuracy: 0.9167 - val_loss: 0.3426 - val_accuracy: 0.8667
 Epoch 26/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.2030 -

accuracy: 0.9229 - val_loss: 0.3541 - val_accuracy: 0.8542
 Epoch 27/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.1856 -
 accuracy: 0.9285 - val_loss: 0.3719 - val_accuracy: 0.8778
 Epoch 28/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.2026 -
 accuracy: 0.9215 - val_loss: 0.3363 - val_accuracy: 0.8708
 Epoch 29/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.2078 -
 accuracy: 0.9128 - val_loss: 0.3816 - val_accuracy: 0.8792
 Epoch 30/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1789 -
 accuracy: 0.9299 - val_loss: 0.4561 - val_accuracy: 0.8722
 Epoch 31/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.1902 -
 accuracy: 0.9302 - val_loss: 0.4405 - val_accuracy: 0.8875
 Epoch 32/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.1894 -
 accuracy: 0.9330 - val_loss: 0.3894 - val_accuracy: 0.8806
 Epoch 33/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.1804 -
 accuracy: 0.9302 - val_loss: 0.4127 - val_accuracy: 0.8722
 Epoch 34/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.1769 -
 accuracy: 0.9292 - val_loss: 0.4147 - val_accuracy: 0.8681
 Epoch 35/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.2012 -
 accuracy: 0.9233 - val_loss: 0.3287 - val_accuracy: 0.8931
 Epoch 36/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.1642 -
 accuracy: 0.9351 - val_loss: 0.3742 - val_accuracy: 0.8681
 Epoch 37/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.1727 -
 accuracy: 0.9312 - val_loss: 0.3257 - val_accuracy: 0.8819
 Epoch 38/50
 2880/2880 [=====] - 9s 3ms/step - loss: 0.1753 -
 accuracy: 0.9316 - val_loss: 0.4294 - val_accuracy: 0.8625
 Epoch 39/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1708 -
 accuracy: 0.9306 - val_loss: 0.5126 - val_accuracy: 0.8569
 Epoch 40/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1692 -
 accuracy: 0.9306 - val_loss: 0.5037 - val_accuracy: 0.8819
 Epoch 41/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1592 -
 accuracy: 0.9361 - val_loss: 0.4393 - val_accuracy: 0.8750
 Epoch 42/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1482 -

accuracy: 0.9424 - val_loss: 0.4765 - val_accuracy: 0.8514
Epoch 43/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1831 -
accuracy: 0.9288 - val_loss: 0.4523 - val_accuracy: 0.8722
Epoch 44/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1490 -
accuracy: 0.9389 - val_loss: 0.4537 - val_accuracy: 0.8583
Epoch 45/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1407 -
accuracy: 0.9431 - val_loss: 0.5700 - val_accuracy: 0.8694
Epoch 46/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1595 -
accuracy: 0.9361 - val_loss: 0.4501 - val_accuracy: 0.8569
Epoch 47/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1262 -
accuracy: 0.9483 - val_loss: 0.4488 - val_accuracy: 0.8750
Epoch 48/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2016 -
accuracy: 0.9323 - val_loss: 0.3818 - val_accuracy: 0.8694
Epoch 49/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1222 -
accuracy: 0.9556 - val_loss: 0.4375 - val_accuracy: 0.8500
Epoch 50/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1609 -
accuracy: 0.9347 - val_loss: 0.3806 - val_accuracy: 0.8681
1200/1200 [=====] - 2s 1ms/step



Sequential with Kfold CV:

Training for fold 2 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_17"

Layer (type)	Output Shape	Param #
dense_87 (Dense)	(None, 4352)	596224
dense_88 (Dense)	(None, 2176)	9472128
dropout_55 (Dropout)	(None, 2176)	0
dense_89 (Dense)	(None, 1088)	2368576
dropout_56 (Dropout)	(None, 1088)	0
dense_90 (Dense)	(None, 544)	592416
dropout_57 (Dropout)	(None, 544)	0
dense_91 (Dense)	(None, 272)	148240
dropout_58 (Dropout)	(None, 272)	0
dense_92 (Dense)	(None, 2)	546

Total params: 13,178,130

Trainable params: 13,178,130

Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50

2880/2880 [=====] - 15s 5ms/step - loss: 2.6515 -
accuracy: 0.5677 - val_loss: 0.6666 - val_accuracy: 0.8736

Epoch 2/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.6586 -
accuracy: 0.6174 - val_loss: 0.4178 - val_accuracy: 0.8694

Epoch 3/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.3296 -
accuracy: 0.8826 - val_loss: 0.4894 - val_accuracy: 0.8403

Epoch 4/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3378 - accuracy: 0.8774 - val_loss: 0.3923 - val_accuracy: 0.8264

Epoch 5/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3257 - accuracy: 0.8795 - val_loss: 0.2811 - val_accuracy: 0.8778

Epoch 6/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3412 - accuracy: 0.8740 - val_loss: 0.3365 - val_accuracy: 0.8833

Epoch 7/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2792 - accuracy: 0.8924 - val_loss: 0.3362 - val_accuracy: 0.8611

Epoch 8/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2899 - accuracy: 0.8840 - val_loss: 0.3514 - val_accuracy: 0.8389

Epoch 9/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2716 - accuracy: 0.8927 - val_loss: 0.3698 - val_accuracy: 0.8514

Epoch 10/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2842 - accuracy: 0.8885 - val_loss: 0.4094 - val_accuracy: 0.8194

Epoch 11/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2679 - accuracy: 0.8865 - val_loss: 0.3067 - val_accuracy: 0.8667

Epoch 12/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2619 - accuracy: 0.8938 - val_loss: 0.3090 - val_accuracy: 0.8944

Epoch 13/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2733 - accuracy: 0.9010 - val_loss: 0.2937 - val_accuracy: 0.8931

Epoch 14/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2789 - accuracy: 0.8965 - val_loss: 0.3299 - val_accuracy: 0.8625

Epoch 15/50
2880/2880 [=====] - 7s 3ms/step - loss: 0.2455 - accuracy: 0.8962 - val_loss: 0.2934 - val_accuracy: 0.8694

Epoch 16/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2497 - accuracy: 0.8993 - val_loss: 0.3532 - val_accuracy: 0.8458

Epoch 17/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2256 - accuracy: 0.9069 - val_loss: 0.3549 - val_accuracy: 0.8417

Epoch 18/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2421 - accuracy: 0.9038 - val_loss: 0.2988 - val_accuracy: 0.8944

Epoch 19/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2433 - accuracy: 0.9038 - val_loss: 0.2897 - val_accuracy: 0.8944

Epoch 20/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2139 - accuracy: 0.9128 - val_loss: 0.3339 - val_accuracy: 0.8889

Epoch 21/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2499 - accuracy: 0.8958 - val_loss: 0.3227 - val_accuracy: 0.8875

Epoch 22/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2044 - accuracy: 0.9181 - val_loss: 0.3126 - val_accuracy: 0.8944

Epoch 23/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2251 - accuracy: 0.9118 - val_loss: 0.3064 - val_accuracy: 0.8722

Epoch 24/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2124 - accuracy: 0.9194 - val_loss: 0.3312 - val_accuracy: 0.8778

Epoch 25/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1951 - accuracy: 0.9201 - val_loss: 0.3669 - val_accuracy: 0.8597

Epoch 26/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2149 - accuracy: 0.9042 - val_loss: 0.3057 - val_accuracy: 0.8875

Epoch 27/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1959 - accuracy: 0.9240 - val_loss: 0.3091 - val_accuracy: 0.8944

Epoch 28/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1810 - accuracy: 0.9260 - val_loss: 0.3564 - val_accuracy: 0.9014

Epoch 29/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1986 - accuracy: 0.9181 - val_loss: 0.3189 - val_accuracy: 0.8708

Epoch 30/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1893 - accuracy: 0.9240 - val_loss: 0.3822 - val_accuracy: 0.8722

Epoch 31/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1848 - accuracy: 0.9215 - val_loss: 0.3323 - val_accuracy: 0.8903

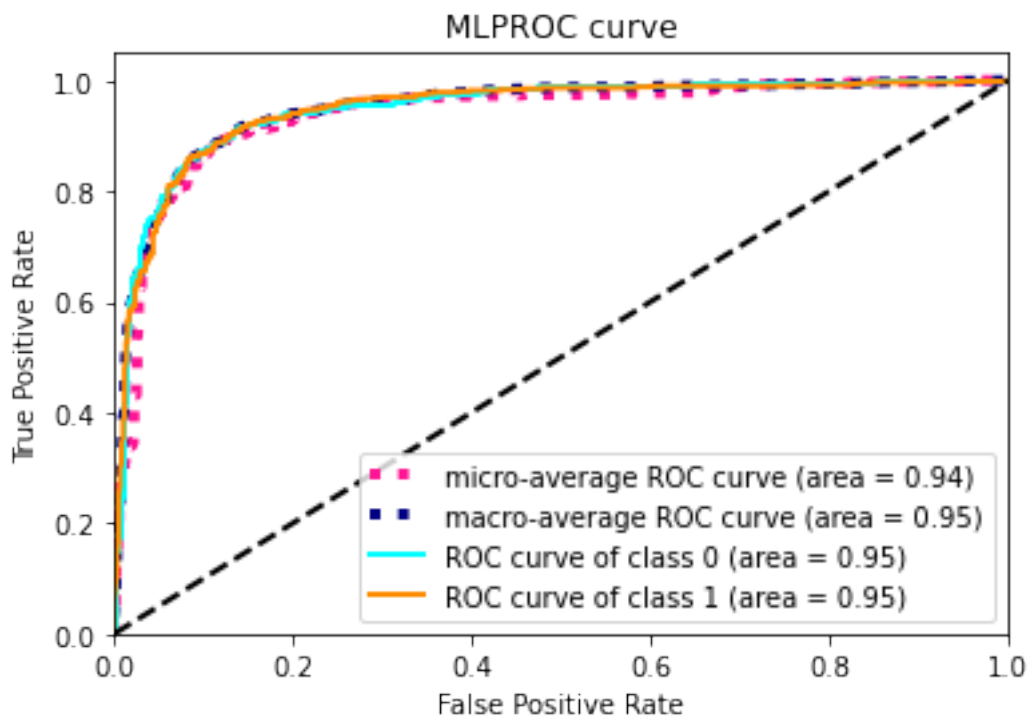
Epoch 32/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2072 - accuracy: 0.9108 - val_loss: 0.3678 - val_accuracy: 0.8583

Epoch 33/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1831 - accuracy: 0.9236 - val_loss: 0.3412 - val_accuracy: 0.8875

Epoch 34/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.2014 - accuracy: 0.9087 - val_loss: 0.3635 - val_accuracy: 0.8431

Epoch 35/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1665 - accuracy: 0.9392 - val_loss: 0.3283 - val_accuracy: 0.8875

Epoch 36/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1620 -
accuracy: 0.9372 - val_loss: 0.3684 - val_accuracy: 0.8889
Epoch 37/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1764 -
accuracy: 0.9267 - val_loss: 0.3349 - val_accuracy: 0.8917
Epoch 38/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1567 -
accuracy: 0.9372 - val_loss: 0.3436 - val_accuracy: 0.8861
Epoch 39/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1715 -
accuracy: 0.9274 - val_loss: 0.3944 - val_accuracy: 0.8958
Epoch 40/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1642 -
accuracy: 0.9312 - val_loss: 0.3418 - val_accuracy: 0.8764
Epoch 41/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1691 -
accuracy: 0.9340 - val_loss: 0.4182 - val_accuracy: 0.8875
Epoch 42/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1608 -
accuracy: 0.9309 - val_loss: 0.4583 - val_accuracy: 0.8153
Epoch 43/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1581 -
accuracy: 0.9333 - val_loss: 0.4011 - val_accuracy: 0.8944
Epoch 44/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1648 -
accuracy: 0.9389 - val_loss: 0.3639 - val_accuracy: 0.9000
Epoch 45/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1502 -
accuracy: 0.9399 - val_loss: 0.3668 - val_accuracy: 0.8778
Epoch 46/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1460 -
accuracy: 0.9448 - val_loss: 0.4534 - val_accuracy: 0.8833
Epoch 47/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1960 -
accuracy: 0.9306 - val_loss: 0.3789 - val_accuracy: 0.8944
Epoch 48/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1391 -
accuracy: 0.9455 - val_loss: 0.4058 - val_accuracy: 0.8806
Epoch 49/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1577 -
accuracy: 0.9337 - val_loss: 0.4215 - val_accuracy: 0.8736
Epoch 50/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1304 -
accuracy: 0.9490 - val_loss: 0.4478 - val_accuracy: 0.8917
1200/1200 [=====] - 2s 1ms/step



Sequential with Kfold CV:

Training for fold 3 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_18"

Layer (type)	Output Shape	Param #
dense_93 (Dense)	(None, 4352)	596224
dense_94 (Dense)	(None, 2176)	9472128
dropout_59 (Dropout)	(None, 2176)	0
dense_95 (Dense)	(None, 1088)	2368576
dropout_60 (Dropout)	(None, 1088)	0
dense_96 (Dense)	(None, 544)	592416
dropout_61 (Dropout)	(None, 544)	0


```

-----
dense_97 (Dense)                (None, 272)                148240
-----
dropout_62 (Dropout)            (None, 272)                0
-----
dense_98 (Dense)                (None, 2)                  546
=====
Total params: 13,178,130
Trainable params: 13,178,130
Non-trainable params: 0
-----
Train on 2880 samples, validate on 720 samples
Epoch 1/50
2880/2880 [=====] - 12s 4ms/step - loss: 1.9597 -
accuracy: 0.5552 - val_loss: 0.6539 - val_accuracy: 0.4958
Epoch 2/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.6851 -
accuracy: 0.6003 - val_loss: 0.3858 - val_accuracy: 0.8667
Epoch 3/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3764 -
accuracy: 0.8573 - val_loss: 0.5026 - val_accuracy: 0.8306
Epoch 4/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3394 -
accuracy: 0.8753 - val_loss: 0.2632 - val_accuracy: 0.9083
Epoch 5/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2937 -
accuracy: 0.8858 - val_loss: 0.2447 - val_accuracy: 0.9125
Epoch 6/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3206 -
accuracy: 0.8826 - val_loss: 0.2691 - val_accuracy: 0.8833
Epoch 7/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3209 -
accuracy: 0.8771 - val_loss: 0.3314 - val_accuracy: 0.8597
Epoch 8/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2823 -
accuracy: 0.8944 - val_loss: 0.4300 - val_accuracy: 0.8083
Epoch 9/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3191 -
accuracy: 0.8809 - val_loss: 0.2538 - val_accuracy: 0.9139
Epoch 10/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2640 -
accuracy: 0.8951 - val_loss: 0.2674 - val_accuracy: 0.8972
Epoch 11/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2741 -
accuracy: 0.8913 - val_loss: 0.3390 - val_accuracy: 0.8653
Epoch 12/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2965 -
accuracy: 0.8830 - val_loss: 0.2970 - val_accuracy: 0.8653

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Epoch 13/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2665 - accuracy: 0.8965 - val_loss: 0.2612 - val_accuracy: 0.8903

Epoch 14/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2701 - accuracy: 0.8955 - val_loss: 0.2513 - val_accuracy: 0.9042

Epoch 15/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2564 - accuracy: 0.9031 - val_loss: 0.4532 - val_accuracy: 0.8208

Epoch 16/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2843 - accuracy: 0.8861 - val_loss: 0.2459 - val_accuracy: 0.9042

Epoch 17/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2531 - accuracy: 0.8969 - val_loss: 0.2816 - val_accuracy: 0.8931

Epoch 18/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2278 - accuracy: 0.9045 - val_loss: 0.3271 - val_accuracy: 0.8833

Epoch 19/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2791 - accuracy: 0.8889 - val_loss: 0.2617 - val_accuracy: 0.8972

Epoch 20/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2360 - accuracy: 0.9087 - val_loss: 0.2941 - val_accuracy: 0.8764

Epoch 21/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2234 - accuracy: 0.9035 - val_loss: 0.2915 - val_accuracy: 0.8917

Epoch 22/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2319 - accuracy: 0.9056 - val_loss: 0.2543 - val_accuracy: 0.9042

Epoch 23/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1998 - accuracy: 0.9198 - val_loss: 0.2955 - val_accuracy: 0.8931

Epoch 24/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2479 - accuracy: 0.9045 - val_loss: 0.3086 - val_accuracy: 0.8986

Epoch 25/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2048 - accuracy: 0.9208 - val_loss: 0.2886 - val_accuracy: 0.8972

Epoch 26/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2300 - accuracy: 0.9125 - val_loss: 0.2779 - val_accuracy: 0.9000

Epoch 27/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2113 - accuracy: 0.9128 - val_loss: 0.3034 - val_accuracy: 0.8833

Epoch 28/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2039 - accuracy: 0.9108 - val_loss: 0.2723 - val_accuracy: 0.9000

Epoch 29/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2217 - accuracy: 0.9118 - val_loss: 0.2880 - val_accuracy: 0.8847

Epoch 30/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1772 - accuracy: 0.9271 - val_loss: 0.2990 - val_accuracy: 0.8944

Epoch 31/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2091 - accuracy: 0.9215 - val_loss: 0.2933 - val_accuracy: 0.9028

Epoch 32/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1935 - accuracy: 0.9198 - val_loss: 0.2933 - val_accuracy: 0.8972

Epoch 33/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2169 - accuracy: 0.9160 - val_loss: 0.3538 - val_accuracy: 0.8611

Epoch 34/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2035 - accuracy: 0.9142 - val_loss: 0.2850 - val_accuracy: 0.8667

Epoch 35/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1674 - accuracy: 0.9330 - val_loss: 0.2922 - val_accuracy: 0.8986

Epoch 36/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1751 - accuracy: 0.9302 - val_loss: 0.3174 - val_accuracy: 0.9028

Epoch 37/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1756 - accuracy: 0.9295 - val_loss: 0.4567 - val_accuracy: 0.8917

Epoch 38/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1875 - accuracy: 0.9257 - val_loss: 0.3012 - val_accuracy: 0.8889

Epoch 39/50
2880/2880 [=====] - 7s 2ms/step - loss: 0.1438 - accuracy: 0.9444 - val_loss: 0.4646 - val_accuracy: 0.8903

Epoch 40/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1713 - accuracy: 0.9292 - val_loss: 0.5024 - val_accuracy: 0.8819

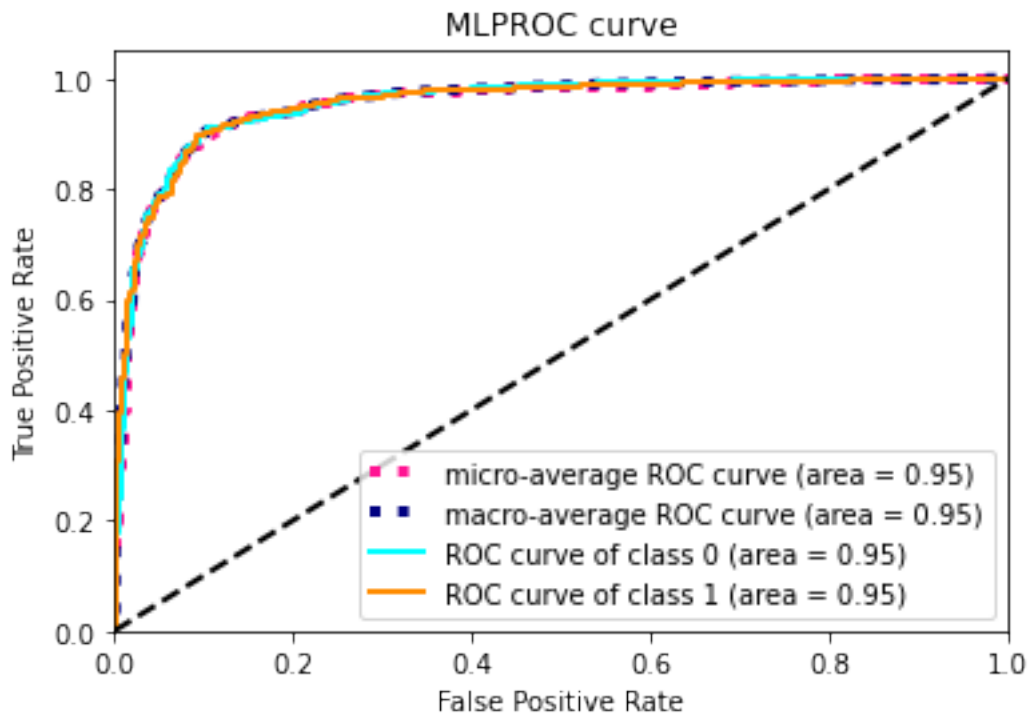
Epoch 41/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1805 - accuracy: 0.9260 - val_loss: 0.3365 - val_accuracy: 0.8917

Epoch 42/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1611 - accuracy: 0.9354 - val_loss: 0.3087 - val_accuracy: 0.8903

Epoch 43/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1467 - accuracy: 0.9403 - val_loss: 0.4310 - val_accuracy: 0.8944

Epoch 44/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1888 - accuracy: 0.9365 - val_loss: 0.3109 - val_accuracy: 0.8889

Epoch 45/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1517 -
 accuracy: 0.9431 - val_loss: 0.4029 - val_accuracy: 0.8833
 Epoch 46/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1633 -
 accuracy: 0.9340 - val_loss: 0.3644 - val_accuracy: 0.8972
 Epoch 47/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1365 -
 accuracy: 0.9469 - val_loss: 0.3793 - val_accuracy: 0.8875
 Epoch 48/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1652 -
 accuracy: 0.9316 - val_loss: 0.4218 - val_accuracy: 0.8944
 Epoch 49/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1824 -
 accuracy: 0.9375 - val_loss: 0.3030 - val_accuracy: 0.8764
 Epoch 50/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.1337 -
 accuracy: 0.9497 - val_loss: 0.3443 - val_accuracy: 0.9042
 1200/1200 [=====] - 2s 1ms/step



Sequential with Kfold CV:
 Training for fold 4 ...
 Adding layer 1:

Adding layer 2:
 Adding layer 3:
 Adding layer 4:
 Model: "sequential_19"

Layer (type)	Output Shape	Param #
dense_99 (Dense)	(None, 4352)	596224
dense_100 (Dense)	(None, 2176)	9472128
dropout_63 (Dropout)	(None, 2176)	0
dense_101 (Dense)	(None, 1088)	2368576
dropout_64 (Dropout)	(None, 1088)	0
dense_102 (Dense)	(None, 544)	592416
dropout_65 (Dropout)	(None, 544)	0
dense_103 (Dense)	(None, 272)	148240
dropout_66 (Dropout)	(None, 272)	0
dense_104 (Dense)	(None, 2)	546

Total params: 13,178,130
 Trainable params: 13,178,130
 Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50
 2880/2880 [=====] - 16s 5ms/step - loss: 2.0844 - accuracy: 0.5358 - val_loss: 0.6851 - val_accuracy: 0.5236

Epoch 2/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.6566 - accuracy: 0.6427 - val_loss: 0.3653 - val_accuracy: 0.8597

Epoch 3/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.3320 - accuracy: 0.8813 - val_loss: 0.4006 - val_accuracy: 0.8528

Epoch 4/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.3220 - accuracy: 0.8747 - val_loss: 0.4131 - val_accuracy: 0.8278

Epoch 5/50
 2880/2880 [=====] - 8s 3ms/step - loss: 0.3045 - accuracy: 0.8813 - val_loss: 0.4588 - val_accuracy: 0.7903

Epoch 6/50

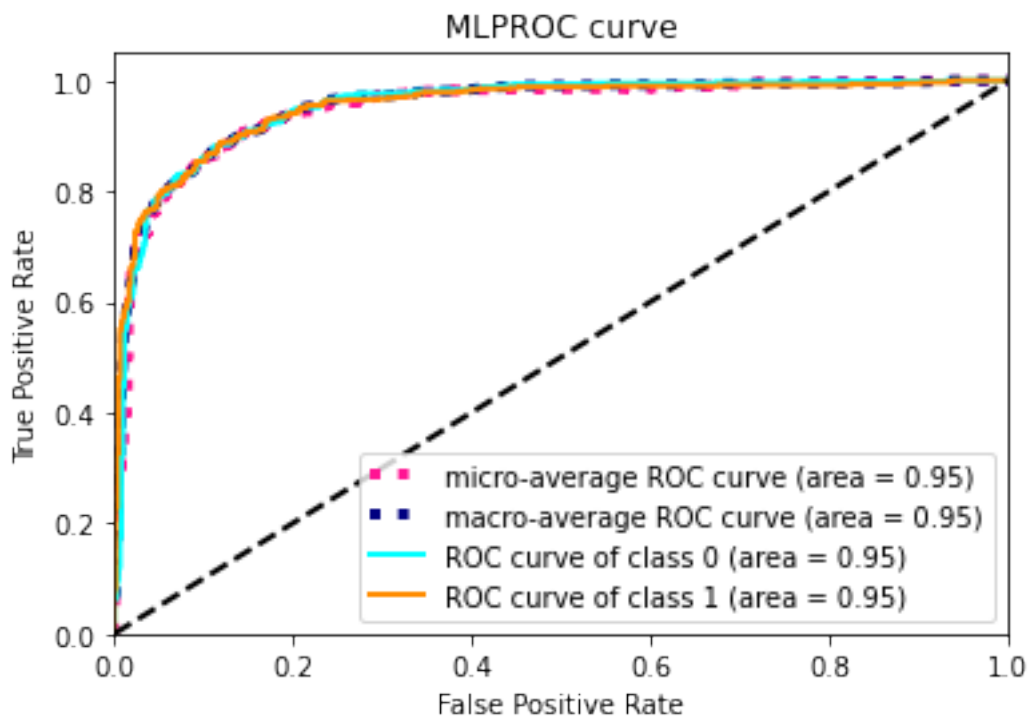
2880/2880 [=====] - 8s 3ms/step - loss: 0.3640 - accuracy: 0.8667 - val_loss: 0.3093 - val_accuracy: 0.8833
Epoch 7/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2616 - accuracy: 0.8948 - val_loss: 0.3598 - val_accuracy: 0.8778
Epoch 8/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3011 - accuracy: 0.8785 - val_loss: 0.3298 - val_accuracy: 0.8792
Epoch 9/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2592 - accuracy: 0.9042 - val_loss: 0.4309 - val_accuracy: 0.8375
Epoch 10/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.3165 - accuracy: 0.8646 - val_loss: 0.3092 - val_accuracy: 0.8806
Epoch 11/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2500 - accuracy: 0.9010 - val_loss: 0.3136 - val_accuracy: 0.8750
Epoch 12/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2658 - accuracy: 0.9007 - val_loss: 0.3186 - val_accuracy: 0.8722
Epoch 13/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2498 - accuracy: 0.9052 - val_loss: 0.3294 - val_accuracy: 0.8736
Epoch 14/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2541 - accuracy: 0.9028 - val_loss: 0.3281 - val_accuracy: 0.8722
Epoch 15/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2425 - accuracy: 0.9042 - val_loss: 0.3946 - val_accuracy: 0.8569
Epoch 16/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2378 - accuracy: 0.9028 - val_loss: 0.3473 - val_accuracy: 0.8792
Epoch 17/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2282 - accuracy: 0.9132 - val_loss: 0.3093 - val_accuracy: 0.8694
Epoch 18/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2713 - accuracy: 0.8962 - val_loss: 0.3820 - val_accuracy: 0.8806
Epoch 19/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2215 - accuracy: 0.9003 - val_loss: 0.3886 - val_accuracy: 0.8819
Epoch 20/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.1988 - accuracy: 0.9208 - val_loss: 0.3782 - val_accuracy: 0.8653
Epoch 21/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2373 - accuracy: 0.9056 - val_loss: 0.4440 - val_accuracy: 0.8708
Epoch 22/50

2880/2880 [=====] - 8s 3ms/step - loss: 0.2415 - accuracy: 0.9087 - val_loss: 0.3714 - val_accuracy: 0.8514
Epoch 23/50
2880/2880 [=====] - 8s 3ms/step - loss: 0.2156 - accuracy: 0.9146 - val_loss: 0.4341 - val_accuracy: 0.8778
Epoch 24/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.2124 - accuracy: 0.9187 - val_loss: 0.3761 - val_accuracy: 0.8819
Epoch 25/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1913 - accuracy: 0.9215 - val_loss: 0.4140 - val_accuracy: 0.8458
Epoch 26/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2113 - accuracy: 0.9184 - val_loss: 0.3789 - val_accuracy: 0.8750
Epoch 27/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2296 - accuracy: 0.9056 - val_loss: 0.3365 - val_accuracy: 0.8833
Epoch 28/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1859 - accuracy: 0.9253 - val_loss: 0.3952 - val_accuracy: 0.8875
Epoch 29/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2002 - accuracy: 0.9146 - val_loss: 0.3621 - val_accuracy: 0.8653
Epoch 30/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1890 - accuracy: 0.9267 - val_loss: 0.6145 - val_accuracy: 0.8750
Epoch 31/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1983 - accuracy: 0.9309 - val_loss: 0.3968 - val_accuracy: 0.8681
Epoch 32/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1963 - accuracy: 0.9219 - val_loss: 0.5336 - val_accuracy: 0.8764
Epoch 33/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1911 - accuracy: 0.9226 - val_loss: 0.4552 - val_accuracy: 0.8806
Epoch 34/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1858 - accuracy: 0.9271 - val_loss: 0.4206 - val_accuracy: 0.8764
Epoch 35/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1704 - accuracy: 0.9368 - val_loss: 0.4951 - val_accuracy: 0.8778
Epoch 36/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1877 - accuracy: 0.9271 - val_loss: 0.4396 - val_accuracy: 0.8778
Epoch 37/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1899 - accuracy: 0.9292 - val_loss: 0.4557 - val_accuracy: 0.8528
Epoch 38/50

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2880/2880 [=====] - 5s 2ms/step - loss: 0.1925 -
accuracy: 0.9236 - val_loss: 0.3664 - val_accuracy: 0.8764
Epoch 39/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1591 -
accuracy: 0.9385 - val_loss: 0.4372 - val_accuracy: 0.8694
Epoch 40/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1718 -
accuracy: 0.9278 - val_loss: 0.4725 - val_accuracy: 0.8694
Epoch 41/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1530 -
accuracy: 0.9441 - val_loss: 0.4034 - val_accuracy: 0.8861
Epoch 42/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1848 -
accuracy: 0.9316 - val_loss: 0.4045 - val_accuracy: 0.8750
Epoch 43/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1508 -
accuracy: 0.9417 - val_loss: 0.4452 - val_accuracy: 0.8694
Epoch 44/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1561 -
accuracy: 0.9375 - val_loss: 0.4787 - val_accuracy: 0.8597
Epoch 45/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1485 -
accuracy: 0.9392 - val_loss: 0.4517 - val_accuracy: 0.8736
Epoch 46/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1625 -
accuracy: 0.9378 - val_loss: 0.4192 - val_accuracy: 0.8764
Epoch 47/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1596 -
accuracy: 0.9420 - val_loss: 0.4411 - val_accuracy: 0.8764
Epoch 48/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1619 -
accuracy: 0.9333 - val_loss: 0.4205 - val_accuracy: 0.8833
Epoch 49/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1128 -
accuracy: 0.9510 - val_loss: 0.5024 - val_accuracy: 0.8653
Epoch 50/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1835 -
accuracy: 0.9299 - val_loss: 0.4067 - val_accuracy: 0.8806
1200/1200 [=====] - 1s 458us/step

```

Sequential with Kfold CV:

Training for fold 5 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_20"

Layer (type)	Output Shape	Param #
dense_105 (Dense)	(None, 4352)	596224
dense_106 (Dense)	(None, 2176)	9472128
dropout_67 (Dropout)	(None, 2176)	0
dense_107 (Dense)	(None, 1088)	2368576
dropout_68 (Dropout)	(None, 1088)	0
dense_108 (Dense)	(None, 544)	592416
dropout_69 (Dropout)	(None, 544)	0

dense_109 (Dense)	(None, 272)	148240
dropout_70 (Dropout)	(None, 272)	0
dense_110 (Dense)	(None, 2)	546

Total params: 13,178,130
 Trainable params: 13,178,130
 Non-trainable params: 0

Train on 2880 samples, validate on 720 samples

Epoch 1/50

2880/2880 [=====] - 6s 2ms/step - loss: 2.6622 - accuracy: 0.5274 - val_loss: 0.6440 - val_accuracy: 0.5889

Epoch 2/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.5889 - accuracy: 0.6722 - val_loss: 0.3602 - val_accuracy: 0.8569

Epoch 3/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.4916 - accuracy: 0.8059 - val_loss: 0.3003 - val_accuracy: 0.8944

Epoch 4/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.3217 - accuracy: 0.8816 - val_loss: 0.2838 - val_accuracy: 0.8944

Epoch 5/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.3430 - accuracy: 0.8781 - val_loss: 0.2938 - val_accuracy: 0.8958

Epoch 6/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.3111 - accuracy: 0.8868 - val_loss: 0.2922 - val_accuracy: 0.8847

Epoch 7/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.3046 - accuracy: 0.8833 - val_loss: 0.2659 - val_accuracy: 0.8681

Epoch 8/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2685 - accuracy: 0.8938 - val_loss: 0.2761 - val_accuracy: 0.8861

Epoch 9/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.3238 - accuracy: 0.8701 - val_loss: 0.3141 - val_accuracy: 0.8375

Epoch 10/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2829 - accuracy: 0.8913 - val_loss: 0.3341 - val_accuracy: 0.8778

Epoch 11/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2682 - accuracy: 0.8896 - val_loss: 0.2849 - val_accuracy: 0.8986

Epoch 12/50

2880/2880 [=====] - 5s 2ms/step - loss: 0.2901 - accuracy: 0.8913 - val_loss: 0.2611 - val_accuracy: 0.8875

Epoch 13/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2565 -
accuracy: 0.9066 - val_loss: 0.2884 - val_accuracy: 0.9014
Epoch 14/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2376 -
accuracy: 0.9094 - val_loss: 0.3454 - val_accuracy: 0.8625
Epoch 15/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.3029 -
accuracy: 0.8878 - val_loss: 0.2665 - val_accuracy: 0.8764
Epoch 16/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2642 -
accuracy: 0.8875 - val_loss: 0.3015 - val_accuracy: 0.8778
Epoch 17/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2443 -
accuracy: 0.9021 - val_loss: 0.2689 - val_accuracy: 0.9069
Epoch 18/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2390 -
accuracy: 0.9069 - val_loss: 0.3660 - val_accuracy: 0.8514
Epoch 19/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2347 -
accuracy: 0.9066 - val_loss: 0.2570 - val_accuracy: 0.9014
Epoch 20/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2385 -
accuracy: 0.9042 - val_loss: 0.2692 - val_accuracy: 0.9014
Epoch 21/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2373 -
accuracy: 0.9076 - val_loss: 0.2672 - val_accuracy: 0.9111
Epoch 22/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2397 -
accuracy: 0.9056 - val_loss: 0.2952 - val_accuracy: 0.8903
Epoch 23/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2430 -
accuracy: 0.9045 - val_loss: 0.2812 - val_accuracy: 0.8972
Epoch 24/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2130 -
accuracy: 0.9128 - val_loss: 0.2857 - val_accuracy: 0.8819
Epoch 25/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2227 -
accuracy: 0.9146 - val_loss: 0.4127 - val_accuracy: 0.8556
Epoch 26/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2146 -
accuracy: 0.9177 - val_loss: 0.2874 - val_accuracy: 0.8944
Epoch 27/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2152 -
accuracy: 0.9191 - val_loss: 0.3216 - val_accuracy: 0.8861
Epoch 28/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1993 -
accuracy: 0.9191 - val_loss: 0.3126 - val_accuracy: 0.8833

Epoch 29/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2253 - accuracy: 0.9059 - val_loss: 0.3495 - val_accuracy: 0.8958

Epoch 30/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2143 - accuracy: 0.9118 - val_loss: 0.3170 - val_accuracy: 0.8986

Epoch 31/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1807 - accuracy: 0.9243 - val_loss: 0.3150 - val_accuracy: 0.8806

Epoch 32/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2370 - accuracy: 0.9101 - val_loss: 0.2622 - val_accuracy: 0.9014

Epoch 33/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1782 - accuracy: 0.9215 - val_loss: 0.2865 - val_accuracy: 0.8861

Epoch 34/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1751 - accuracy: 0.9288 - val_loss: 0.2881 - val_accuracy: 0.8958

Epoch 35/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.2061 - accuracy: 0.9149 - val_loss: 0.3228 - val_accuracy: 0.8931

Epoch 36/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1788 - accuracy: 0.9274 - val_loss: 0.3224 - val_accuracy: 0.8944

Epoch 37/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1819 - accuracy: 0.9309 - val_loss: 0.3140 - val_accuracy: 0.8819

Epoch 38/50
2880/2880 [=====] - 6s 2ms/step - loss: 0.1878 - accuracy: 0.9240 - val_loss: 0.3301 - val_accuracy: 0.8861

Epoch 39/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1659 - accuracy: 0.9309 - val_loss: 0.3174 - val_accuracy: 0.8931

Epoch 40/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1801 - accuracy: 0.9274 - val_loss: 0.3214 - val_accuracy: 0.8833

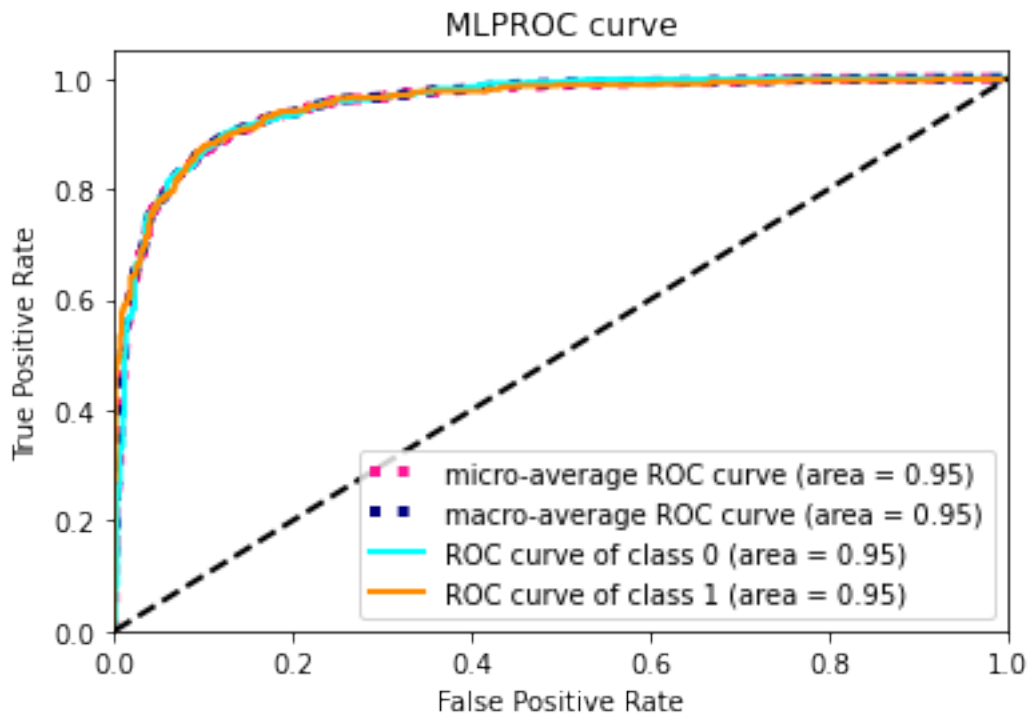
Epoch 41/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1801 - accuracy: 0.9271 - val_loss: 0.3351 - val_accuracy: 0.8931

Epoch 42/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1550 - accuracy: 0.9378 - val_loss: 0.3658 - val_accuracy: 0.8833

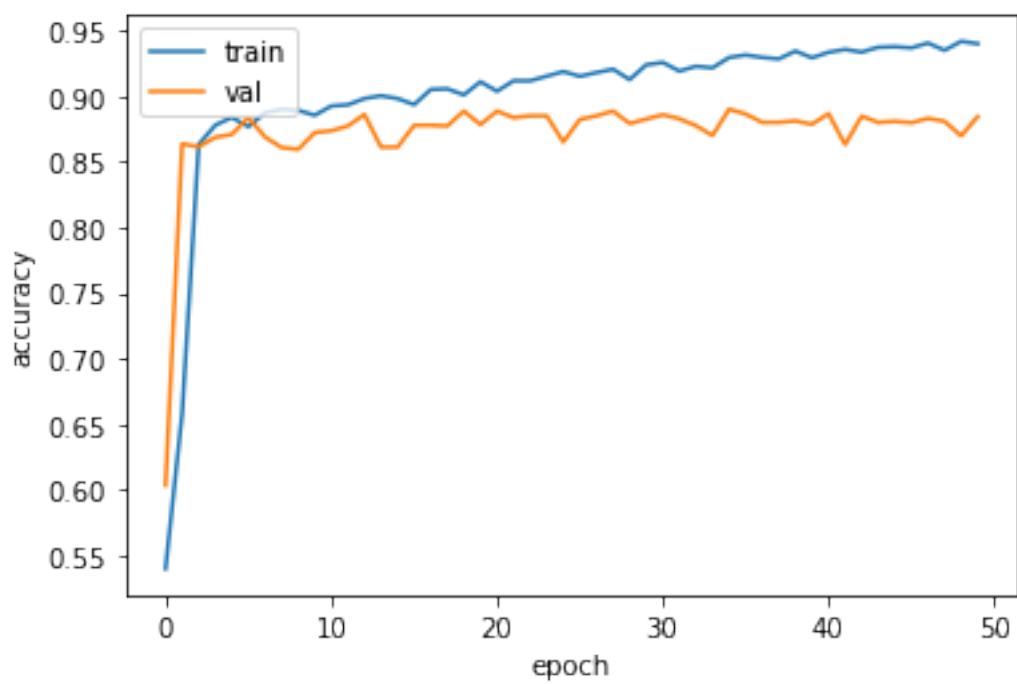
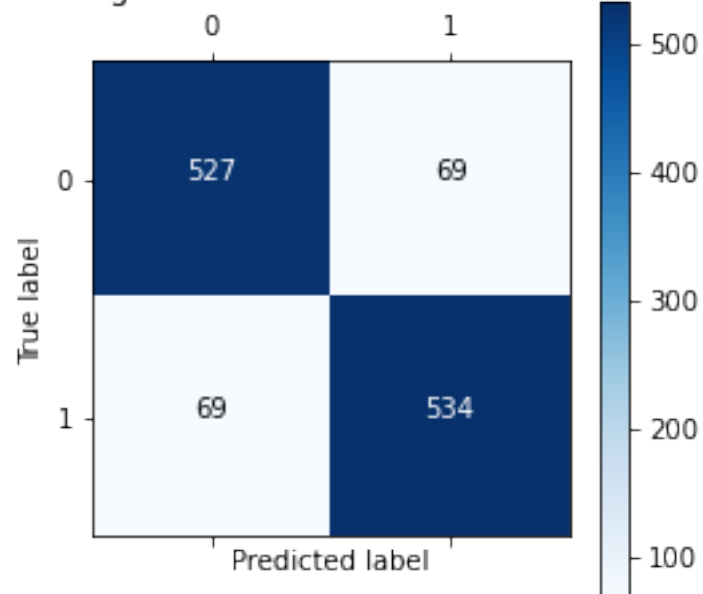
Epoch 43/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1909 - accuracy: 0.9240 - val_loss: 0.2885 - val_accuracy: 0.8931

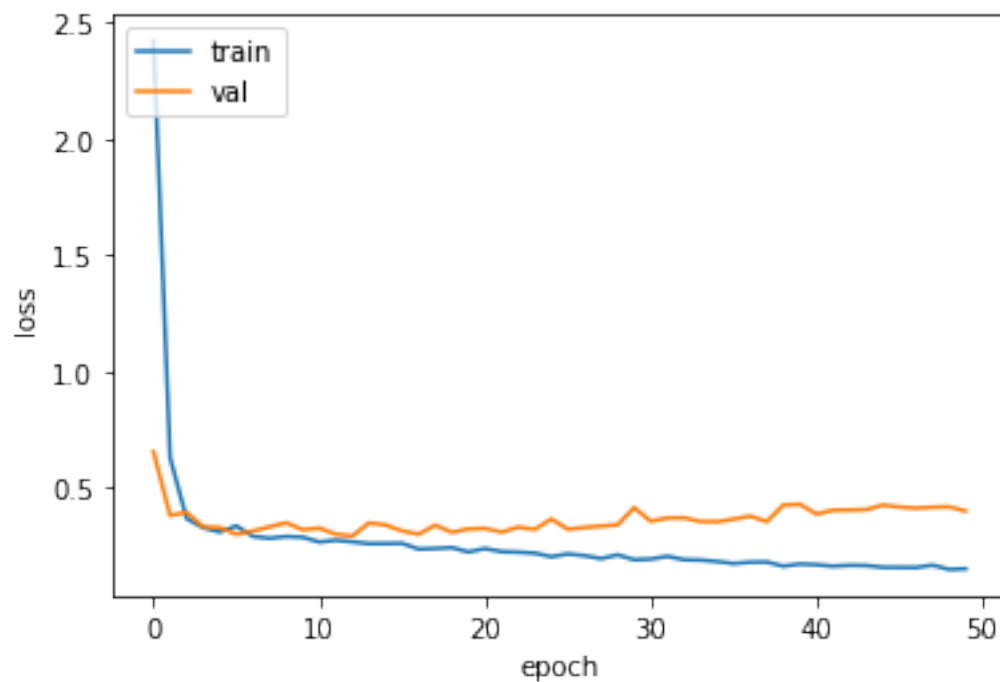
Epoch 44/50
2880/2880 [=====] - 5s 2ms/step - loss: 0.1657 - accuracy: 0.9347 - val_loss: 0.4194 - val_accuracy: 0.8931

Epoch 45/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1953 - accuracy: 0.9233 - val_loss: 0.3339 - val_accuracy: 0.9000
 Epoch 46/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1529 - accuracy: 0.9312 - val_loss: 0.3964 - val_accuracy: 0.8847
 Epoch 47/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1630 - accuracy: 0.9347 - val_loss: 0.4108 - val_accuracy: 0.8819
 Epoch 48/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1650 - accuracy: 0.9319 - val_loss: 0.4480 - val_accuracy: 0.8764
 Epoch 49/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1649 - accuracy: 0.9312 - val_loss: 0.4241 - val_accuracy: 0.8833
 Epoch 50/50
 2880/2880 [=====] - 5s 2ms/step - loss: 0.1462 - accuracy: 0.9368 - val_loss: 0.4159 - val_accuracy: 0.8778
 1200/1200 [=====] - 1s 476us/step



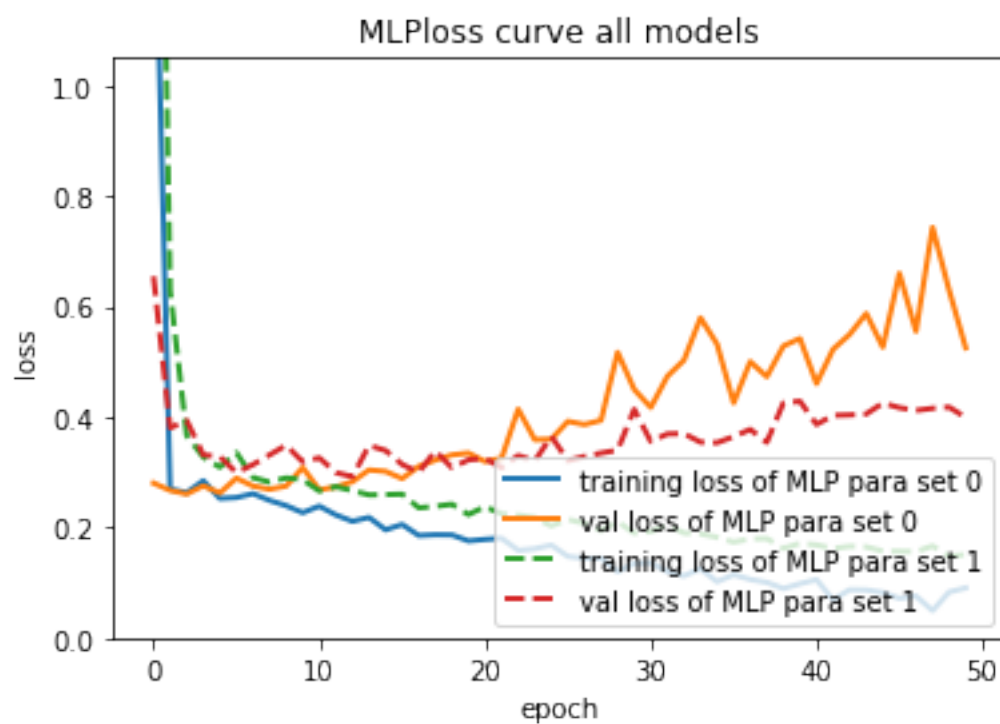
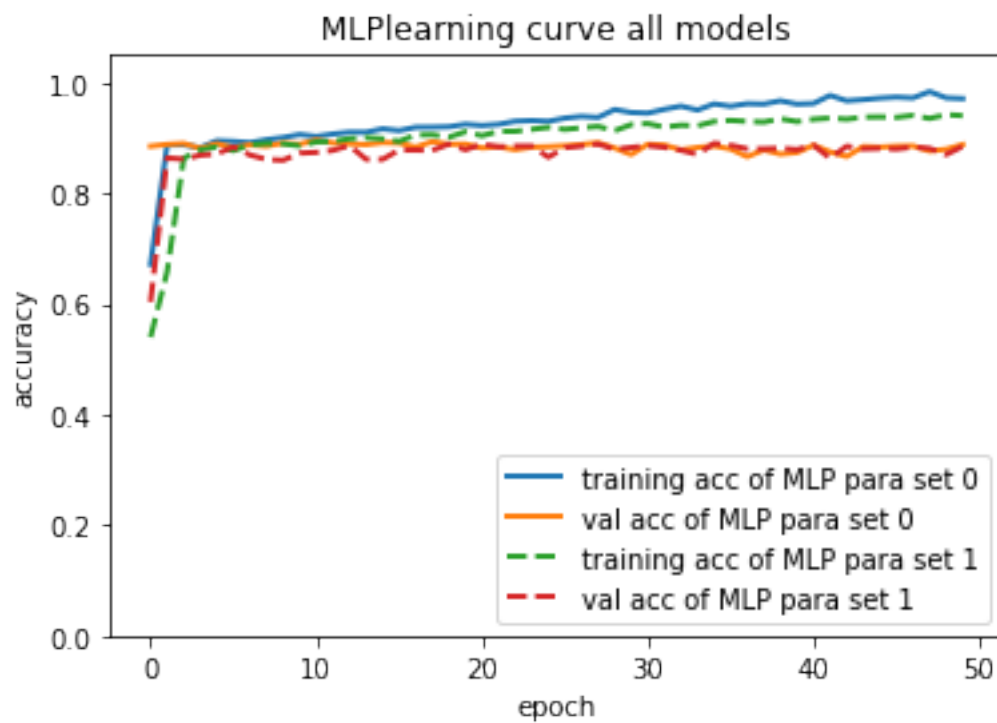
MLP Avg Confusion matrix across all folds





Average scores for pseudo test set across all folds:
 > Accuracy: 0.8846666574478149 (+- 0.006227174625387633)
 > Loss: 0.40233149101336796
 > Avg runtime per test instance: 0.003231040994326274

 #####



Opt model parameter found on the pseudo test set:

```
{'num_hidden_layer': 4, 'hidden_layer_activation': ['relu', 'tanh', 'relu',  
'tanh'], 'dropout': [0.5, 0.25, 0.125, 0.0625], 'last_activation': 'softmax'}
```

Best average pseudo test set accuracy score with the opt model:

0.8846666574478149

Average runtime per test instance: 0.003231040994326274

```
[8]: from B1 import B1_functions_all as B1_functions
```

```
[9]: TaskB1_opt_models_dict, TaskB1_res_dict = B1_functions.get_B1_results()
```

-----Reading Task B1 dataset-----

-----Task B1: Gird searching on
SVM-----

SVM Grid search CV on Dataset A:

Training scores:

```
0.216 (+/-0.000) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'rbf'}  
0.592 (+/-0.012) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'linear'}  
0.216 (+/-0.000) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'rbf'}  
0.592 (+/-0.012) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'linear'}  
0.216 (+/-0.000) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'rbf'}  
0.592 (+/-0.012) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'linear'}  
0.216 (+/-0.000) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'rbf'}  
0.592 (+/-0.012) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'linear'}  
0.216 (+/-0.000) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'rbf'}  
0.738 (+/-0.007) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'linear'}  
0.216 (+/-0.000) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'rbf'}  
0.738 (+/-0.007) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'linear'}  
0.267 (+/-0.016) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'rbf'}  
0.738 (+/-0.007) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'linear'}  
0.216 (+/-0.000) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'rbf'}  
0.738 (+/-0.007) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'linear'}  
0.215 (+/-0.001) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'rbf'}  
0.770 (+/-0.008) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'linear'}  
0.493 (+/-0.009) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'rbf'}  
0.770 (+/-0.008) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'linear'}  
0.605 (+/-0.008) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'rbf'}  
0.770 (+/-0.008) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'linear'}  
0.216 (+/-0.000) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}
```

0.770 (+/-0.008) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'linear'}
 0.494 (+/-0.015) for {'C': 1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.775 (+/-0.010) for {'C': 1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.675 (+/-0.009) for {'C': 1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.775 (+/-0.010) for {'C': 1, 'gamma': 0.001, 'kernel': 'linear'}
 0.859 (+/-0.005) for {'C': 1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.775 (+/-0.010) for {'C': 1, 'gamma': 0.01, 'kernel': 'linear'}
 1.000 (+/-0.000) for {'C': 1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.775 (+/-0.010) for {'C': 1, 'gamma': 0.1, 'kernel': 'linear'}
 0.661 (+/-0.005) for {'C': 10, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.777 (+/-0.007) for {'C': 10, 'gamma': 0.0001, 'kernel': 'linear'}
 0.815 (+/-0.007) for {'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}
 0.777 (+/-0.007) for {'C': 10, 'gamma': 0.001, 'kernel': 'linear'}
 0.985 (+/-0.003) for {'C': 10, 'gamma': 0.01, 'kernel': 'rbf'}
 0.777 (+/-0.007) for {'C': 10, 'gamma': 0.01, 'kernel': 'linear'}
 1.000 (+/-0.000) for {'C': 10, 'gamma': 0.1, 'kernel': 'rbf'}
 0.777 (+/-0.007) for {'C': 10, 'gamma': 0.1, 'kernel': 'linear'}

Validation scores:

0.216 (+/-0.000) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.583 (+/-0.035) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'linear'}
 0.216 (+/-0.000) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'rbf'}
 0.583 (+/-0.035) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'linear'}
 0.216 (+/-0.000) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'rbf'}
 0.583 (+/-0.035) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'linear'}
 0.216 (+/-0.000) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'rbf'}
 0.583 (+/-0.035) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'linear'}
 0.216 (+/-0.000) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.724 (+/-0.029) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'linear'}
 0.216 (+/-0.000) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'rbf'}
 0.724 (+/-0.029) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'linear'}
 0.265 (+/-0.009) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'rbf'}
 0.724 (+/-0.029) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'linear'}
 0.216 (+/-0.000) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'rbf'}
 0.724 (+/-0.029) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'linear'}
 0.216 (+/-0.002) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.741 (+/-0.027) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.485 (+/-0.007) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.741 (+/-0.027) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'linear'}
 0.554 (+/-0.034) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.741 (+/-0.027) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'linear'}
 0.216 (+/-0.000) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.741 (+/-0.027) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'linear'}
 0.487 (+/-0.018) for {'C': 1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.721 (+/-0.022) for {'C': 1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.651 (+/-0.038) for {'C': 1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.721 (+/-0.022) for {'C': 1, 'gamma': 0.001, 'kernel': 'linear'}

0.714 (+/-0.045) for {'C': 1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.721 (+/-0.022) for {'C': 1, 'gamma': 0.01, 'kernel': 'linear'}
 0.520 (+/-0.042) for {'C': 1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.721 (+/-0.022) for {'C': 1, 'gamma': 0.1, 'kernel': 'linear'}
 0.647 (+/-0.027) for {'C': 10, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.707 (+/-0.019) for {'C': 10, 'gamma': 0.0001, 'kernel': 'linear'}
 0.760 (+/-0.044) for {'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}
 0.707 (+/-0.019) for {'C': 10, 'gamma': 0.001, 'kernel': 'linear'}
 0.729 (+/-0.040) for {'C': 10, 'gamma': 0.01, 'kernel': 'rbf'}
 0.707 (+/-0.019) for {'C': 10, 'gamma': 0.01, 'kernel': 'linear'}
 0.535 (+/-0.043) for {'C': 10, 'gamma': 0.1, 'kernel': 'rbf'}
 0.707 (+/-0.019) for {'C': 10, 'gamma': 0.1, 'kernel': 'linear'}

Prediction on a pseudo test set (split from Dataset A):

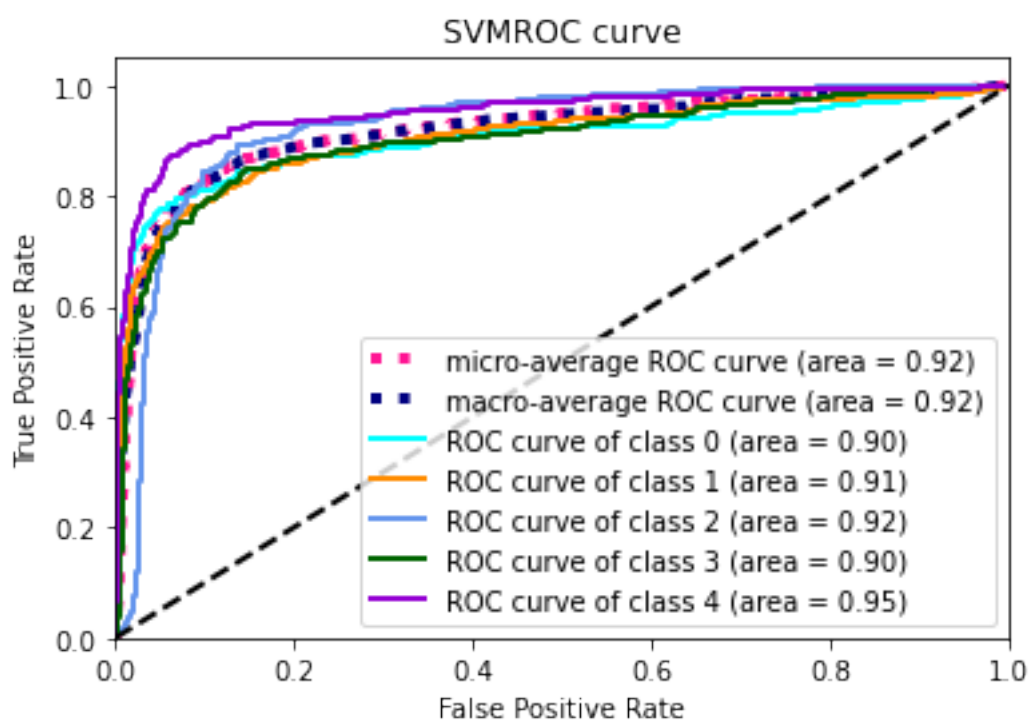
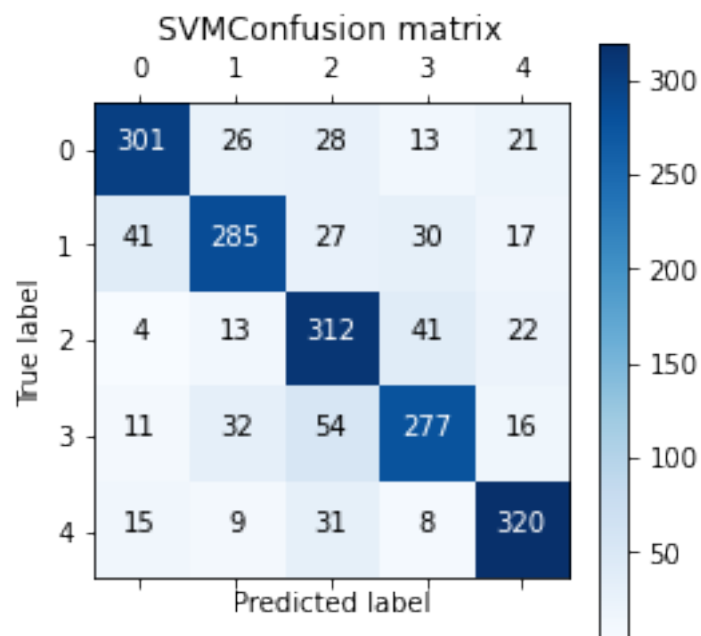
	precision	recall	f1-score	support
0	0.81	0.77	0.79	389
1	0.79	0.72	0.75	400
2	0.70	0.81	0.75	392
3	0.76	0.72	0.74	390
4	0.81	0.83	0.82	383
accuracy			0.77	1954
macro avg	0.77	0.77	0.77	1954
weighted avg	0.77	0.77	0.77	1954

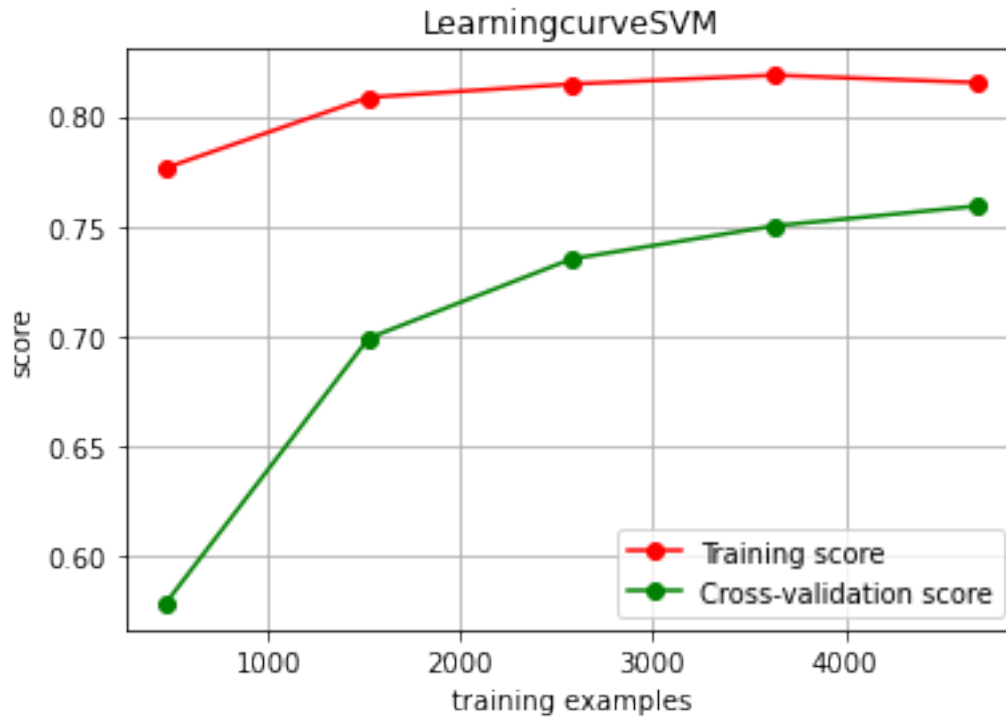
Accuracy: 0.77021494370522

Best parameters found on Dataset A:

{'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}

Average runtime per test instance: 0.0013042773780705618





-----Task B1: Grid searching on Random Forest-----

RF Grid search CV on Dataset A:

Training scores:

```
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 64, 'n_estimators': 1024}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 512}
1.000 (+/-0.000) for {'max_depth': 128, 'n_estimators': 1024}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 64}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 128}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 256}
1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 512}
```

1.000 (+/-0.000) for {'max_depth': 256, 'n_estimators': 1024}
 1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 64}
 1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 128}
 1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 256}
 1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 512}
 1.000 (+/-0.000) for {'max_depth': 512, 'n_estimators': 1024}
 1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 64}
 1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 128}
 1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 256}
 1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 512}
 1.000 (+/-0.000) for {'max_depth': 1024, 'n_estimators': 1024}

Validation scores:

0.703 (+/-0.018) for {'max_depth': 64, 'n_estimators': 64}
 0.714 (+/-0.021) for {'max_depth': 64, 'n_estimators': 128}
 0.715 (+/-0.020) for {'max_depth': 64, 'n_estimators': 256}
 0.718 (+/-0.021) for {'max_depth': 64, 'n_estimators': 512}
 0.718 (+/-0.029) for {'max_depth': 64, 'n_estimators': 1024}
 0.697 (+/-0.034) for {'max_depth': 128, 'n_estimators': 64}
 0.713 (+/-0.020) for {'max_depth': 128, 'n_estimators': 128}
 0.716 (+/-0.020) for {'max_depth': 128, 'n_estimators': 256}
 0.717 (+/-0.031) for {'max_depth': 128, 'n_estimators': 512}
 0.721 (+/-0.025) for {'max_depth': 128, 'n_estimators': 1024}
 0.705 (+/-0.021) for {'max_depth': 256, 'n_estimators': 64}
 0.712 (+/-0.018) for {'max_depth': 256, 'n_estimators': 128}
 0.717 (+/-0.023) for {'max_depth': 256, 'n_estimators': 256}
 0.720 (+/-0.022) for {'max_depth': 256, 'n_estimators': 512}
 0.720 (+/-0.024) for {'max_depth': 256, 'n_estimators': 1024}
 0.709 (+/-0.012) for {'max_depth': 512, 'n_estimators': 64}
 0.707 (+/-0.028) for {'max_depth': 512, 'n_estimators': 128}
 0.720 (+/-0.018) for {'max_depth': 512, 'n_estimators': 256}
 0.717 (+/-0.017) for {'max_depth': 512, 'n_estimators': 512}
 0.718 (+/-0.024) for {'max_depth': 512, 'n_estimators': 1024}
 0.703 (+/-0.022) for {'max_depth': 1024, 'n_estimators': 64}
 0.712 (+/-0.021) for {'max_depth': 1024, 'n_estimators': 128}
 0.717 (+/-0.023) for {'max_depth': 1024, 'n_estimators': 256}
 0.718 (+/-0.021) for {'max_depth': 1024, 'n_estimators': 512}
 0.718 (+/-0.020) for {'max_depth': 1024, 'n_estimators': 1024}

Prediction on a pseudo test set (split from Dataset A):

	precision	recall	f1-score	support
0	0.80	0.66	0.72	389
1	0.71	0.68	0.70	400
2	0.69	0.82	0.75	392
3	0.71	0.70	0.71	390
4	0.79	0.84	0.82	383

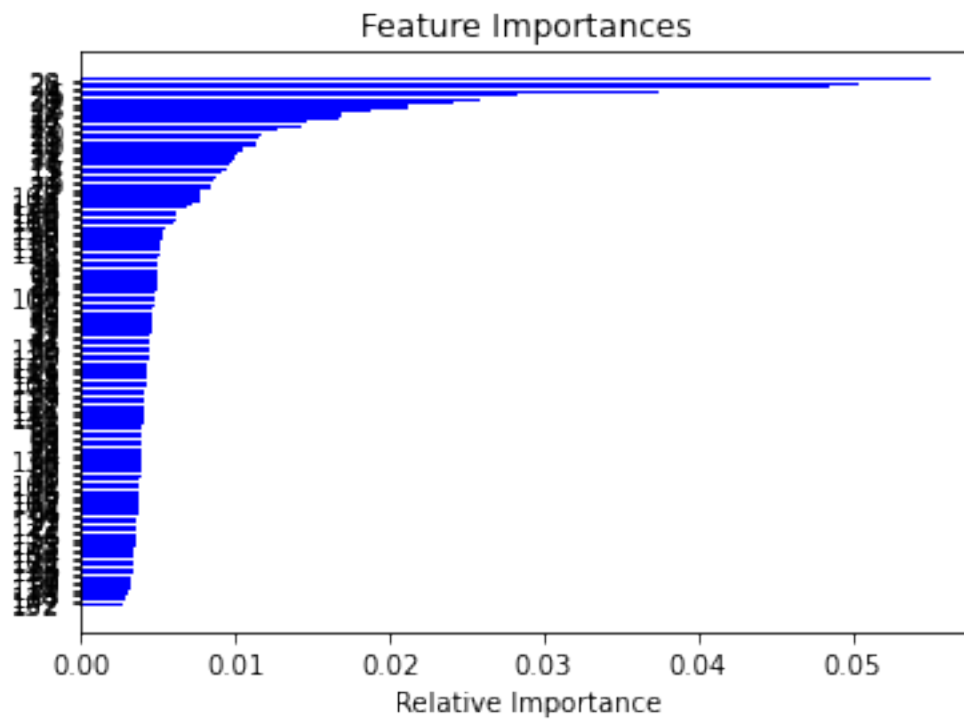
accuracy			0.74	1954
macro avg	0.74	0.74	0.74	1954
weighted avg	0.74	0.74	0.74	1954

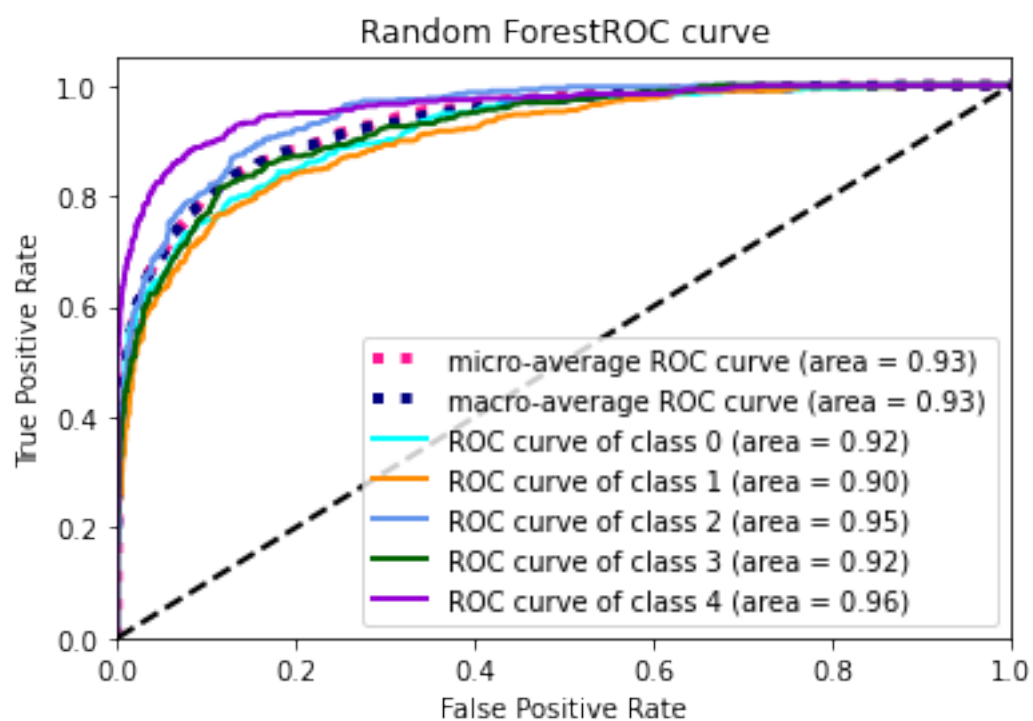
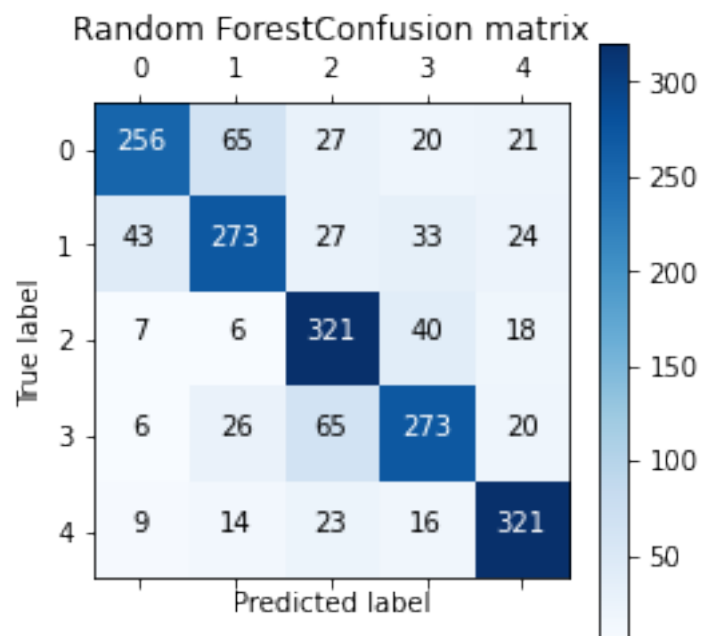
Accuracy: 0.7389969293756398

Best parameters found on Dataset A:

`{'max_depth': 128, 'n_estimators': 1024}`

Average runtime per test instance: 0.00046991606451715883







-----Task B1: Grid searching on
KNN-----

KNN Grid search CV on Dataset A:

Training scores:

0.632 (+/-0.018) for {'n_neighbors': 8}
 0.600 (+/-0.008) for {'n_neighbors': 16}
 0.574 (+/-0.006) for {'n_neighbors': 32}
 0.545 (+/-0.006) for {'n_neighbors': 64}
 0.527 (+/-0.011) for {'n_neighbors': 128}

Validation scores:

0.484 (+/-0.026) for {'n_neighbors': 8}
 0.502 (+/-0.027) for {'n_neighbors': 16}
 0.510 (+/-0.026) for {'n_neighbors': 32}
 0.509 (+/-0.023) for {'n_neighbors': 64}
 0.507 (+/-0.021) for {'n_neighbors': 128}

Prediction on a pseudo test set (split from Dataset A):

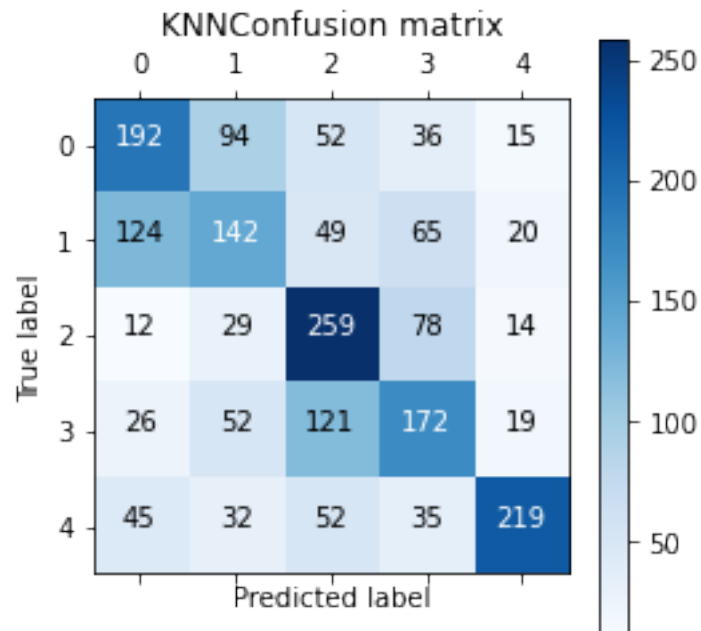
	precision	recall	f1-score	support
0	0.48	0.49	0.49	389
1	0.41	0.35	0.38	400
2	0.49	0.66	0.56	392
3	0.45	0.44	0.44	390
4	0.76	0.57	0.65	383
accuracy			0.50	1954
macro avg	0.52	0.50	0.50	1954
weighted avg	0.52	0.50	0.50	1954

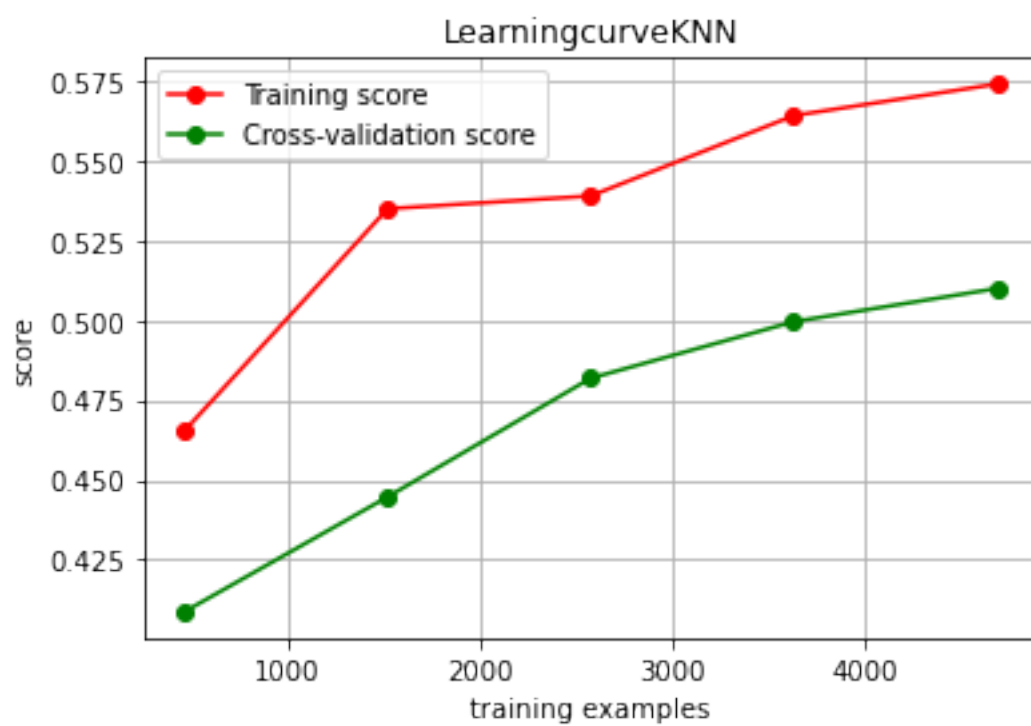
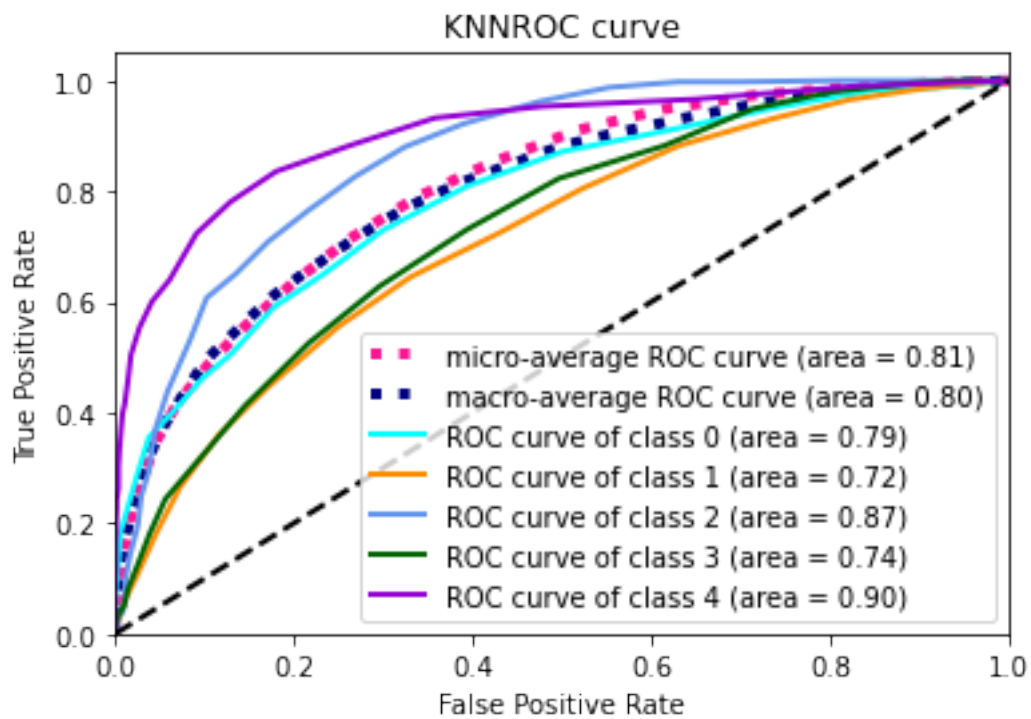
Accuracy: 0.503582395087001

Best parameters found on Dataset A:

`{'n_neighbors': 32}`

Average runtime per test instance: 0.003438198700653982





-----Task B1: Gird searching on
MLP-----

#####

Squential with Kfold CV:

Training for fold 1 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_21"

Layer (type)	Output Shape	Param #
dense_111 (Dense)	(None, 2176)	298112
dense_112 (Dense)	(None, 1088)	2368576
dropout_71 (Dropout)	(None, 1088)	0
dense_113 (Dense)	(None, 544)	592416
dropout_72 (Dropout)	(None, 544)	0
dense_114 (Dense)	(None, 272)	148240
dropout_73 (Dropout)	(None, 272)	0
dense_115 (Dense)	(None, 5)	1365

Total params: 3,408,709

Trainable params: 3,408,709

Non-trainable params: 0

Train on 4688 samples, validate on 1173 samples

Epoch 1/50

4688/4688 [=====] - 5s 1ms/step - loss: 2.4175 -
accuracy: 0.2513 - val_loss: 1.4331 - val_accuracy: 0.4697

Epoch 2/50

4688/4688 [=====] - 3s 557us/step - loss: 1.2505 -
accuracy: 0.4985 - val_loss: 1.1148 - val_accuracy: 0.5772

Epoch 3/50

4688/4688 [=====] - 3s 566us/step - loss: 1.1889 -
accuracy: 0.5105 - val_loss: 1.0000 - val_accuracy: 0.6309

Epoch 4/50

4688/4688 [=====] - 3s 564us/step - loss: 1.0193 -

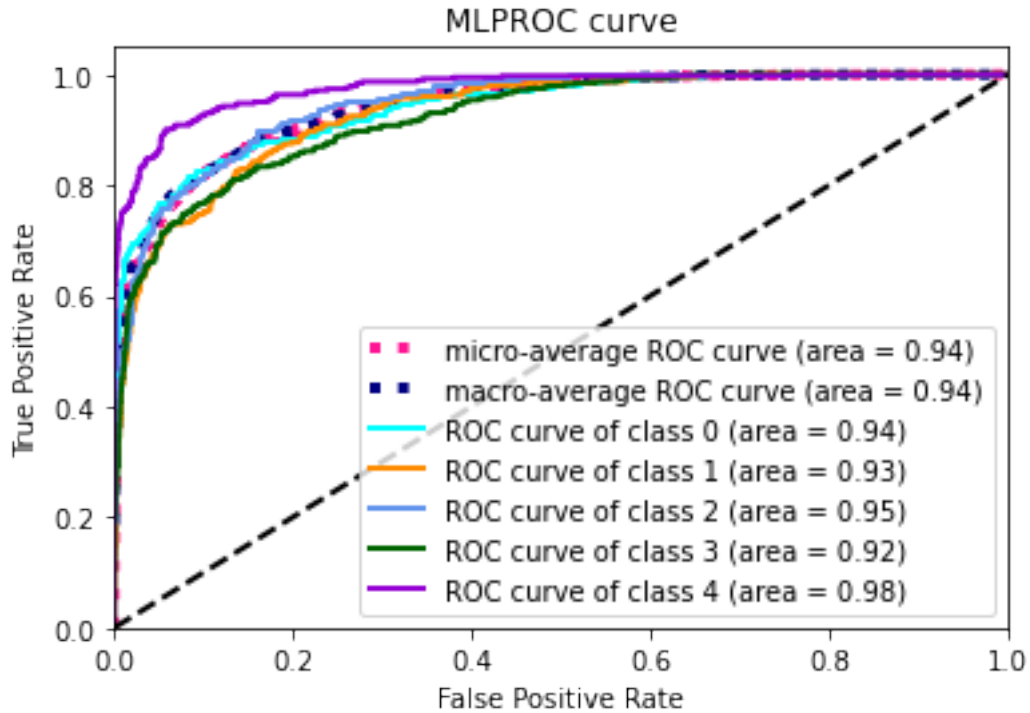
accuracy: 0.5870 - val_loss: 0.9899 - val_accuracy: 0.5678
 Epoch 5/50
 4688/4688 [=====] - 3s 557us/step - loss: 0.9510 -
 accuracy: 0.6201 - val_loss: 0.9177 - val_accuracy: 0.6377
 Epoch 6/50
 4688/4688 [=====] - 3s 599us/step - loss: 0.9720 -
 accuracy: 0.6137 - val_loss: 1.0129 - val_accuracy: 0.5652
 Epoch 7/50
 4688/4688 [=====] - 3s 604us/step - loss: 0.8172 -
 accuracy: 0.6847 - val_loss: 0.9100 - val_accuracy: 0.6198
 Epoch 8/50
 4688/4688 [=====] - 3s 592us/step - loss: 0.8484 -
 accuracy: 0.6685 - val_loss: 0.7664 - val_accuracy: 0.6786
 Epoch 9/50
 4688/4688 [=====] - 3s 615us/step - loss: 0.8175 -
 accuracy: 0.6751 - val_loss: 1.0573 - val_accuracy: 0.5797
 Epoch 10/50
 4688/4688 [=====] - 3s 628us/step - loss: 0.7459 -
 accuracy: 0.7152 - val_loss: 1.0214 - val_accuracy: 0.5729
 Epoch 11/50
 4688/4688 [=====] - 3s 605us/step - loss: 0.7657 -
 accuracy: 0.7039 - val_loss: 0.7260 - val_accuracy: 0.7212
 Epoch 12/50
 4688/4688 [=====] - 3s 605us/step - loss: 0.7245 -
 accuracy: 0.7257 - val_loss: 0.6921 - val_accuracy: 0.7357
 Epoch 13/50
 4688/4688 [=====] - 3s 620us/step - loss: 0.6477 -
 accuracy: 0.7494 - val_loss: 0.7476 - val_accuracy: 0.7059
 Epoch 14/50
 4688/4688 [=====] - 3s 598us/step - loss: 0.7013 -
 accuracy: 0.7302 - val_loss: 0.7887 - val_accuracy: 0.6905
 Epoch 15/50
 4688/4688 [=====] - 3s 612us/step - loss: 0.6537 -
 accuracy: 0.7491 - val_loss: 0.6826 - val_accuracy: 0.7340
 Epoch 16/50
 4688/4688 [=====] - 3s 606us/step - loss: 0.6151 -
 accuracy: 0.7543 - val_loss: 0.8139 - val_accuracy: 0.6394
 Epoch 17/50
 4688/4688 [=====] - 3s 607us/step - loss: 0.6362 -
 accuracy: 0.7517 - val_loss: 0.6643 - val_accuracy: 0.7485
 Epoch 18/50
 4688/4688 [=====] - 3s 596us/step - loss: 0.5593 -
 accuracy: 0.7826 - val_loss: 0.6281 - val_accuracy: 0.7647
 Epoch 19/50
 4688/4688 [=====] - 3s 592us/step - loss: 0.6210 -
 accuracy: 0.7579 - val_loss: 0.6253 - val_accuracy: 0.7613
 Epoch 20/50
 4688/4688 [=====] - 3s 599us/step - loss: 0.5588 -

accuracy: 0.7818 - val_loss: 0.6548 - val_accuracy: 0.7425
 Epoch 21/50
 4688/4688 [=====] - 3s 558us/step - loss: 0.4977 -
 accuracy: 0.8010 - val_loss: 1.0502 - val_accuracy: 0.6317
 Epoch 22/50
 4688/4688 [=====] - 3s 560us/step - loss: 0.5926 -
 accuracy: 0.7726 - val_loss: 0.8098 - val_accuracy: 0.6760
 Epoch 23/50
 4688/4688 [=====] - 3s 562us/step - loss: 0.5076 -
 accuracy: 0.8038 - val_loss: 0.6438 - val_accuracy: 0.7374
 Epoch 24/50
 4688/4688 [=====] - 3s 579us/step - loss: 0.5060 -
 accuracy: 0.8048 - val_loss: 0.6879 - val_accuracy: 0.7460
 Epoch 25/50
 4688/4688 [=====] - 3s 562us/step - loss: 0.4712 -
 accuracy: 0.8119 - val_loss: 0.6873 - val_accuracy: 0.7408
 Epoch 26/50
 4688/4688 [=====] - 3s 561us/step - loss: 0.5273 -
 accuracy: 0.7965 - val_loss: 0.7042 - val_accuracy: 0.7306
 Epoch 27/50
 4688/4688 [=====] - 3s 573us/step - loss: 0.4121 -
 accuracy: 0.8362 - val_loss: 0.6950 - val_accuracy: 0.7434
 Epoch 28/50
 4688/4688 [=====] - 3s 583us/step - loss: 0.4252 -
 accuracy: 0.8311 - val_loss: 0.7367 - val_accuracy: 0.7562
 Epoch 29/50
 4688/4688 [=====] - 3s 555us/step - loss: 0.5100 -
 accuracy: 0.8070 - val_loss: 0.7053 - val_accuracy: 0.7280
 Epoch 30/50
 4688/4688 [=====] - 3s 562us/step - loss: 0.4645 -
 accuracy: 0.8242 - val_loss: 0.7412 - val_accuracy: 0.7545
 Epoch 31/50
 4688/4688 [=====] - 3s 563us/step - loss: 0.3892 -
 accuracy: 0.8471 - val_loss: 0.6753 - val_accuracy: 0.7553
 Epoch 32/50
 4688/4688 [=====] - 3s 570us/step - loss: 0.3937 -
 accuracy: 0.8475 - val_loss: 0.7678 - val_accuracy: 0.6957
 Epoch 33/50
 4688/4688 [=====] - 3s 567us/step - loss: 0.4193 -
 accuracy: 0.8319 - val_loss: 0.6486 - val_accuracy: 0.7613
 Epoch 34/50
 4688/4688 [=====] - 3s 569us/step - loss: 0.4211 -
 accuracy: 0.8364 - val_loss: 0.9098 - val_accuracy: 0.6360
 Epoch 35/50
 4688/4688 [=====] - 3s 572us/step - loss: 0.3587 -
 accuracy: 0.8637 - val_loss: 0.6792 - val_accuracy: 0.7664
 Epoch 36/50
 4688/4688 [=====] - 3s 566us/step - loss: 0.4070 -

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accuracy: 0.8426 - val_loss: 0.6251 - val_accuracy: 0.7698
Epoch 37/50
4688/4688 [=====] - 3s 571us/step - loss: 0.3393 -
accuracy: 0.8720 - val_loss: 0.7765 - val_accuracy: 0.7357
Epoch 38/50
4688/4688 [=====] - 3s 570us/step - loss: 0.3385 -
accuracy: 0.8724 - val_loss: 0.7424 - val_accuracy: 0.7434
Epoch 39/50
4688/4688 [=====] - 3s 581us/step - loss: 0.3507 -
accuracy: 0.8697 - val_loss: 0.6779 - val_accuracy: 0.7886
Epoch 40/50
4688/4688 [=====] - 3s 566us/step - loss: 0.3339 -
accuracy: 0.8697 - val_loss: 0.8294 - val_accuracy: 0.7477
Epoch 41/50
4688/4688 [=====] - 3s 566us/step - loss: 0.3136 -
accuracy: 0.8793 - val_loss: 0.7567 - val_accuracy: 0.7451
Epoch 42/50
4688/4688 [=====] - 3s 563us/step - loss: 0.3601 -
accuracy: 0.8635 - val_loss: 0.7133 - val_accuracy: 0.7766
Epoch 43/50
4688/4688 [=====] - 3s 567us/step - loss: 0.3821 -
accuracy: 0.8652 - val_loss: 0.7990 - val_accuracy: 0.7400
Epoch 44/50
4688/4688 [=====] - 3s 571us/step - loss: 0.2712 -
accuracy: 0.8983 - val_loss: 0.8001 - val_accuracy: 0.7741
Epoch 45/50
4688/4688 [=====] - 3s 569us/step - loss: 0.2338 -
accuracy: 0.9132 - val_loss: 0.8517 - val_accuracy: 0.7400
Epoch 46/50
4688/4688 [=====] - 3s 565us/step - loss: 0.3678 -
accuracy: 0.8594 - val_loss: 0.8513 - val_accuracy: 0.7084
Epoch 47/50
4688/4688 [=====] - 3s 560us/step - loss: 0.2971 -
accuracy: 0.8887 - val_loss: 0.9158 - val_accuracy: 0.7477
Epoch 48/50
4688/4688 [=====] - 3s 563us/step - loss: 0.2186 -
accuracy: 0.9168 - val_loss: 0.9476 - val_accuracy: 0.7519
Epoch 49/50
4688/4688 [=====] - 3s 559us/step - loss: 0.3182 -
accuracy: 0.8842 - val_loss: 0.8523 - val_accuracy: 0.7570
Epoch 50/50
4688/4688 [=====] - 3s 555us/step - loss: 0.2734 -
accuracy: 0.8997 - val_loss: 0.9372 - val_accuracy: 0.7408
1954/1954 [=====] - 1s 260us/step

```



Sequential with Kfold CV:

Training for fold 2 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_22"

Layer (type)	Output Shape	Param #
dense_116 (Dense)	(None, 2176)	298112
dense_117 (Dense)	(None, 1088)	2368576
dropout_74 (Dropout)	(None, 1088)	0
dense_118 (Dense)	(None, 544)	592416
dropout_75 (Dropout)	(None, 544)	0
dense_119 (Dense)	(None, 272)	148240
dropout_76 (Dropout)	(None, 272)	0

```

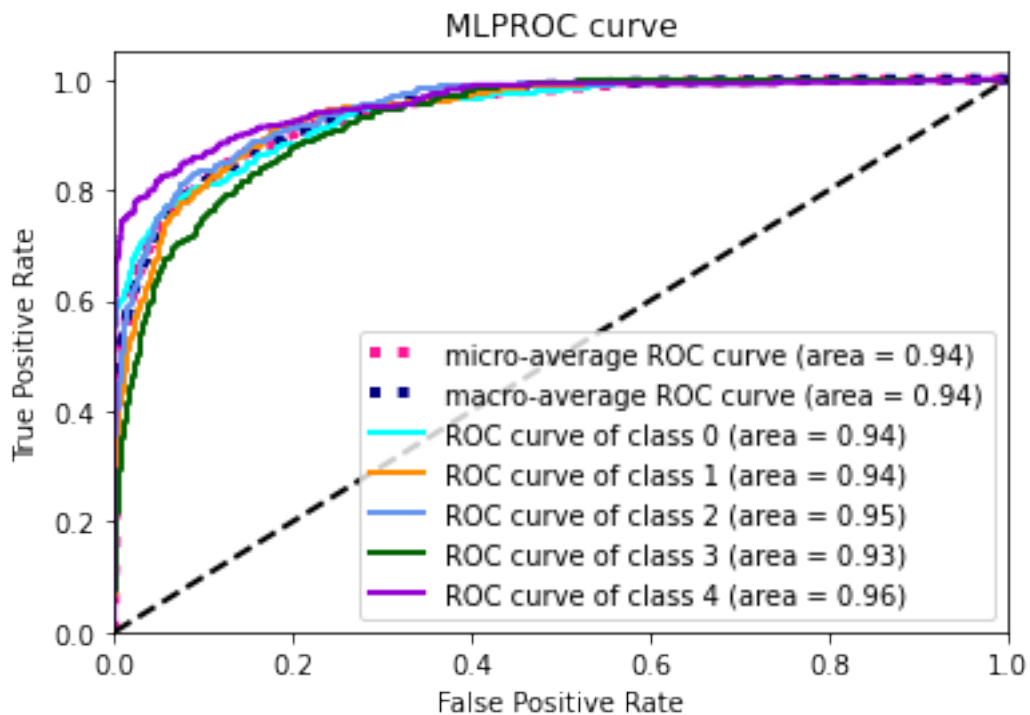
dense_120 (Dense)                (None, 5)                1365
=====
Total params: 3,408,709
Trainable params: 3,408,709
Non-trainable params: 0
-----
Train on 4689 samples, validate on 1172 samples
Epoch 1/50
4689/4689 [=====] - 5s 1ms/step - loss: 2.4753 -
accuracy: 0.2696 - val_loss: 2.0849 - val_accuracy: 0.3183
Epoch 2/50
4689/4689 [=====] - 3s 587us/step - loss: 1.4808 -
accuracy: 0.3962 - val_loss: 1.2031 - val_accuracy: 0.4608
Epoch 3/50
4689/4689 [=====] - 3s 615us/step - loss: 1.1869 -
accuracy: 0.4961 - val_loss: 1.1796 - val_accuracy: 0.5137
Epoch 4/50
4689/4689 [=====] - 3s 586us/step - loss: 1.1054 -
accuracy: 0.5406 - val_loss: 1.2378 - val_accuracy: 0.5171
Epoch 5/50
4689/4689 [=====] - 3s 592us/step - loss: 1.0472 -
accuracy: 0.5835 - val_loss: 1.0320 - val_accuracy: 0.6109
Epoch 6/50
4689/4689 [=====] - 3s 591us/step - loss: 0.9643 -
accuracy: 0.6070 - val_loss: 0.9129 - val_accuracy: 0.6621
Epoch 7/50
4689/4689 [=====] - 3s 596us/step - loss: 0.9064 -
accuracy: 0.6443 - val_loss: 0.9750 - val_accuracy: 0.6271
Epoch 8/50
4689/4689 [=====] - 3s 593us/step - loss: 0.8700 -
accuracy: 0.6583 - val_loss: 0.9410 - val_accuracy: 0.6254
Epoch 9/50
4689/4689 [=====] - 3s 608us/step - loss: 0.8829 -
accuracy: 0.6502 - val_loss: 0.8536 - val_accuracy: 0.6766
Epoch 10/50
4689/4689 [=====] - 3s 611us/step - loss: 0.8479 -
accuracy: 0.6643 - val_loss: 0.7850 - val_accuracy: 0.6954
Epoch 11/50
4689/4689 [=====] - 3s 581us/step - loss: 0.7448 -
accuracy: 0.7121 - val_loss: 1.3562 - val_accuracy: 0.5819
Epoch 12/50
4689/4689 [=====] - 3s 586us/step - loss: 0.8446 -
accuracy: 0.6829 - val_loss: 0.9789 - val_accuracy: 0.6032
Epoch 13/50
4689/4689 [=====] - 3s 580us/step - loss: 0.7213 -
accuracy: 0.7206 - val_loss: 0.8799 - val_accuracy: 0.6792
Epoch 14/50
4689/4689 [=====] - 3s 590us/step - loss: 0.7315 -

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accuracy: 0.7210 - val_loss: 0.9911 - val_accuracy: 0.6655
 Epoch 15/50
 4689/4689 [=====] - 3s 565us/step - loss: 0.7179 -
 accuracy: 0.7304 - val_loss: 1.4686 - val_accuracy: 0.5375
 Epoch 16/50
 4689/4689 [=====] - 3s 577us/step - loss: 0.7627 -
 accuracy: 0.7129 - val_loss: 0.6841 - val_accuracy: 0.7509
 Epoch 17/50
 4689/4689 [=====] - 3s 606us/step - loss: 0.6910 -
 accuracy: 0.7400 - val_loss: 0.7560 - val_accuracy: 0.7261
 Epoch 18/50
 4689/4689 [=====] - 3s 586us/step - loss: 0.6569 -
 accuracy: 0.7428 - val_loss: 0.9460 - val_accuracy: 0.6817
 Epoch 19/50
 4689/4689 [=====] - 3s 571us/step - loss: 0.6359 -
 accuracy: 0.7628 - val_loss: 0.9312 - val_accuracy: 0.6664
 Epoch 20/50
 4689/4689 [=====] - 3s 631us/step - loss: 0.7028 -
 accuracy: 0.7324 - val_loss: 0.9294 - val_accuracy: 0.6928
 Epoch 21/50
 4689/4689 [=====] - 3s 617us/step - loss: 0.6360 -
 accuracy: 0.7562 - val_loss: 0.6603 - val_accuracy: 0.7483
 Epoch 22/50
 4689/4689 [=====] - 3s 577us/step - loss: 0.5722 -
 accuracy: 0.7769 - val_loss: 0.8087 - val_accuracy: 0.6911
 Epoch 23/50
 4689/4689 [=====] - 3s 630us/step - loss: 0.5764 -
 accuracy: 0.7784 - val_loss: 0.8947 - val_accuracy: 0.6817
 Epoch 24/50
 4689/4689 [=====] - 3s 585us/step - loss: 0.5831 -
 accuracy: 0.7722 - val_loss: 0.8724 - val_accuracy: 0.7005
 Epoch 25/50
 4689/4689 [=====] - 3s 577us/step - loss: 0.5465 -
 accuracy: 0.7889 - val_loss: 0.8563 - val_accuracy: 0.6604
 Epoch 26/50
 4689/4689 [=====] - 3s 623us/step - loss: 0.5612 -
 accuracy: 0.7797 - val_loss: 1.1201 - val_accuracy: 0.6980
 Epoch 27/50
 4689/4689 [=====] - 3s 579us/step - loss: 0.5479 -
 accuracy: 0.8017 - val_loss: 0.7057 - val_accuracy: 0.7398
 Epoch 28/50
 4689/4689 [=====] - 3s 564us/step - loss: 0.5237 -
 accuracy: 0.7923 - val_loss: 0.7805 - val_accuracy: 0.7227
 Epoch 29/50
 4689/4689 [=====] - 3s 573us/step - loss: 0.5516 -
 accuracy: 0.7897 - val_loss: 1.2664 - val_accuracy: 0.6502
 Epoch 30/50
 4689/4689 [=====] - 3s 557us/step - loss: 0.5767 -

accuracy: 0.7882 - val_loss: 0.7211 - val_accuracy: 0.7338
 Epoch 31/50
 4689/4689 [=====] - 3s 561us/step - loss: 0.4725 -
 accuracy: 0.8202 - val_loss: 0.7152 - val_accuracy: 0.7278
 Epoch 32/50
 4689/4689 [=====] - 3s 562us/step - loss: 0.4796 -
 accuracy: 0.8174 - val_loss: 1.1517 - val_accuracy: 0.6297
 Epoch 33/50
 4689/4689 [=====] - 3s 568us/step - loss: 0.5244 -
 accuracy: 0.8091 - val_loss: 0.6905 - val_accuracy: 0.7611
 Epoch 34/50
 4689/4689 [=====] - 3s 559us/step - loss: 0.4467 -
 accuracy: 0.8258 - val_loss: 1.0056 - val_accuracy: 0.6860
 Epoch 35/50
 4689/4689 [=====] - 3s 561us/step - loss: 0.4800 -
 accuracy: 0.8164 - val_loss: 0.8583 - val_accuracy: 0.7295
 Epoch 36/50
 4689/4689 [=====] - 3s 569us/step - loss: 0.4136 -
 accuracy: 0.8375 - val_loss: 0.9195 - val_accuracy: 0.7150
 Epoch 37/50
 4689/4689 [=====] - 3s 563us/step - loss: 0.4571 -
 accuracy: 0.8238 - val_loss: 0.7403 - val_accuracy: 0.7363
 Epoch 38/50
 4689/4689 [=====] - 3s 550us/step - loss: 0.3889 -
 accuracy: 0.8501 - val_loss: 0.6969 - val_accuracy: 0.7577
 Epoch 39/50
 4689/4689 [=====] - 3s 566us/step - loss: 0.4256 -
 accuracy: 0.8292 - val_loss: 0.7697 - val_accuracy: 0.7517
 Epoch 40/50
 4689/4689 [=====] - 3s 571us/step - loss: 0.3883 -
 accuracy: 0.8524 - val_loss: 1.0102 - val_accuracy: 0.7159
 Epoch 41/50
 4689/4689 [=====] - 3s 565us/step - loss: 0.4096 -
 accuracy: 0.8420 - val_loss: 0.7284 - val_accuracy: 0.7662
 Epoch 42/50
 4689/4689 [=====] - 3s 562us/step - loss: 0.4223 -
 accuracy: 0.8392 - val_loss: 0.7649 - val_accuracy: 0.7491
 Epoch 43/50
 4689/4689 [=====] - 3s 562us/step - loss: 0.3508 -
 accuracy: 0.8656 - val_loss: 0.9438 - val_accuracy: 0.7449
 Epoch 44/50
 4689/4689 [=====] - 3s 576us/step - loss: 0.4331 -
 accuracy: 0.8373 - val_loss: 0.8289 - val_accuracy: 0.7338
 Epoch 45/50
 4689/4689 [=====] - 3s 585us/step - loss: 0.4307 -
 accuracy: 0.8270 - val_loss: 0.8323 - val_accuracy: 0.7398
 Epoch 46/50
 4689/4689 [=====] - 3s 572us/step - loss: 0.4017 -

accuracy: 0.8454 - val_loss: 0.8798 - val_accuracy: 0.7483
Epoch 47/50
4689/4689 [=====] - 3s 569us/step - loss: 0.4293 -
accuracy: 0.8405 - val_loss: 0.7050 - val_accuracy: 0.7671
Epoch 48/50
4689/4689 [=====] - 3s 567us/step - loss: 0.3504 -
accuracy: 0.8697 - val_loss: 1.0737 - val_accuracy: 0.6792
Epoch 49/50
4689/4689 [=====] - 3s 561us/step - loss: 0.3960 -
accuracy: 0.8592 - val_loss: 0.7311 - val_accuracy: 0.7611
Epoch 50/50
4689/4689 [=====] - 3s 563us/step - loss: 0.3310 -
accuracy: 0.8705 - val_loss: 1.1414 - val_accuracy: 0.7457
1954/1954 [=====] - 0s 238us/step



Sequential with Kfold CV:

Training for fold 3 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_23"

Layer (type)	Output Shape	Param #
--------------	--------------	---------

```

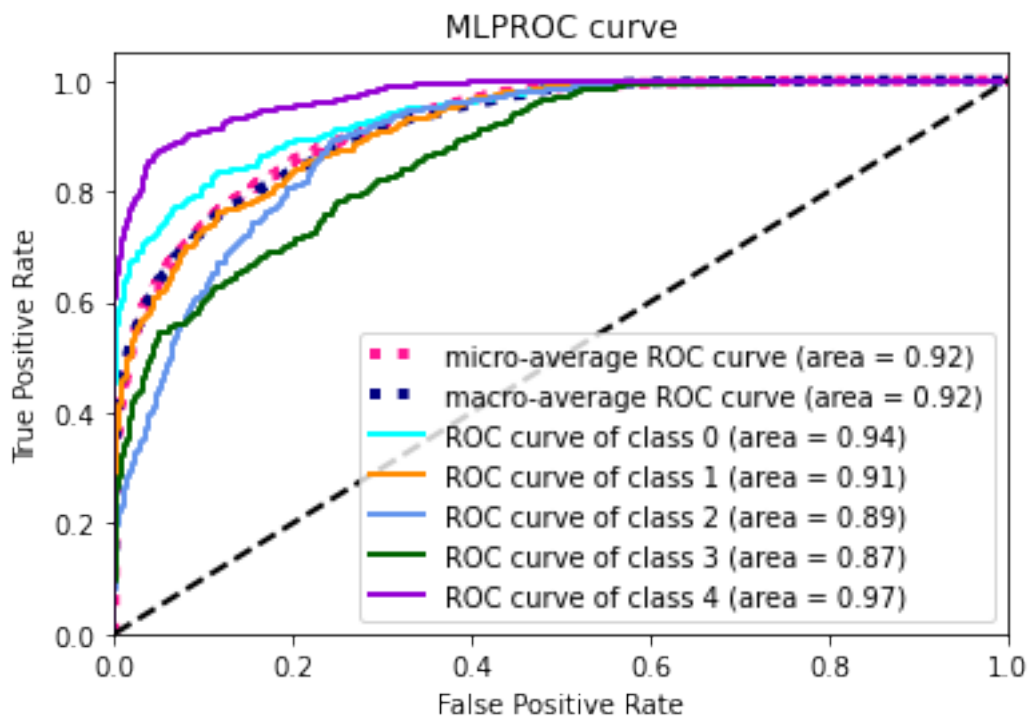
=====
dense_121 (Dense)                (None, 2176)                298112
-----
dense_122 (Dense)                (None, 1088)                2368576
-----
dropout_77 (Dropout)            (None, 1088)                0
-----
dense_123 (Dense)                (None, 544)                 592416
-----
dropout_78 (Dropout)            (None, 544)                 0
-----
dense_124 (Dense)                (None, 272)                 148240
-----
dropout_79 (Dropout)            (None, 272)                 0
-----
dense_125 (Dense)                (None, 5)                   1365
=====
Total params: 3,408,709
Trainable params: 3,408,709
Non-trainable params: 0
-----
Train on 4689 samples, validate on 1172 samples
Epoch 1/50
4689/4689 [=====] - 5s 1ms/step - loss: 2.6471 -
accuracy: 0.2608 - val_loss: 1.5418 - val_accuracy: 0.2449
Epoch 2/50
4689/4689 [=====] - 3s 561us/step - loss: 1.3331 -
accuracy: 0.4348 - val_loss: 1.2171 - val_accuracy: 0.5034
Epoch 3/50
4689/4689 [=====] - 3s 556us/step - loss: 1.2419 -
accuracy: 0.4873 - val_loss: 1.0170 - val_accuracy: 0.6075
Epoch 4/50
4689/4689 [=====] - 3s 563us/step - loss: 1.0292 -
accuracy: 0.5747 - val_loss: 1.2940 - val_accuracy: 0.4906
Epoch 5/50
4689/4689 [=====] - 3s 560us/step - loss: 1.0838 -
accuracy: 0.5696 - val_loss: 0.9984 - val_accuracy: 0.5922
Epoch 6/50
4689/4689 [=====] - 3s 558us/step - loss: 0.9255 -
accuracy: 0.6355 - val_loss: 1.1330 - val_accuracy: 0.5802
Epoch 7/50
4689/4689 [=====] - 3s 557us/step - loss: 0.9762 -
accuracy: 0.6257 - val_loss: 1.3763 - val_accuracy: 0.5794
Epoch 8/50
4689/4689 [=====] - 3s 563us/step - loss: 0.8991 -
accuracy: 0.6517 - val_loss: 0.9152 - val_accuracy: 0.6331
Epoch 9/50
4689/4689 [=====] - 3s 566us/step - loss: 0.8197 -

```

accuracy: 0.6818 - val_loss: 1.0712 - val_accuracy: 0.6101
 Epoch 10/50
 4689/4689 [=====] - 3s 564us/step - loss: 0.8790 -
 accuracy: 0.6729 - val_loss: 0.8213 - val_accuracy: 0.6758
 Epoch 11/50
 4689/4689 [=====] - 3s 567us/step - loss: 0.7776 -
 accuracy: 0.6995 - val_loss: 1.0944 - val_accuracy: 0.6254
 Epoch 12/50
 4689/4689 [=====] - 3s 567us/step - loss: 0.7915 -
 accuracy: 0.6989 - val_loss: 0.8635 - val_accuracy: 0.6869
 Epoch 13/50
 4689/4689 [=====] - 3s 556us/step - loss: 0.7379 -
 accuracy: 0.7115 - val_loss: 0.9734 - val_accuracy: 0.5964
 Epoch 14/50
 4689/4689 [=====] - 3s 565us/step - loss: 0.6730 -
 accuracy: 0.7388 - val_loss: 1.2883 - val_accuracy: 0.6519
 Epoch 15/50
 4689/4689 [=====] - 3s 573us/step - loss: 0.7978 -
 accuracy: 0.7080 - val_loss: 0.8306 - val_accuracy: 0.6809
 Epoch 16/50
 4689/4689 [=====] - 3s 564us/step - loss: 0.6708 -
 accuracy: 0.7364 - val_loss: 1.0543 - val_accuracy: 0.7022
 Epoch 17/50
 4689/4689 [=====] - 3s 556us/step - loss: 0.7153 -
 accuracy: 0.7302 - val_loss: 0.9098 - val_accuracy: 0.6536
 Epoch 18/50
 4689/4689 [=====] - 3s 561us/step - loss: 0.6452 -
 accuracy: 0.7496 - val_loss: 1.0437 - val_accuracy: 0.6459
 Epoch 19/50
 4689/4689 [=====] - 3s 564us/step - loss: 0.6249 -
 accuracy: 0.7554 - val_loss: 0.8899 - val_accuracy: 0.7039
 Epoch 20/50
 4689/4689 [=====] - 3s 575us/step - loss: 0.6715 -
 accuracy: 0.7396 - val_loss: 0.8768 - val_accuracy: 0.6664
 Epoch 21/50
 4689/4689 [=====] - 3s 575us/step - loss: 0.6167 -
 accuracy: 0.7569 - val_loss: 0.6599 - val_accuracy: 0.7662
 Epoch 22/50
 4689/4689 [=====] - 3s 564us/step - loss: 0.5390 -
 accuracy: 0.7910 - val_loss: 1.0192 - val_accuracy: 0.6365
 Epoch 23/50
 4689/4689 [=====] - 3s 562us/step - loss: 0.6466 -
 accuracy: 0.7462 - val_loss: 0.7320 - val_accuracy: 0.7321
 Epoch 24/50
 4689/4689 [=====] - 3s 560us/step - loss: 0.5630 -
 accuracy: 0.7746 - val_loss: 0.7698 - val_accuracy: 0.7688
 Epoch 25/50
 4689/4689 [=====] - 3s 569us/step - loss: 0.6277 -

accuracy: 0.7688 - val_loss: 0.8328 - val_accuracy: 0.7304
Epoch 26/50
4689/4689 [=====] - 3s 560us/step - loss: 0.5471 -
accuracy: 0.7921 - val_loss: 0.9662 - val_accuracy: 0.5896
Epoch 27/50
4689/4689 [=====] - 3s 563us/step - loss: 0.5398 -
accuracy: 0.7865 - val_loss: 0.7927 - val_accuracy: 0.7235
Epoch 28/50
4689/4689 [=====] - 3s 563us/step - loss: 0.5872 -
accuracy: 0.7686 - val_loss: 0.8375 - val_accuracy: 0.7253
Epoch 29/50
4689/4689 [=====] - 3s 573us/step - loss: 0.5156 -
accuracy: 0.8036 - val_loss: 0.7648 - val_accuracy: 0.7150
Epoch 30/50
4689/4689 [=====] - 3s 572us/step - loss: 0.4968 -
accuracy: 0.7965 - val_loss: 0.6435 - val_accuracy: 0.7739
Epoch 31/50
4689/4689 [=====] - 3s 568us/step - loss: 0.4722 -
accuracy: 0.8089 - val_loss: 0.8470 - val_accuracy: 0.6945
Epoch 32/50
4689/4689 [=====] - 3s 559us/step - loss: 0.5598 -
accuracy: 0.7829 - val_loss: 0.9696 - val_accuracy: 0.6834
Epoch 33/50
4689/4689 [=====] - 3s 576us/step - loss: 0.4842 -
accuracy: 0.8160 - val_loss: 1.2420 - val_accuracy: 0.6971
Epoch 34/50
4689/4689 [=====] - 3s 564us/step - loss: 0.5060 -
accuracy: 0.8121 - val_loss: 0.7033 - val_accuracy: 0.7415
Epoch 35/50
4689/4689 [=====] - 3s 576us/step - loss: 0.4287 -
accuracy: 0.8260 - val_loss: 1.1339 - val_accuracy: 0.6732
Epoch 36/50
4689/4689 [=====] - 3s 570us/step - loss: 0.5208 -
accuracy: 0.8010 - val_loss: 0.7691 - val_accuracy: 0.7090
Epoch 37/50
4689/4689 [=====] - 3s 595us/step - loss: 0.4920 -
accuracy: 0.8081 - val_loss: 0.6896 - val_accuracy: 0.7594
Epoch 38/50
4689/4689 [=====] - 3s 579us/step - loss: 0.4286 -
accuracy: 0.8264 - val_loss: 0.7794 - val_accuracy: 0.7543
Epoch 39/50
4689/4689 [=====] - 3s 573us/step - loss: 0.4614 -
accuracy: 0.8202 - val_loss: 1.1558 - val_accuracy: 0.6920
Epoch 40/50
4689/4689 [=====] - 3s 569us/step - loss: 0.4746 -
accuracy: 0.8224 - val_loss: 1.0884 - val_accuracy: 0.7048
Epoch 41/50
4689/4689 [=====] - 3s 584us/step - loss: 0.4472 -

accuracy: 0.8273 - val_loss: 0.7152 - val_accuracy: 0.7372
Epoch 42/50
4689/4689 [=====] - 3s 573us/step - loss: 0.3950 -
accuracy: 0.8454 - val_loss: 0.9720 - val_accuracy: 0.7065
Epoch 43/50
4689/4689 [=====] - 3s 579us/step - loss: 0.4640 -
accuracy: 0.8217 - val_loss: 0.9199 - val_accuracy: 0.7210
Epoch 44/50
4689/4689 [=====] - 3s 575us/step - loss: 0.3967 -
accuracy: 0.8479 - val_loss: 0.6921 - val_accuracy: 0.7662
Epoch 45/50
4689/4689 [=====] - 3s 570us/step - loss: 0.3698 -
accuracy: 0.8563 - val_loss: 1.0112 - val_accuracy: 0.6800
Epoch 46/50
4689/4689 [=====] - 3s 564us/step - loss: 0.4124 -
accuracy: 0.8433 - val_loss: 0.7724 - val_accuracy: 0.7662
Epoch 47/50
4689/4689 [=====] - 3s 568us/step - loss: 0.3679 -
accuracy: 0.8620 - val_loss: 0.8776 - val_accuracy: 0.7543
Epoch 48/50
4689/4689 [=====] - 3s 568us/step - loss: 0.4186 -
accuracy: 0.8452 - val_loss: 0.7987 - val_accuracy: 0.7381
Epoch 49/50
4689/4689 [=====] - 3s 556us/step - loss: 0.3105 -
accuracy: 0.8816 - val_loss: 1.0405 - val_accuracy: 0.6894
Epoch 50/50
4689/4689 [=====] - 3s 565us/step - loss: 0.4669 -
accuracy: 0.8403 - val_loss: 0.9245 - val_accuracy: 0.7090
1954/1954 [=====] - 0s 242us/step



Sequential with Kfold CV:

Training for fold 4 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_24"

Layer (type)	Output Shape	Param #
dense_126 (Dense)	(None, 2176)	298112
dense_127 (Dense)	(None, 1088)	2368576
dropout_80 (Dropout)	(None, 1088)	0
dense_128 (Dense)	(None, 544)	592416
dropout_81 (Dropout)	(None, 544)	0
dense_129 (Dense)	(None, 272)	148240
dropout_82 (Dropout)	(None, 272)	0

```

dense_130 (Dense)                (None, 5)                1365
=====
Total params: 3,408,709
Trainable params: 3,408,709
Non-trainable params: 0
-----
Train on 4689 samples, validate on 1172 samples
Epoch 1/50
4689/4689 [=====] - 5s 1ms/step - loss: 2.4417 -
accuracy: 0.2583 - val_loss: 2.0449 - val_accuracy: 0.2807
Epoch 2/50
4689/4689 [=====] - 3s 570us/step - loss: 1.3734 -
accuracy: 0.4525 - val_loss: 1.8142 - val_accuracy: 0.3131
Epoch 3/50
4689/4689 [=====] - 3s 564us/step - loss: 1.2088 -
accuracy: 0.5033 - val_loss: 1.6039 - val_accuracy: 0.3968
Epoch 4/50
4689/4689 [=====] - 3s 564us/step - loss: 1.1459 -
accuracy: 0.5620 - val_loss: 0.9268 - val_accuracy: 0.6485
Epoch 5/50
4689/4689 [=====] - 3s 556us/step - loss: 1.0385 -
accuracy: 0.5658 - val_loss: 1.1693 - val_accuracy: 0.5350
Epoch 6/50
4689/4689 [=====] - 3s 562us/step - loss: 0.9583 -
accuracy: 0.6187 - val_loss: 1.0050 - val_accuracy: 0.5896
Epoch 7/50
4689/4689 [=====] - 3s 561us/step - loss: 0.9202 -
accuracy: 0.6392 - val_loss: 1.0311 - val_accuracy: 0.5853
Epoch 8/50
4689/4689 [=====] - 3s 567us/step - loss: 0.8353 -
accuracy: 0.6618 - val_loss: 1.0110 - val_accuracy: 0.5418
Epoch 9/50
4689/4689 [=====] - 3s 572us/step - loss: 0.8271 -
accuracy: 0.6822 - val_loss: 0.9298 - val_accuracy: 0.6348
Epoch 10/50
4689/4689 [=====] - 3s 556us/step - loss: 0.7965 -
accuracy: 0.6848 - val_loss: 0.9277 - val_accuracy: 0.5734
Epoch 11/50
4689/4689 [=====] - 3s 560us/step - loss: 0.7779 -
accuracy: 0.6854 - val_loss: 0.8498 - val_accuracy: 0.6681
Epoch 12/50
4689/4689 [=====] - 3s 562us/step - loss: 0.7529 -
accuracy: 0.7119 - val_loss: 0.8588 - val_accuracy: 0.6340
Epoch 13/50
4689/4689 [=====] - 3s 579us/step - loss: 0.7203 -
accuracy: 0.7147 - val_loss: 1.2631 - val_accuracy: 0.5981
Epoch 14/50
4689/4689 [=====] - 3s 565us/step - loss: 0.7621 -

```

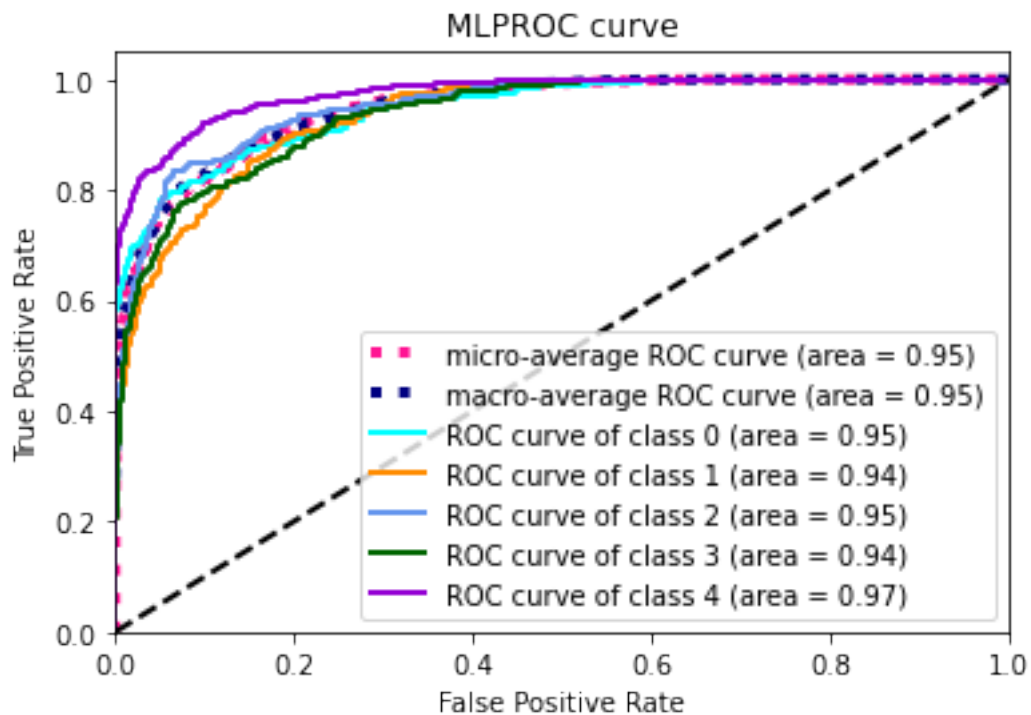
accuracy: 0.7168 - val_loss: 0.8866 - val_accuracy: 0.6800
Epoch 15/50
4689/4689 [=====] - 3s 566us/step - loss: 0.7179 -
accuracy: 0.7191 - val_loss: 0.7543 - val_accuracy: 0.6997
Epoch 16/50
4689/4689 [=====] - 3s 561us/step - loss: 0.6337 -
accuracy: 0.7569 - val_loss: 1.2529 - val_accuracy: 0.6135
Epoch 17/50
4689/4689 [=====] - 3s 565us/step - loss: 0.7594 -
accuracy: 0.7112 - val_loss: 0.8348 - val_accuracy: 0.6399
Epoch 18/50
4689/4689 [=====] - 3s 576us/step - loss: 0.6081 -
accuracy: 0.7607 - val_loss: 0.7937 - val_accuracy: 0.6980
Epoch 19/50
4689/4689 [=====] - 3s 570us/step - loss: 0.6338 -
accuracy: 0.7496 - val_loss: 0.7909 - val_accuracy: 0.6920
Epoch 20/50
4689/4689 [=====] - 3s 555us/step - loss: 0.6453 -
accuracy: 0.7415 - val_loss: 0.7640 - val_accuracy: 0.7099
Epoch 21/50
4689/4689 [=====] - 3s 566us/step - loss: 0.5915 -
accuracy: 0.7688 - val_loss: 0.8225 - val_accuracy: 0.7031
Epoch 22/50
4689/4689 [=====] - 3s 571us/step - loss: 0.6186 -
accuracy: 0.7588 - val_loss: 1.0537 - val_accuracy: 0.6561
Epoch 23/50
4689/4689 [=====] - 3s 576us/step - loss: 0.6073 -
accuracy: 0.7656 - val_loss: 0.7441 - val_accuracy: 0.7398
Epoch 24/50
4689/4689 [=====] - 3s 573us/step - loss: 0.5525 -
accuracy: 0.7835 - val_loss: 0.7261 - val_accuracy: 0.7090
Epoch 25/50
4689/4689 [=====] - 3s 584us/step - loss: 0.5144 -
accuracy: 0.8017 - val_loss: 0.8745 - val_accuracy: 0.6638
Epoch 26/50
4689/4689 [=====] - 3s 629us/step - loss: 0.5562 -
accuracy: 0.7788 - val_loss: 0.7999 - val_accuracy: 0.7099
Epoch 27/50
4689/4689 [=====] - 3s 572us/step - loss: 0.5522 -
accuracy: 0.7829 - val_loss: 1.1382 - val_accuracy: 0.6886
Epoch 28/50
4689/4689 [=====] - 3s 589us/step - loss: 0.5747 -
accuracy: 0.7855 - val_loss: 0.6948 - val_accuracy: 0.7167
Epoch 29/50
4689/4689 [=====] - 3s 627us/step - loss: 0.4657 -
accuracy: 0.8128 - val_loss: 0.7436 - val_accuracy: 0.7261
Epoch 30/50
4689/4689 [=====] - 3s 582us/step - loss: 0.5365 -

```

accuracy: 0.7878 - val_loss: 0.7911 - val_accuracy: 0.7312
Epoch 31/50
4689/4689 [=====] - 3s 570us/step - loss: 0.4699 -
accuracy: 0.8149 - val_loss: 0.7297 - val_accuracy: 0.7457
Epoch 32/50
4689/4689 [=====] - 3s 618us/step - loss: 0.4876 -
accuracy: 0.8070 - val_loss: 0.8710 - val_accuracy: 0.7176
Epoch 33/50
4689/4689 [=====] - 3s 580us/step - loss: 0.4800 -
accuracy: 0.8100 - val_loss: 0.9452 - val_accuracy: 0.6177
Epoch 34/50
4689/4689 [=====] - 3s 565us/step - loss: 0.5351 -
accuracy: 0.7912 - val_loss: 0.7583 - val_accuracy: 0.7201
Epoch 35/50
4689/4689 [=====] - 3s 566us/step - loss: 0.4464 -
accuracy: 0.8232 - val_loss: 1.0094 - val_accuracy: 0.7022
Epoch 36/50
4689/4689 [=====] - 3s 565us/step - loss: 0.4532 -
accuracy: 0.8277 - val_loss: 0.7671 - val_accuracy: 0.7304
Epoch 37/50
4689/4689 [=====] - 3s 566us/step - loss: 0.5166 -
accuracy: 0.7997 - val_loss: 0.8137 - val_accuracy: 0.7287
Epoch 38/50
4689/4689 [=====] - 3s 562us/step - loss: 0.4083 -
accuracy: 0.8379 - val_loss: 0.7561 - val_accuracy: 0.7440
Epoch 39/50
4689/4689 [=====] - 3s 564us/step - loss: 0.4704 -
accuracy: 0.8123 - val_loss: 1.1343 - val_accuracy: 0.6681
Epoch 40/50
4689/4689 [=====] - 3s 559us/step - loss: 0.4652 -
accuracy: 0.8181 - val_loss: 0.7783 - val_accuracy: 0.7500
Epoch 41/50
4689/4689 [=====] - 3s 564us/step - loss: 0.4073 -
accuracy: 0.8386 - val_loss: 0.9110 - val_accuracy: 0.7133
Epoch 42/50
4689/4689 [=====] - 3s 579us/step - loss: 0.4062 -
accuracy: 0.8439 - val_loss: 1.2937 - val_accuracy: 0.6254
Epoch 43/50
4689/4689 [=====] - 3s 569us/step - loss: 0.4456 -
accuracy: 0.8362 - val_loss: 0.9278 - val_accuracy: 0.7244
Epoch 44/50
4689/4689 [=====] - 3s 570us/step - loss: 0.3570 -
accuracy: 0.8571 - val_loss: 0.8520 - val_accuracy: 0.7338
Epoch 45/50
4689/4689 [=====] - 3s 574us/step - loss: 0.4336 -
accuracy: 0.8394 - val_loss: 0.8567 - val_accuracy: 0.7500
Epoch 46/50
4689/4689 [=====] - 3s 571us/step - loss: 0.3908 -

```

accuracy: 0.8560 - val_loss: 0.7552 - val_accuracy: 0.7585
Epoch 47/50
4689/4689 [=====] - 3s 558us/step - loss: 0.3052 -
accuracy: 0.8812 - val_loss: 1.1236 - val_accuracy: 0.7056
Epoch 48/50
4689/4689 [=====] - 3s 566us/step - loss: 0.3971 -
accuracy: 0.8422 - val_loss: 1.5165 - val_accuracy: 0.6997
Epoch 49/50
4689/4689 [=====] - 3s 575us/step - loss: 0.4624 -
accuracy: 0.8447 - val_loss: 0.7846 - val_accuracy: 0.7551
Epoch 50/50
4689/4689 [=====] - 3s 559us/step - loss: 0.3464 -
accuracy: 0.8695 - val_loss: 0.7942 - val_accuracy: 0.7543
1954/1954 [=====] - 0s 237us/step



Sequential with Kfold CV:
Training for fold 5 ...
Adding layer 1:
Adding layer 2:
Adding layer 3:
Model: "sequential_25"

Layer (type) Output Shape Param #

```

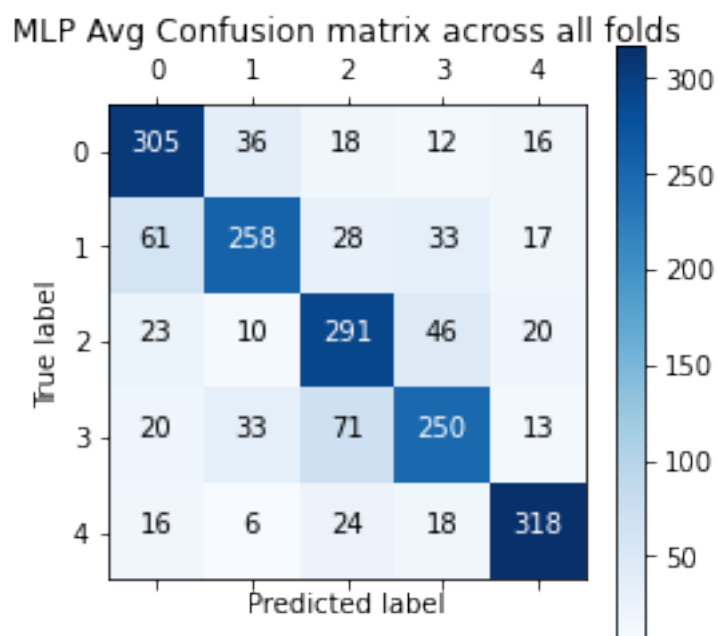
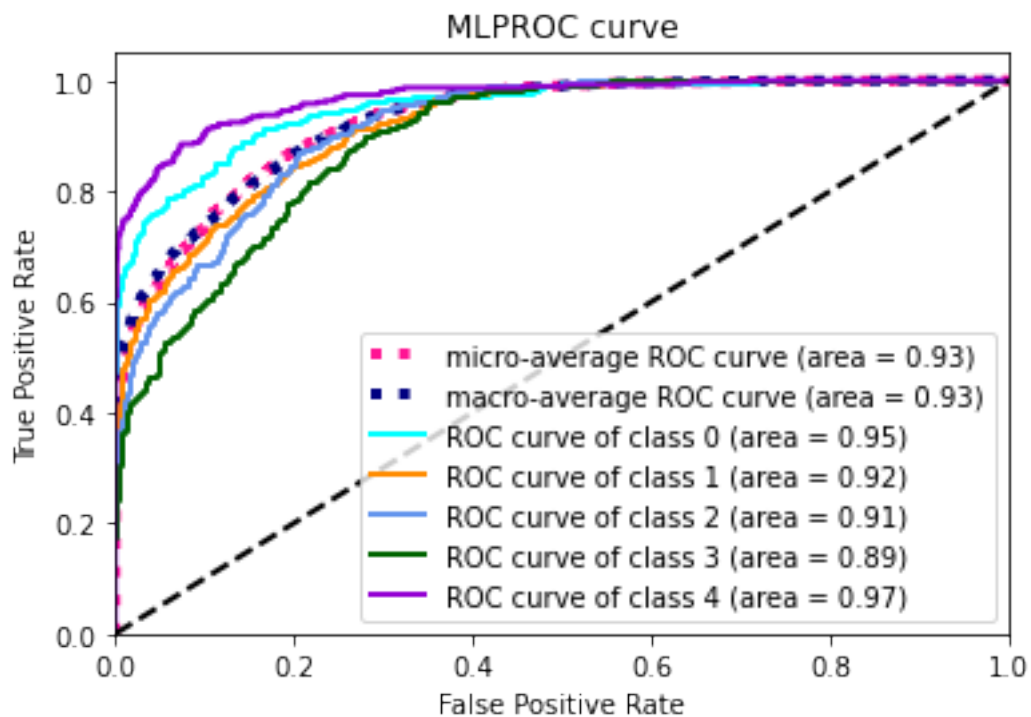
=====
dense_131 (Dense)                (None, 2176)                298112
-----
dense_132 (Dense)                (None, 1088)                2368576
-----
dropout_83 (Dropout)            (None, 1088)                0
-----
dense_133 (Dense)                (None, 544)                 592416
-----
dropout_84 (Dropout)            (None, 544)                 0
-----
dense_134 (Dense)                (None, 272)                 148240
-----
dropout_85 (Dropout)            (None, 272)                 0
-----
dense_135 (Dense)                (None, 5)                   1365
=====
Total params: 3,408,709
Trainable params: 3,408,709
Non-trainable params: 0
-----
Train on 4689 samples, validate on 1172 samples
Epoch 1/50
4689/4689 [=====] - 5s 1000us/step - loss: 2.3642 -
accuracy: 0.2322 - val_loss: 1.5982 - val_accuracy: 0.3251
Epoch 2/50
4689/4689 [=====] - 3s 588us/step - loss: 1.3677 -
accuracy: 0.4316 - val_loss: 1.6841 - val_accuracy: 0.3703
Epoch 3/50
4689/4689 [=====] - 3s 601us/step - loss: 1.1885 -
accuracy: 0.5272 - val_loss: 3.2602 - val_accuracy: 0.3840
Epoch 4/50
4689/4689 [=====] - 3s 580us/step - loss: 1.3174 -
accuracy: 0.5404 - val_loss: 1.4051 - val_accuracy: 0.4514
Epoch 5/50
4689/4689 [=====] - 3s 571us/step - loss: 1.0409 -
accuracy: 0.5907 - val_loss: 1.2064 - val_accuracy: 0.5776
Epoch 6/50
4689/4689 [=====] - 3s 567us/step - loss: 0.9549 -
accuracy: 0.6270 - val_loss: 1.0321 - val_accuracy: 0.5896
Epoch 7/50
4689/4689 [=====] - 3s 561us/step - loss: 0.8868 -
accuracy: 0.6470 - val_loss: 0.9957 - val_accuracy: 0.6237
Epoch 8/50
4689/4689 [=====] - 3s 562us/step - loss: 0.8832 -
accuracy: 0.6517 - val_loss: 0.9062 - val_accuracy: 0.6340
Epoch 9/50
4689/4689 [=====] - 3s 558us/step - loss: 0.7903 -

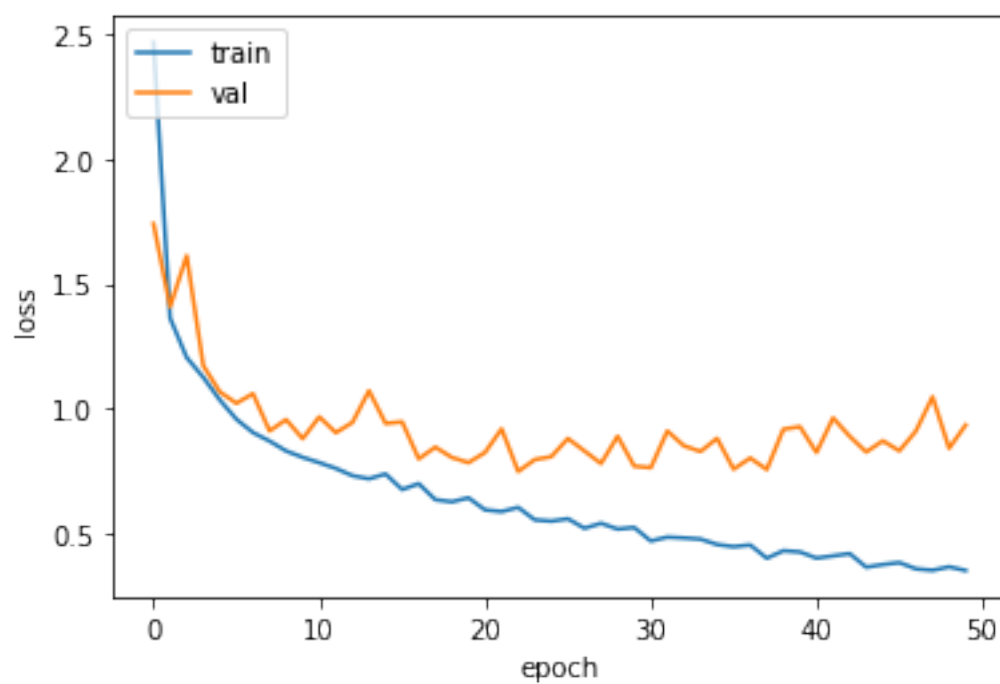
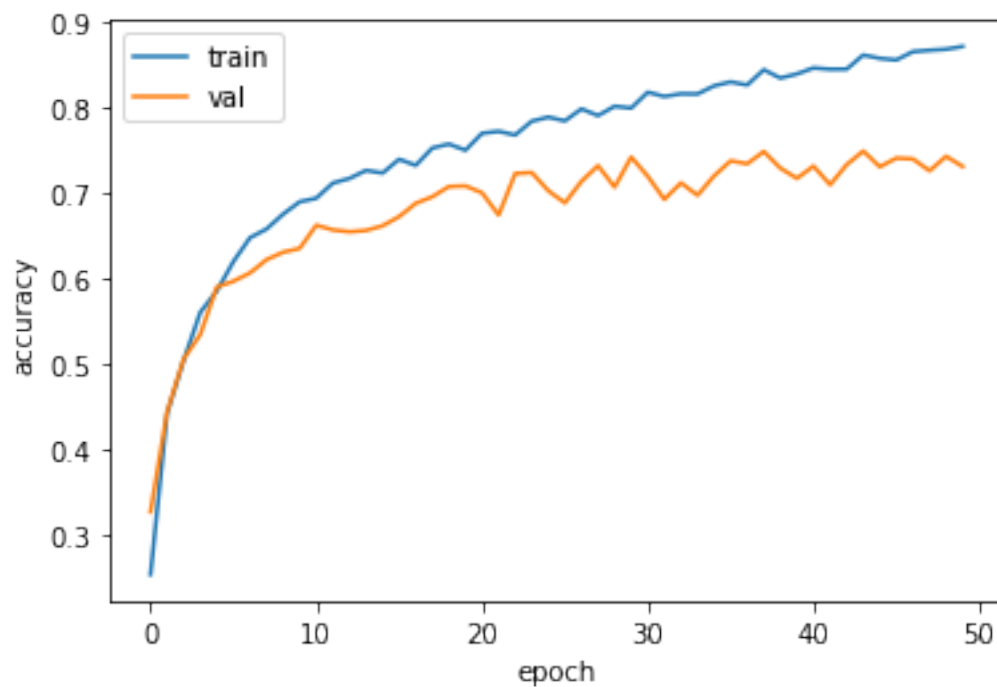
```

accuracy: 0.6897 - val_loss: 0.8547 - val_accuracy: 0.6553
 Epoch 10/50
 4689/4689 [=====] - 3s 568us/step - loss: 0.7392 -
 accuracy: 0.7140 - val_loss: 0.8292 - val_accuracy: 0.6613
 Epoch 11/50
 4689/4689 [=====] - 3s 568us/step - loss: 0.8365 -
 accuracy: 0.6709 - val_loss: 0.7966 - val_accuracy: 0.7176
 Epoch 12/50
 4689/4689 [=====] - 3s 567us/step - loss: 0.6729 -
 accuracy: 0.7413 - val_loss: 1.1107 - val_accuracy: 0.6271
 Epoch 13/50
 4689/4689 [=====] - 3s 575us/step - loss: 0.8133 -
 accuracy: 0.6914 - val_loss: 0.8463 - val_accuracy: 0.6962
 Epoch 14/50
 4689/4689 [=====] - 3s 567us/step - loss: 0.7101 -
 accuracy: 0.7279 - val_loss: 1.3926 - val_accuracy: 0.5956
 Epoch 15/50
 4689/4689 [=====] - 3s 584us/step - loss: 0.7877 -
 accuracy: 0.7125 - val_loss: 0.9539 - val_accuracy: 0.6587
 Epoch 16/50
 4689/4689 [=====] - 3s 566us/step - loss: 0.6800 -
 accuracy: 0.7394 - val_loss: 0.9164 - val_accuracy: 0.6587
 Epoch 17/50
 4689/4689 [=====] - 3s 572us/step - loss: 0.6782 -
 accuracy: 0.7306 - val_loss: 0.8129 - val_accuracy: 0.6741
 Epoch 18/50
 4689/4689 [=====] - 3s 591us/step - loss: 0.6890 -
 accuracy: 0.7300 - val_loss: 0.8027 - val_accuracy: 0.6903
 Epoch 19/50
 4689/4689 [=====] - 3s 604us/step - loss: 0.6005 -
 accuracy: 0.7628 - val_loss: 0.7694 - val_accuracy: 0.7167
 Epoch 20/50
 4689/4689 [=====] - 3s 641us/step - loss: 0.6170 -
 accuracy: 0.7573 - val_loss: 0.6772 - val_accuracy: 0.7321
 Epoch 21/50
 4689/4689 [=====] - 3s 598us/step - loss: 0.6114 -
 accuracy: 0.7686 - val_loss: 0.9144 - val_accuracy: 0.6544
 Epoch 22/50
 4689/4689 [=====] - 3s 601us/step - loss: 0.5969 -
 accuracy: 0.7637 - val_loss: 0.8901 - val_accuracy: 0.7142
 Epoch 23/50
 4689/4689 [=====] - 3s 599us/step - loss: 0.6653 -
 accuracy: 0.7473 - val_loss: 0.7106 - val_accuracy: 0.7253
 Epoch 24/50
 4689/4689 [=====] - 3s 591us/step - loss: 0.5481 -
 accuracy: 0.7872 - val_loss: 0.9068 - val_accuracy: 0.6980
 Epoch 25/50
 4689/4689 [=====] - 3s 601us/step - loss: 0.5681 -

accuracy: 0.7748 - val_loss: 0.7723 - val_accuracy: 0.7201
Epoch 26/50
4689/4689 [=====] - 3s 589us/step - loss: 0.5832 -
accuracy: 0.7771 - val_loss: 0.7964 - val_accuracy: 0.7167
Epoch 27/50
4689/4689 [=====] - 3s 590us/step - loss: 0.5319 -
accuracy: 0.7869 - val_loss: 0.8057 - val_accuracy: 0.6758
Epoch 28/50
4689/4689 [=====] - 3s 590us/step - loss: 0.5728 -
accuracy: 0.7776 - val_loss: 0.8360 - val_accuracy: 0.7415
Epoch 29/50
4689/4689 [=====] - 3s 600us/step - loss: 0.5257 -
accuracy: 0.7968 - val_loss: 0.9540 - val_accuracy: 0.7176
Epoch 30/50
4689/4689 [=====] - 3s 592us/step - loss: 0.5255 -
accuracy: 0.8021 - val_loss: 0.9349 - val_accuracy: 0.7193
Epoch 31/50
4689/4689 [=====] - 3s 567us/step - loss: 0.5248 -
accuracy: 0.8006 - val_loss: 0.8338 - val_accuracy: 0.6766
Epoch 32/50
4689/4689 [=====] - 3s 563us/step - loss: 0.4859 -
accuracy: 0.8121 - val_loss: 0.7777 - val_accuracy: 0.7389
Epoch 33/50
4689/4689 [=====] - 3s 574us/step - loss: 0.4814 -
accuracy: 0.8155 - val_loss: 0.7150 - val_accuracy: 0.7244
Epoch 34/50
4689/4689 [=====] - 3s 570us/step - loss: 0.4571 -
accuracy: 0.8160 - val_loss: 0.7497 - val_accuracy: 0.7056
Epoch 35/50
4689/4689 [=====] - 3s 581us/step - loss: 0.5438 -
accuracy: 0.7995 - val_loss: 0.7096 - val_accuracy: 0.7312
Epoch 36/50
4689/4689 [=====] - 3s 570us/step - loss: 0.4197 -
accuracy: 0.8433 - val_loss: 0.6907 - val_accuracy: 0.7662
Epoch 37/50
4689/4689 [=====] - 3s 581us/step - loss: 0.4433 -
accuracy: 0.8302 - val_loss: 0.9756 - val_accuracy: 0.7133
Epoch 38/50
4689/4689 [=====] - 3s 565us/step - loss: 0.4179 -
accuracy: 0.8364 - val_loss: 0.7898 - val_accuracy: 0.7457
Epoch 39/50
4689/4689 [=====] - 3s 566us/step - loss: 0.4244 -
accuracy: 0.8430 - val_loss: 0.8364 - val_accuracy: 0.7474
Epoch 40/50
4689/4689 [=====] - 3s 570us/step - loss: 0.4458 -
accuracy: 0.8360 - val_loss: 0.9183 - val_accuracy: 0.6698
Epoch 41/50
4689/4689 [=====] - 3s 569us/step - loss: 0.4073 -

accuracy: 0.8467 - val_loss: 0.9958 - val_accuracy: 0.6980
Epoch 42/50
4689/4689 [=====] - 3s 564us/step - loss: 0.4455 -
accuracy: 0.8339 - val_loss: 1.0579 - val_accuracy: 0.6928
Epoch 43/50
4689/4689 [=====] - 3s 565us/step - loss: 0.4325 -
accuracy: 0.8379 - val_loss: 0.8423 - val_accuracy: 0.7381
Epoch 44/50
4689/4689 [=====] - 3s 573us/step - loss: 0.3437 -
accuracy: 0.8686 - val_loss: 0.9433 - val_accuracy: 0.7398
Epoch 45/50
4689/4689 [=====] - 3s 563us/step - loss: 0.3873 -
accuracy: 0.8537 - val_loss: 0.7895 - val_accuracy: 0.7457
Epoch 46/50
4689/4689 [=====] - 3s 559us/step - loss: 0.3210 -
accuracy: 0.8763 - val_loss: 0.8810 - val_accuracy: 0.7253
Epoch 47/50
4689/4689 [=====] - 3s 564us/step - loss: 0.3691 -
accuracy: 0.8567 - val_loss: 0.9169 - val_accuracy: 0.7270
Epoch 48/50
4689/4689 [=====] - 3s 589us/step - loss: 0.3552 -
accuracy: 0.8631 - val_loss: 0.8885 - val_accuracy: 0.7637
Epoch 49/50
4689/4689 [=====] - 3s 567us/step - loss: 0.3221 -
accuracy: 0.8731 - val_loss: 0.7822 - val_accuracy: 0.7543
Epoch 50/50
4689/4689 [=====] - 3s 566us/step - loss: 0.3173 -
accuracy: 0.8795 - val_loss: 0.8623 - val_accuracy: 0.7073
1954/1954 [=====] - 1s 266us/step





Average scores for pseudo test set across all folds:
> Accuracy: 0.7290685892105102 (+- 0.03517560582029268)

```
> Loss: 0.9378791475491244
> Avg runtime per test instance: 0.0009290013611011642
```

```
#####
```

```
#####
```

```
Sequential with Kfold CV:
```

```
Training for fold 1 ...
```

```
Adding layer 1:
```

```
Adding layer 2:
```

```
Adding layer 3:
```

```
Adding layer 4:
```

```
Model: "sequential_26"
```

Layer (type)	Output Shape	Param #
dense_136 (Dense)	(None, 4352)	596224
dense_137 (Dense)	(None, 2176)	9472128
dropout_86 (Dropout)	(None, 2176)	0
dense_138 (Dense)	(None, 1088)	2368576
dropout_87 (Dropout)	(None, 1088)	0
dense_139 (Dense)	(None, 544)	592416
dropout_88 (Dropout)	(None, 544)	0
dense_140 (Dense)	(None, 272)	148240
dropout_89 (Dropout)	(None, 272)	0
dense_141 (Dense)	(None, 5)	1365

```
Total params: 13,178,949
```

```
Trainable params: 13,178,949
```

```
Non-trainable params: 0
```

```
Train on 4688 samples, validate on 1173 samples
```

```
Epoch 1/50
```

```
4688/4688 [=====] - 11s 2ms/step - loss: 4.3250 -
```

```
accuracy: 0.2080 - val_loss: 1.6381 - val_accuracy: 0.1927
```

```
Epoch 2/50
```

```
4688/4688 [=====] - 8s 2ms/step - loss: 1.6570 -
```

```
accuracy: 0.2261 - val_loss: 1.5656 - val_accuracy: 0.2361
```

Epoch 3/50
4688/4688 [=====] - 8s 2ms/step - loss: 1.5505 -
accuracy: 0.3140 - val_loss: 1.2868 - val_accuracy: 0.4808

Epoch 4/50
4688/4688 [=====] - 8s 2ms/step - loss: 1.3801 -
accuracy: 0.4230 - val_loss: 1.2946 - val_accuracy: 0.4425

Epoch 5/50
4688/4688 [=====] - 8s 2ms/step - loss: 1.2720 -
accuracy: 0.4723 - val_loss: 1.1768 - val_accuracy: 0.5115

Epoch 6/50
4688/4688 [=====] - 8s 2ms/step - loss: 1.1505 -
accuracy: 0.5109 - val_loss: 1.0828 - val_accuracy: 0.5507

Epoch 7/50
4688/4688 [=====] - 8s 2ms/step - loss: 1.1253 -
accuracy: 0.5482 - val_loss: 1.0192 - val_accuracy: 0.6206

Epoch 8/50
4688/4688 [=====] - 8s 2ms/step - loss: 1.0036 -
accuracy: 0.5872 - val_loss: 0.9291 - val_accuracy: 0.6300

Epoch 9/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.9915 -
accuracy: 0.6094 - val_loss: 0.8415 - val_accuracy: 0.6684

Epoch 10/50
4688/4688 [=====] - 8s 2ms/step - loss: 1.0096 -
accuracy: 0.6067 - val_loss: 0.8176 - val_accuracy: 0.6931

Epoch 11/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.9224 -
accuracy: 0.6416 - val_loss: 0.7930 - val_accuracy: 0.7059

Epoch 12/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.8431 -
accuracy: 0.6734 - val_loss: 0.9875 - val_accuracy: 0.6309

Epoch 13/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.8366 -
accuracy: 0.6811 - val_loss: 0.8496 - val_accuracy: 0.6777

Epoch 14/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.7750 -
accuracy: 0.7003 - val_loss: 0.8860 - val_accuracy: 0.6462

Epoch 15/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.8505 -
accuracy: 0.6736 - val_loss: 1.0178 - val_accuracy: 0.6198

Epoch 16/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.7384 -
accuracy: 0.7216 - val_loss: 0.9540 - val_accuracy: 0.6684

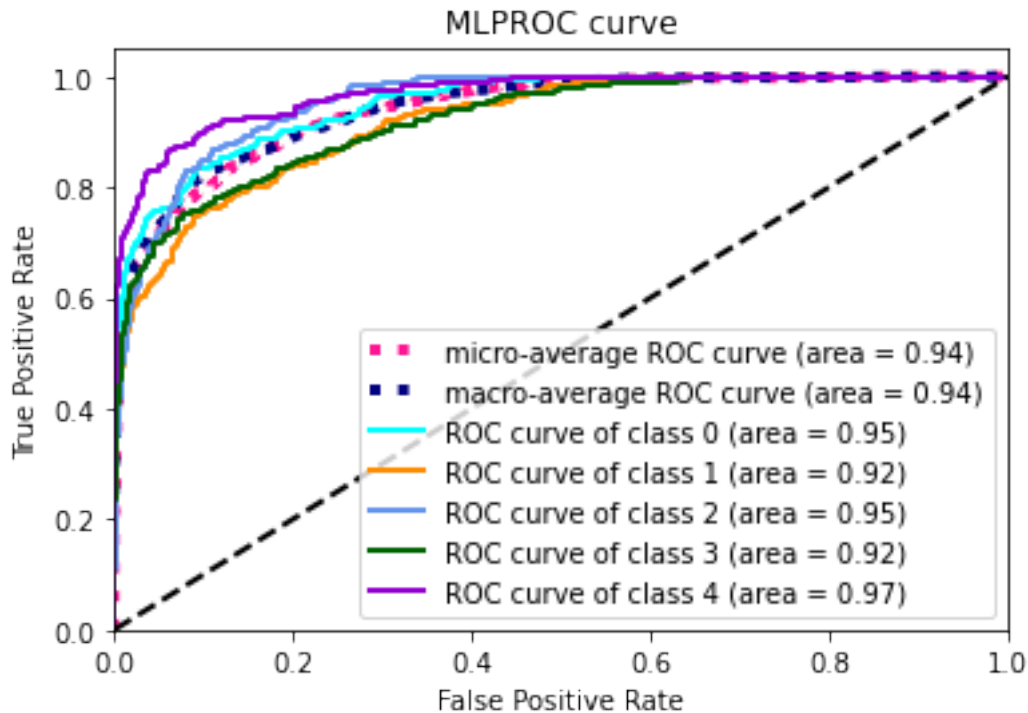
Epoch 17/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.8062 -
accuracy: 0.6962 - val_loss: 0.7126 - val_accuracy: 0.7400

Epoch 18/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.7250 -
accuracy: 0.7229 - val_loss: 0.7854 - val_accuracy: 0.6965

Epoch 19/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.7328 -
accuracy: 0.7186 - val_loss: 0.6936 - val_accuracy: 0.7425
Epoch 20/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.6463 -
accuracy: 0.7651 - val_loss: 0.8724 - val_accuracy: 0.6684
Epoch 21/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.7168 -
accuracy: 0.7186 - val_loss: 0.8075 - val_accuracy: 0.7093
Epoch 22/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.7039 -
accuracy: 0.7351 - val_loss: 0.7483 - val_accuracy: 0.7400
Epoch 23/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.6396 -
accuracy: 0.7541 - val_loss: 0.8198 - val_accuracy: 0.7263
Epoch 24/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.7021 -
accuracy: 0.7363 - val_loss: 0.6572 - val_accuracy: 0.7613
Epoch 25/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.6067 -
accuracy: 0.7692 - val_loss: 0.7760 - val_accuracy: 0.7357
Epoch 26/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5930 -
accuracy: 0.7722 - val_loss: 0.7308 - val_accuracy: 0.7417
Epoch 27/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.7106 -
accuracy: 0.7385 - val_loss: 0.6560 - val_accuracy: 0.7562
Epoch 28/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5734 -
accuracy: 0.7867 - val_loss: 0.8840 - val_accuracy: 0.6641
Epoch 29/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.6168 -
accuracy: 0.7632 - val_loss: 0.7125 - val_accuracy: 0.7519
Epoch 30/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5917 -
accuracy: 0.7818 - val_loss: 0.7746 - val_accuracy: 0.7059
Epoch 31/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5694 -
accuracy: 0.7873 - val_loss: 0.6795 - val_accuracy: 0.7681
Epoch 32/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5435 -
accuracy: 0.7929 - val_loss: 0.6806 - val_accuracy: 0.7579
Epoch 33/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5240 -
accuracy: 0.7952 - val_loss: 0.8198 - val_accuracy: 0.7050
Epoch 34/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5905 -
accuracy: 0.7750 - val_loss: 0.7037 - val_accuracy: 0.7511

Epoch 35/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5459 -
accuracy: 0.7863 - val_loss: 0.8252 - val_accuracy: 0.7366
Epoch 36/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5030 -
accuracy: 0.8108 - val_loss: 0.7484 - val_accuracy: 0.7442
Epoch 37/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.4883 -
accuracy: 0.8095 - val_loss: 0.9270 - val_accuracy: 0.7008
Epoch 38/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5209 -
accuracy: 0.8031 - val_loss: 0.7708 - val_accuracy: 0.7280
Epoch 39/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.4824 -
accuracy: 0.8110 - val_loss: 0.7021 - val_accuracy: 0.7673
Epoch 40/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.4682 -
accuracy: 0.8234 - val_loss: 0.8232 - val_accuracy: 0.7323
Epoch 41/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5158 -
accuracy: 0.8035 - val_loss: 0.7145 - val_accuracy: 0.7621
Epoch 42/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.4323 -
accuracy: 0.8370 - val_loss: 0.7317 - val_accuracy: 0.7664
Epoch 43/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.4860 -
accuracy: 0.8187 - val_loss: 0.9048 - val_accuracy: 0.7059
Epoch 44/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.4652 -
accuracy: 0.8232 - val_loss: 0.7772 - val_accuracy: 0.7656
Epoch 45/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.5028 -
accuracy: 0.8091 - val_loss: 0.7145 - val_accuracy: 0.7818
Epoch 46/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.3957 -
accuracy: 0.8560 - val_loss: 0.8852 - val_accuracy: 0.7204
Epoch 47/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.4050 -
accuracy: 0.8419 - val_loss: 0.7729 - val_accuracy: 0.7562
Epoch 48/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.4341 -
accuracy: 0.8381 - val_loss: 0.9681 - val_accuracy: 0.7008
Epoch 49/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.4138 -
accuracy: 0.8362 - val_loss: 0.8110 - val_accuracy: 0.7587
Epoch 50/50
4688/4688 [=====] - 8s 2ms/step - loss: 0.4519 -
accuracy: 0.8232 - val_loss: 0.7668 - val_accuracy: 0.7468

1954/1954 [=====] - 1s 641us/step



Sequential with Kfold CV:

Training for fold 2 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_27"

Layer (type)	Output Shape	Param #
=====		
dense_142 (Dense)	(None, 4352)	596224

dense_143 (Dense)	(None, 2176)	9472128

dropout_90 (Dropout)	(None, 2176)	0

dense_144 (Dense)	(None, 1088)	2368576

dropout_91 (Dropout)	(None, 1088)	0

dense_145 (Dense)	(None, 544)	592416


```

-----
dropout_92 (Dropout)          (None, 544)          0
-----
dense_146 (Dense)             (None, 272)         148240
-----
dropout_93 (Dropout)          (None, 272)          0
-----
dense_147 (Dense)             (None, 5)            1365
=====
Total params: 13,178,949
Trainable params: 13,178,949
Non-trainable params: 0
-----
Train on 4689 samples, validate on 1172 samples
Epoch 1/50
4689/4689 [=====] - 11s 2ms/step - loss: 4.0237 -
accuracy: 0.2103 - val_loss: 2.0487 - val_accuracy: 0.2005
Epoch 2/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.7188 -
accuracy: 0.2190 - val_loss: 2.0395 - val_accuracy: 0.2014
Epoch 3/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.6763 -
accuracy: 0.2563 - val_loss: 2.3217 - val_accuracy: 0.2005
Epoch 4/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.6178 -
accuracy: 0.3137 - val_loss: 2.3415 - val_accuracy: 0.3379
Epoch 5/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.4634 -
accuracy: 0.4182 - val_loss: 1.4950 - val_accuracy: 0.4206
Epoch 6/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.1945 -
accuracy: 0.4907 - val_loss: 1.3545 - val_accuracy: 0.4778
Epoch 7/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.1283 -
accuracy: 0.5285 - val_loss: 2.1440 - val_accuracy: 0.3814
Epoch 8/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.2197 -
accuracy: 0.5451 - val_loss: 1.3135 - val_accuracy: 0.5034
Epoch 9/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.0666 -
accuracy: 0.5841 - val_loss: 0.9585 - val_accuracy: 0.6314
Epoch 10/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.0192 -
accuracy: 0.5865 - val_loss: 1.2158 - val_accuracy: 0.5811
Epoch 11/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.0091 -
accuracy: 0.5984 - val_loss: 1.4115 - val_accuracy: 0.6169
Epoch 12/50

```

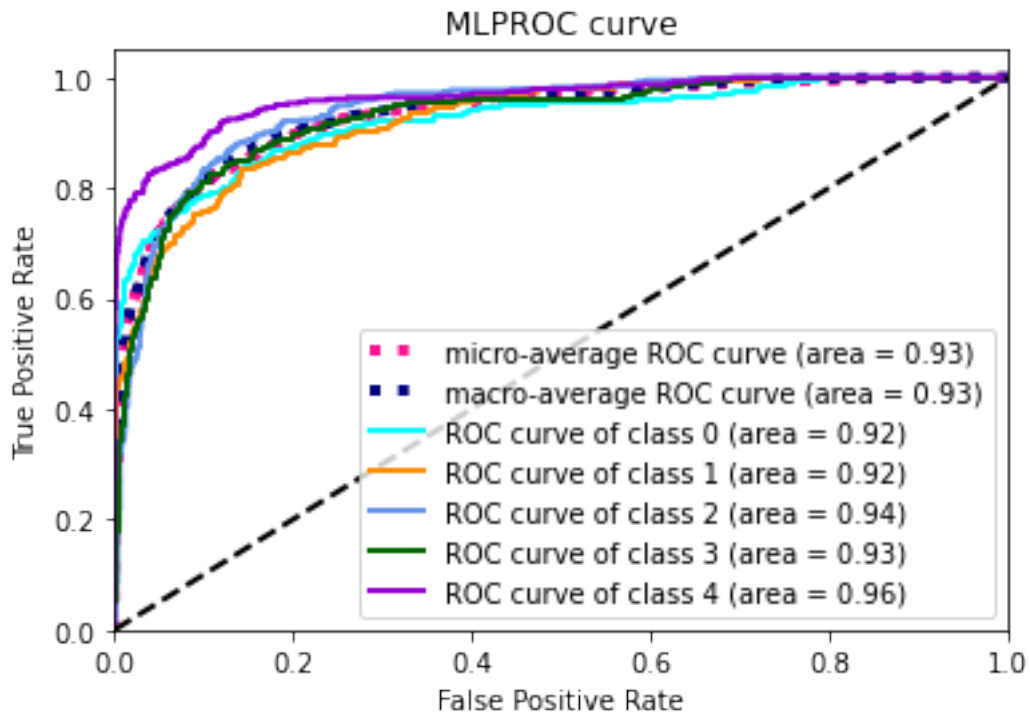
4689/4689 [=====] - 8s 2ms/step - loss: 0.9830 - accuracy: 0.6298 - val_loss: 1.7074 - val_accuracy: 0.5265
Epoch 13/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.9878 - accuracy: 0.6351 - val_loss: 1.1789 - val_accuracy: 0.5111
Epoch 14/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.9125 - accuracy: 0.6485 - val_loss: 0.9778 - val_accuracy: 0.6706
Epoch 15/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8228 - accuracy: 0.7016 - val_loss: 1.1151 - val_accuracy: 0.5939
Epoch 16/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8526 - accuracy: 0.6588 - val_loss: 1.1300 - val_accuracy: 0.5717
Epoch 17/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8317 - accuracy: 0.6940 - val_loss: 0.9140 - val_accuracy: 0.6340
Epoch 18/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7947 - accuracy: 0.6989 - val_loss: 0.8501 - val_accuracy: 0.6749
Epoch 19/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8151 - accuracy: 0.6844 - val_loss: 1.0098 - val_accuracy: 0.6195
Epoch 20/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7334 - accuracy: 0.7187 - val_loss: 1.0968 - val_accuracy: 0.6578
Epoch 21/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7978 - accuracy: 0.7016 - val_loss: 0.9364 - val_accuracy: 0.6664
Epoch 22/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7162 - accuracy: 0.7270 - val_loss: 0.9176 - val_accuracy: 0.6493
Epoch 23/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8106 - accuracy: 0.6933 - val_loss: 0.9856 - val_accuracy: 0.6510
Epoch 24/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7663 - accuracy: 0.7095 - val_loss: 1.1486 - val_accuracy: 0.6553
Epoch 25/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7592 - accuracy: 0.7189 - val_loss: 1.0055 - val_accuracy: 0.6101
Epoch 26/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7202 - accuracy: 0.7281 - val_loss: 0.8178 - val_accuracy: 0.6997
Epoch 27/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6462 - accuracy: 0.7573 - val_loss: 0.7484 - val_accuracy: 0.7235
Epoch 28/50

4689/4689 [=====] - 8s 2ms/step - loss: 0.6734 - accuracy: 0.7537 - val_loss: 0.8239 - val_accuracy: 0.7082
Epoch 29/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7149 - accuracy: 0.7334 - val_loss: 1.0383 - val_accuracy: 0.6254
Epoch 30/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6406 - accuracy: 0.7579 - val_loss: 1.1286 - val_accuracy: 0.6203
Epoch 31/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7253 - accuracy: 0.7298 - val_loss: 1.1251 - val_accuracy: 0.6254
Epoch 32/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6666 - accuracy: 0.7633 - val_loss: 0.8580 - val_accuracy: 0.6894
Epoch 33/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6398 - accuracy: 0.7646 - val_loss: 0.6853 - val_accuracy: 0.7346
Epoch 34/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5581 - accuracy: 0.7899 - val_loss: 1.0711 - val_accuracy: 0.6101
Epoch 35/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6727 - accuracy: 0.7498 - val_loss: 0.8397 - val_accuracy: 0.6962
Epoch 36/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6281 - accuracy: 0.7695 - val_loss: 0.7886 - val_accuracy: 0.7125
Epoch 37/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6073 - accuracy: 0.7759 - val_loss: 0.7944 - val_accuracy: 0.7022
Epoch 38/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5855 - accuracy: 0.7801 - val_loss: 0.9283 - val_accuracy: 0.7065
Epoch 39/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5844 - accuracy: 0.7778 - val_loss: 0.9900 - val_accuracy: 0.7116
Epoch 40/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5675 - accuracy: 0.7863 - val_loss: 1.0926 - val_accuracy: 0.6689
Epoch 41/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6561 - accuracy: 0.7639 - val_loss: 0.7815 - val_accuracy: 0.7201
Epoch 42/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5367 - accuracy: 0.8019 - val_loss: 1.3795 - val_accuracy: 0.6237
Epoch 43/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6566 - accuracy: 0.7626 - val_loss: 0.8611 - val_accuracy: 0.7108
Epoch 44/50

```

4689/4689 [=====] - 8s 2ms/step - loss: 0.5751 -
accuracy: 0.7831 - val_loss: 0.8333 - val_accuracy: 0.7048
Epoch 45/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5836 -
accuracy: 0.7720 - val_loss: 0.8343 - val_accuracy: 0.7090
Epoch 46/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5336 -
accuracy: 0.7919 - val_loss: 0.7028 - val_accuracy: 0.7628
Epoch 47/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5552 -
accuracy: 0.7893 - val_loss: 0.7527 - val_accuracy: 0.7466
Epoch 48/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5359 -
accuracy: 0.7961 - val_loss: 0.9366 - val_accuracy: 0.7039
Epoch 49/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5247 -
accuracy: 0.8049 - val_loss: 0.9575 - val_accuracy: 0.7099
Epoch 50/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5140 -
accuracy: 0.8025 - val_loss: 1.0556 - val_accuracy: 0.7218
1954/1954 [=====] - 1s 633us/step

```



Sequential with Kfold CV:

Training for fold 3 ...
 Adding layer 1:
 Adding layer 2:
 Adding layer 3:
 Adding layer 4:
 Model: "sequential_28"

Layer (type)	Output Shape	Param #
dense_148 (Dense)	(None, 4352)	596224
dense_149 (Dense)	(None, 2176)	9472128
dropout_94 (Dropout)	(None, 2176)	0
dense_150 (Dense)	(None, 1088)	2368576
dropout_95 (Dropout)	(None, 1088)	0
dense_151 (Dense)	(None, 544)	592416
dropout_96 (Dropout)	(None, 544)	0
dense_152 (Dense)	(None, 272)	148240
dropout_97 (Dropout)	(None, 272)	0
dense_153 (Dense)	(None, 5)	1365

Total params: 13,178,949
 Trainable params: 13,178,949
 Non-trainable params: 0

Train on 4689 samples, validate on 1172 samples
 Epoch 1/50
 4689/4689 [=====] - 11s 2ms/step - loss: 3.8730 - accuracy: 0.2054 - val_loss: 2.3876 - val_accuracy: 0.1971
 Epoch 2/50
 4689/4689 [=====] - 8s 2ms/step - loss: 1.7506 - accuracy: 0.2378 - val_loss: 2.6762 - val_accuracy: 0.2184
 Epoch 3/50
 4689/4689 [=====] - 8s 2ms/step - loss: 1.6635 - accuracy: 0.3210 - val_loss: 2.7767 - val_accuracy: 0.1988
 Epoch 4/50
 4689/4689 [=====] - 8s 2ms/step - loss: 1.6333 - accuracy: 0.3312 - val_loss: 1.6755 - val_accuracy: 0.2210
 Epoch 5/50
 4689/4689 [=====] - 8s 2ms/step - loss: 1.2763 -

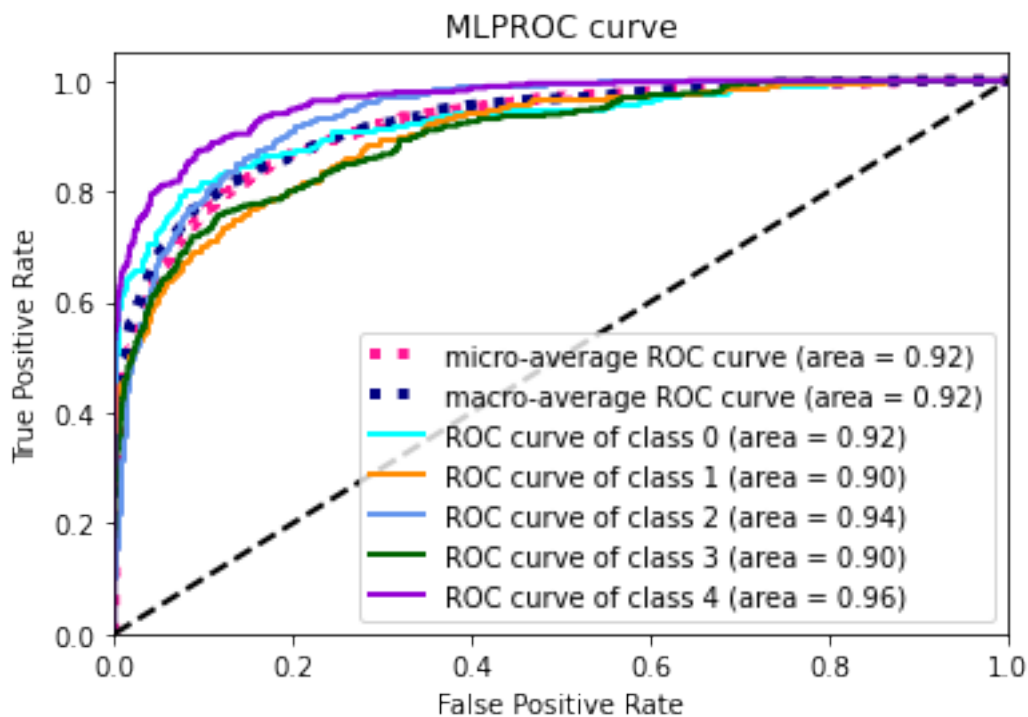
accuracy: 0.4557 - val_loss: 1.3432 - val_accuracy: 0.3515
 Epoch 6/50
 4689/4689 [=====] - 8s 2ms/step - loss: 1.2552 -
 accuracy: 0.4715 - val_loss: 1.5296 - val_accuracy: 0.5324
 Epoch 7/50
 4689/4689 [=====] - 8s 2ms/step - loss: 1.2047 -
 accuracy: 0.5146 - val_loss: 1.5151 - val_accuracy: 0.4343
 Epoch 8/50
 4689/4689 [=====] - 8s 2ms/step - loss: 1.1778 -
 accuracy: 0.5187 - val_loss: 1.2024 - val_accuracy: 0.5128
 Epoch 9/50
 4689/4689 [=====] - 8s 2ms/step - loss: 1.0935 -
 accuracy: 0.5545 - val_loss: 1.2547 - val_accuracy: 0.4386
 Epoch 10/50
 4689/4689 [=====] - 8s 2ms/step - loss: 1.0704 -
 accuracy: 0.5528 - val_loss: 1.5536 - val_accuracy: 0.4863
 Epoch 11/50
 4689/4689 [=====] - 8s 2ms/step - loss: 1.0763 -
 accuracy: 0.5760 - val_loss: 1.0940 - val_accuracy: 0.5469
 Epoch 12/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.9794 -
 accuracy: 0.6102 - val_loss: 1.0362 - val_accuracy: 0.5333
 Epoch 13/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.9789 -
 accuracy: 0.6082 - val_loss: 1.0005 - val_accuracy: 0.6425
 Epoch 14/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.9705 -
 accuracy: 0.6238 - val_loss: 0.9790 - val_accuracy: 0.6015
 Epoch 15/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.8453 -
 accuracy: 0.6773 - val_loss: 1.1148 - val_accuracy: 0.5563
 Epoch 16/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.8860 -
 accuracy: 0.6520 - val_loss: 1.1445 - val_accuracy: 0.6246
 Epoch 17/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.8761 -
 accuracy: 0.6665 - val_loss: 0.8444 - val_accuracy: 0.6664
 Epoch 18/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.8456 -
 accuracy: 0.6801 - val_loss: 1.1690 - val_accuracy: 0.5145
 Epoch 19/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.8256 -
 accuracy: 0.6831 - val_loss: 0.8050 - val_accuracy: 0.6988
 Epoch 20/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.7852 -
 accuracy: 0.6957 - val_loss: 0.9902 - val_accuracy: 0.6109
 Epoch 21/50
 4689/4689 [=====] - 9s 2ms/step - loss: 0.7514 -

accuracy: 0.7123 - val_loss: 0.8125 - val_accuracy: 0.7014
Epoch 22/50
4689/4689 [=====] - 9s 2ms/step - loss: 0.7643 -
accuracy: 0.7127 - val_loss: 1.3133 - val_accuracy: 0.6152
Epoch 23/50
4689/4689 [=====] - 9s 2ms/step - loss: 0.8787 -
accuracy: 0.6884 - val_loss: 1.0505 - val_accuracy: 0.6485
Epoch 24/50
4689/4689 [=====] - 9s 2ms/step - loss: 0.7433 -
accuracy: 0.7208 - val_loss: 1.0683 - val_accuracy: 0.6340
Epoch 25/50
4689/4689 [=====] - 9s 2ms/step - loss: 0.7404 -
accuracy: 0.7245 - val_loss: 1.2188 - val_accuracy: 0.5759
Epoch 26/50
4689/4689 [=====] - 9s 2ms/step - loss: 0.7299 -
accuracy: 0.7287 - val_loss: 0.9219 - val_accuracy: 0.6706
Epoch 27/50
4689/4689 [=====] - 9s 2ms/step - loss: 0.6756 -
accuracy: 0.7430 - val_loss: 0.8099 - val_accuracy: 0.6903
Epoch 28/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6455 -
accuracy: 0.7496 - val_loss: 0.8854 - val_accuracy: 0.7176
Epoch 29/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7017 -
accuracy: 0.7317 - val_loss: 0.8890 - val_accuracy: 0.6613
Epoch 30/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6907 -
accuracy: 0.7351 - val_loss: 0.6914 - val_accuracy: 0.7440
Epoch 31/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6061 -
accuracy: 0.7731 - val_loss: 0.7483 - val_accuracy: 0.7218
Epoch 32/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6475 -
accuracy: 0.7575 - val_loss: 0.8727 - val_accuracy: 0.6928
Epoch 33/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6492 -
accuracy: 0.7592 - val_loss: 1.3000 - val_accuracy: 0.5768
Epoch 34/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7103 -
accuracy: 0.7334 - val_loss: 1.0099 - val_accuracy: 0.6519
Epoch 35/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6558 -
accuracy: 0.7520 - val_loss: 1.2856 - val_accuracy: 0.6032
Epoch 36/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6722 -
accuracy: 0.7462 - val_loss: 0.6993 - val_accuracy: 0.7389
Epoch 37/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5919 -

```

accuracy: 0.7746 - val_loss: 0.7120 - val_accuracy: 0.7398
Epoch 38/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6239 -
accuracy: 0.7607 - val_loss: 1.1380 - val_accuracy: 0.6246
Epoch 39/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7002 -
accuracy: 0.7364 - val_loss: 0.8770 - val_accuracy: 0.7005
Epoch 40/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6310 -
accuracy: 0.7592 - val_loss: 0.8037 - val_accuracy: 0.7167
Epoch 41/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5880 -
accuracy: 0.7754 - val_loss: 1.0212 - val_accuracy: 0.6758
Epoch 42/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6465 -
accuracy: 0.7550 - val_loss: 0.6764 - val_accuracy: 0.7406
Epoch 43/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5984 -
accuracy: 0.7735 - val_loss: 0.7936 - val_accuracy: 0.6988
Epoch 44/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6386 -
accuracy: 0.7603 - val_loss: 0.8009 - val_accuracy: 0.6920
Epoch 45/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5661 -
accuracy: 0.7835 - val_loss: 0.8133 - val_accuracy: 0.7082
Epoch 46/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6224 -
accuracy: 0.7639 - val_loss: 0.9571 - val_accuracy: 0.6664
Epoch 47/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5703 -
accuracy: 0.7857 - val_loss: 0.9087 - val_accuracy: 0.7125
Epoch 48/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5491 -
accuracy: 0.7897 - val_loss: 0.6590 - val_accuracy: 0.7696
Epoch 49/50
4689/4689 [=====] - 9s 2ms/step - loss: 0.4987 -
accuracy: 0.8085 - val_loss: 0.9966 - val_accuracy: 0.7022
Epoch 50/50
4689/4689 [=====] - 9s 2ms/step - loss: 0.5503 -
accuracy: 0.7904 - val_loss: 1.0950 - val_accuracy: 0.7099
1954/1954 [=====] - 1s 701us/step

```

Sequential with Kfold CV:

Training for fold 4 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_29"

Layer (type)	Output Shape	Param #
dense_154 (Dense)	(None, 4352)	596224
dense_155 (Dense)	(None, 2176)	9472128
dropout_98 (Dropout)	(None, 2176)	0
dense_156 (Dense)	(None, 1088)	2368576
dropout_99 (Dropout)	(None, 1088)	0
dense_157 (Dense)	(None, 544)	592416
dropout_100 (Dropout)	(None, 544)	0

```

-----
dense_158 (Dense)                (None, 272)                148240
-----
dropout_101 (Dropout)            (None, 272)                0
-----
dense_159 (Dense)                (None, 5)                  1365
=====
Total params: 13,178,949
Trainable params: 13,178,949
Non-trainable params: 0
-----
Train on 4689 samples, validate on 1172 samples
Epoch 1/50
4689/4689 [=====] - 12s 3ms/step - loss: 4.3956 -
accuracy: 0.2024 - val_loss: 2.0463 - val_accuracy: 0.2048
Epoch 2/50
4689/4689 [=====] - 9s 2ms/step - loss: 1.7143 -
accuracy: 0.2273 - val_loss: 2.0997 - val_accuracy: 0.1724
Epoch 3/50
4689/4689 [=====] - 9s 2ms/step - loss: 1.6132 -
accuracy: 0.2917 - val_loss: 1.8044 - val_accuracy: 0.3379
Epoch 4/50
4689/4689 [=====] - 9s 2ms/step - loss: 1.4868 -
accuracy: 0.3764 - val_loss: 1.1498 - val_accuracy: 0.5614
Epoch 5/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.2817 -
accuracy: 0.4519 - val_loss: 1.3095 - val_accuracy: 0.4130
Epoch 6/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.2329 -
accuracy: 0.4803 - val_loss: 1.3498 - val_accuracy: 0.4727
Epoch 7/50
4689/4689 [=====] - 9s 2ms/step - loss: 1.1466 -
accuracy: 0.5231 - val_loss: 1.1543 - val_accuracy: 0.5427
Epoch 8/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.0974 -
accuracy: 0.5408 - val_loss: 1.0557 - val_accuracy: 0.5657
Epoch 9/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.0742 -
accuracy: 0.5654 - val_loss: 1.4051 - val_accuracy: 0.4676
Epoch 10/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.1015 -
accuracy: 0.5666 - val_loss: 1.2692 - val_accuracy: 0.5452
Epoch 11/50
4689/4689 [=====] - 8s 2ms/step - loss: 1.0111 -
accuracy: 0.6006 - val_loss: 1.2174 - val_accuracy: 0.4582
Epoch 12/50
4689/4689 [=====] - 9s 2ms/step - loss: 0.9494 -
accuracy: 0.6206 - val_loss: 0.9386 - val_accuracy: 0.6288

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Epoch 13/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.9082 - accuracy: 0.6488 - val_loss: 1.1407 - val_accuracy: 0.5717

Epoch 14/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8597 - accuracy: 0.6799 - val_loss: 1.4098 - val_accuracy: 0.5469

Epoch 15/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.9962 - accuracy: 0.6221 - val_loss: 1.1353 - val_accuracy: 0.5776

Epoch 16/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8611 - accuracy: 0.6652 - val_loss: 0.7631 - val_accuracy: 0.7056

Epoch 17/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8229 - accuracy: 0.6761 - val_loss: 1.7338 - val_accuracy: 0.5742

Epoch 18/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.9106 - accuracy: 0.6897 - val_loss: 1.1455 - val_accuracy: 0.6280

Epoch 19/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8212 - accuracy: 0.6946 - val_loss: 0.6716 - val_accuracy: 0.7509

Epoch 20/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8230 - accuracy: 0.6882 - val_loss: 0.8644 - val_accuracy: 0.6416

Epoch 21/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7843 - accuracy: 0.6965 - val_loss: 0.7173 - val_accuracy: 0.7543

Epoch 22/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7340 - accuracy: 0.7185 - val_loss: 0.8348 - val_accuracy: 0.7056

Epoch 23/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7669 - accuracy: 0.7112 - val_loss: 0.7204 - val_accuracy: 0.7295

Epoch 24/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7869 - accuracy: 0.6989 - val_loss: 0.9831 - val_accuracy: 0.6741

Epoch 25/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7730 - accuracy: 0.7025 - val_loss: 0.8246 - val_accuracy: 0.7039

Epoch 26/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6846 - accuracy: 0.7362 - val_loss: 0.9533 - val_accuracy: 0.6706

Epoch 27/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.7545 - accuracy: 0.7164 - val_loss: 1.5720 - val_accuracy: 0.5794

Epoch 28/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.8226 - accuracy: 0.7038 - val_loss: 0.8346 - val_accuracy: 0.7449

Epoch 29/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6530 - accuracy: 0.7586 - val_loss: 0.7435 - val_accuracy: 0.7099

Epoch 30/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6873 - accuracy: 0.7315 - val_loss: 0.6653 - val_accuracy: 0.7534

Epoch 31/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6983 - accuracy: 0.7343 - val_loss: 0.7678 - val_accuracy: 0.7167

Epoch 32/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6706 - accuracy: 0.7466 - val_loss: 0.9087 - val_accuracy: 0.6510

Epoch 33/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6687 - accuracy: 0.7481 - val_loss: 0.6884 - val_accuracy: 0.7474

Epoch 34/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6371 - accuracy: 0.7524 - val_loss: 0.7420 - val_accuracy: 0.7713

Epoch 35/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6781 - accuracy: 0.7407 - val_loss: 0.6400 - val_accuracy: 0.7577

Epoch 36/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5833 - accuracy: 0.7754 - val_loss: 1.1193 - val_accuracy: 0.6826

Epoch 37/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6792 - accuracy: 0.7511 - val_loss: 0.8044 - val_accuracy: 0.7031

Epoch 38/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6245 - accuracy: 0.7639 - val_loss: 0.8826 - val_accuracy: 0.6962

Epoch 39/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6199 - accuracy: 0.7635 - val_loss: 0.9175 - val_accuracy: 0.6544

Epoch 40/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6146 - accuracy: 0.7633 - val_loss: 0.7371 - val_accuracy: 0.7440

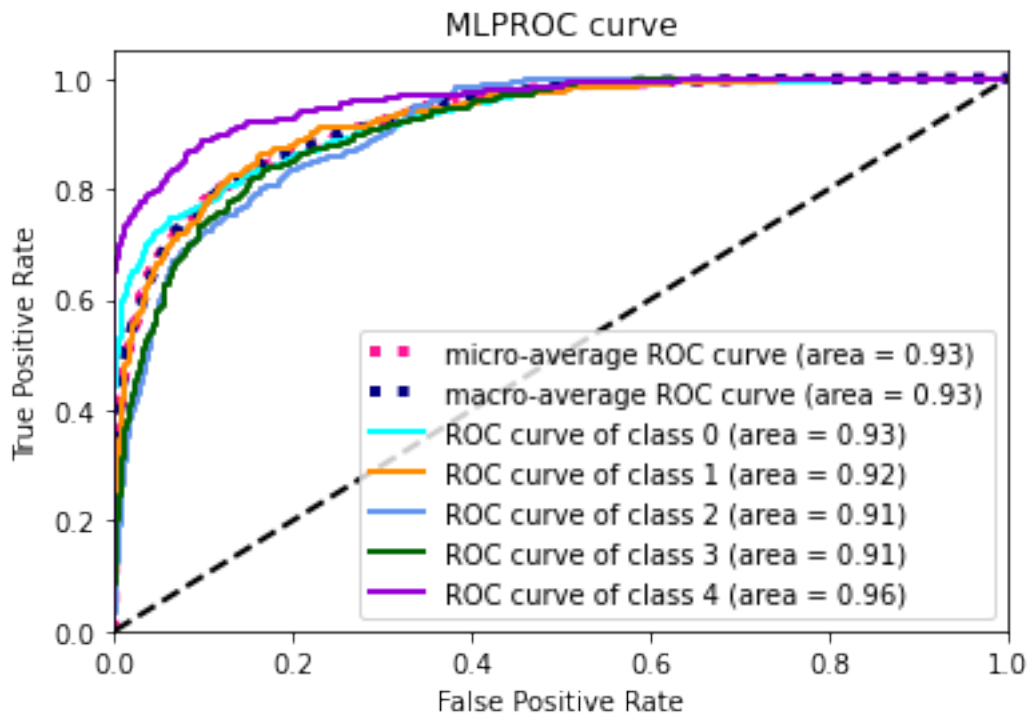
Epoch 41/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5693 - accuracy: 0.7784 - val_loss: 0.6097 - val_accuracy: 0.7688

Epoch 42/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5721 - accuracy: 0.7844 - val_loss: 0.8690 - val_accuracy: 0.6971

Epoch 43/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.6009 - accuracy: 0.7724 - val_loss: 0.8957 - val_accuracy: 0.7278

Epoch 44/50
4689/4689 [=====] - 8s 2ms/step - loss: 0.5646 - accuracy: 0.7852 - val_loss: 0.6552 - val_accuracy: 0.7841

Epoch 45/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.5519 - accuracy: 0.7855 - val_loss: 0.7807 - val_accuracy: 0.7073
 Epoch 46/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.5342 - accuracy: 0.7861 - val_loss: 0.6627 - val_accuracy: 0.7756
 Epoch 47/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.6178 - accuracy: 0.7724 - val_loss: 0.7850 - val_accuracy: 0.7491
 Epoch 48/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.6114 - accuracy: 0.7754 - val_loss: 0.8071 - val_accuracy: 0.7594
 Epoch 49/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.5103 - accuracy: 0.8136 - val_loss: 0.6622 - val_accuracy: 0.7722
 Epoch 50/50
 4689/4689 [=====] - 8s 2ms/step - loss: 0.5701 - accuracy: 0.7884 - val_loss: 0.9241 - val_accuracy: 0.7406
 1954/1954 [=====] - 1s 671us/step



Sequential with Kfold CV:
 Training for fold 5 ...
 Adding layer 1:

Adding layer 2:
 Adding layer 3:
 Adding layer 4:
 Model: "sequential_30"

Layer (type)	Output Shape	Param #
dense_160 (Dense)	(None, 4352)	596224
dense_161 (Dense)	(None, 2176)	9472128
dropout_102 (Dropout)	(None, 2176)	0
dense_162 (Dense)	(None, 1088)	2368576
dropout_103 (Dropout)	(None, 1088)	0
dense_163 (Dense)	(None, 544)	592416
dropout_104 (Dropout)	(None, 544)	0
dense_164 (Dense)	(None, 272)	148240
dropout_105 (Dropout)	(None, 272)	0
dense_165 (Dense)	(None, 5)	1365

Total params: 13,178,949
 Trainable params: 13,178,949
 Non-trainable params: 0

Train on 4689 samples, validate on 1172 samples

Epoch 1/50

4689/4689 [=====] - 12s 2ms/step - loss: 4.0180 - accuracy: 0.2067 - val_loss: 2.4379 - val_accuracy: 0.1852

Epoch 2/50

4689/4689 [=====] - 11s 2ms/step - loss: 1.7492 - accuracy: 0.2116 - val_loss: 2.1233 - val_accuracy: 0.1997

Epoch 3/50

4689/4689 [=====] - 11s 2ms/step - loss: 1.7192 - accuracy: 0.2288 - val_loss: 1.8770 - val_accuracy: 0.1766

Epoch 4/50

4689/4689 [=====] - 11s 2ms/step - loss: 1.6015 - accuracy: 0.2905 - val_loss: 1.9141 - val_accuracy: 0.1766

Epoch 5/50

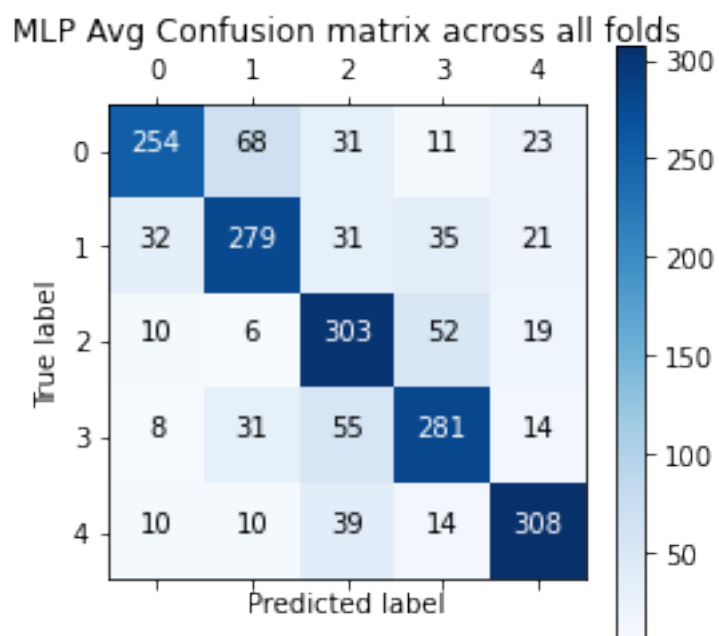
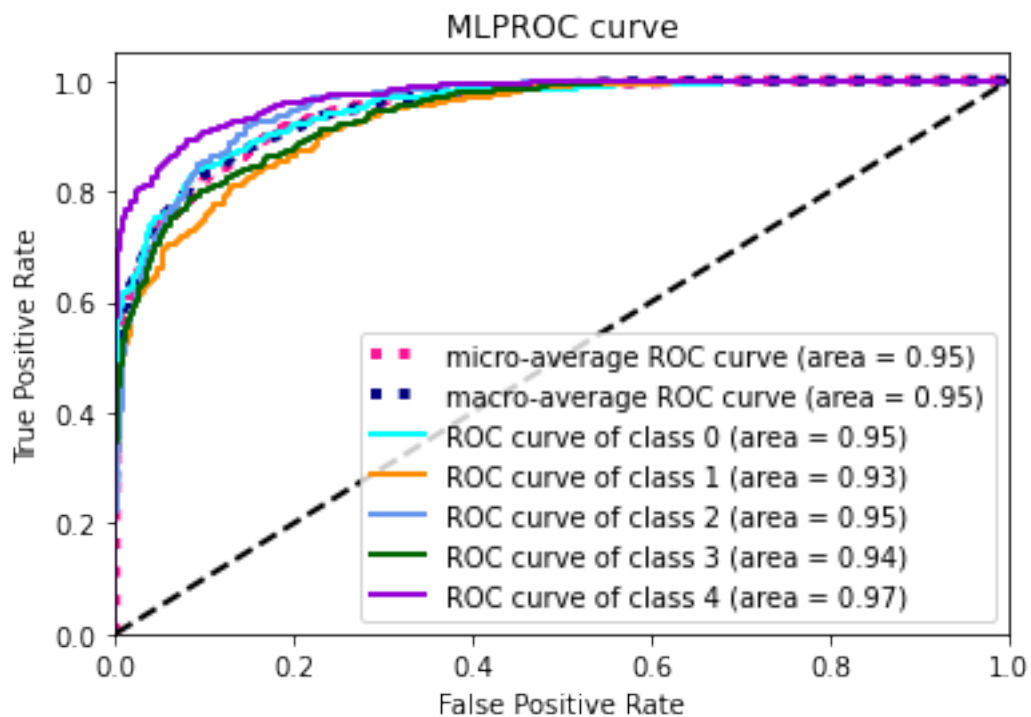
4689/4689 [=====] - 11s 2ms/step - loss: 1.4457 - accuracy: 0.3918 - val_loss: 1.7642 - val_accuracy: 0.2765

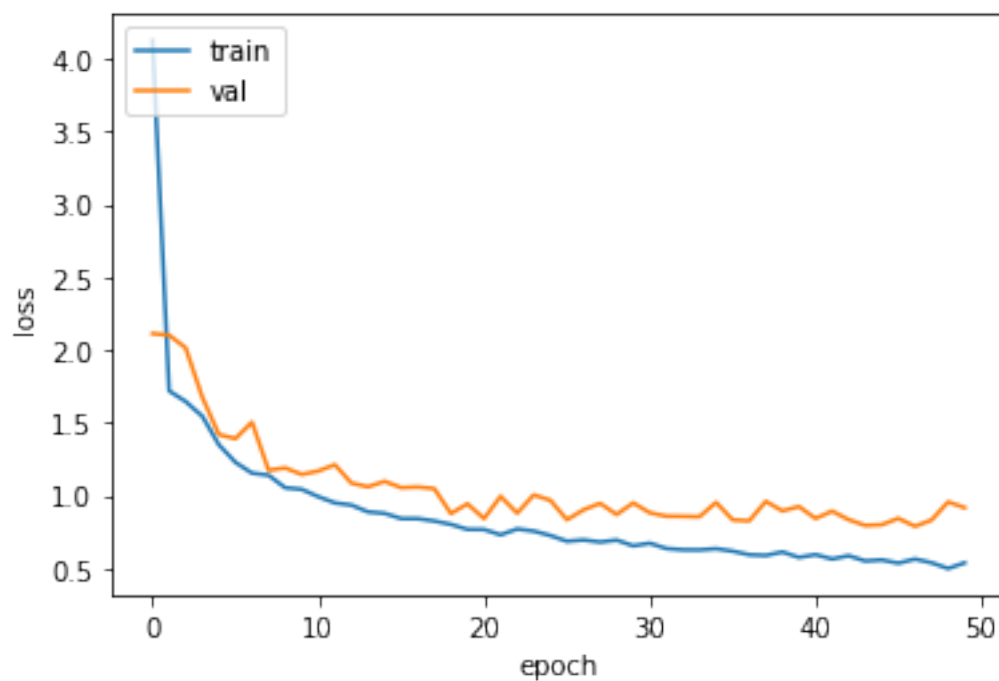
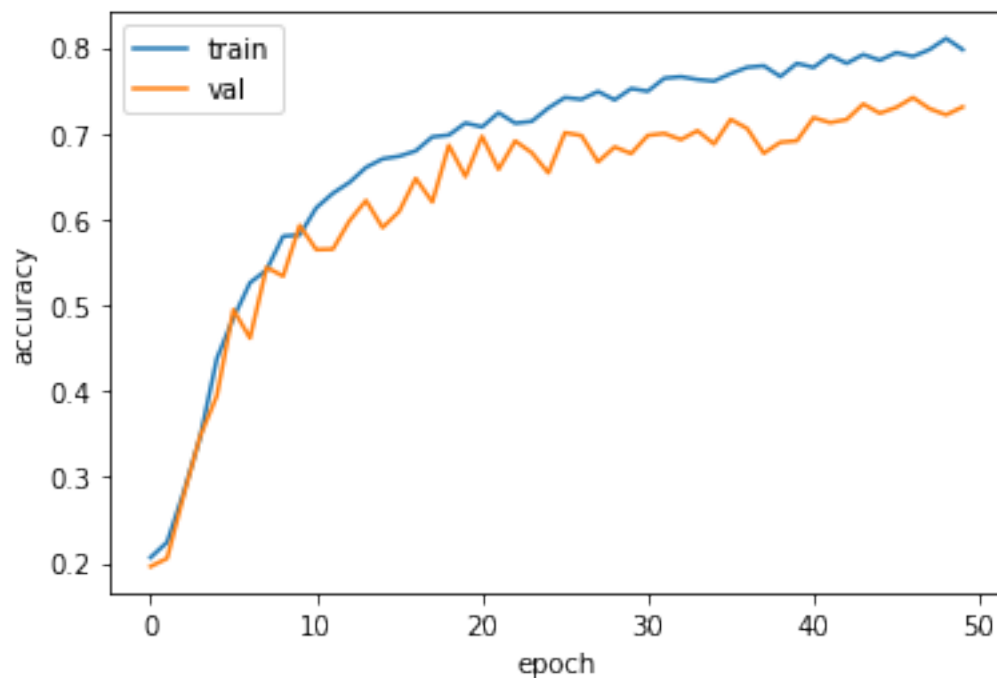
Epoch 6/50

4689/4689 [=====] - 11s 2ms/step - loss: 1.3009 - accuracy: 0.4722 - val_loss: 1.6291 - val_accuracy: 0.4403
Epoch 7/50
4689/4689 [=====] - 11s 2ms/step - loss: 1.1566 - accuracy: 0.5165 - val_loss: 1.6820 - val_accuracy: 0.3302
Epoch 8/50
4689/4689 [=====] - 11s 2ms/step - loss: 1.1925 - accuracy: 0.5135 - val_loss: 1.3593 - val_accuracy: 0.5085
Epoch 9/50
4689/4689 [=====] - 11s 2ms/step - loss: 1.0337 - accuracy: 0.5882 - val_loss: 1.4819 - val_accuracy: 0.4633
Epoch 10/50
4689/4689 [=====] - 11s 2ms/step - loss: 1.0054 - accuracy: 0.5967 - val_loss: 0.8600 - val_accuracy: 0.6587
Epoch 11/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.9332 - accuracy: 0.6505 - val_loss: 1.3187 - val_accuracy: 0.4957
Epoch 12/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.9841 - accuracy: 0.6174 - val_loss: 1.3824 - val_accuracy: 0.5068
Epoch 13/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.9523 - accuracy: 0.6415 - val_loss: 1.2479 - val_accuracy: 0.5879
Epoch 14/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.9118 - accuracy: 0.6494 - val_loss: 1.0385 - val_accuracy: 0.6442
Epoch 15/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.8641 - accuracy: 0.6771 - val_loss: 1.0959 - val_accuracy: 0.6041
Epoch 16/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.8619 - accuracy: 0.6694 - val_loss: 1.2717 - val_accuracy: 0.4753
Epoch 17/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.8621 - accuracy: 0.6654 - val_loss: 1.0818 - val_accuracy: 0.6237
Epoch 18/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.8410 - accuracy: 0.6880 - val_loss: 1.2795 - val_accuracy: 0.5870
Epoch 19/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.8055 - accuracy: 0.7095 - val_loss: 1.1934 - val_accuracy: 0.6186
Epoch 20/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.8410 - accuracy: 0.6925 - val_loss: 0.8841 - val_accuracy: 0.6698
Epoch 21/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.7732 - accuracy: 0.7083 - val_loss: 0.9254 - val_accuracy: 0.6510
Epoch 22/50

4689/4689 [=====] - 11s 2ms/step - loss: 0.7234 -
accuracy: 0.7266 - val_loss: 1.1501 - val_accuracy: 0.5802
Epoch 23/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.7467 -
accuracy: 0.7121 - val_loss: 0.8112 - val_accuracy: 0.7005
Epoch 24/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.7706 -
accuracy: 0.7044 - val_loss: 1.1555 - val_accuracy: 0.6630
Epoch 25/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.7391 -
accuracy: 0.7321 - val_loss: 1.0051 - val_accuracy: 0.6442
Epoch 26/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.6922 -
accuracy: 0.7432 - val_loss: 0.7365 - val_accuracy: 0.7210
Epoch 27/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.6786 -
accuracy: 0.7428 - val_loss: 0.7138 - val_accuracy: 0.7381
Epoch 28/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.6794 -
accuracy: 0.7496 - val_loss: 1.2956 - val_accuracy: 0.4991
Epoch 29/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.7737 -
accuracy: 0.7078 - val_loss: 0.9559 - val_accuracy: 0.6724
Epoch 30/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.6526 -
accuracy: 0.7541 - val_loss: 1.4787 - val_accuracy: 0.5589
Epoch 31/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.7543 -
accuracy: 0.7206 - val_loss: 1.0782 - val_accuracy: 0.6561
Epoch 32/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.6413 -
accuracy: 0.7605 - val_loss: 0.9620 - val_accuracy: 0.7082
Epoch 33/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.6457 -
accuracy: 0.7624 - val_loss: 0.7823 - val_accuracy: 0.6997
Epoch 34/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.6275 -
accuracy: 0.7624 - val_loss: 0.7374 - val_accuracy: 0.7312
Epoch 35/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.6111 -
accuracy: 0.7754 - val_loss: 1.1648 - val_accuracy: 0.6442
Epoch 36/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.6939 -
accuracy: 0.7456 - val_loss: 0.7984 - val_accuracy: 0.7031
Epoch 37/50
4689/4689 [=====] - 11s 2ms/step - loss: 0.5900 -
accuracy: 0.7731 - val_loss: 0.8834 - val_accuracy: 0.6826
Epoch 38/50

4689/4689 [=====] - 11s 2ms/step - loss: 0.5781 -
 accuracy: 0.7852 - val_loss: 1.0709 - val_accuracy: 0.6288
 Epoch 39/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.6650 -
 accuracy: 0.7419 - val_loss: 0.9787 - val_accuracy: 0.6143
 Epoch 40/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.5835 -
 accuracy: 0.7752 - val_loss: 1.1569 - val_accuracy: 0.5947
 Epoch 41/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.6319 -
 accuracy: 0.7622 - val_loss: 1.0761 - val_accuracy: 0.6647
 Epoch 42/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.6236 -
 accuracy: 0.7761 - val_loss: 0.7994 - val_accuracy: 0.7346
 Epoch 43/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.5815 -
 accuracy: 0.7799 - val_loss: 0.7064 - val_accuracy: 0.7372
 Epoch 44/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.4991 -
 accuracy: 0.8066 - val_loss: 0.8968 - val_accuracy: 0.7244
 Epoch 45/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.5742 -
 accuracy: 0.7752 - val_loss: 0.8467 - val_accuracy: 0.7108
 Epoch 46/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.5812 -
 accuracy: 0.7720 - val_loss: 0.9985 - val_accuracy: 0.7261
 Epoch 47/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.6613 -
 accuracy: 0.7579 - val_loss: 0.7133 - val_accuracy: 0.7440
 Epoch 48/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.5509 -
 accuracy: 0.7882 - val_loss: 0.7787 - val_accuracy: 0.7099
 Epoch 49/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.5358 -
 accuracy: 0.7893 - val_loss: 1.3433 - val_accuracy: 0.6647
 Epoch 50/50
 4689/4689 [=====] - 11s 2ms/step - loss: 0.5936 -
 accuracy: 0.7827 - val_loss: 0.7327 - val_accuracy: 0.7346
 1954/1954 [=====] - 3s 1ms/step

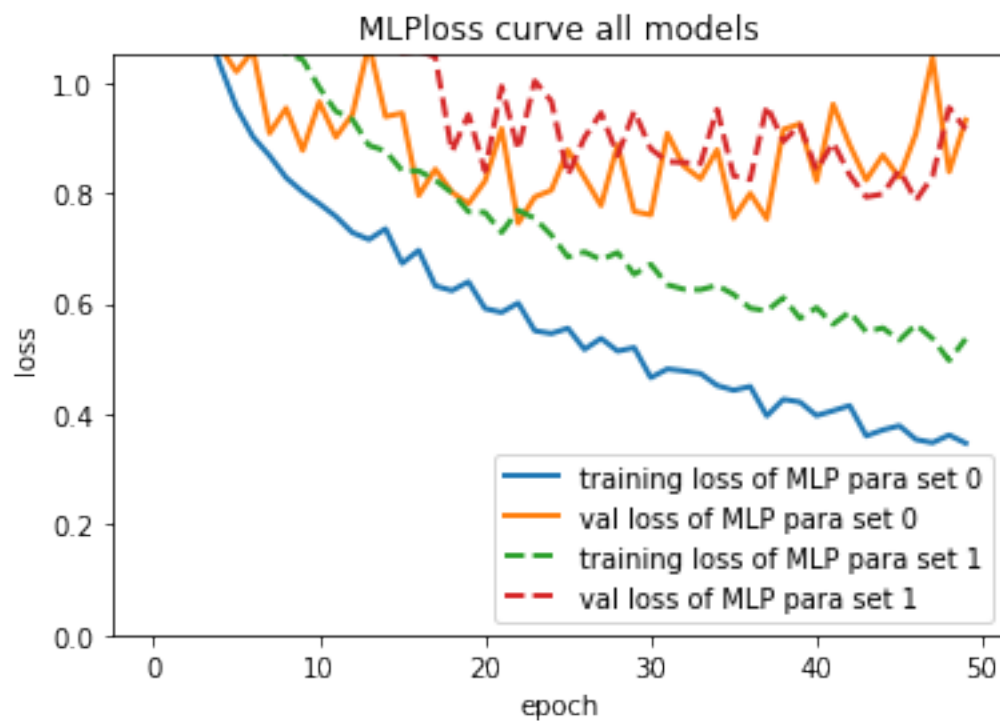
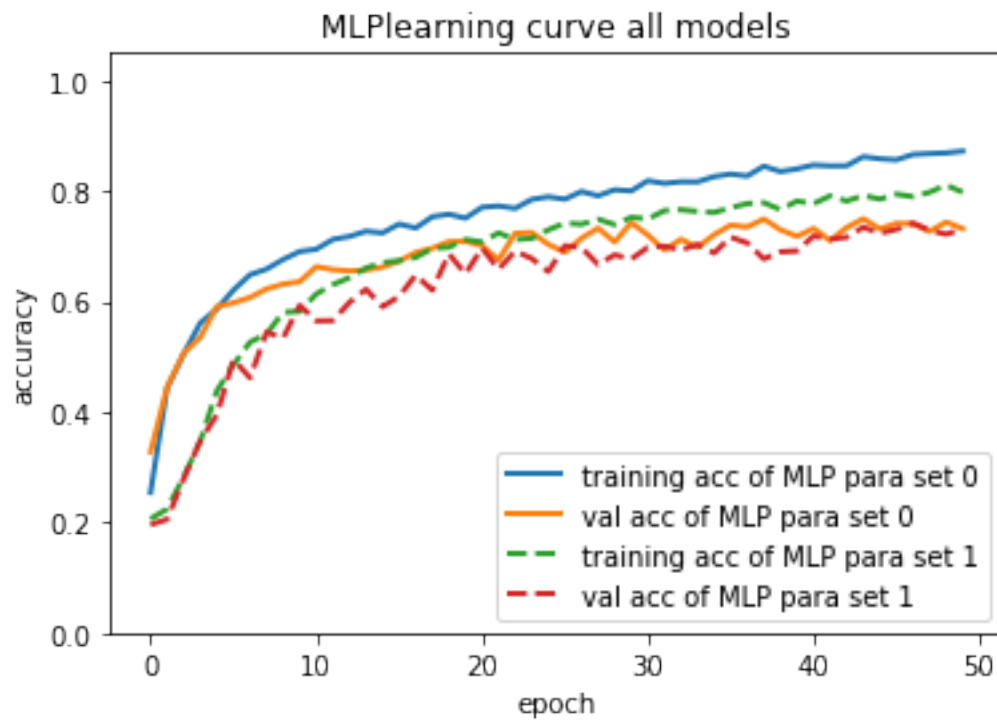




Average scores for pseudo test set across all folds:
> Accuracy: 0.7301944732666016 (+- 0.01786776206097665)
> Loss: 0.9133736537081193

> Avg runtime per test instance: 0.0022417235398853813

#####



Opt model parameter found on the pseudo test set:

```
{'num_hidden_layer': 4, 'hidden_layer_activation': ['relu', 'tanh', 'relu',  
'tanh'], 'dropout': [0.5, 0.25, 0.125, 0.0625], 'last_activation': 'softmax'}
```

Best average pseudo test set accuracy score with the opt model:

0.7301944732666016

Average runtime per test instance: 0.0022417235398853813

[]:

```
[14]: from B2 import B2_functions_all as B2_functions
```

```
[15]: TaskB2_opt_models_dict, TaskB2_res_dict = B2_functions.get_B2_results()
```

-----Reading Task B2 dataset-----

-----Task B2: Grid searching on
SVM-----

SVM Grid search CV on Dataset A:

Training scores:

```
0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'rbf'}  
0.846 (+/-0.005) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'linear'}  
0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'sigmoid'}  
0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'rbf'}  
0.846 (+/-0.005) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'linear'}  
0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'sigmoid'}  
0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'rbf'}  
0.846 (+/-0.005) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'linear'}  
0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'sigmoid'}  
0.472 (+/-0.120) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'rbf'}  
0.846 (+/-0.005) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'linear'}  
0.367 (+/-0.001) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'sigmoid'}  
0.207 (+/-0.000) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'rbf'}  
0.846 (+/-0.005) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'linear'}  
0.207 (+/-0.000) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'sigmoid'}  
0.207 (+/-0.000) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'rbf'}  
0.846 (+/-0.005) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'linear'}  
0.207 (+/-0.000) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'sigmoid'}
```

0.368 (+/-0.002) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'rbf'}
 0.846 (+/-0.005) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'linear'}
 0.368 (+/-0.002) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.848 (+/-0.005) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'rbf'}
 0.846 (+/-0.005) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'linear'}
 0.845 (+/-0.005) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.207 (+/-0.000) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.844 (+/-0.005) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.207 (+/-0.000) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.368 (+/-0.002) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.844 (+/-0.005) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'linear'}
 0.368 (+/-0.002) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.848 (+/-0.005) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.844 (+/-0.005) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'linear'}
 0.846 (+/-0.005) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.848 (+/-0.005) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.844 (+/-0.005) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'linear'}
 0.845 (+/-0.005) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.368 (+/-0.002) for {'C': 1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.845 (+/-0.005) for {'C': 1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.368 (+/-0.002) for {'C': 1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.848 (+/-0.005) for {'C': 1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.845 (+/-0.005) for {'C': 1, 'gamma': 0.001, 'kernel': 'linear'}
 0.846 (+/-0.005) for {'C': 1, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.847 (+/-0.004) for {'C': 1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.845 (+/-0.005) for {'C': 1, 'gamma': 0.01, 'kernel': 'linear'}
 0.846 (+/-0.005) for {'C': 1, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.848 (+/-0.005) for {'C': 1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.845 (+/-0.005) for {'C': 1, 'gamma': 0.1, 'kernel': 'linear'}
 0.843 (+/-0.006) for {'C': 1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.847 (+/-0.005) for {'C': 10, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.845 (+/-0.005) for {'C': 10, 'gamma': 0.0001, 'kernel': 'linear'}
 0.846 (+/-0.005) for {'C': 10, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.846 (+/-0.005) for {'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}
 0.845 (+/-0.005) for {'C': 10, 'gamma': 0.001, 'kernel': 'linear'}
 0.846 (+/-0.005) for {'C': 10, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.847 (+/-0.006) for {'C': 10, 'gamma': 0.01, 'kernel': 'rbf'}
 0.845 (+/-0.005) for {'C': 10, 'gamma': 0.01, 'kernel': 'linear'}
 0.844 (+/-0.005) for {'C': 10, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.849 (+/-0.003) for {'C': 10, 'gamma': 0.1, 'kernel': 'rbf'}
 0.845 (+/-0.005) for {'C': 10, 'gamma': 0.1, 'kernel': 'linear'}
 0.836 (+/-0.005) for {'C': 10, 'gamma': 0.1, 'kernel': 'sigmoid'}

Validation scores:

0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.846 (+/-0.019) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'linear'}
 0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.0001, 'kernel': 'sigmoid'}

0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'rbf'}
 0.846 (+/-0.019) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'linear'}
 0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'rbf'}
 0.846 (+/-0.019) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'linear'}
 0.207 (+/-0.000) for {'C': 0.001, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.469 (+/-0.112) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'rbf'}
 0.846 (+/-0.019) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'linear'}
 0.367 (+/-0.006) for {'C': 0.001, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.207 (+/-0.000) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.846 (+/-0.021) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'linear'}
 0.207 (+/-0.000) for {'C': 0.01, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.207 (+/-0.000) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'rbf'}
 0.846 (+/-0.021) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'linear'}
 0.207 (+/-0.000) for {'C': 0.01, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.368 (+/-0.007) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'rbf'}
 0.846 (+/-0.021) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'linear'}
 0.368 (+/-0.006) for {'C': 0.01, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.848 (+/-0.019) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'rbf'}
 0.846 (+/-0.021) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'linear'}
 0.845 (+/-0.021) for {'C': 0.01, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.207 (+/-0.000) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.845 (+/-0.020) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.207 (+/-0.000) for {'C': 0.1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.368 (+/-0.008) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.845 (+/-0.020) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'linear'}
 0.368 (+/-0.006) for {'C': 0.1, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.848 (+/-0.018) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.845 (+/-0.020) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'linear'}
 0.846 (+/-0.019) for {'C': 0.1, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.848 (+/-0.019) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.845 (+/-0.020) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'linear'}
 0.845 (+/-0.019) for {'C': 0.1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.368 (+/-0.008) for {'C': 1, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.845 (+/-0.022) for {'C': 1, 'gamma': 0.0001, 'kernel': 'linear'}
 0.368 (+/-0.006) for {'C': 1, 'gamma': 0.0001, 'kernel': 'sigmoid'}
 0.848 (+/-0.019) for {'C': 1, 'gamma': 0.001, 'kernel': 'rbf'}
 0.845 (+/-0.022) for {'C': 1, 'gamma': 0.001, 'kernel': 'linear'}
 0.846 (+/-0.019) for {'C': 1, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.847 (+/-0.019) for {'C': 1, 'gamma': 0.01, 'kernel': 'rbf'}
 0.845 (+/-0.022) for {'C': 1, 'gamma': 0.01, 'kernel': 'linear'}
 0.846 (+/-0.021) for {'C': 1, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.848 (+/-0.020) for {'C': 1, 'gamma': 0.1, 'kernel': 'rbf'}
 0.845 (+/-0.022) for {'C': 1, 'gamma': 0.1, 'kernel': 'linear'}
 0.845 (+/-0.019) for {'C': 1, 'gamma': 0.1, 'kernel': 'sigmoid'}
 0.847 (+/-0.019) for {'C': 10, 'gamma': 0.0001, 'kernel': 'rbf'}
 0.844 (+/-0.021) for {'C': 10, 'gamma': 0.0001, 'kernel': 'linear'}
 0.846 (+/-0.019) for {'C': 10, 'gamma': 0.0001, 'kernel': 'sigmoid'}

0.845 (+/-0.021) for {'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}
 0.844 (+/-0.021) for {'C': 10, 'gamma': 0.001, 'kernel': 'linear'}
 0.846 (+/-0.021) for {'C': 10, 'gamma': 0.001, 'kernel': 'sigmoid'}
 0.845 (+/-0.018) for {'C': 10, 'gamma': 0.01, 'kernel': 'rbf'}
 0.844 (+/-0.021) for {'C': 10, 'gamma': 0.01, 'kernel': 'linear'}
 0.844 (+/-0.020) for {'C': 10, 'gamma': 0.01, 'kernel': 'sigmoid'}
 0.847 (+/-0.019) for {'C': 10, 'gamma': 0.1, 'kernel': 'rbf'}
 0.844 (+/-0.021) for {'C': 10, 'gamma': 0.1, 'kernel': 'linear'}
 0.837 (+/-0.022) for {'C': 10, 'gamma': 0.1, 'kernel': 'sigmoid'}

Prediction on a pseudo test set (split from Dataset A):

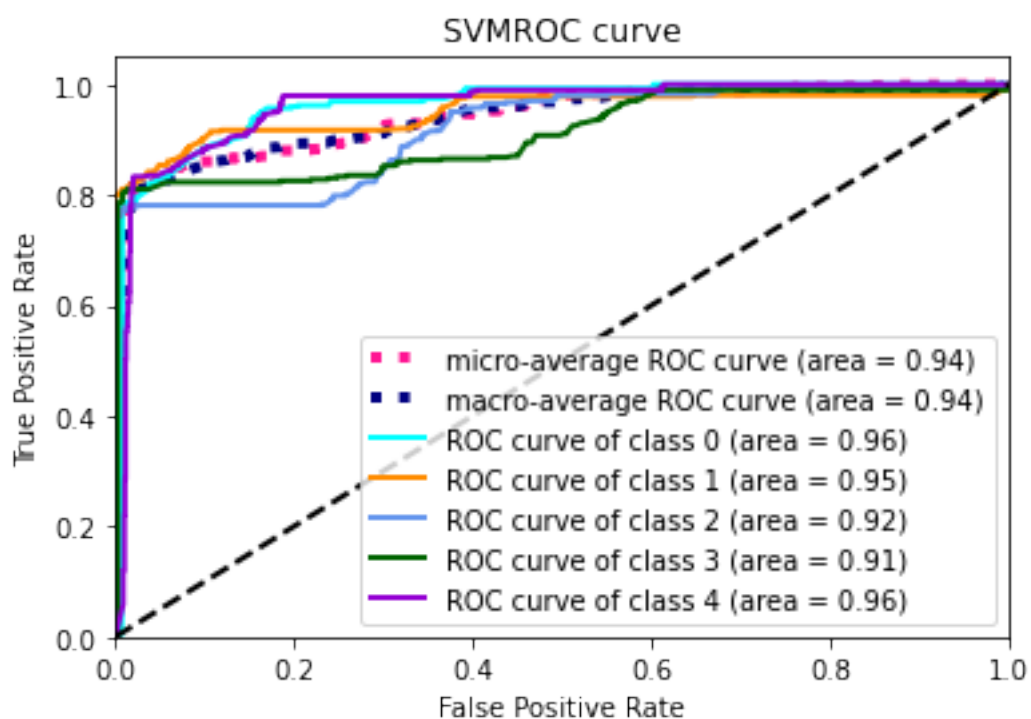
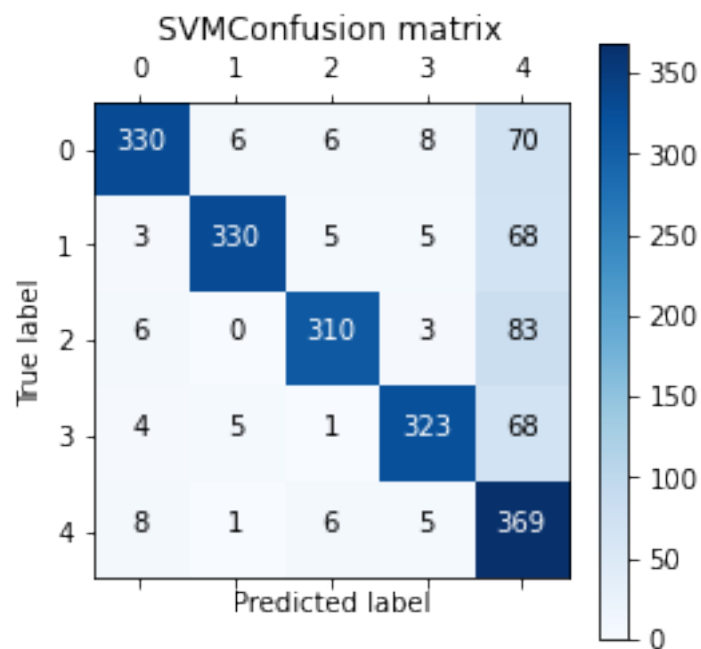
	precision	recall	f1-score	support
0	0.91	0.82	0.86	420
1	1.00	0.80	0.89	411
2	0.99	0.77	0.87	402
3	0.96	0.81	0.87	401
4	0.56	0.95	0.70	389
accuracy			0.83	2023
macro avg	0.88	0.83	0.84	2023
weighted avg	0.89	0.83	0.84	2023

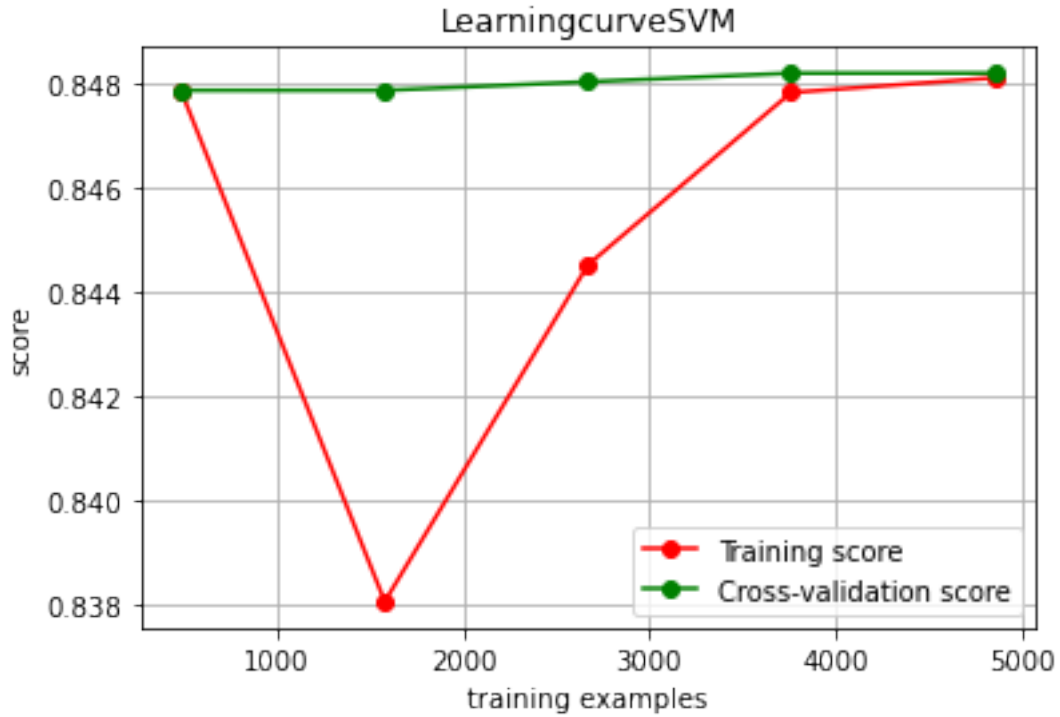
Accuracy: 0.8284725654967869

Best parameters found on Dataset A:

{'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}

Average runtime per test instance: 0.00011334758669918737





-----Task B2: Grid searching on Random Forest-----

RF Grid search CV on Dataset A:

Training scores:

```
0.935 (+/-0.003) for {'max_depth': 64, 'n_estimators': 64}
0.935 (+/-0.003) for {'max_depth': 64, 'n_estimators': 128}
0.935 (+/-0.003) for {'max_depth': 64, 'n_estimators': 256}
0.935 (+/-0.003) for {'max_depth': 64, 'n_estimators': 512}
0.935 (+/-0.003) for {'max_depth': 64, 'n_estimators': 1024}
0.935 (+/-0.003) for {'max_depth': 128, 'n_estimators': 64}
0.935 (+/-0.003) for {'max_depth': 128, 'n_estimators': 128}
0.935 (+/-0.003) for {'max_depth': 128, 'n_estimators': 256}
0.935 (+/-0.003) for {'max_depth': 128, 'n_estimators': 512}
0.935 (+/-0.003) for {'max_depth': 128, 'n_estimators': 1024}
0.935 (+/-0.003) for {'max_depth': 256, 'n_estimators': 64}
0.935 (+/-0.003) for {'max_depth': 256, 'n_estimators': 128}
0.935 (+/-0.003) for {'max_depth': 256, 'n_estimators': 256}
0.935 (+/-0.003) for {'max_depth': 256, 'n_estimators': 512}
```

0.935 (+/-0.003) for {'max_depth': 256, 'n_estimators': 1024}
0.935 (+/-0.003) for {'max_depth': 512, 'n_estimators': 64}
0.935 (+/-0.003) for {'max_depth': 512, 'n_estimators': 128}
0.935 (+/-0.003) for {'max_depth': 512, 'n_estimators': 256}
0.935 (+/-0.003) for {'max_depth': 512, 'n_estimators': 512}
0.935 (+/-0.003) for {'max_depth': 512, 'n_estimators': 1024}
0.935 (+/-0.003) for {'max_depth': 1024, 'n_estimators': 64}
0.935 (+/-0.003) for {'max_depth': 1024, 'n_estimators': 128}
0.935 (+/-0.003) for {'max_depth': 1024, 'n_estimators': 256}
0.935 (+/-0.003) for {'max_depth': 1024, 'n_estimators': 512}
0.935 (+/-0.003) for {'max_depth': 1024, 'n_estimators': 1024}

Validation scores:

0.867 (+/-0.016) for {'max_depth': 64, 'n_estimators': 64}
0.867 (+/-0.015) for {'max_depth': 64, 'n_estimators': 128}
0.866 (+/-0.019) for {'max_depth': 64, 'n_estimators': 256}
0.866 (+/-0.017) for {'max_depth': 64, 'n_estimators': 512}
0.866 (+/-0.017) for {'max_depth': 64, 'n_estimators': 1024}
0.868 (+/-0.016) for {'max_depth': 128, 'n_estimators': 64}
0.867 (+/-0.017) for {'max_depth': 128, 'n_estimators': 128}
0.866 (+/-0.018) for {'max_depth': 128, 'n_estimators': 256}
0.866 (+/-0.016) for {'max_depth': 128, 'n_estimators': 512}
0.868 (+/-0.016) for {'max_depth': 128, 'n_estimators': 1024}
0.865 (+/-0.018) for {'max_depth': 256, 'n_estimators': 64}
0.866 (+/-0.020) for {'max_depth': 256, 'n_estimators': 128}
0.865 (+/-0.020) for {'max_depth': 256, 'n_estimators': 256}
0.867 (+/-0.021) for {'max_depth': 256, 'n_estimators': 512}
0.866 (+/-0.019) for {'max_depth': 256, 'n_estimators': 1024}
0.866 (+/-0.016) for {'max_depth': 512, 'n_estimators': 64}
0.866 (+/-0.018) for {'max_depth': 512, 'n_estimators': 128}
0.866 (+/-0.019) for {'max_depth': 512, 'n_estimators': 256}
0.866 (+/-0.015) for {'max_depth': 512, 'n_estimators': 512}
0.866 (+/-0.018) for {'max_depth': 512, 'n_estimators': 1024}
0.865 (+/-0.016) for {'max_depth': 1024, 'n_estimators': 64}
0.867 (+/-0.017) for {'max_depth': 1024, 'n_estimators': 128}
0.866 (+/-0.016) for {'max_depth': 1024, 'n_estimators': 256}
0.867 (+/-0.020) for {'max_depth': 1024, 'n_estimators': 512}
0.867 (+/-0.018) for {'max_depth': 1024, 'n_estimators': 1024}

Prediction on a pseudo test set (split from Dataset A):

	precision	recall	f1-score	support
0	0.89	0.87	0.88	420
1	0.93	0.85	0.89	411
2	0.89	0.82	0.86	402
3	0.87	0.85	0.86	401
4	0.74	0.92	0.82	389

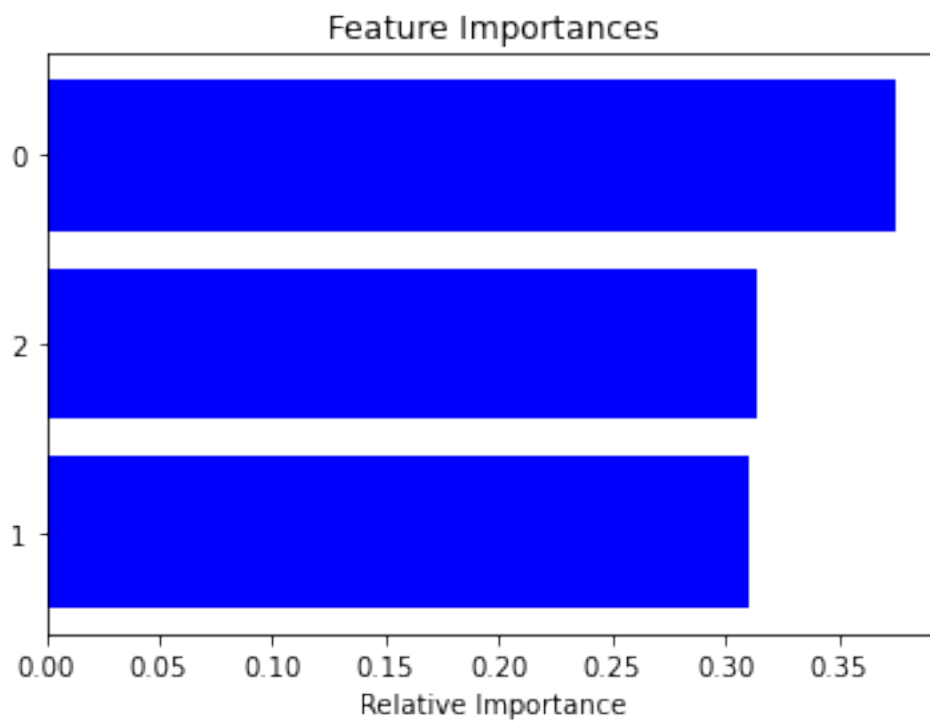
accuracy			0.86	2023
macro avg	0.87	0.86	0.86	2023
weighted avg	0.87	0.86	0.86	2023

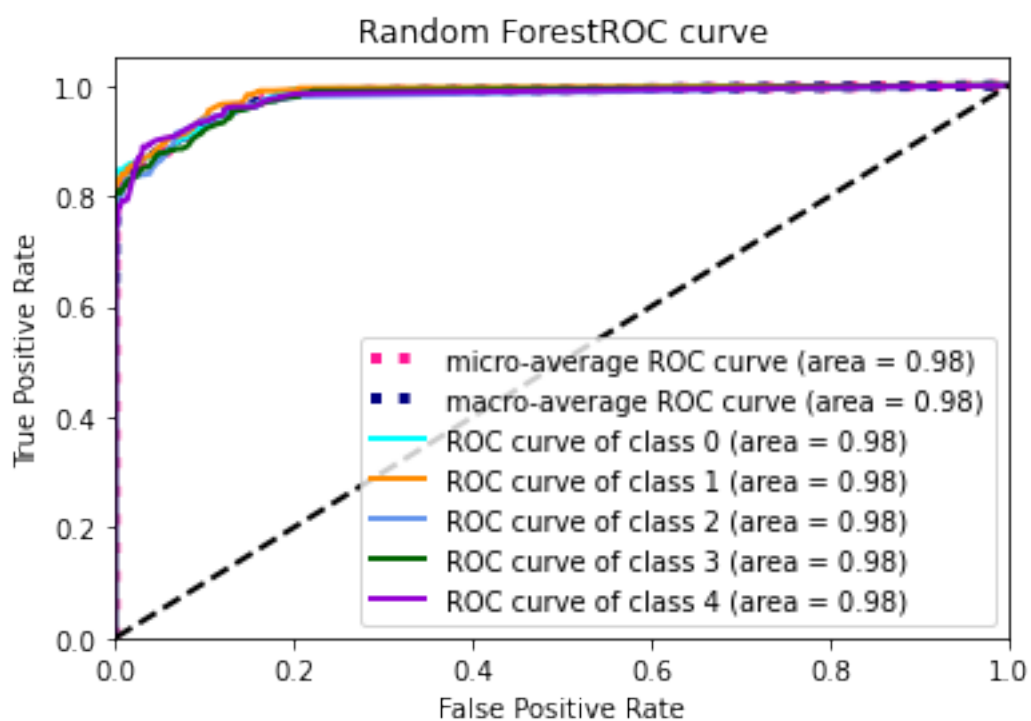
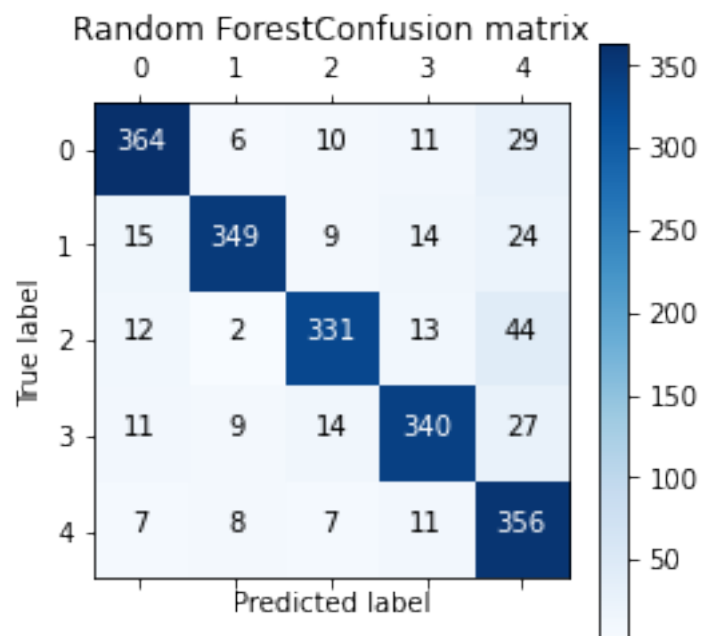
Accuracy: 0.8601087493821058

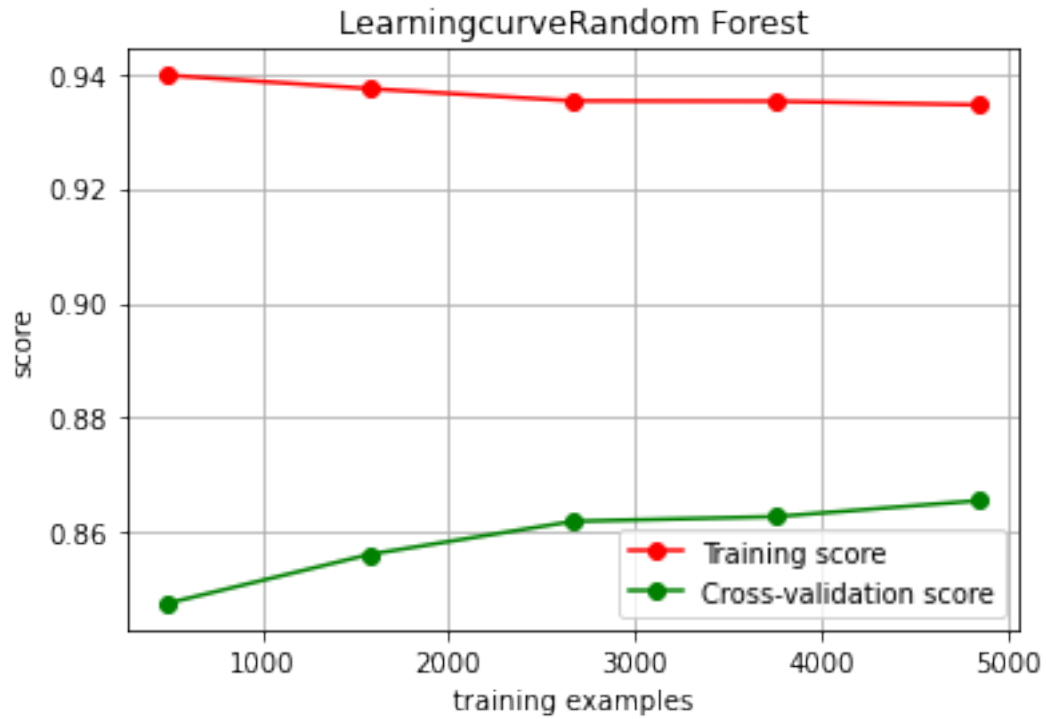
Best parameters found on Dataset A:

`{'max_depth': 128, 'n_estimators': 64}`

Average runtime per test instance: 1.924119252588156e-05







-----Task B2: Grid searching on
KNN-----

KNN Grid search CV on Dataset A:

Training scores:

0.879 (+/-0.004) for {'n_neighbors': 8}
 0.864 (+/-0.004) for {'n_neighbors': 16}
 0.860 (+/-0.005) for {'n_neighbors': 32}
 0.852 (+/-0.005) for {'n_neighbors': 64}
 0.847 (+/-0.005) for {'n_neighbors': 128}

Validation scores:

0.853 (+/-0.030) for {'n_neighbors': 8}
 0.847 (+/-0.022) for {'n_neighbors': 16}
 0.843 (+/-0.023) for {'n_neighbors': 32}
 0.842 (+/-0.019) for {'n_neighbors': 64}
 0.840 (+/-0.019) for {'n_neighbors': 128}

Prediction on a pseudo test set (split from Dataset A):

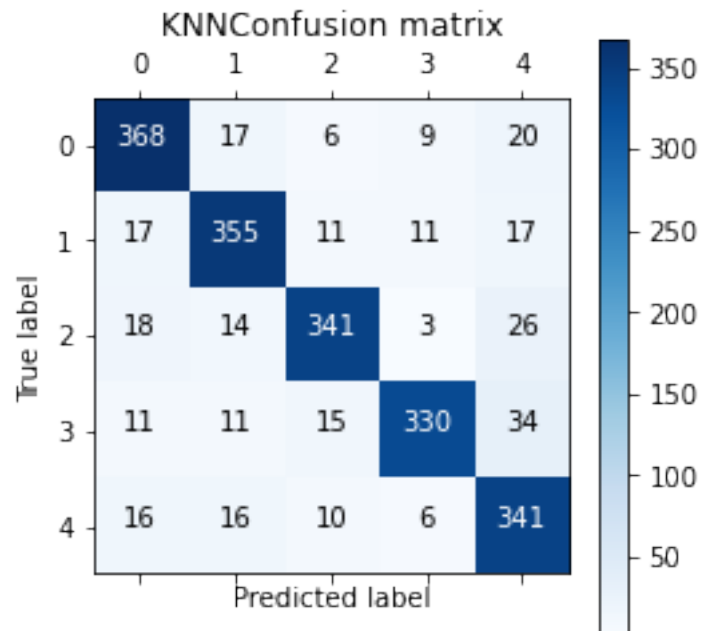
	precision	recall	f1-score	support
0	0.86	0.88	0.87	420
1	0.86	0.86	0.86	411
2	0.89	0.85	0.87	402
3	0.92	0.82	0.87	401
4	0.78	0.88	0.82	389
accuracy			0.86	2023
macro avg	0.86	0.86	0.86	2023
weighted avg	0.86	0.86	0.86	2023

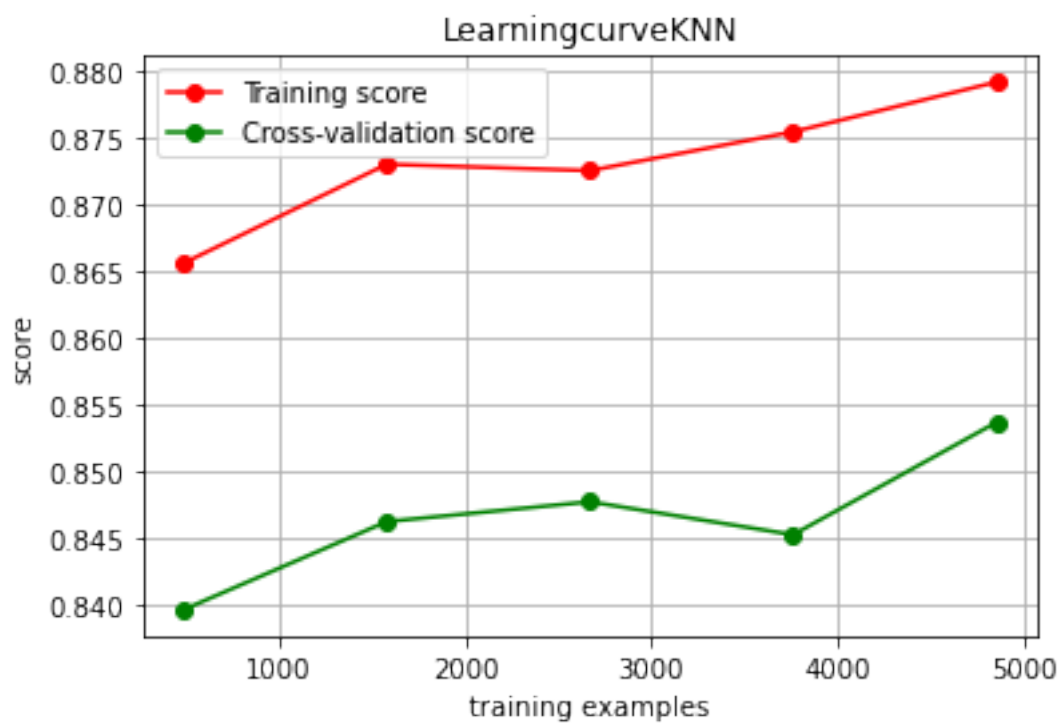
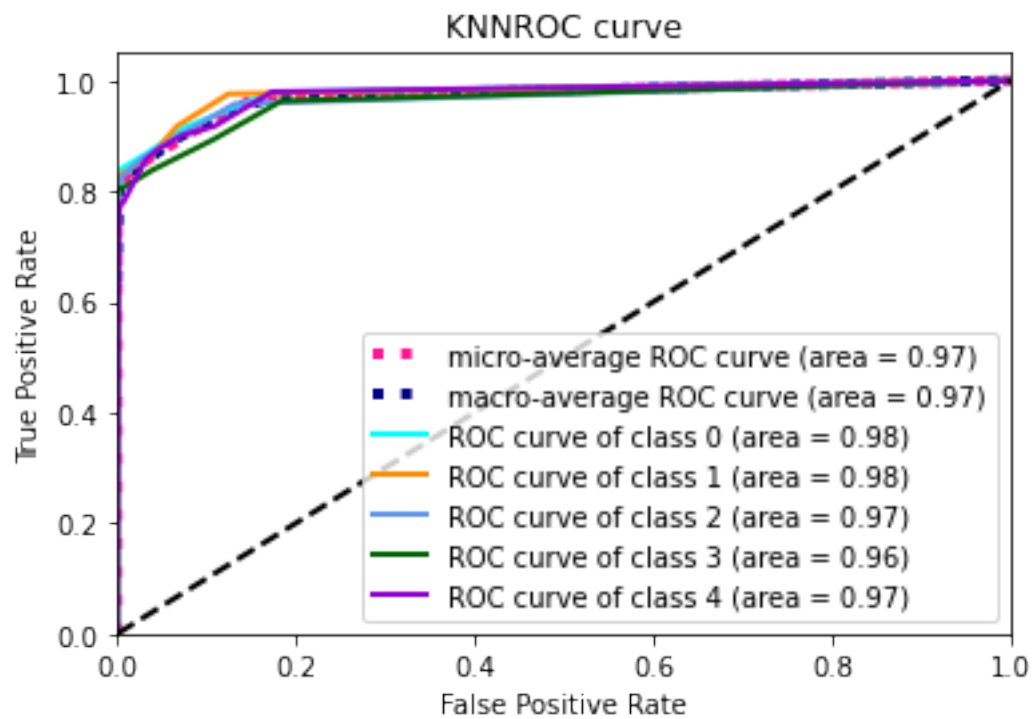
Accuracy: 0.8576371725160653

Best parameters found on Dataset A:

`{'n_neighbors': 8}`

Average runtime per test instance: 6.944144414429375e-05





-----Task B2: Gird searching on
MLP-----

#####

Squential with Kfold CV:

Training for fold 1 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_31"

Layer (type)	Output Shape	Param #
dense_166 (Dense)	(None, 48)	192
dense_167 (Dense)	(None, 24)	1176
dropout_106 (Dropout)	(None, 24)	0
dense_168 (Dense)	(None, 12)	300
dropout_107 (Dropout)	(None, 12)	0
dense_169 (Dense)	(None, 6)	78
dropout_108 (Dropout)	(None, 6)	0
dense_170 (Dense)	(None, 5)	35

Total params: 1,781

Trainable params: 1,781

Non-trainable params: 0

Train on 4853 samples, validate on 1214 samples

Epoch 1/50

4853/4853 [=====] - 4s 885us/step - loss: 1.5750 -
accuracy: 0.2475 - val_loss: 1.4781 - val_accuracy: 0.3616

Epoch 2/50

4853/4853 [=====] - 0s 41us/step - loss: 1.4961 -
accuracy: 0.3433 - val_loss: 1.4022 - val_accuracy: 0.5214

Epoch 3/50

4853/4853 [=====] - 0s 35us/step - loss: 1.4367 -
accuracy: 0.3991 - val_loss: 1.3422 - val_accuracy: 0.6853

Epoch 4/50

4853/4853 [=====] - 0s 34us/step - loss: 1.3808 -

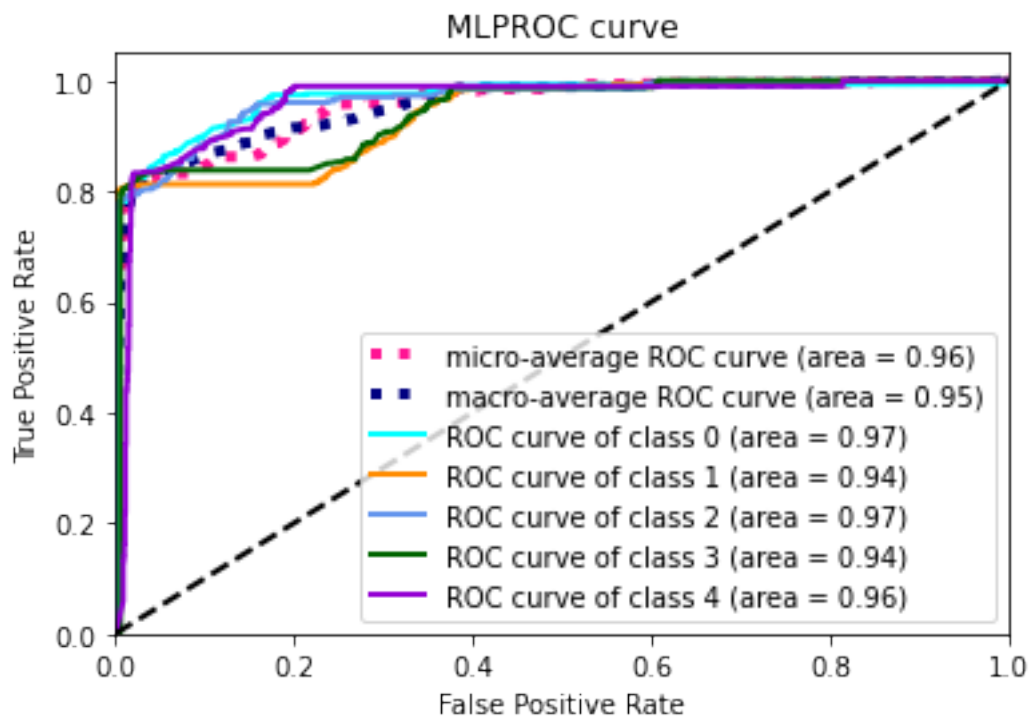
accuracy: 0.4731 - val_loss: 1.2817 - val_accuracy: 0.6862
 Epoch 5/50
 4853/4853 [=====] - 0s 23us/step - loss: 1.3483 -
 accuracy: 0.4859 - val_loss: 1.2291 - val_accuracy: 0.6853
 Epoch 6/50
 4853/4853 [=====] - 0s 22us/step - loss: 1.3115 -
 accuracy: 0.5170 - val_loss: 1.1768 - val_accuracy: 0.8418
 Epoch 7/50
 4853/4853 [=====] - 0s 22us/step - loss: 1.2857 -
 accuracy: 0.5314 - val_loss: 1.1290 - val_accuracy: 0.8443
 Epoch 8/50
 4853/4853 [=====] - 0s 35us/step - loss: 1.2598 -
 accuracy: 0.5308 - val_loss: 1.0957 - val_accuracy: 0.8443
 Epoch 9/50
 4853/4853 [=====] - 0s 47us/step - loss: 1.2223 -
 accuracy: 0.5677 - val_loss: 1.0565 - val_accuracy: 0.8451
 Epoch 10/50
 4853/4853 [=====] - 0s 46us/step - loss: 1.2085 -
 accuracy: 0.5683 - val_loss: 1.0260 - val_accuracy: 0.8476
 Epoch 11/50
 4853/4853 [=====] - 0s 42us/step - loss: 1.1728 -
 accuracy: 0.5943 - val_loss: 0.9905 - val_accuracy: 0.8451
 Epoch 12/50
 4853/4853 [=====] - 0s 47us/step - loss: 1.1624 -
 accuracy: 0.6038 - val_loss: 0.9599 - val_accuracy: 0.8443
 Epoch 13/50
 4853/4853 [=====] - 0s 42us/step - loss: 1.1341 -
 accuracy: 0.6153 - val_loss: 0.9324 - val_accuracy: 0.8443
 Epoch 14/50
 4853/4853 [=====] - 0s 54us/step - loss: 1.1145 -
 accuracy: 0.6198 - val_loss: 0.9030 - val_accuracy: 0.8468
 Epoch 15/50
 4853/4853 [=====] - 0s 28us/step - loss: 1.1029 -
 accuracy: 0.6192 - val_loss: 0.8766 - val_accuracy: 0.8435
 Epoch 16/50
 4853/4853 [=====] - 0s 37us/step - loss: 1.0934 -
 accuracy: 0.6322 - val_loss: 0.8578 - val_accuracy: 0.8427
 Epoch 17/50
 4853/4853 [=====] - 0s 45us/step - loss: 1.0723 -
 accuracy: 0.6513 - val_loss: 0.8330 - val_accuracy: 0.8443
 Epoch 18/50
 4853/4853 [=====] - 0s 35us/step - loss: 1.0331 -
 accuracy: 0.6833 - val_loss: 0.8071 - val_accuracy: 0.8451
 Epoch 19/50
 4853/4853 [=====] - 0s 33us/step - loss: 1.0374 -
 accuracy: 0.6765 - val_loss: 0.7907 - val_accuracy: 0.8451
 Epoch 20/50
 4853/4853 [=====] - 0s 32us/step - loss: 1.0239 -

accuracy: 0.6893 - val_loss: 0.7738 - val_accuracy: 0.8443
 Epoch 21/50
 4853/4853 [=====] - 0s 34us/step - loss: 0.9977 -
 accuracy: 0.6973 - val_loss: 0.7557 - val_accuracy: 0.8451
 Epoch 22/50
 4853/4853 [=====] - 0s 42us/step - loss: 0.9950 -
 accuracy: 0.7020 - val_loss: 0.7412 - val_accuracy: 0.8443
 Epoch 23/50
 4853/4853 [=====] - 0s 27us/step - loss: 0.9630 -
 accuracy: 0.7142 - val_loss: 0.7253 - val_accuracy: 0.8443
 Epoch 24/50
 4853/4853 [=====] - 0s 20us/step - loss: 0.9476 -
 accuracy: 0.7183 - val_loss: 0.7081 - val_accuracy: 0.8435
 Epoch 25/50
 4853/4853 [=====] - 0s 22us/step - loss: 0.9310 -
 accuracy: 0.7216 - val_loss: 0.6950 - val_accuracy: 0.8443
 Epoch 26/50
 4853/4853 [=====] - 0s 21us/step - loss: 0.9305 -
 accuracy: 0.7140 - val_loss: 0.6842 - val_accuracy: 0.8427
 Epoch 27/50
 4853/4853 [=====] - 0s 22us/step - loss: 0.9147 -
 accuracy: 0.7239 - val_loss: 0.6750 - val_accuracy: 0.8435
 Epoch 28/50
 4853/4853 [=====] - 0s 51us/step - loss: 0.9085 -
 accuracy: 0.7264 - val_loss: 0.6638 - val_accuracy: 0.8418
 Epoch 29/50
 4853/4853 [=====] - 0s 30us/step - loss: 0.8987 -
 accuracy: 0.7268 - val_loss: 0.6534 - val_accuracy: 0.8418
 Epoch 30/50
 4853/4853 [=====] - 0s 39us/step - loss: 0.8934 -
 accuracy: 0.7309 - val_loss: 0.6433 - val_accuracy: 0.8418
 Epoch 31/50
 4853/4853 [=====] - 0s 34us/step - loss: 0.8799 -
 accuracy: 0.7255 - val_loss: 0.6353 - val_accuracy: 0.8402
 Epoch 32/50
 4853/4853 [=====] - 0s 41us/step - loss: 0.8691 -
 accuracy: 0.7313 - val_loss: 0.6307 - val_accuracy: 0.8410
 Epoch 33/50
 4853/4853 [=====] - 0s 33us/step - loss: 0.8579 -
 accuracy: 0.7344 - val_loss: 0.6217 - val_accuracy: 0.8410
 Epoch 34/50
 4853/4853 [=====] - 0s 33us/step - loss: 0.8776 -
 accuracy: 0.7224 - val_loss: 0.6149 - val_accuracy: 0.8418
 Epoch 35/50
 4853/4853 [=====] - 0s 43us/step - loss: 0.8553 -
 accuracy: 0.7311 - val_loss: 0.6087 - val_accuracy: 0.8418
 Epoch 36/50
 4853/4853 [=====] - 0s 46us/step - loss: 0.8473 -

```

accuracy: 0.7317 - val_loss: 0.6023 - val_accuracy: 0.8418
Epoch 37/50
4853/4853 [=====] - 0s 42us/step - loss: 0.8371 -
accuracy: 0.7377 - val_loss: 0.5953 - val_accuracy: 0.8418
Epoch 38/50
4853/4853 [=====] - 0s 47us/step - loss: 0.8236 -
accuracy: 0.7402 - val_loss: 0.5905 - val_accuracy: 0.8418
Epoch 39/50
4853/4853 [=====] - 0s 49us/step - loss: 0.8194 -
accuracy: 0.7412 - val_loss: 0.5830 - val_accuracy: 0.8418
Epoch 40/50
4853/4853 [=====] - 0s 40us/step - loss: 0.8075 -
accuracy: 0.7418 - val_loss: 0.5810 - val_accuracy: 0.8418
Epoch 41/50
4853/4853 [=====] - 0s 22us/step - loss: 0.7986 -
accuracy: 0.7457 - val_loss: 0.5788 - val_accuracy: 0.8410
Epoch 42/50
4853/4853 [=====] - 0s 20us/step - loss: 0.8122 -
accuracy: 0.7342 - val_loss: 0.5736 - val_accuracy: 0.8418
Epoch 43/50
4853/4853 [=====] - 0s 23us/step - loss: 0.8125 -
accuracy: 0.7367 - val_loss: 0.5694 - val_accuracy: 0.8410
Epoch 44/50
4853/4853 [=====] - 0s 38us/step - loss: 0.7907 -
accuracy: 0.7465 - val_loss: 0.5654 - val_accuracy: 0.8427
Epoch 45/50
4853/4853 [=====] - 0s 32us/step - loss: 0.7936 -
accuracy: 0.7439 - val_loss: 0.5608 - val_accuracy: 0.8418
Epoch 46/50
4853/4853 [=====] - 0s 35us/step - loss: 0.7731 -
accuracy: 0.7525 - val_loss: 0.5569 - val_accuracy: 0.8427
Epoch 47/50
4853/4853 [=====] - 0s 43us/step - loss: 0.7795 -
accuracy: 0.7501 - val_loss: 0.5532 - val_accuracy: 0.8418
Epoch 48/50
4853/4853 [=====] - 0s 30us/step - loss: 0.7848 -
accuracy: 0.7449 - val_loss: 0.5511 - val_accuracy: 0.8427
Epoch 49/50
4853/4853 [=====] - 0s 45us/step - loss: 0.7783 -
accuracy: 0.7459 - val_loss: 0.5490 - val_accuracy: 0.8427
Epoch 50/50
4853/4853 [=====] - 0s 32us/step - loss: 0.7793 -
accuracy: 0.7443 - val_loss: 0.5447 - val_accuracy: 0.8410
2023/2023 [=====] - 0s 84us/step

```



Sequential with Kfold CV:

Training for fold 2 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_32"

Layer (type)	Output Shape	Param #
dense_171 (Dense)	(None, 48)	192
dense_172 (Dense)	(None, 24)	1176
dropout_109 (Dropout)	(None, 24)	0
dense_173 (Dense)	(None, 12)	300
dropout_110 (Dropout)	(None, 12)	0
dense_174 (Dense)	(None, 6)	78
dropout_111 (Dropout)	(None, 6)	0

```

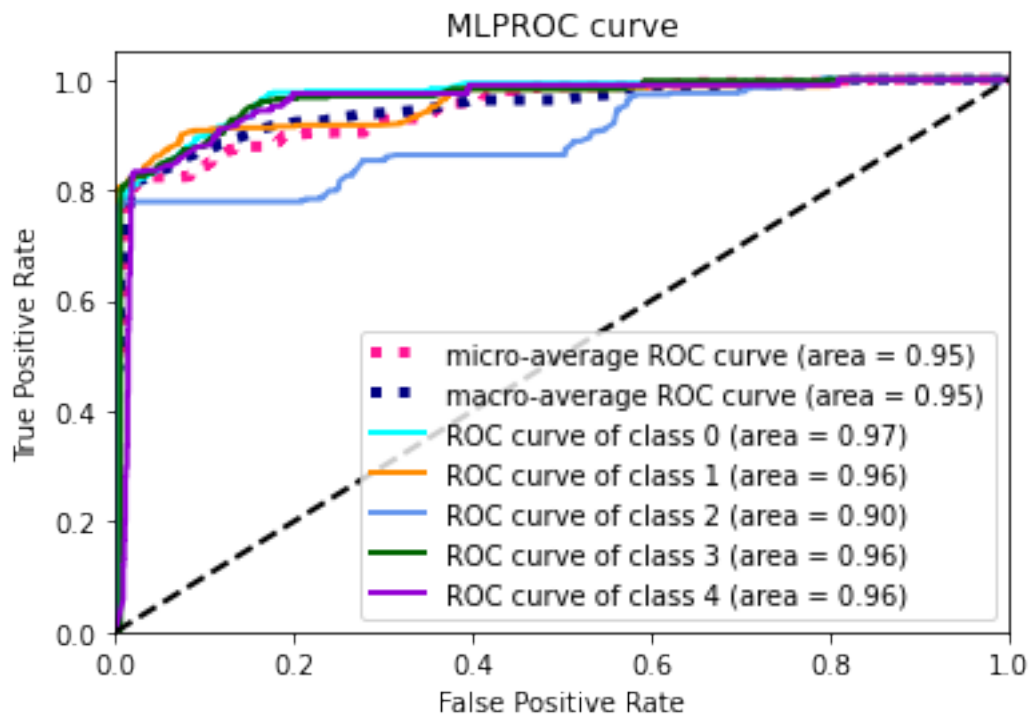
dense_175 (Dense)                (None, 5)                35
=====
Total params: 1,781
Trainable params: 1,781
Non-trainable params: 0
-----
Train on 4853 samples, validate on 1214 samples
Epoch 1/50
4853/4853 [=====] - 4s 899us/step - loss: 1.6142 -
accuracy: 0.2155 - val_loss: 1.5017 - val_accuracy: 0.3649
Epoch 2/50
4853/4853 [=====] - 0s 41us/step - loss: 1.5108 -
accuracy: 0.3128 - val_loss: 1.4313 - val_accuracy: 0.3682
Epoch 3/50
4853/4853 [=====] - 0s 40us/step - loss: 1.4580 -
accuracy: 0.3538 - val_loss: 1.3830 - val_accuracy: 0.5445
Epoch 4/50
4853/4853 [=====] - 0s 28us/step - loss: 1.4158 -
accuracy: 0.3995 - val_loss: 1.3190 - val_accuracy: 0.5445
Epoch 5/50
4853/4853 [=====] - 0s 31us/step - loss: 1.3747 -
accuracy: 0.4379 - val_loss: 1.2627 - val_accuracy: 0.5437
Epoch 6/50
4853/4853 [=====] - 0s 42us/step - loss: 1.3225 -
accuracy: 0.4719 - val_loss: 1.2062 - val_accuracy: 0.6269
Epoch 7/50
4853/4853 [=====] - 0s 45us/step - loss: 1.2880 -
accuracy: 0.5114 - val_loss: 1.1497 - val_accuracy: 0.7076
Epoch 8/50
4853/4853 [=====] - 0s 25us/step - loss: 1.2554 -
accuracy: 0.5370 - val_loss: 1.0933 - val_accuracy: 0.7084
Epoch 9/50
4853/4853 [=====] - 0s 23us/step - loss: 1.2163 -
accuracy: 0.5549 - val_loss: 1.0539 - val_accuracy: 0.7076
Epoch 10/50
4853/4853 [=====] - 0s 33us/step - loss: 1.1907 -
accuracy: 0.5735 - val_loss: 1.0189 - val_accuracy: 0.7084
Epoch 11/50
4853/4853 [=====] - 0s 34us/step - loss: 1.1626 -
accuracy: 0.5862 - val_loss: 0.9771 - val_accuracy: 0.7076
Epoch 12/50
4853/4853 [=====] - 0s 37us/step - loss: 1.1291 -
accuracy: 0.5899 - val_loss: 0.9480 - val_accuracy: 0.7076
Epoch 13/50
4853/4853 [=====] - 0s 36us/step - loss: 1.1121 -
accuracy: 0.5920 - val_loss: 0.9199 - val_accuracy: 0.7076
Epoch 14/50
4853/4853 [=====] - 0s 37us/step - loss: 1.1032 -

```

accuracy: 0.5902 - val_loss: 0.8922 - val_accuracy: 0.7076
 Epoch 15/50
 4853/4853 [=====] - 0s 21us/step - loss: 1.0648 -
 accuracy: 0.6073 - val_loss: 0.8582 - val_accuracy: 0.7076
 Epoch 16/50
 4853/4853 [=====] - 0s 22us/step - loss: 1.0455 -
 accuracy: 0.6042 - val_loss: 0.8361 - val_accuracy: 0.7084
 Epoch 17/50
 4853/4853 [=====] - 0s 23us/step - loss: 1.0437 -
 accuracy: 0.6052 - val_loss: 0.8111 - val_accuracy: 0.7076
 Epoch 18/50
 4853/4853 [=====] - 0s 37us/step - loss: 1.0090 -
 accuracy: 0.6155 - val_loss: 0.7938 - val_accuracy: 0.7076
 Epoch 19/50
 4853/4853 [=====] - 0s 35us/step - loss: 1.0039 -
 accuracy: 0.6211 - val_loss: 0.7817 - val_accuracy: 0.7084
 Epoch 20/50
 4853/4853 [=====] - 0s 53us/step - loss: 0.9867 -
 accuracy: 0.6227 - val_loss: 0.7638 - val_accuracy: 0.7084
 Epoch 21/50
 4853/4853 [=====] - 0s 53us/step - loss: 0.9811 -
 accuracy: 0.6295 - val_loss: 0.7502 - val_accuracy: 0.7076
 Epoch 22/50
 4853/4853 [=====] - 0s 50us/step - loss: 0.9605 -
 accuracy: 0.6279 - val_loss: 0.7345 - val_accuracy: 0.7084
 Epoch 23/50
 4853/4853 [=====] - 0s 38us/step - loss: 0.9607 -
 accuracy: 0.6371 - val_loss: 0.7220 - val_accuracy: 0.7084
 Epoch 24/50
 4853/4853 [=====] - 0s 26us/step - loss: 0.9403 -
 accuracy: 0.6400 - val_loss: 0.7211 - val_accuracy: 0.7084
 Epoch 25/50
 4853/4853 [=====] - 0s 34us/step - loss: 0.9313 -
 accuracy: 0.6474 - val_loss: 0.7079 - val_accuracy: 0.7084
 Epoch 26/50
 4853/4853 [=====] - 0s 34us/step - loss: 0.9362 -
 accuracy: 0.6357 - val_loss: 0.6999 - val_accuracy: 0.7084
 Epoch 27/50
 4853/4853 [=====] - 0s 51us/step - loss: 0.9270 -
 accuracy: 0.6410 - val_loss: 0.6828 - val_accuracy: 0.7092
 Epoch 28/50
 4853/4853 [=====] - 0s 32us/step - loss: 0.9012 -
 accuracy: 0.6610 - val_loss: 0.6733 - val_accuracy: 0.7100
 Epoch 29/50
 4853/4853 [=====] - 0s 56us/step - loss: 0.9151 -
 accuracy: 0.6520 - val_loss: 0.6654 - val_accuracy: 0.7084
 Epoch 30/50
 4853/4853 [=====] - 0s 35us/step - loss: 0.8890 -

accuracy: 0.6703 - val_loss: 0.6579 - val_accuracy: 0.7109
 Epoch 31/50
 4853/4853 [=====] - 0s 44us/step - loss: 0.8907 -
 accuracy: 0.6606 - val_loss: 0.6528 - val_accuracy: 0.7100
 Epoch 32/50
 4853/4853 [=====] - 0s 39us/step - loss: 0.8779 -
 accuracy: 0.6654 - val_loss: 0.6461 - val_accuracy: 0.7109
 Epoch 33/50
 4853/4853 [=====] - 0s 32us/step - loss: 0.8832 -
 accuracy: 0.6722 - val_loss: 0.6351 - val_accuracy: 0.8674
 Epoch 34/50
 4853/4853 [=====] - 0s 28us/step - loss: 0.8633 -
 accuracy: 0.6823 - val_loss: 0.6294 - val_accuracy: 0.7191
 Epoch 35/50
 4853/4853 [=====] - 0s 28us/step - loss: 0.8712 -
 accuracy: 0.6872 - val_loss: 0.6271 - val_accuracy: 0.8682
 Epoch 36/50
 4853/4853 [=====] - 0s 30us/step - loss: 0.8558 -
 accuracy: 0.6938 - val_loss: 0.6197 - val_accuracy: 0.8682
 Epoch 37/50
 4853/4853 [=====] - 0s 53us/step - loss: 0.8666 -
 accuracy: 0.6948 - val_loss: 0.6157 - val_accuracy: 0.8674
 Epoch 38/50
 4853/4853 [=====] - 0s 33us/step - loss: 0.8324 -
 accuracy: 0.7107 - val_loss: 0.6118 - val_accuracy: 0.8674
 Epoch 39/50
 4853/4853 [=====] - 0s 34us/step - loss: 0.8397 -
 accuracy: 0.7039 - val_loss: 0.5988 - val_accuracy: 0.8674
 Epoch 40/50
 4853/4853 [=====] - 0s 53us/step - loss: 0.8422 -
 accuracy: 0.7189 - val_loss: 0.5915 - val_accuracy: 0.8674
 Epoch 41/50
 4853/4853 [=====] - 0s 38us/step - loss: 0.8373 -
 accuracy: 0.7226 - val_loss: 0.5833 - val_accuracy: 0.8674
 Epoch 42/50
 4853/4853 [=====] - 0s 27us/step - loss: 0.8314 -
 accuracy: 0.7268 - val_loss: 0.5802 - val_accuracy: 0.8674
 Epoch 43/50
 4853/4853 [=====] - 0s 45us/step - loss: 0.8178 -
 accuracy: 0.7253 - val_loss: 0.5850 - val_accuracy: 0.8600
 Epoch 44/50
 4853/4853 [=====] - 0s 36us/step - loss: 0.8118 -
 accuracy: 0.7373 - val_loss: 0.5689 - val_accuracy: 0.8674
 Epoch 45/50
 4853/4853 [=====] - 0s 22us/step - loss: 0.8164 -
 accuracy: 0.7350 - val_loss: 0.5743 - val_accuracy: 0.8649
 Epoch 46/50
 4853/4853 [=====] - 0s 23us/step - loss: 0.8137 -

accuracy: 0.7243 - val_loss: 0.5659 - val_accuracy: 0.8674
Epoch 47/50
4853/4853 [=====] - 0s 21us/step - loss: 0.8019 -
accuracy: 0.7338 - val_loss: 0.5666 - val_accuracy: 0.8649
Epoch 48/50
4853/4853 [=====] - 0s 21us/step - loss: 0.8008 -
accuracy: 0.7340 - val_loss: 0.5536 - val_accuracy: 0.8674
Epoch 49/50
4853/4853 [=====] - 0s 23us/step - loss: 0.8039 -
accuracy: 0.7327 - val_loss: 0.5498 - val_accuracy: 0.8666
Epoch 50/50
4853/4853 [=====] - 0s 32us/step - loss: 0.7774 -
accuracy: 0.7342 - val_loss: 0.5462 - val_accuracy: 0.8666
2023/2023 [=====] - 0s 95us/step



Sequential with Kfold CV:

Training for fold 3 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_33"

Layer (type)	Output Shape	Param #
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```

=====
dense_176 (Dense)                (None, 48)                192
-----
dense_177 (Dense)                (None, 24)                1176
-----
dropout_112 (Dropout)           (None, 24)                0
-----
dense_178 (Dense)                (None, 12)                300
-----
dropout_113 (Dropout)           (None, 12)                0
-----
dense_179 (Dense)                (None, 6)                 78
-----
dropout_114 (Dropout)           (None, 6)                 0
-----
dense_180 (Dense)                (None, 5)                 35
=====
Total params: 1,781
Trainable params: 1,781
Non-trainable params: 0
-----
Train on 4854 samples, validate on 1213 samples
Epoch 1/50
4854/4854 [=====] - 4s 820us/step - loss: 1.6146 -
accuracy: 0.1448 - val_loss: 1.5211 - val_accuracy: 0.1022
Epoch 2/50
4854/4854 [=====] - 0s 31us/step - loss: 1.5433 -
accuracy: 0.2340 - val_loss: 1.4780 - val_accuracy: 0.5243
Epoch 3/50
4854/4854 [=====] - 0s 38us/step - loss: 1.4989 -
accuracy: 0.3068 - val_loss: 1.4367 - val_accuracy: 0.6727
Epoch 4/50
4854/4854 [=====] - 0s 40us/step - loss: 1.4582 -
accuracy: 0.3754 - val_loss: 1.3880 - val_accuracy: 0.6719
Epoch 5/50
4854/4854 [=====] - 0s 38us/step - loss: 1.4240 -
accuracy: 0.4178 - val_loss: 1.3549 - val_accuracy: 0.6777
Epoch 6/50
4854/4854 [=====] - 0s 42us/step - loss: 1.3980 -
accuracy: 0.4596 - val_loss: 1.3158 - val_accuracy: 0.6752
Epoch 7/50
4854/4854 [=====] - 0s 44us/step - loss: 1.3683 -
accuracy: 0.4813 - val_loss: 1.2781 - val_accuracy: 0.7964
Epoch 8/50
4854/4854 [=====] - 0s 31us/step - loss: 1.3357 -
accuracy: 0.5000 - val_loss: 1.2359 - val_accuracy: 0.6834
Epoch 9/50
4854/4854 [=====] - 0s 30us/step - loss: 1.3049 -

```

```

accuracy: 0.5072 - val_loss: 1.1930 - val_accuracy: 0.6810
Epoch 10/50
4854/4854 [=====] - 0s 30us/step - loss: 1.2770 -
accuracy: 0.5200 - val_loss: 1.1550 - val_accuracy: 0.6810
Epoch 11/50
4854/4854 [=====] - 0s 19us/step - loss: 1.2494 -
accuracy: 0.5383 - val_loss: 1.1292 - val_accuracy: 0.6810
Epoch 12/50
4854/4854 [=====] - 0s 22us/step - loss: 1.2350 -
accuracy: 0.5400 - val_loss: 1.0978 - val_accuracy: 0.6785
Epoch 13/50
4854/4854 [=====] - 0s 35us/step - loss: 1.2106 -
accuracy: 0.5455 - val_loss: 1.0690 - val_accuracy: 0.6826
Epoch 14/50
4854/4854 [=====] - 0s 35us/step - loss: 1.1828 -
accuracy: 0.5612 - val_loss: 1.0328 - val_accuracy: 0.6785
Epoch 15/50
4854/4854 [=====] - 0s 41us/step - loss: 1.1616 -
accuracy: 0.5682 - val_loss: 1.0001 - val_accuracy: 0.6785
Epoch 16/50
4854/4854 [=====] - 0s 43us/step - loss: 1.1379 -
accuracy: 0.5688 - val_loss: 0.9693 - val_accuracy: 0.6785
Epoch 17/50
4854/4854 [=====] - 0s 53us/step - loss: 1.1167 -
accuracy: 0.5820 - val_loss: 0.9463 - val_accuracy: 0.6801
Epoch 18/50
4854/4854 [=====] - 0s 33us/step - loss: 1.0958 -
accuracy: 0.5906 - val_loss: 0.9202 - val_accuracy: 0.6785
Epoch 19/50
4854/4854 [=====] - 0s 34us/step - loss: 1.0716 -
accuracy: 0.5960 - val_loss: 0.8962 - val_accuracy: 0.6801
Epoch 20/50
4854/4854 [=====] - 0s 28us/step - loss: 1.0714 -
accuracy: 0.5989 - val_loss: 0.8771 - val_accuracy: 0.6785
Epoch 21/50
4854/4854 [=====] - 0s 31us/step - loss: 1.0454 -
accuracy: 0.6063 - val_loss: 0.8629 - val_accuracy: 0.6818
Epoch 22/50
4854/4854 [=====] - 0s 40us/step - loss: 1.0427 -
accuracy: 0.6055 - val_loss: 0.8459 - val_accuracy: 0.6801
Epoch 23/50
4854/4854 [=====] - 0s 38us/step - loss: 1.0215 -
accuracy: 0.6224 - val_loss: 0.8301 - val_accuracy: 0.7519
Epoch 24/50
4854/4854 [=====] - 0s 35us/step - loss: 1.0054 -
accuracy: 0.6339 - val_loss: 0.8118 - val_accuracy: 0.6892
Epoch 25/50
4854/4854 [=====] - 0s 33us/step - loss: 0.9940 -

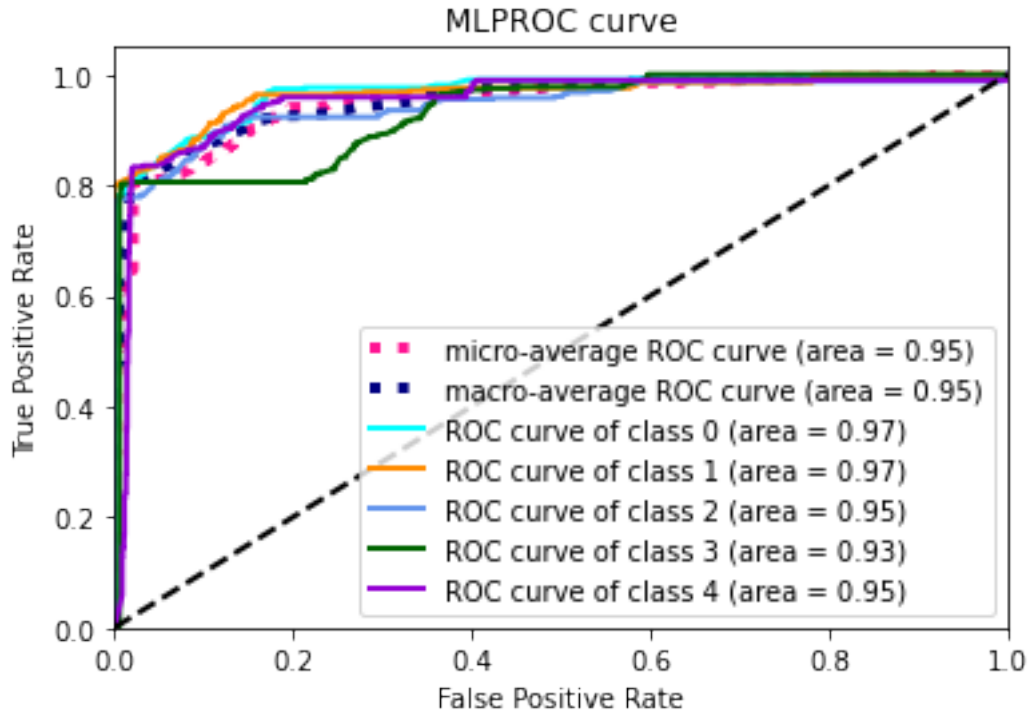
```

accuracy: 0.6345 - val_loss: 0.8010 - val_accuracy: 0.6826
 Epoch 26/50
 4854/4854 [=====] - 0s 50us/step - loss: 0.9795 -
 accuracy: 0.6405 - val_loss: 0.7891 - val_accuracy: 0.6834
 Epoch 27/50
 4854/4854 [=====] - 0s 28us/step - loss: 0.9786 -
 accuracy: 0.6382 - val_loss: 0.7796 - val_accuracy: 0.6818
 Epoch 28/50
 4854/4854 [=====] - 0s 42us/step - loss: 0.9672 -
 accuracy: 0.6397 - val_loss: 0.7694 - val_accuracy: 0.6966
 Epoch 29/50
 4854/4854 [=====] - 0s 45us/step - loss: 0.9581 -
 accuracy: 0.6452 - val_loss: 0.7611 - val_accuracy: 0.7007
 Epoch 30/50
 4854/4854 [=====] - 0s 50us/step - loss: 0.9503 -
 accuracy: 0.6590 - val_loss: 0.7568 - val_accuracy: 0.8285
 Epoch 31/50
 4854/4854 [=====] - 0s 34us/step - loss: 0.9316 -
 accuracy: 0.6562 - val_loss: 0.7460 - val_accuracy: 0.6999
 Epoch 32/50
 4854/4854 [=====] - 0s 30us/step - loss: 0.9255 -
 accuracy: 0.6539 - val_loss: 0.7372 - val_accuracy: 0.6826
 Epoch 33/50
 4854/4854 [=====] - 0s 29us/step - loss: 0.9149 -
 accuracy: 0.6568 - val_loss: 0.7281 - val_accuracy: 0.7560
 Epoch 34/50
 4854/4854 [=====] - 0s 41us/step - loss: 0.9127 -
 accuracy: 0.6607 - val_loss: 0.7175 - val_accuracy: 0.7049
 Epoch 35/50
 4854/4854 [=====] - 0s 34us/step - loss: 0.8963 -
 accuracy: 0.6733 - val_loss: 0.7079 - val_accuracy: 0.6958
 Epoch 36/50
 4854/4854 [=====] - 0s 47us/step - loss: 0.8914 -
 accuracy: 0.6677 - val_loss: 0.7068 - val_accuracy: 0.8508
 Epoch 37/50
 4854/4854 [=====] - 0s 42us/step - loss: 0.8732 -
 accuracy: 0.7015 - val_loss: 0.6951 - val_accuracy: 0.7815
 Epoch 38/50
 4854/4854 [=====] - 0s 25us/step - loss: 0.8657 -
 accuracy: 0.6854 - val_loss: 0.6876 - val_accuracy: 0.8203
 Epoch 39/50
 4854/4854 [=====] - 0s 19us/step - loss: 0.8671 -
 accuracy: 0.6902 - val_loss: 0.6813 - val_accuracy: 0.7865
 Epoch 40/50
 4854/4854 [=====] - 0s 22us/step - loss: 0.8659 -
 accuracy: 0.6877 - val_loss: 0.6753 - val_accuracy: 0.7741
 Epoch 41/50
 4854/4854 [=====] - 0s 36us/step - loss: 0.8496 -

```

accuracy: 0.6893 - val_loss: 0.6746 - val_accuracy: 0.8277
Epoch 42/50
4854/4854 [=====] - 0s 31us/step - loss: 0.8495 -
accuracy: 0.6963 - val_loss: 0.6653 - val_accuracy: 0.8376
Epoch 43/50
4854/4854 [=====] - 0s 47us/step - loss: 0.8436 -
accuracy: 0.6943 - val_loss: 0.6584 - val_accuracy: 0.7675
Epoch 44/50
4854/4854 [=====] - 0s 51us/step - loss: 0.8371 -
accuracy: 0.6924 - val_loss: 0.6542 - val_accuracy: 0.8392
Epoch 45/50
4854/4854 [=====] - 0s 29us/step - loss: 0.8423 -
accuracy: 0.6930 - val_loss: 0.6589 - val_accuracy: 0.8508
Epoch 46/50
4854/4854 [=====] - 0s 33us/step - loss: 0.8393 -
accuracy: 0.7011 - val_loss: 0.6581 - val_accuracy: 0.8417
Epoch 47/50
4854/4854 [=====] - 0s 34us/step - loss: 0.8124 -
accuracy: 0.7134 - val_loss: 0.6431 - val_accuracy: 0.8442
Epoch 48/50
4854/4854 [=====] - 0s 56us/step - loss: 0.8335 -
accuracy: 0.7023 - val_loss: 0.6418 - val_accuracy: 0.8467
Epoch 49/50
4854/4854 [=====] - 0s 27us/step - loss: 0.8073 -
accuracy: 0.7083 - val_loss: 0.6327 - val_accuracy: 0.8508
Epoch 50/50
4854/4854 [=====] - 0s 44us/step - loss: 0.7965 -
accuracy: 0.7260 - val_loss: 0.6379 - val_accuracy: 0.8483
2023/2023 [=====] - 0s 88us/step

```



Sequential with Kfold CV:

Training for fold 4 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_34"

Layer (type)	Output Shape	Param #
dense_181 (Dense)	(None, 48)	192
dense_182 (Dense)	(None, 24)	1176
dropout_115 (Dropout)	(None, 24)	0
dense_183 (Dense)	(None, 12)	300
dropout_116 (Dropout)	(None, 12)	0
dense_184 (Dense)	(None, 6)	78
dropout_117 (Dropout)	(None, 6)	0

```

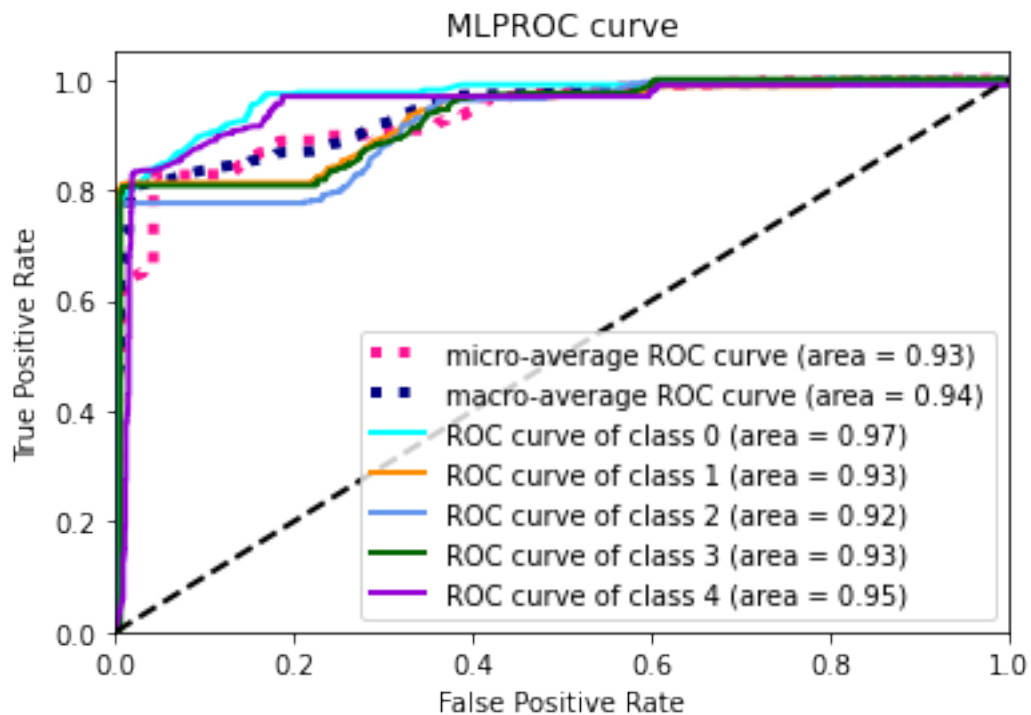
dense_185 (Dense)                (None, 5)                35
=====
Total params: 1,781
Trainable params: 1,781
Non-trainable params: 0
-----
Train on 4854 samples, validate on 1213 samples
Epoch 1/50
4854/4854 [=====] - 4s 725us/step - loss: 1.6012 -
accuracy: 0.2188 - val_loss: 1.5573 - val_accuracy: 0.3570
Epoch 2/50
4854/4854 [=====] - 0s 24us/step - loss: 1.5521 -
accuracy: 0.2936 - val_loss: 1.5127 - val_accuracy: 0.5161
Epoch 3/50
4854/4854 [=====] - 0s 27us/step - loss: 1.5131 -
accuracy: 0.3603 - val_loss: 1.4570 - val_accuracy: 0.6702
Epoch 4/50
4854/4854 [=====] - 0s 28us/step - loss: 1.4735 -
accuracy: 0.4063 - val_loss: 1.4097 - val_accuracy: 0.5556
Epoch 5/50
4854/4854 [=====] - 0s 28us/step - loss: 1.4352 -
accuracy: 0.4236 - val_loss: 1.3669 - val_accuracy: 0.5194
Epoch 6/50
4854/4854 [=====] - 0s 28us/step - loss: 1.3989 -
accuracy: 0.4501 - val_loss: 1.3231 - val_accuracy: 0.5169
Epoch 7/50
4854/4854 [=====] - 0s 29us/step - loss: 1.3645 -
accuracy: 0.4771 - val_loss: 1.2737 - val_accuracy: 0.6801
Epoch 8/50
4854/4854 [=====] - 0s 28us/step - loss: 1.3293 -
accuracy: 0.4893 - val_loss: 1.2286 - val_accuracy: 0.6892
Epoch 9/50
4854/4854 [=====] - 0s 28us/step - loss: 1.2987 -
accuracy: 0.5068 - val_loss: 1.1843 - val_accuracy: 0.6801
Epoch 10/50
4854/4854 [=====] - 0s 30us/step - loss: 1.2672 -
accuracy: 0.5126 - val_loss: 1.1416 - val_accuracy: 0.6801
Epoch 11/50
4854/4854 [=====] - 0s 27us/step - loss: 1.2372 -
accuracy: 0.5157 - val_loss: 1.1082 - val_accuracy: 0.6810
Epoch 12/50
4854/4854 [=====] - 0s 28us/step - loss: 1.2124 -
accuracy: 0.5299 - val_loss: 1.0706 - val_accuracy: 0.6801
Epoch 13/50
4854/4854 [=====] - 0s 30us/step - loss: 1.1856 -
accuracy: 0.5352 - val_loss: 1.0415 - val_accuracy: 0.6810
Epoch 14/50
4854/4854 [=====] - 0s 30us/step - loss: 1.1551 -

```

accuracy: 0.5525 - val_loss: 1.0190 - val_accuracy: 0.6810
 Epoch 15/50
 4854/4854 [=====] - 0s 30us/step - loss: 1.1376 -
 accuracy: 0.5606 - val_loss: 0.9975 - val_accuracy: 0.6801
 Epoch 16/50
 4854/4854 [=====] - 0s 28us/step - loss: 1.1143 -
 accuracy: 0.5816 - val_loss: 0.9792 - val_accuracy: 0.6793
 Epoch 17/50
 4854/4854 [=====] - 0s 30us/step - loss: 1.1125 -
 accuracy: 0.5859 - val_loss: 0.9635 - val_accuracy: 0.6801
 Epoch 18/50
 4854/4854 [=====] - 0s 29us/step - loss: 1.0819 -
 accuracy: 0.5921 - val_loss: 0.9474 - val_accuracy: 0.6785
 Epoch 19/50
 4854/4854 [=====] - 0s 28us/step - loss: 1.0657 -
 accuracy: 0.6131 - val_loss: 0.9339 - val_accuracy: 0.6793
 Epoch 20/50
 4854/4854 [=====] - 0s 30us/step - loss: 1.0639 -
 accuracy: 0.6108 - val_loss: 0.9219 - val_accuracy: 0.6793
 Epoch 21/50
 4854/4854 [=====] - 0s 28us/step - loss: 1.0488 -
 accuracy: 0.6205 - val_loss: 0.9125 - val_accuracy: 0.6801
 Epoch 22/50
 4854/4854 [=====] - 0s 31us/step - loss: 1.0364 -
 accuracy: 0.6286 - val_loss: 0.9026 - val_accuracy: 0.6793
 Epoch 23/50
 4854/4854 [=====] - 0s 26us/step - loss: 1.0265 -
 accuracy: 0.6286 - val_loss: 0.8919 - val_accuracy: 0.6801
 Epoch 24/50
 4854/4854 [=====] - 0s 28us/step - loss: 1.0153 -
 accuracy: 0.6298 - val_loss: 0.8812 - val_accuracy: 0.6801
 Epoch 25/50
 4854/4854 [=====] - 0s 28us/step - loss: 1.0025 -
 accuracy: 0.6409 - val_loss: 0.8747 - val_accuracy: 0.6801
 Epoch 26/50
 4854/4854 [=====] - 0s 30us/step - loss: 0.9817 -
 accuracy: 0.6457 - val_loss: 0.8658 - val_accuracy: 0.6801
 Epoch 27/50
 4854/4854 [=====] - 0s 28us/step - loss: 0.9823 -
 accuracy: 0.6593 - val_loss: 0.8587 - val_accuracy: 0.6801
 Epoch 28/50
 4854/4854 [=====] - 0s 28us/step - loss: 0.9609 -
 accuracy: 0.6454 - val_loss: 0.8487 - val_accuracy: 0.6801
 Epoch 29/50
 4854/4854 [=====] - 0s 32us/step - loss: 0.9673 -
 accuracy: 0.6457 - val_loss: 0.8385 - val_accuracy: 0.6810
 Epoch 30/50
 4854/4854 [=====] - 0s 27us/step - loss: 0.9583 -

accuracy: 0.6508 - val_loss: 0.8286 - val_accuracy: 0.6818
 Epoch 31/50
 4854/4854 [=====] - 0s 29us/step - loss: 0.9490 -
 accuracy: 0.6603 - val_loss: 0.8218 - val_accuracy: 0.6810
 Epoch 32/50
 4854/4854 [=====] - 0s 29us/step - loss: 0.9288 -
 accuracy: 0.6712 - val_loss: 0.8162 - val_accuracy: 0.7370
 Epoch 33/50
 4854/4854 [=====] - 0s 30us/step - loss: 0.9142 -
 accuracy: 0.6912 - val_loss: 0.8098 - val_accuracy: 0.7378
 Epoch 34/50
 4854/4854 [=====] - 0s 29us/step - loss: 0.9189 -
 accuracy: 0.6852 - val_loss: 0.8027 - val_accuracy: 0.7683
 Epoch 35/50
 4854/4854 [=====] - 0s 30us/step - loss: 0.9049 -
 accuracy: 0.6976 - val_loss: 0.7948 - val_accuracy: 0.6908
 Epoch 36/50
 4854/4854 [=====] - 0s 29us/step - loss: 0.9007 -
 accuracy: 0.6840 - val_loss: 0.7873 - val_accuracy: 0.7980
 Epoch 37/50
 4854/4854 [=====] - 0s 28us/step - loss: 0.9099 -
 accuracy: 0.6976 - val_loss: 0.7827 - val_accuracy: 0.8335
 Epoch 38/50
 4854/4854 [=====] - 0s 31us/step - loss: 0.8888 -
 accuracy: 0.7048 - val_loss: 0.7767 - val_accuracy: 0.8326
 Epoch 39/50
 4854/4854 [=====] - 0s 28us/step - loss: 0.8859 -
 accuracy: 0.7105 - val_loss: 0.7719 - val_accuracy: 0.8318
 Epoch 40/50
 4854/4854 [=====] - 0s 28us/step - loss: 0.8662 -
 accuracy: 0.7279 - val_loss: 0.7644 - val_accuracy: 0.8318
 Epoch 41/50
 4854/4854 [=====] - 0s 28us/step - loss: 0.8721 -
 accuracy: 0.7367 - val_loss: 0.7600 - val_accuracy: 0.8318
 Epoch 42/50
 4854/4854 [=====] - 0s 32us/step - loss: 0.8644 -
 accuracy: 0.7349 - val_loss: 0.7561 - val_accuracy: 0.8335
 Epoch 43/50
 4854/4854 [=====] - 0s 29us/step - loss: 0.8588 -
 accuracy: 0.7501 - val_loss: 0.7539 - val_accuracy: 0.8335
 Epoch 44/50
 4854/4854 [=====] - 0s 31us/step - loss: 0.8384 -
 accuracy: 0.7528 - val_loss: 0.7475 - val_accuracy: 0.8335
 Epoch 45/50
 4854/4854 [=====] - 0s 27us/step - loss: 0.8393 -
 accuracy: 0.7678 - val_loss: 0.7414 - val_accuracy: 0.8335
 Epoch 46/50
 4854/4854 [=====] - 0s 28us/step - loss: 0.8381 -

accuracy: 0.7621 - val_loss: 0.7337 - val_accuracy: 0.8335
Epoch 47/50
4854/4854 [=====] - 0s 27us/step - loss: 0.8345 -
accuracy: 0.7682 - val_loss: 0.7303 - val_accuracy: 0.8351
Epoch 48/50
4854/4854 [=====] - 0s 28us/step - loss: 0.8139 -
accuracy: 0.7763 - val_loss: 0.7237 - val_accuracy: 0.8359
Epoch 49/50
4854/4854 [=====] - 0s 31us/step - loss: 0.8278 -
accuracy: 0.7686 - val_loss: 0.7190 - val_accuracy: 0.8351
Epoch 50/50
4854/4854 [=====] - 0s 27us/step - loss: 0.8173 -
accuracy: 0.7695 - val_loss: 0.7160 - val_accuracy: 0.8359
2023/2023 [=====] - 0s 83us/step



Sequential with Kfold CV:

Training for fold 5 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Model: "sequential_35"

Layer (type)	Output Shape	Param #
--------------	--------------	---------

```

=====
dense_186 (Dense)                (None, 48)                192
-----
dense_187 (Dense)                (None, 24)                1176
-----
dropout_118 (Dropout)            (None, 24)                0
-----
dense_188 (Dense)                (None, 12)                300
-----
dropout_119 (Dropout)            (None, 12)                0
-----
dense_189 (Dense)                (None, 6)                 78
-----
dropout_120 (Dropout)            (None, 6)                 0
-----
dense_190 (Dense)                (None, 5)                 35
=====
Total params: 1,781
Trainable params: 1,781
Non-trainable params: 0
-----
Train on 4854 samples, validate on 1213 samples
Epoch 1/50
4854/4854 [=====] - 3s 689us/step - loss: 1.5671 -
accuracy: 0.2382 - val_loss: 1.4726 - val_accuracy: 0.1797
Epoch 2/50
4854/4854 [=====] - 0s 25us/step - loss: 1.4774 -
accuracy: 0.3164 - val_loss: 1.4051 - val_accuracy: 0.3528
Epoch 3/50
4854/4854 [=====] - 0s 26us/step - loss: 1.4247 -
accuracy: 0.3793 - val_loss: 1.3582 - val_accuracy: 0.5268
Epoch 4/50
4854/4854 [=====] - 0s 30us/step - loss: 1.3899 -
accuracy: 0.4157 - val_loss: 1.3091 - val_accuracy: 0.5243
Epoch 5/50
4854/4854 [=====] - 0s 29us/step - loss: 1.3533 -
accuracy: 0.4330 - val_loss: 1.2713 - val_accuracy: 0.5251
Epoch 6/50
4854/4854 [=====] - 0s 28us/step - loss: 1.3290 -
accuracy: 0.4557 - val_loss: 1.2326 - val_accuracy: 0.5251
Epoch 7/50
4854/4854 [=====] - 0s 32us/step - loss: 1.3009 -
accuracy: 0.4639 - val_loss: 1.1982 - val_accuracy: 0.5251
Epoch 8/50
4854/4854 [=====] - 0s 28us/step - loss: 1.2716 -
accuracy: 0.4813 - val_loss: 1.1669 - val_accuracy: 0.5251
Epoch 9/50
4854/4854 [=====] - 0s 30us/step - loss: 1.2424 -

```

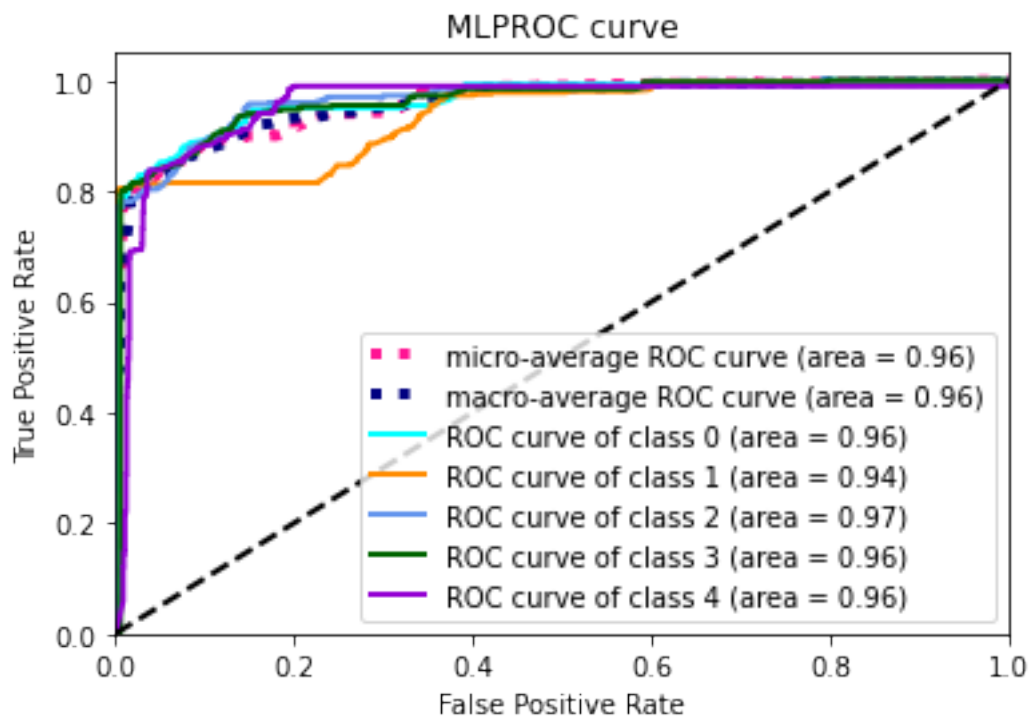
```

accuracy: 0.5037 - val_loss: 1.1302 - val_accuracy: 0.5251
Epoch 10/50
4854/4854 [=====] - 0s 29us/step - loss: 1.2165 -
accuracy: 0.5169 - val_loss: 1.1065 - val_accuracy: 0.5251
Epoch 11/50
4854/4854 [=====] - 0s 30us/step - loss: 1.1875 -
accuracy: 0.5408 - val_loss: 1.0766 - val_accuracy: 0.6686
Epoch 12/50
4854/4854 [=====] - 0s 27us/step - loss: 1.1747 -
accuracy: 0.5476 - val_loss: 1.0538 - val_accuracy: 0.6843
Epoch 13/50
4854/4854 [=====] - 0s 28us/step - loss: 1.1654 -
accuracy: 0.5567 - val_loss: 1.0381 - val_accuracy: 0.8046
Epoch 14/50
4854/4854 [=====] - 0s 32us/step - loss: 1.1497 -
accuracy: 0.5754 - val_loss: 1.0089 - val_accuracy: 0.8425
Epoch 15/50
4854/4854 [=====] - 0s 29us/step - loss: 1.1337 -
accuracy: 0.6086 - val_loss: 0.9800 - val_accuracy: 0.8425
Epoch 16/50
4854/4854 [=====] - 0s 27us/step - loss: 1.1102 -
accuracy: 0.6154 - val_loss: 0.9649 - val_accuracy: 0.8425
Epoch 17/50
4854/4854 [=====] - 0s 31us/step - loss: 1.0932 -
accuracy: 0.6257 - val_loss: 0.9390 - val_accuracy: 0.8417
Epoch 18/50
4854/4854 [=====] - 0s 27us/step - loss: 1.0683 -
accuracy: 0.6471 - val_loss: 0.9146 - val_accuracy: 0.8417
Epoch 19/50
4854/4854 [=====] - 0s 29us/step - loss: 1.0607 -
accuracy: 0.6539 - val_loss: 0.8998 - val_accuracy: 0.8417
Epoch 20/50
4854/4854 [=====] - 0s 29us/step - loss: 1.0435 -
accuracy: 0.6549 - val_loss: 0.8748 - val_accuracy: 0.8409
Epoch 21/50
4854/4854 [=====] - 0s 29us/step - loss: 1.0239 -
accuracy: 0.6685 - val_loss: 0.8523 - val_accuracy: 0.8409
Epoch 22/50
4854/4854 [=====] - 0s 29us/step - loss: 1.0115 -
accuracy: 0.6704 - val_loss: 0.8316 - val_accuracy: 0.8409
Epoch 23/50
4854/4854 [=====] - 0s 30us/step - loss: 0.9880 -
accuracy: 0.6817 - val_loss: 0.8093 - val_accuracy: 0.8417
Epoch 24/50
4854/4854 [=====] - 0s 29us/step - loss: 0.9703 -
accuracy: 0.6850 - val_loss: 0.7865 - val_accuracy: 0.8417
Epoch 25/50
4854/4854 [=====] - 0s 31us/step - loss: 0.9612 -

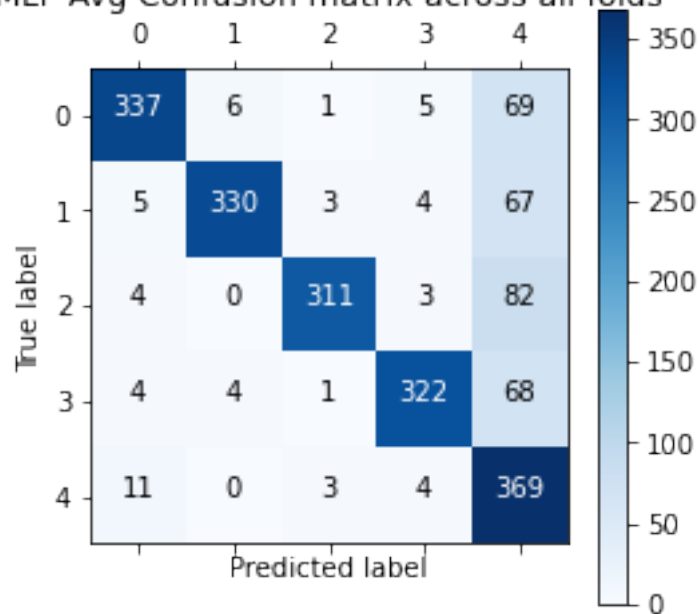
```

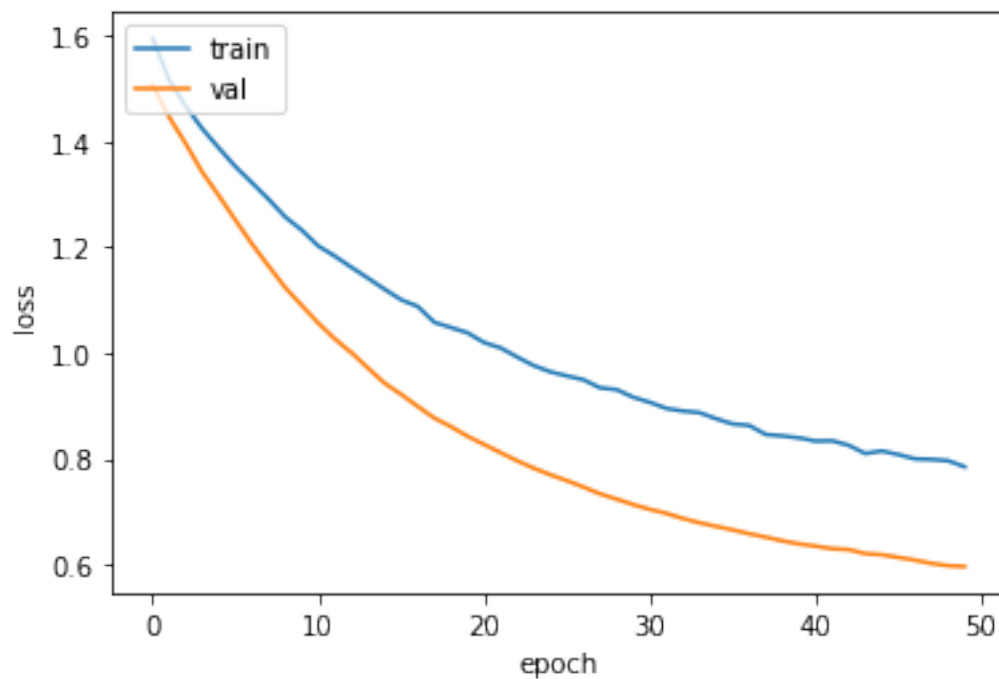
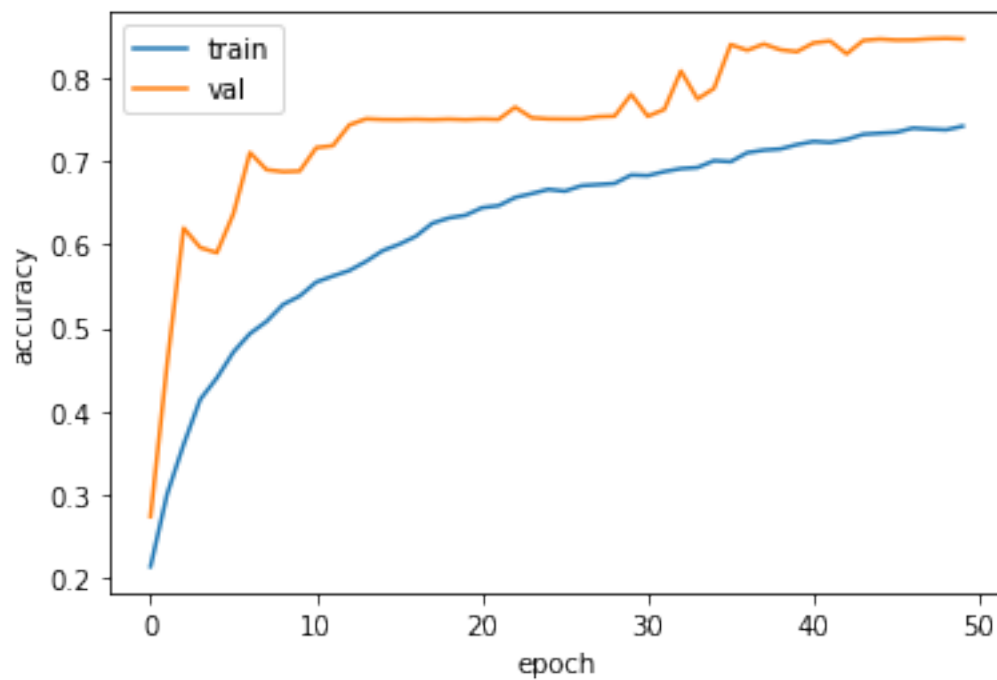
accuracy: 0.6879 - val_loss: 0.7684 - val_accuracy: 0.8409
 Epoch 26/50
 4854/4854 [=====] - 0s 30us/step - loss: 0.9533 -
 accuracy: 0.6860 - val_loss: 0.7523 - val_accuracy: 0.8409
 Epoch 27/50
 4854/4854 [=====] - 0s 27us/step - loss: 0.9428 -
 accuracy: 0.6922 - val_loss: 0.7345 - val_accuracy: 0.8409
 Epoch 28/50
 4854/4854 [=====] - 0s 30us/step - loss: 0.9311 -
 accuracy: 0.6885 - val_loss: 0.7113 - val_accuracy: 0.8409
 Epoch 29/50
 4854/4854 [=====] - 0s 30us/step - loss: 0.9125 -
 accuracy: 0.6984 - val_loss: 0.6980 - val_accuracy: 0.8409
 Epoch 30/50
 4854/4854 [=====] - 0s 30us/step - loss: 0.8886 -
 accuracy: 0.7079 - val_loss: 0.6781 - val_accuracy: 0.8409
 Epoch 31/50
 4854/4854 [=====] - 0s 27us/step - loss: 0.8806 -
 accuracy: 0.7126 - val_loss: 0.6643 - val_accuracy: 0.8409
 Epoch 32/50
 4854/4854 [=====] - 0s 29us/step - loss: 0.8724 -
 accuracy: 0.7178 - val_loss: 0.6521 - val_accuracy: 0.8417
 Epoch 33/50
 4854/4854 [=====] - 0s 28us/step - loss: 0.8792 -
 accuracy: 0.7025 - val_loss: 0.6390 - val_accuracy: 0.8417
 Epoch 34/50
 4854/4854 [=====] - 0s 30us/step - loss: 0.8620 -
 accuracy: 0.7132 - val_loss: 0.6283 - val_accuracy: 0.8417
 Epoch 35/50
 4854/4854 [=====] - 0s 29us/step - loss: 0.8492 -
 accuracy: 0.7159 - val_loss: 0.6208 - val_accuracy: 0.8434
 Epoch 36/50
 4854/4854 [=====] - 0s 31us/step - loss: 0.8320 -
 accuracy: 0.7217 - val_loss: 0.6101 - val_accuracy: 0.8442
 Epoch 37/50
 4854/4854 [=====] - 0s 29us/step - loss: 0.8263 -
 accuracy: 0.7215 - val_loss: 0.6007 - val_accuracy: 0.8442
 Epoch 38/50
 4854/4854 [=====] - 0s 31us/step - loss: 0.8167 -
 accuracy: 0.7274 - val_loss: 0.5902 - val_accuracy: 0.8442
 Epoch 39/50
 4854/4854 [=====] - 0s 32us/step - loss: 0.8024 -
 accuracy: 0.7295 - val_loss: 0.5873 - val_accuracy: 0.8442
 Epoch 40/50
 4854/4854 [=====] - 0s 29us/step - loss: 0.8140 -
 accuracy: 0.7252 - val_loss: 0.5811 - val_accuracy: 0.8450
 Epoch 41/50
 4854/4854 [=====] - 0s 28us/step - loss: 0.8075 -

accuracy: 0.7262 - val_loss: 0.5754 - val_accuracy: 0.8450
Epoch 42/50
4854/4854 [=====] - 0s 30us/step - loss: 0.8107 -
accuracy: 0.7225 - val_loss: 0.5729 - val_accuracy: 0.8442
Epoch 43/50
4854/4854 [=====] - 0s 28us/step - loss: 0.7929 -
accuracy: 0.7260 - val_loss: 0.5729 - val_accuracy: 0.8450
Epoch 44/50
4854/4854 [=====] - 0s 30us/step - loss: 0.7698 -
accuracy: 0.7344 - val_loss: 0.5654 - val_accuracy: 0.8450
Epoch 45/50
4854/4854 [=====] - 0s 31us/step - loss: 0.7802 -
accuracy: 0.7301 - val_loss: 0.5553 - val_accuracy: 0.8450
Epoch 46/50
4854/4854 [=====] - 0s 29us/step - loss: 0.7734 -
accuracy: 0.7359 - val_loss: 0.5508 - val_accuracy: 0.8450
Epoch 47/50
4854/4854 [=====] - 0s 31us/step - loss: 0.7685 -
accuracy: 0.7353 - val_loss: 0.5463 - val_accuracy: 0.8450
Epoch 48/50
4854/4854 [=====] - 0s 28us/step - loss: 0.7586 -
accuracy: 0.7373 - val_loss: 0.5383 - val_accuracy: 0.8450
Epoch 49/50
4854/4854 [=====] - 0s 31us/step - loss: 0.7626 -
accuracy: 0.7349 - val_loss: 0.5365 - val_accuracy: 0.8450
Epoch 50/50
4854/4854 [=====] - 0s 28us/step - loss: 0.7514 -
accuracy: 0.7384 - val_loss: 0.5347 - val_accuracy: 0.8450
2023/2023 [=====] - 0s 88us/step



MLP Avg Confusion matrix across all folds





Average scores for pseudo test set across all folds:
> Accuracy: 0.8255066752433777 (+- 0.001210805477908015)
> Loss: 0.63940720067894

> Avg runtime per test instance: 0.0011530807568658065

#####

#####

Sequential with Kfold CV:

Training for fold 1 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_36"

Layer (type)	Output Shape	Param #
dense_191 (Dense)	(None, 96)	384
dense_192 (Dense)	(None, 48)	4656
dropout_121 (Dropout)	(None, 48)	0
dense_193 (Dense)	(None, 24)	1176
dropout_122 (Dropout)	(None, 24)	0
dense_194 (Dense)	(None, 12)	300
dropout_123 (Dropout)	(None, 12)	0
dense_195 (Dense)	(None, 6)	78
dropout_124 (Dropout)	(None, 6)	0
dense_196 (Dense)	(None, 5)	35

Total params: 6,629

Trainable params: 6,629

Non-trainable params: 0

Train on 4853 samples, validate on 1214 samples

Epoch 1/50

4853/4853 [=====] - 4s 924us/step - loss: 1.5452 - accuracy: 0.3179 - val_loss: 1.3924 - val_accuracy: 0.7636

Epoch 2/50

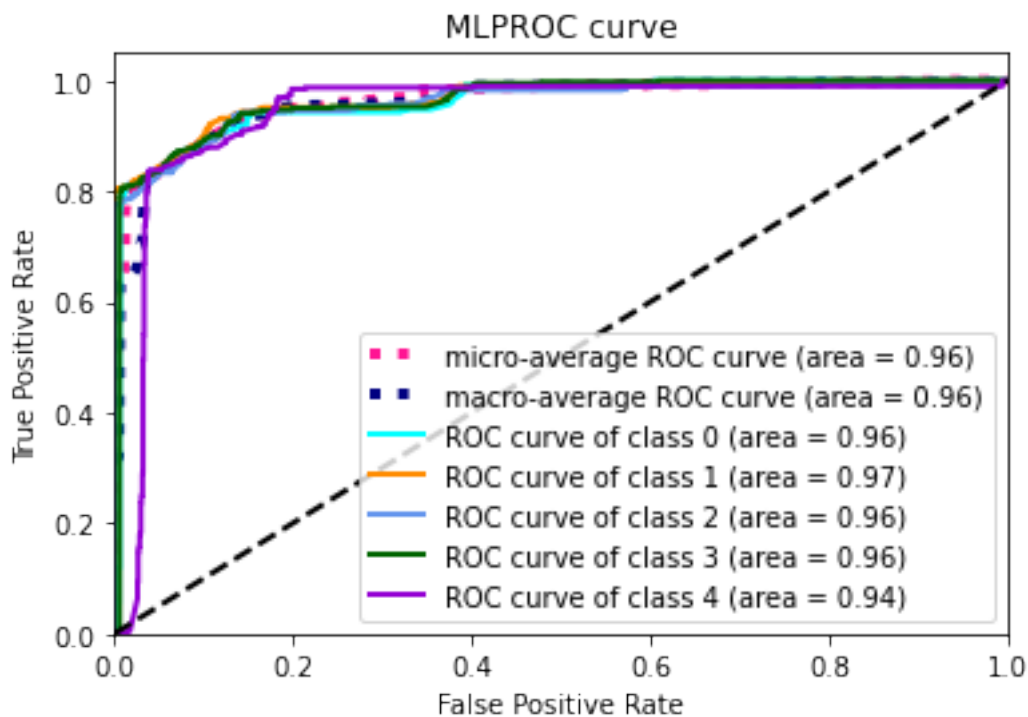
4853/4853 [=====] - 0s 73us/step - loss: 1.4230 - accuracy: 0.5263 - val_loss: 1.3136 - val_accuracy: 0.8460

Epoch 3/50

4853/4853 [=====] - 0s 50us/step - loss: 1.3552 - accuracy: 0.6351 - val_loss: 1.2352 - val_accuracy: 0.8460
Epoch 4/50
4853/4853 [=====] - 0s 43us/step - loss: 1.3049 - accuracy: 0.6693 - val_loss: 1.1787 - val_accuracy: 0.8460
Epoch 5/50
4853/4853 [=====] - 0s 61us/step - loss: 1.2510 - accuracy: 0.7057 - val_loss: 1.1164 - val_accuracy: 0.8460
Epoch 6/50
4853/4853 [=====] - 0s 50us/step - loss: 1.1945 - accuracy: 0.7373 - val_loss: 1.0607 - val_accuracy: 0.8468
Epoch 7/50
4853/4853 [=====] - 0s 46us/step - loss: 1.1428 - accuracy: 0.7667 - val_loss: 1.0039 - val_accuracy: 0.8468
Epoch 8/50
4853/4853 [=====] - 0s 48us/step - loss: 1.0993 - accuracy: 0.7657 - val_loss: 0.9528 - val_accuracy: 0.8468
Epoch 9/50
4853/4853 [=====] - 0s 58us/step - loss: 1.0508 - accuracy: 0.7744 - val_loss: 0.8992 - val_accuracy: 0.8468
Epoch 10/50
4853/4853 [=====] - 0s 42us/step - loss: 1.0160 - accuracy: 0.7725 - val_loss: 0.8519 - val_accuracy: 0.8468
Epoch 11/50
4853/4853 [=====] - 0s 37us/step - loss: 0.9735 - accuracy: 0.7799 - val_loss: 0.8168 - val_accuracy: 0.8468
Epoch 12/50
4853/4853 [=====] - 0s 49us/step - loss: 0.9330 - accuracy: 0.7888 - val_loss: 0.7836 - val_accuracy: 0.8468
Epoch 13/50
4853/4853 [=====] - 0s 86us/step - loss: 0.9139 - accuracy: 0.7882 - val_loss: 0.7561 - val_accuracy: 0.8468
Epoch 14/50
4853/4853 [=====] - 0s 64us/step - loss: 0.8811 - accuracy: 0.7830 - val_loss: 0.7310 - val_accuracy: 0.8476
Epoch 15/50
4853/4853 [=====] - 0s 59us/step - loss: 0.8600 - accuracy: 0.7915 - val_loss: 0.7105 - val_accuracy: 0.8476
Epoch 16/50
4853/4853 [=====] - 0s 62us/step - loss: 0.8319 - accuracy: 0.7894 - val_loss: 0.6931 - val_accuracy: 0.8476
Epoch 17/50
4853/4853 [=====] - 0s 49us/step - loss: 0.8161 - accuracy: 0.7968 - val_loss: 0.6773 - val_accuracy: 0.8484
Epoch 18/50
4853/4853 [=====] - 0s 53us/step - loss: 0.7969 - accuracy: 0.8018 - val_loss: 0.6630 - val_accuracy: 0.8484
Epoch 19/50

4853/4853 [=====] - 0s 38us/step - loss: 0.7831 -
 accuracy: 0.8009 - val_loss: 0.6497 - val_accuracy: 0.8493
 Epoch 20/50
 4853/4853 [=====] - 0s 49us/step - loss: 0.7674 -
 accuracy: 0.8028 - val_loss: 0.6374 - val_accuracy: 0.8493
 Epoch 21/50
 4853/4853 [=====] - 0s 43us/step - loss: 0.7547 -
 accuracy: 0.8061 - val_loss: 0.6246 - val_accuracy: 0.8493
 Epoch 22/50
 4853/4853 [=====] - 0s 46us/step - loss: 0.7381 -
 accuracy: 0.8053 - val_loss: 0.6143 - val_accuracy: 0.8493
 Epoch 23/50
 4853/4853 [=====] - 0s 76us/step - loss: 0.7314 -
 accuracy: 0.8040 - val_loss: 0.6067 - val_accuracy: 0.8493
 Epoch 24/50
 4853/4853 [=====] - 0s 68us/step - loss: 0.7204 -
 accuracy: 0.8096 - val_loss: 0.5992 - val_accuracy: 0.8493
 Epoch 25/50
 4853/4853 [=====] - 0s 47us/step - loss: 0.7051 -
 accuracy: 0.8036 - val_loss: 0.5908 - val_accuracy: 0.8493
 Epoch 26/50
 4853/4853 [=====] - 0s 50us/step - loss: 0.6943 -
 accuracy: 0.8160 - val_loss: 0.5823 - val_accuracy: 0.8493
 Epoch 27/50
 4853/4853 [=====] - 0s 60us/step - loss: 0.6826 -
 accuracy: 0.8121 - val_loss: 0.5791 - val_accuracy: 0.8493
 Epoch 28/50
 4853/4853 [=====] - 0s 40us/step - loss: 0.6854 -
 accuracy: 0.8113 - val_loss: 0.5716 - val_accuracy: 0.8493
 Epoch 29/50
 4853/4853 [=====] - 0s 44us/step - loss: 0.6737 -
 accuracy: 0.8123 - val_loss: 0.5630 - val_accuracy: 0.8493
 Epoch 30/50
 4853/4853 [=====] - 0s 38us/step - loss: 0.6591 -
 accuracy: 0.8191 - val_loss: 0.5618 - val_accuracy: 0.8493
 Epoch 31/50
 4853/4853 [=====] - 0s 30us/step - loss: 0.6635 -
 accuracy: 0.8160 - val_loss: 0.5584 - val_accuracy: 0.8493
 Epoch 32/50
 4853/4853 [=====] - 0s 45us/step - loss: 0.6460 -
 accuracy: 0.8236 - val_loss: 0.5558 - val_accuracy: 0.8493
 Epoch 33/50
 4853/4853 [=====] - 0s 51us/step - loss: 0.6472 -
 accuracy: 0.8178 - val_loss: 0.5430 - val_accuracy: 0.8501
 Epoch 34/50
 4853/4853 [=====] - 0s 54us/step - loss: 0.6368 -
 accuracy: 0.8220 - val_loss: 0.5451 - val_accuracy: 0.8493
 Epoch 35/50

4853/4853 [=====] - 0s 53us/step - loss: 0.6289 -
 accuracy: 0.8218 - val_loss: 0.5327 - val_accuracy: 0.8509
 Epoch 36/50
 4853/4853 [=====] - 0s 36us/step - loss: 0.6339 -
 accuracy: 0.8191 - val_loss: 0.5348 - val_accuracy: 0.8501
 Epoch 37/50
 4853/4853 [=====] - 0s 41us/step - loss: 0.6254 -
 accuracy: 0.8246 - val_loss: 0.5326 - val_accuracy: 0.8501
 Epoch 38/50
 4853/4853 [=====] - 0s 46us/step - loss: 0.6267 -
 accuracy: 0.8216 - val_loss: 0.5284 - val_accuracy: 0.8501
 Epoch 39/50
 4853/4853 [=====] - 0s 58us/step - loss: 0.6105 -
 accuracy: 0.8294 - val_loss: 0.5168 - val_accuracy: 0.8509
 Epoch 40/50
 4853/4853 [=====] - 0s 65us/step - loss: 0.6120 -
 accuracy: 0.8234 - val_loss: 0.5127 - val_accuracy: 0.8501
 Epoch 41/50
 4853/4853 [=====] - 0s 48us/step - loss: 0.5955 -
 accuracy: 0.8281 - val_loss: 0.5100 - val_accuracy: 0.8509
 Epoch 42/50
 4853/4853 [=====] - 0s 52us/step - loss: 0.6037 -
 accuracy: 0.8218 - val_loss: 0.5061 - val_accuracy: 0.8509
 Epoch 43/50
 4853/4853 [=====] - 0s 51us/step - loss: 0.5869 -
 accuracy: 0.8298 - val_loss: 0.5141 - val_accuracy: 0.8484
 Epoch 44/50
 4853/4853 [=====] - 0s 49us/step - loss: 0.5869 -
 accuracy: 0.8257 - val_loss: 0.4999 - val_accuracy: 0.8509
 Epoch 45/50
 4853/4853 [=====] - 0s 52us/step - loss: 0.5853 -
 accuracy: 0.8257 - val_loss: 0.4983 - val_accuracy: 0.8517
 Epoch 46/50
 4853/4853 [=====] - 0s 68us/step - loss: 0.5711 -
 accuracy: 0.8349 - val_loss: 0.4956 - val_accuracy: 0.8509
 Epoch 47/50
 4853/4853 [=====] - 0s 63us/step - loss: 0.5718 -
 accuracy: 0.8271 - val_loss: 0.5143 - val_accuracy: 0.8402
 Epoch 48/50
 4853/4853 [=====] - 0s 47us/step - loss: 0.5664 -
 accuracy: 0.8261 - val_loss: 0.4934 - val_accuracy: 0.8501
 Epoch 49/50
 4853/4853 [=====] - 0s 47us/step - loss: 0.5677 -
 accuracy: 0.8302 - val_loss: 0.4899 - val_accuracy: 0.8509
 Epoch 50/50
 4853/4853 [=====] - 0s 27us/step - loss: 0.5564 -
 accuracy: 0.8296 - val_loss: 0.4874 - val_accuracy: 0.8493
 2023/2023 [=====] - 0s 113us/step



Sequential with Kfold CV:

Training for fold 2 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_37"

Layer (type)	Output Shape	Param #
dense_197 (Dense)	(None, 96)	384
dense_198 (Dense)	(None, 48)	4656
dropout_125 (Dropout)	(None, 48)	0
dense_199 (Dense)	(None, 24)	1176
dropout_126 (Dropout)	(None, 24)	0
dense_200 (Dense)	(None, 12)	300
dropout_127 (Dropout)	(None, 12)	0

```

-----
dense_201 (Dense)                (None, 6)                78
-----
dropout_128 (Dropout)            (None, 6)                0
-----
dense_202 (Dense)                (None, 5)                35
=====
Total params: 6,629
Trainable params: 6,629
Non-trainable params: 0
-----
Train on 4853 samples, validate on 1214 samples
Epoch 1/50
4853/4853 [=====] - 5s 1ms/step - loss: 1.4705 -
accuracy: 0.4179 - val_loss: 1.2784 - val_accuracy: 0.6993
Epoch 2/50
4853/4853 [=====] - 0s 47us/step - loss: 1.3215 -
accuracy: 0.5671 - val_loss: 1.1660 - val_accuracy: 0.8221
Epoch 3/50
4853/4853 [=====] - 0s 63us/step - loss: 1.2496 -
accuracy: 0.5996 - val_loss: 1.0755 - val_accuracy: 0.6985
Epoch 4/50
4853/4853 [=====] - 0s 60us/step - loss: 1.1801 -
accuracy: 0.6336 - val_loss: 1.0061 - val_accuracy: 0.7010
Epoch 5/50
4853/4853 [=====] - 0s 60us/step - loss: 1.1257 -
accuracy: 0.6571 - val_loss: 0.9470 - val_accuracy: 0.7010
Epoch 6/50
4853/4853 [=====] - 0s 40us/step - loss: 1.0733 -
accuracy: 0.6858 - val_loss: 0.9099 - val_accuracy: 0.7018
Epoch 7/50
4853/4853 [=====] - 0s 29us/step - loss: 1.0406 -
accuracy: 0.6985 - val_loss: 0.8744 - val_accuracy: 0.8526
Epoch 8/50
4853/4853 [=====] - 0s 41us/step - loss: 1.0068 -
accuracy: 0.7148 - val_loss: 0.8453 - val_accuracy: 0.8517
Epoch 9/50
4853/4853 [=====] - 0s 52us/step - loss: 0.9795 -
accuracy: 0.7416 - val_loss: 0.8211 - val_accuracy: 0.8534
Epoch 10/50
4853/4853 [=====] - 0s 61us/step - loss: 0.9459 -
accuracy: 0.7538 - val_loss: 0.7930 - val_accuracy: 0.8550
Epoch 11/50
4853/4853 [=====] - 0s 68us/step - loss: 0.9233 -
accuracy: 0.7717 - val_loss: 0.7702 - val_accuracy: 0.8558
Epoch 12/50
4853/4853 [=====] - 0s 56us/step - loss: 0.9021 -
accuracy: 0.7830 - val_loss: 0.7513 - val_accuracy: 0.8542

```

Epoch 13/50
4853/4853 [=====] - 0s 58us/step - loss: 0.8839 - accuracy: 0.7902 - val_loss: 0.7355 - val_accuracy: 0.8526

Epoch 14/50
4853/4853 [=====] - 0s 55us/step - loss: 0.8602 - accuracy: 0.8022 - val_loss: 0.7254 - val_accuracy: 0.8542

Epoch 15/50
4853/4853 [=====] - 0s 46us/step - loss: 0.8476 - accuracy: 0.8049 - val_loss: 0.7147 - val_accuracy: 0.8542

Epoch 16/50
4853/4853 [=====] - 0s 71us/step - loss: 0.8309 - accuracy: 0.8020 - val_loss: 0.7029 - val_accuracy: 0.8575

Epoch 17/50
4853/4853 [=====] - 0s 41us/step - loss: 0.8200 - accuracy: 0.8088 - val_loss: 0.6916 - val_accuracy: 0.8575

Epoch 18/50
4853/4853 [=====] - 0s 28us/step - loss: 0.8077 - accuracy: 0.8139 - val_loss: 0.6766 - val_accuracy: 0.8575

Epoch 19/50
4853/4853 [=====] - 0s 31us/step - loss: 0.7860 - accuracy: 0.8166 - val_loss: 0.6673 - val_accuracy: 0.8575

Epoch 20/50
4853/4853 [=====] - 0s 43us/step - loss: 0.7859 - accuracy: 0.8195 - val_loss: 0.6610 - val_accuracy: 0.8575

Epoch 21/50
4853/4853 [=====] - 0s 61us/step - loss: 0.7636 - accuracy: 0.8236 - val_loss: 0.6491 - val_accuracy: 0.8575

Epoch 22/50
4853/4853 [=====] - 0s 45us/step - loss: 0.7548 - accuracy: 0.8255 - val_loss: 0.6428 - val_accuracy: 0.8575

Epoch 23/50
4853/4853 [=====] - 0s 54us/step - loss: 0.7507 - accuracy: 0.8211 - val_loss: 0.6303 - val_accuracy: 0.8583

Epoch 24/50
4853/4853 [=====] - 0s 35us/step - loss: 0.7352 - accuracy: 0.8242 - val_loss: 0.6304 - val_accuracy: 0.8583

Epoch 25/50
4853/4853 [=====] - 0s 29us/step - loss: 0.7242 - accuracy: 0.8312 - val_loss: 0.6168 - val_accuracy: 0.8583

Epoch 26/50
4853/4853 [=====] - 0s 48us/step - loss: 0.7153 - accuracy: 0.8251 - val_loss: 0.6065 - val_accuracy: 0.8583

Epoch 27/50
4853/4853 [=====] - 0s 70us/step - loss: 0.7023 - accuracy: 0.8300 - val_loss: 0.5983 - val_accuracy: 0.8575

Epoch 28/50
4853/4853 [=====] - 0s 70us/step - loss: 0.7032 - accuracy: 0.8310 - val_loss: 0.5916 - val_accuracy: 0.8583

Epoch 29/50
4853/4853 [=====] - 0s 64us/step - loss: 0.6905 - accuracy: 0.8317 - val_loss: 0.5972 - val_accuracy: 0.8583

Epoch 30/50
4853/4853 [=====] - 0s 73us/step - loss: 0.6794 - accuracy: 0.8308 - val_loss: 0.5817 - val_accuracy: 0.8583

Epoch 31/50
4853/4853 [=====] - 0s 69us/step - loss: 0.6722 - accuracy: 0.8345 - val_loss: 0.5775 - val_accuracy: 0.8583

Epoch 32/50
4853/4853 [=====] - 0s 55us/step - loss: 0.6732 - accuracy: 0.8372 - val_loss: 0.5716 - val_accuracy: 0.8583

Epoch 33/50
4853/4853 [=====] - 0s 68us/step - loss: 0.6673 - accuracy: 0.8358 - val_loss: 0.5633 - val_accuracy: 0.8583

Epoch 34/50
4853/4853 [=====] - 0s 55us/step - loss: 0.6583 - accuracy: 0.8349 - val_loss: 0.5648 - val_accuracy: 0.8583

Epoch 35/50
4853/4853 [=====] - 0s 59us/step - loss: 0.6530 - accuracy: 0.8349 - val_loss: 0.5523 - val_accuracy: 0.8583

Epoch 36/50
4853/4853 [=====] - 0s 43us/step - loss: 0.6384 - accuracy: 0.8393 - val_loss: 0.5479 - val_accuracy: 0.8583

Epoch 37/50
4853/4853 [=====] - 0s 49us/step - loss: 0.6344 - accuracy: 0.8339 - val_loss: 0.5505 - val_accuracy: 0.8583

Epoch 38/50
4853/4853 [=====] - 0s 59us/step - loss: 0.6342 - accuracy: 0.8331 - val_loss: 0.5402 - val_accuracy: 0.8583

Epoch 39/50
4853/4853 [=====] - 0s 49us/step - loss: 0.6260 - accuracy: 0.8345 - val_loss: 0.5339 - val_accuracy: 0.8583

Epoch 40/50
4853/4853 [=====] - 0s 65us/step - loss: 0.6194 - accuracy: 0.8356 - val_loss: 0.5421 - val_accuracy: 0.8583

Epoch 41/50
4853/4853 [=====] - 0s 44us/step - loss: 0.6158 - accuracy: 0.8393 - val_loss: 0.5381 - val_accuracy: 0.8583

Epoch 42/50
4853/4853 [=====] - 0s 65us/step - loss: 0.6125 - accuracy: 0.8360 - val_loss: 0.5231 - val_accuracy: 0.8583

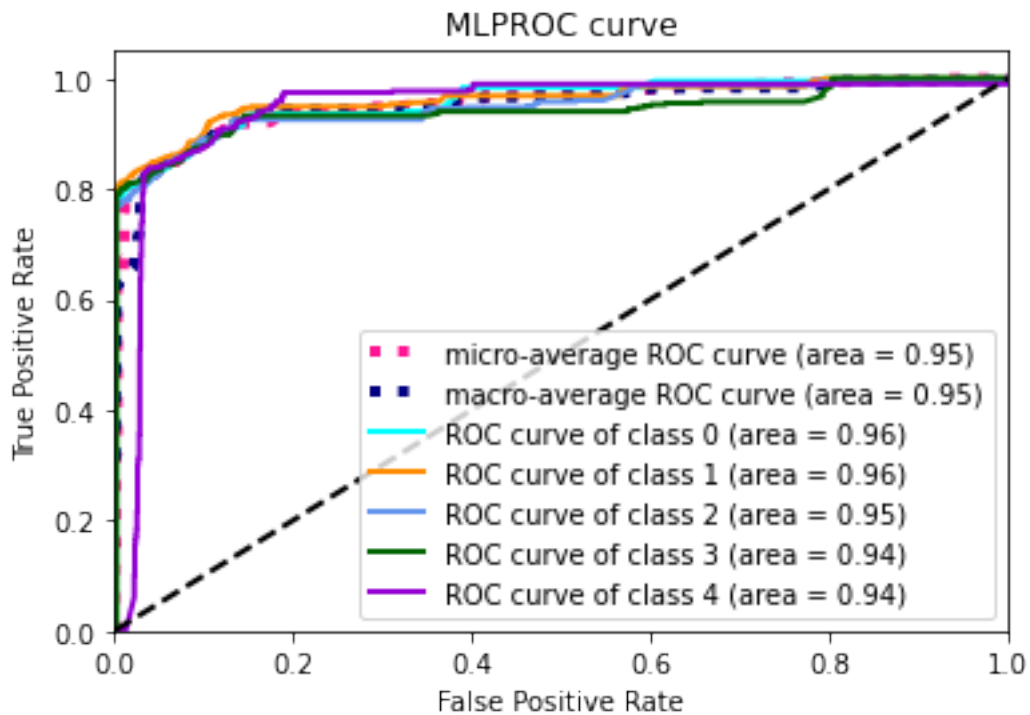
Epoch 43/50
4853/4853 [=====] - 0s 66us/step - loss: 0.6092 - accuracy: 0.8339 - val_loss: 0.5250 - val_accuracy: 0.8583

Epoch 44/50
4853/4853 [=====] - 0s 28us/step - loss: 0.6054 - accuracy: 0.8337 - val_loss: 0.5183 - val_accuracy: 0.8583


```

Epoch 45/50
4853/4853 [=====] - 0s 29us/step - loss: 0.5978 -
accuracy: 0.8382 - val_loss: 0.5204 - val_accuracy: 0.8583
Epoch 46/50
4853/4853 [=====] - 0s 39us/step - loss: 0.5980 -
accuracy: 0.8399 - val_loss: 0.5216 - val_accuracy: 0.8583
Epoch 47/50
4853/4853 [=====] - 0s 42us/step - loss: 0.5989 -
accuracy: 0.8349 - val_loss: 0.5094 - val_accuracy: 0.8575
Epoch 48/50
4853/4853 [=====] - 0s 41us/step - loss: 0.5857 -
accuracy: 0.8407 - val_loss: 0.5064 - val_accuracy: 0.8583
Epoch 49/50
4853/4853 [=====] - 0s 39us/step - loss: 0.5834 -
accuracy: 0.8370 - val_loss: 0.5074 - val_accuracy: 0.8583
Epoch 50/50
4853/4853 [=====] - 0s 41us/step - loss: 0.5771 -
accuracy: 0.8391 - val_loss: 0.4953 - val_accuracy: 0.8575
2023/2023 [=====] - 0s 103us/step

```



```

Sequential with Kfold CV:
Training for fold 3 ...
Adding layer 1:

```

Adding layer 2:
 Adding layer 3:
 Adding layer 4:
 Model: "sequential_38"

Layer (type)	Output Shape	Param #
dense_203 (Dense)	(None, 96)	384
dense_204 (Dense)	(None, 48)	4656
dropout_129 (Dropout)	(None, 48)	0
dense_205 (Dense)	(None, 24)	1176
dropout_130 (Dropout)	(None, 24)	0
dense_206 (Dense)	(None, 12)	300
dropout_131 (Dropout)	(None, 12)	0
dense_207 (Dense)	(None, 6)	78
dropout_132 (Dropout)	(None, 6)	0
dense_208 (Dense)	(None, 5)	35

Total params: 6,629
 Trainable params: 6,629
 Non-trainable params: 0

Train on 4854 samples, validate on 1213 samples

Epoch 1/50

4854/4854 [=====] - 4s 840us/step - loss: 1.5568 - accuracy: 0.3105 - val_loss: 1.4089 - val_accuracy: 0.5194

Epoch 2/50

4854/4854 [=====] - 0s 41us/step - loss: 1.4183 - accuracy: 0.4928 - val_loss: 1.2932 - val_accuracy: 0.6843

Epoch 3/50

4854/4854 [=====] - 0s 40us/step - loss: 1.3340 - accuracy: 0.5717 - val_loss: 1.1927 - val_accuracy: 0.6843

Epoch 4/50

4854/4854 [=====] - 0s 38us/step - loss: 1.2613 - accuracy: 0.6018 - val_loss: 1.1149 - val_accuracy: 0.6843

Epoch 5/50

4854/4854 [=====] - 0s 42us/step - loss: 1.2006 - accuracy: 0.6193 - val_loss: 1.0426 - val_accuracy: 0.6834

Epoch 6/50

4854/4854 [=====] - 0s 44us/step - loss: 1.1514 - accuracy: 0.6316 - val_loss: 0.9914 - val_accuracy: 0.6843
Epoch 7/50
4854/4854 [=====] - 0s 42us/step - loss: 1.1049 - accuracy: 0.6364 - val_loss: 0.9477 - val_accuracy: 0.6834
Epoch 8/50
4854/4854 [=====] - 0s 42us/step - loss: 1.0704 - accuracy: 0.6609 - val_loss: 0.9071 - val_accuracy: 0.6834
Epoch 9/50
4854/4854 [=====] - 0s 42us/step - loss: 1.0273 - accuracy: 0.6761 - val_loss: 0.8765 - val_accuracy: 0.6834
Epoch 10/50
4854/4854 [=====] - 0s 42us/step - loss: 1.0065 - accuracy: 0.6774 - val_loss: 0.8508 - val_accuracy: 0.6843
Epoch 11/50
4854/4854 [=====] - 0s 42us/step - loss: 0.9828 - accuracy: 0.6996 - val_loss: 0.8237 - val_accuracy: 0.8434
Epoch 12/50
4854/4854 [=====] - 0s 39us/step - loss: 0.9654 - accuracy: 0.7037 - val_loss: 0.7989 - val_accuracy: 0.8425
Epoch 13/50
4854/4854 [=====] - 0s 43us/step - loss: 0.9502 - accuracy: 0.7159 - val_loss: 0.7787 - val_accuracy: 0.8425
Epoch 14/50
4854/4854 [=====] - 0s 41us/step - loss: 0.9137 - accuracy: 0.7340 - val_loss: 0.7585 - val_accuracy: 0.8467
Epoch 15/50
4854/4854 [=====] - 0s 41us/step - loss: 0.9073 - accuracy: 0.7396 - val_loss: 0.7417 - val_accuracy: 0.8475
Epoch 16/50
4854/4854 [=====] - 0s 42us/step - loss: 0.8930 - accuracy: 0.7435 - val_loss: 0.7220 - val_accuracy: 0.8467
Epoch 17/50
4854/4854 [=====] - 0s 39us/step - loss: 0.8652 - accuracy: 0.7678 - val_loss: 0.7012 - val_accuracy: 0.8467
Epoch 18/50
4854/4854 [=====] - 0s 41us/step - loss: 0.8566 - accuracy: 0.7746 - val_loss: 0.6904 - val_accuracy: 0.8475
Epoch 19/50
4854/4854 [=====] - 0s 41us/step - loss: 0.8231 - accuracy: 0.7833 - val_loss: 0.6749 - val_accuracy: 0.8475
Epoch 20/50
4854/4854 [=====] - 0s 40us/step - loss: 0.8128 - accuracy: 0.7930 - val_loss: 0.6615 - val_accuracy: 0.8475
Epoch 21/50
4854/4854 [=====] - 0s 41us/step - loss: 0.7973 - accuracy: 0.7977 - val_loss: 0.6515 - val_accuracy: 0.8483
Epoch 22/50

4854/4854 [=====] - 0s 43us/step - loss: 0.7837 - accuracy: 0.8022 - val_loss: 0.6415 - val_accuracy: 0.8475
Epoch 23/50
4854/4854 [=====] - 0s 41us/step - loss: 0.7748 - accuracy: 0.8028 - val_loss: 0.6342 - val_accuracy: 0.8491
Epoch 24/50
4854/4854 [=====] - 0s 39us/step - loss: 0.7582 - accuracy: 0.8024 - val_loss: 0.6229 - val_accuracy: 0.8483
Epoch 25/50
4854/4854 [=====] - 0s 42us/step - loss: 0.7473 - accuracy: 0.8094 - val_loss: 0.6157 - val_accuracy: 0.8491
Epoch 26/50
4854/4854 [=====] - 0s 43us/step - loss: 0.7310 - accuracy: 0.8086 - val_loss: 0.6095 - val_accuracy: 0.8483
Epoch 27/50
4854/4854 [=====] - 0s 43us/step - loss: 0.7263 - accuracy: 0.8156 - val_loss: 0.6019 - val_accuracy: 0.8483
Epoch 28/50
4854/4854 [=====] - 0s 39us/step - loss: 0.7236 - accuracy: 0.8129 - val_loss: 0.5946 - val_accuracy: 0.8491
Epoch 29/50
4854/4854 [=====] - 0s 41us/step - loss: 0.7102 - accuracy: 0.8191 - val_loss: 0.5899 - val_accuracy: 0.8483
Epoch 30/50
4854/4854 [=====] - 0s 42us/step - loss: 0.6952 - accuracy: 0.8189 - val_loss: 0.5878 - val_accuracy: 0.8475
Epoch 31/50
4854/4854 [=====] - 0s 42us/step - loss: 0.6933 - accuracy: 0.8173 - val_loss: 0.5825 - val_accuracy: 0.8475
Epoch 32/50
4854/4854 [=====] - 0s 42us/step - loss: 0.6918 - accuracy: 0.8226 - val_loss: 0.5773 - val_accuracy: 0.8475
Epoch 33/50
4854/4854 [=====] - 0s 39us/step - loss: 0.6779 - accuracy: 0.8193 - val_loss: 0.5724 - val_accuracy: 0.8491
Epoch 34/50
4854/4854 [=====] - 0s 38us/step - loss: 0.6742 - accuracy: 0.8232 - val_loss: 0.5712 - val_accuracy: 0.8475
Epoch 35/50
4854/4854 [=====] - 0s 38us/step - loss: 0.6680 - accuracy: 0.8228 - val_loss: 0.5693 - val_accuracy: 0.8467
Epoch 36/50
4854/4854 [=====] - 0s 43us/step - loss: 0.6697 - accuracy: 0.8257 - val_loss: 0.5644 - val_accuracy: 0.8475
Epoch 37/50
4854/4854 [=====] - 0s 43us/step - loss: 0.6492 - accuracy: 0.8280 - val_loss: 0.5572 - val_accuracy: 0.8475
Epoch 38/50

4854/4854 [=====] - ETA: 0s - loss: 0.6609 - accuracy: 0.82 - 0s 41us/step - loss: 0.6515 - accuracy: 0.8300 - val_loss: 0.5553 - val_accuracy: 0.8483

Epoch 39/50

4854/4854 [=====] - 0s 43us/step - loss: 0.6480 - accuracy: 0.8263 - val_loss: 0.5485 - val_accuracy: 0.8491

Epoch 40/50

4854/4854 [=====] - 0s 39us/step - loss: 0.6374 - accuracy: 0.8274 - val_loss: 0.5440 - val_accuracy: 0.8483

Epoch 41/50

4854/4854 [=====] - 0s 42us/step - loss: 0.6352 - accuracy: 0.8269 - val_loss: 0.5402 - val_accuracy: 0.8491

Epoch 42/50

4854/4854 [=====] - 0s 40us/step - loss: 0.6317 - accuracy: 0.8292 - val_loss: 0.5471 - val_accuracy: 0.8483

Epoch 43/50

4854/4854 [=====] - 0s 42us/step - loss: 0.6312 - accuracy: 0.8300 - val_loss: 0.5437 - val_accuracy: 0.8483

Epoch 44/50

4854/4854 [=====] - 0s 42us/step - loss: 0.6207 - accuracy: 0.8350 - val_loss: 0.5354 - val_accuracy: 0.8483

Epoch 45/50

4854/4854 [=====] - 0s 41us/step - loss: 0.6204 - accuracy: 0.8267 - val_loss: 0.5361 - val_accuracy: 0.8483

Epoch 46/50

4854/4854 [=====] - 0s 42us/step - loss: 0.6193 - accuracy: 0.8282 - val_loss: 0.5271 - val_accuracy: 0.8491

Epoch 47/50

4854/4854 [=====] - 0s 41us/step - loss: 0.6129 - accuracy: 0.8346 - val_loss: 0.5153 - val_accuracy: 0.8491

Epoch 48/50

4854/4854 [=====] - 0s 44us/step - loss: 0.6124 - accuracy: 0.8321 - val_loss: 0.5259 - val_accuracy: 0.8483

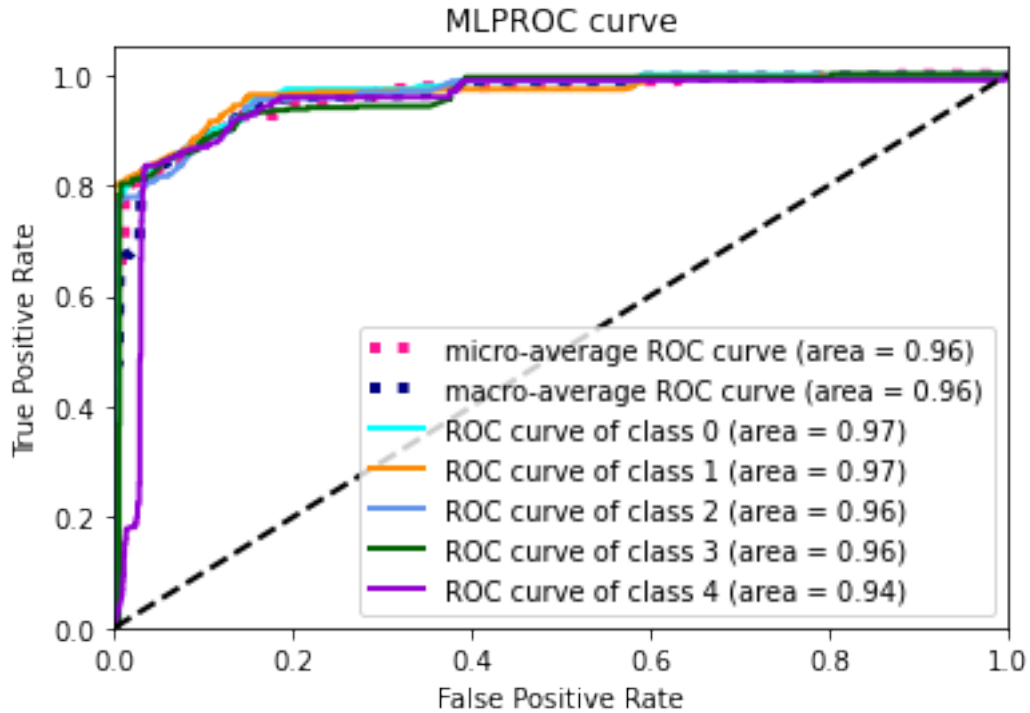
Epoch 49/50

4854/4854 [=====] - 0s 42us/step - loss: 0.6046 - accuracy: 0.8315 - val_loss: 0.5144 - val_accuracy: 0.8500

Epoch 50/50

4854/4854 [=====] - 0s 38us/step - loss: 0.6051 - accuracy: 0.8282 - val_loss: 0.5168 - val_accuracy: 0.8500

2023/2023 [=====] - 0s 104us/step



Sequential with Kfold CV:

Training for fold 4 ...

Adding layer 1:

Adding layer 2:

Adding layer 3:

Adding layer 4:

Model: "sequential_39"

Layer (type)	Output Shape	Param #
dense_209 (Dense)	(None, 96)	384
dense_210 (Dense)	(None, 48)	4656
dropout_133 (Dropout)	(None, 48)	0
dense_211 (Dense)	(None, 24)	1176
dropout_134 (Dropout)	(None, 24)	0
dense_212 (Dense)	(None, 12)	300
dropout_135 (Dropout)	(None, 12)	0

```

-----
dense_213 (Dense)                (None, 6)                78
-----
dropout_136 (Dropout)            (None, 6)                0
-----
dense_214 (Dense)                (None, 5)                35
=====
Total params: 6,629
Trainable params: 6,629
Non-trainable params: 0
-----
Train on 4854 samples, validate on 1213 samples
Epoch 1/50
4854/4854 [=====] - 5s 992us/step - loss: 1.5046 -
accuracy: 0.3113 - val_loss: 1.3401 - val_accuracy: 0.5251
Epoch 2/50
4854/4854 [=====] - 0s 57us/step - loss: 1.3684 -
accuracy: 0.4524 - val_loss: 1.2396 - val_accuracy: 0.7840
Epoch 3/50
4854/4854 [=====] - 0s 32us/step - loss: 1.2888 -
accuracy: 0.5610 - val_loss: 1.1484 - val_accuracy: 0.8228
Epoch 4/50
4854/4854 [=====] - 0s 29us/step - loss: 1.2006 -
accuracy: 0.6650 - val_loss: 1.0528 - val_accuracy: 0.8244
Epoch 5/50
4854/4854 [=====] - 0s 41us/step - loss: 1.1199 -
accuracy: 0.7105 - val_loss: 0.9805 - val_accuracy: 0.8228
Epoch 6/50
4854/4854 [=====] - 0s 43us/step - loss: 1.0597 -
accuracy: 0.7305 - val_loss: 0.9237 - val_accuracy: 0.8252
Epoch 7/50
4854/4854 [=====] - 0s 42us/step - loss: 1.0108 -
accuracy: 0.7505 - val_loss: 0.8795 - val_accuracy: 0.8261
Epoch 8/50
4854/4854 [=====] - 0s 45us/step - loss: 0.9711 -
accuracy: 0.7575 - val_loss: 0.8409 - val_accuracy: 0.8252
Epoch 9/50
4854/4854 [=====] - 0s 34us/step - loss: 0.9220 -
accuracy: 0.7748 - val_loss: 0.8056 - val_accuracy: 0.8252
Epoch 10/50
4854/4854 [=====] - 0s 29us/step - loss: 0.8867 -
accuracy: 0.7851 - val_loss: 0.7840 - val_accuracy: 0.8252
Epoch 11/50
4854/4854 [=====] - 0s 29us/step - loss: 0.8681 -
accuracy: 0.7857 - val_loss: 0.7577 - val_accuracy: 0.8252
Epoch 12/50
4854/4854 [=====] - 0s 53us/step - loss: 0.8294 -
accuracy: 0.8000 - val_loss: 0.7420 - val_accuracy: 0.8244

```

Epoch 13/50
4854/4854 [=====] - 0s 54us/step - loss: 0.8182 - accuracy: 0.8004 - val_loss: 0.7293 - val_accuracy: 0.8244

Epoch 14/50
4854/4854 [=====] - 0s 63us/step - loss: 0.8034 - accuracy: 0.7998 - val_loss: 0.7177 - val_accuracy: 0.8261

Epoch 15/50
4854/4854 [=====] - 0s 82us/step - loss: 0.7769 - accuracy: 0.8115 - val_loss: 0.7067 - val_accuracy: 0.8261

Epoch 16/50
4854/4854 [=====] - 0s 70us/step - loss: 0.7676 - accuracy: 0.8177 - val_loss: 0.6929 - val_accuracy: 0.8252

Epoch 17/50
4854/4854 [=====] - 0s 63us/step - loss: 0.7562 - accuracy: 0.8123 - val_loss: 0.6844 - val_accuracy: 0.8236

Epoch 18/50
4854/4854 [=====] - 0s 65us/step - loss: 0.7396 - accuracy: 0.8179 - val_loss: 0.6742 - val_accuracy: 0.8244

Epoch 19/50
4854/4854 [=====] - 0s 66us/step - loss: 0.7268 - accuracy: 0.8226 - val_loss: 0.6687 - val_accuracy: 0.8236

Epoch 20/50
4854/4854 [=====] - 0s 44us/step - loss: 0.7098 - accuracy: 0.8276 - val_loss: 0.6599 - val_accuracy: 0.8244

Epoch 21/50
4854/4854 [=====] - 0s 41us/step - loss: 0.6965 - accuracy: 0.8267 - val_loss: 0.6520 - val_accuracy: 0.8236

Epoch 22/50
4854/4854 [=====] - 0s 69us/step - loss: 0.6861 - accuracy: 0.8321 - val_loss: 0.6451 - val_accuracy: 0.8252

Epoch 23/50
4854/4854 [=====] - 0s 56us/step - loss: 0.6754 - accuracy: 0.8340 - val_loss: 0.6406 - val_accuracy: 0.8252

Epoch 24/50
4854/4854 [=====] - 0s 40us/step - loss: 0.6748 - accuracy: 0.8288 - val_loss: 0.6335 - val_accuracy: 0.8244

Epoch 25/50
4854/4854 [=====] - 0s 53us/step - loss: 0.6547 - accuracy: 0.8352 - val_loss: 0.6264 - val_accuracy: 0.8244

Epoch 26/50
4854/4854 [=====] - 0s 64us/step - loss: 0.6495 - accuracy: 0.8329 - val_loss: 0.6248 - val_accuracy: 0.8244

Epoch 27/50
4854/4854 [=====] - 0s 65us/step - loss: 0.6480 - accuracy: 0.8360 - val_loss: 0.6183 - val_accuracy: 0.8236

Epoch 28/50
4854/4854 [=====] - 0s 48us/step - loss: 0.6336 - accuracy: 0.8381 - val_loss: 0.6126 - val_accuracy: 0.8244

Epoch 29/50
4854/4854 [=====] - 0s 45us/step - loss: 0.6245 - accuracy: 0.8385 - val_loss: 0.6014 - val_accuracy: 0.8244

Epoch 30/50
4854/4854 [=====] - 0s 62us/step - loss: 0.6162 - accuracy: 0.8407 - val_loss: 0.6021 - val_accuracy: 0.8236

Epoch 31/50
4854/4854 [=====] - 0s 34us/step - loss: 0.6150 - accuracy: 0.8381 - val_loss: 0.5916 - val_accuracy: 0.8244

Epoch 32/50
4854/4854 [=====] - 0s 29us/step - loss: 0.6057 - accuracy: 0.8407 - val_loss: 0.5846 - val_accuracy: 0.8244

Epoch 33/50
4854/4854 [=====] - 0s 45us/step - loss: 0.5946 - accuracy: 0.8424 - val_loss: 0.5867 - val_accuracy: 0.8261

Epoch 34/50
4854/4854 [=====] - 0s 53us/step - loss: 0.5910 - accuracy: 0.8430 - val_loss: 0.5788 - val_accuracy: 0.8244

Epoch 35/50
4854/4854 [=====] - 0s 60us/step - loss: 0.5789 - accuracy: 0.8463 - val_loss: 0.5702 - val_accuracy: 0.8252

Epoch 36/50
4854/4854 [=====] - 0s 57us/step - loss: 0.5749 - accuracy: 0.8418 - val_loss: 0.5662 - val_accuracy: 0.8261

Epoch 37/50
4854/4854 [=====] - 0s 39us/step - loss: 0.5769 - accuracy: 0.8422 - val_loss: 0.5642 - val_accuracy: 0.8261

Epoch 38/50
4854/4854 [=====] - 0s 28us/step - loss: 0.5667 - accuracy: 0.8424 - val_loss: 0.5661 - val_accuracy: 0.8261

Epoch 39/50
4854/4854 [=====] - 0s 33us/step - loss: 0.5665 - accuracy: 0.8447 - val_loss: 0.5572 - val_accuracy: 0.8269

Epoch 40/50
4854/4854 [=====] - 0s 39us/step - loss: 0.5555 - accuracy: 0.8447 - val_loss: 0.5567 - val_accuracy: 0.8269

Epoch 41/50
4854/4854 [=====] - 0s 44us/step - loss: 0.5459 - accuracy: 0.8461 - val_loss: 0.5497 - val_accuracy: 0.8252

Epoch 42/50
4854/4854 [=====] - 0s 41us/step - loss: 0.5489 - accuracy: 0.8451 - val_loss: 0.5458 - val_accuracy: 0.8269

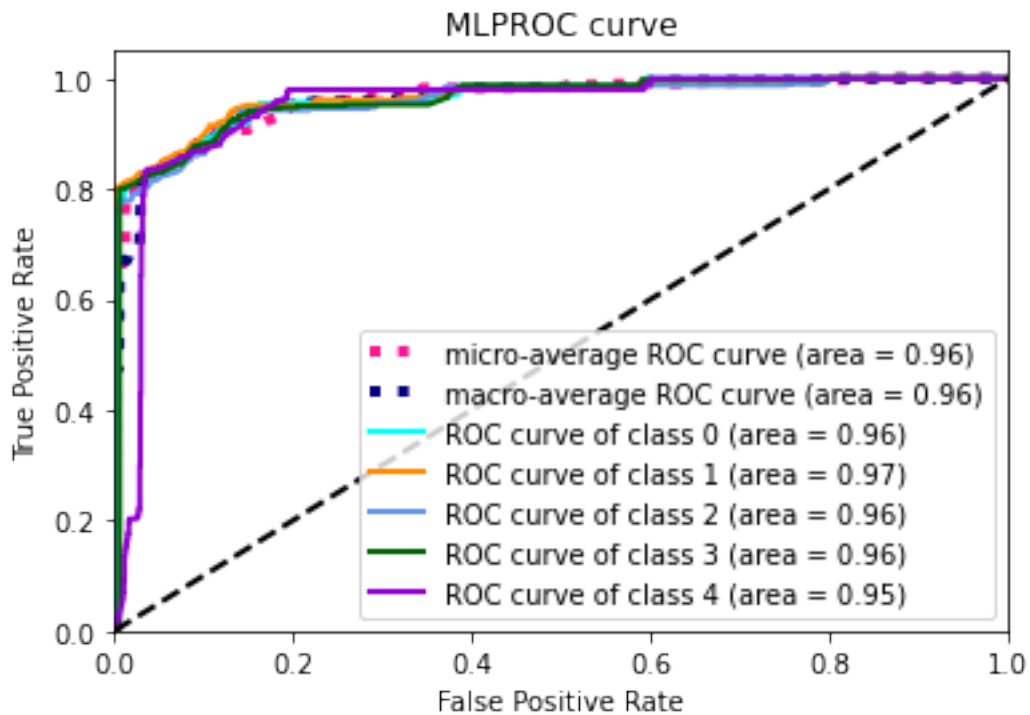
Epoch 43/50
4854/4854 [=====] - 0s 32us/step - loss: 0.5483 - accuracy: 0.8428 - val_loss: 0.5456 - val_accuracy: 0.8269

Epoch 44/50
4854/4854 [=====] - 0s 43us/step - loss: 0.5453 - accuracy: 0.8449 - val_loss: 0.5433 - val_accuracy: 0.8269

```

Epoch 45/50
4854/4854 [=====] - 0s 46us/step - loss: 0.5393 -
accuracy: 0.8455 - val_loss: 0.5365 - val_accuracy: 0.8269
Epoch 46/50
4854/4854 [=====] - 0s 63us/step - loss: 0.5318 -
accuracy: 0.8478 - val_loss: 0.5384 - val_accuracy: 0.8269
Epoch 47/50
4854/4854 [=====] - 0s 56us/step - loss: 0.5326 -
accuracy: 0.8438 - val_loss: 0.5392 - val_accuracy: 0.8261
Epoch 48/50
4854/4854 [=====] - 0s 50us/step - loss: 0.5291 -
accuracy: 0.8451 - val_loss: 0.5353 - val_accuracy: 0.8269
Epoch 49/50
4854/4854 [=====] - 0s 45us/step - loss: 0.5286 -
accuracy: 0.8473 - val_loss: 0.5276 - val_accuracy: 0.8269
Epoch 50/50
4854/4854 [=====] - 0s 49us/step - loss: 0.5178 -
accuracy: 0.8453 - val_loss: 0.5295 - val_accuracy: 0.8269
2023/2023 [=====] - 0s 199us/step

```



```

Sequential with Kfold CV:
Training for fold 5 ...
Adding layer 1:

```

Adding layer 2:
 Adding layer 3:
 Adding layer 4:
 Model: "sequential_40"

Layer (type)	Output Shape	Param #
dense_215 (Dense)	(None, 96)	384
dense_216 (Dense)	(None, 48)	4656
dropout_137 (Dropout)	(None, 48)	0
dense_217 (Dense)	(None, 24)	1176
dropout_138 (Dropout)	(None, 24)	0
dense_218 (Dense)	(None, 12)	300
dropout_139 (Dropout)	(None, 12)	0
dense_219 (Dense)	(None, 6)	78
dropout_140 (Dropout)	(None, 6)	0
dense_220 (Dense)	(None, 5)	35

Total params: 6,629
 Trainable params: 6,629
 Non-trainable params: 0

Train on 4854 samples, validate on 1213 samples

Epoch 1/50

4854/4854 [=====] - 6s 1ms/step - loss: 1.4709 - accuracy: 0.4370 - val_loss: 1.2388 - val_accuracy: 0.8500

Epoch 2/50

4854/4854 [=====] - 0s 63us/step - loss: 1.2820 - accuracy: 0.6152 - val_loss: 1.1088 - val_accuracy: 0.8508

Epoch 3/50

4854/4854 [=====] - 0s 72us/step - loss: 1.1968 - accuracy: 0.6687 - val_loss: 1.0131 - val_accuracy: 0.8508

Epoch 4/50

4854/4854 [=====] - 0s 45us/step - loss: 1.1223 - accuracy: 0.6908 - val_loss: 0.9462 - val_accuracy: 0.8508

Epoch 5/50

4854/4854 [=====] - 0s 48us/step - loss: 1.0645 - accuracy: 0.7136 - val_loss: 0.8938 - val_accuracy: 0.8508

Epoch 6/50

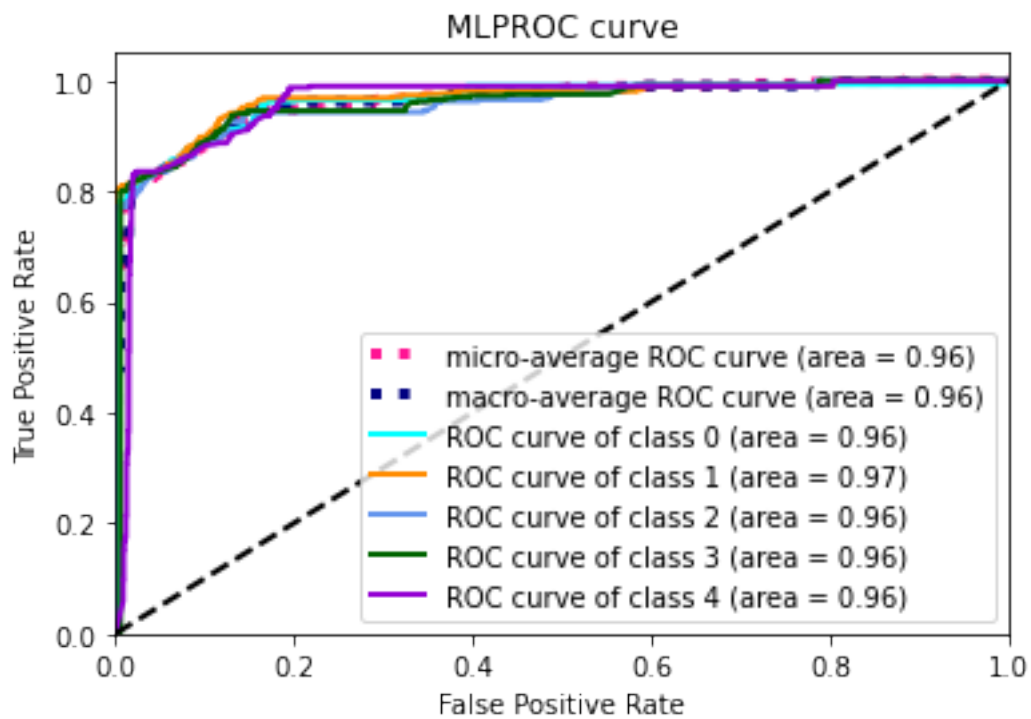
4854/4854 [=====] - 0s 61us/step - loss: 1.0180 - accuracy: 0.7316 - val_loss: 0.8502 - val_accuracy: 0.8508
Epoch 7/50
4854/4854 [=====] - 0s 57us/step - loss: 0.9879 - accuracy: 0.7417 - val_loss: 0.8135 - val_accuracy: 0.8508
Epoch 8/50
4854/4854 [=====] - 0s 63us/step - loss: 0.9484 - accuracy: 0.7633 - val_loss: 0.7859 - val_accuracy: 0.8516
Epoch 9/50
4854/4854 [=====] - 0s 75us/step - loss: 0.9201 - accuracy: 0.7756 - val_loss: 0.7604 - val_accuracy: 0.8500
Epoch 10/50
4854/4854 [=====] - 0s 47us/step - loss: 0.8926 - accuracy: 0.7769 - val_loss: 0.7375 - val_accuracy: 0.8508
Epoch 11/50
4854/4854 [=====] - 0s 52us/step - loss: 0.8788 - accuracy: 0.7839 - val_loss: 0.7169 - val_accuracy: 0.8524
Epoch 12/50
4854/4854 [=====] - 0s 50us/step - loss: 0.8439 - accuracy: 0.7915 - val_loss: 0.7008 - val_accuracy: 0.8500
Epoch 13/50
4854/4854 [=====] - 0s 46us/step - loss: 0.8351 - accuracy: 0.7903 - val_loss: 0.6837 - val_accuracy: 0.8500
Epoch 14/50
4854/4854 [=====] - 0s 51us/step - loss: 0.8093 - accuracy: 0.8004 - val_loss: 0.6689 - val_accuracy: 0.8508
Epoch 15/50
4854/4854 [=====] - 0s 27us/step - loss: 0.7934 - accuracy: 0.8010 - val_loss: 0.6538 - val_accuracy: 0.8508
Epoch 16/50
4854/4854 [=====] - 0s 31us/step - loss: 0.7835 - accuracy: 0.8030 - val_loss: 0.6434 - val_accuracy: 0.8508
Epoch 17/50
4854/4854 [=====] - 0s 57us/step - loss: 0.7630 - accuracy: 0.8084 - val_loss: 0.6343 - val_accuracy: 0.8508
Epoch 18/50
4854/4854 [=====] - 0s 67us/step - loss: 0.7532 - accuracy: 0.8084 - val_loss: 0.6193 - val_accuracy: 0.8516
Epoch 19/50
4854/4854 [=====] - 0s 67us/step - loss: 0.7349 - accuracy: 0.8121 - val_loss: 0.6129 - val_accuracy: 0.8508
Epoch 20/50
4854/4854 [=====] - 0s 55us/step - loss: 0.7234 - accuracy: 0.8148 - val_loss: 0.6007 - val_accuracy: 0.8524
Epoch 21/50
4854/4854 [=====] - 0s 45us/step - loss: 0.7124 - accuracy: 0.8142 - val_loss: 0.5932 - val_accuracy: 0.8508
Epoch 22/50

4854/4854 [=====] - 0s 66us/step - loss: 0.7148 - accuracy: 0.8127 - val_loss: 0.5927 - val_accuracy: 0.8524
Epoch 23/50
4854/4854 [=====] - 0s 55us/step - loss: 0.6961 - accuracy: 0.8169 - val_loss: 0.5797 - val_accuracy: 0.8516
Epoch 24/50
4854/4854 [=====] - 0s 43us/step - loss: 0.6807 - accuracy: 0.8199 - val_loss: 0.5756 - val_accuracy: 0.8533
Epoch 25/50
4854/4854 [=====] - 0s 51us/step - loss: 0.6805 - accuracy: 0.8175 - val_loss: 0.5673 - val_accuracy: 0.8533
Epoch 26/50
4854/4854 [=====] - 0s 46us/step - loss: 0.6672 - accuracy: 0.8237 - val_loss: 0.5649 - val_accuracy: 0.8533
Epoch 27/50
4854/4854 [=====] - 0s 29us/step - loss: 0.6623 - accuracy: 0.8228 - val_loss: 0.5555 - val_accuracy: 0.8533
Epoch 28/50
4854/4854 [=====] - 0s 46us/step - loss: 0.6571 - accuracy: 0.8220 - val_loss: 0.5518 - val_accuracy: 0.8533
Epoch 29/50
4854/4854 [=====] - 0s 45us/step - loss: 0.6476 - accuracy: 0.8197 - val_loss: 0.5470 - val_accuracy: 0.8533
Epoch 30/50
4854/4854 [=====] - 0s 71us/step - loss: 0.6446 - accuracy: 0.8245 - val_loss: 0.5391 - val_accuracy: 0.8533
Epoch 31/50
4854/4854 [=====] - 0s 71us/step - loss: 0.6410 - accuracy: 0.8239 - val_loss: 0.5375 - val_accuracy: 0.8533
Epoch 32/50
4854/4854 [=====] - 0s 56us/step - loss: 0.6322 - accuracy: 0.8228 - val_loss: 0.5328 - val_accuracy: 0.8541
Epoch 33/50
4854/4854 [=====] - 0s 46us/step - loss: 0.6236 - accuracy: 0.8272 - val_loss: 0.5262 - val_accuracy: 0.8533
Epoch 34/50
4854/4854 [=====] - 0s 61us/step - loss: 0.6122 - accuracy: 0.8255 - val_loss: 0.5202 - val_accuracy: 0.8541
Epoch 35/50
4854/4854 [=====] - 0s 80us/step - loss: 0.6092 - accuracy: 0.8282 - val_loss: 0.5167 - val_accuracy: 0.8541
Epoch 36/50
4854/4854 [=====] - 0s 48us/step - loss: 0.6036 - accuracy: 0.8263 - val_loss: 0.5219 - val_accuracy: 0.8508
Epoch 37/50
4854/4854 [=====] - 0s 47us/step - loss: 0.5978 - accuracy: 0.8228 - val_loss: 0.5098 - val_accuracy: 0.8541
Epoch 38/50

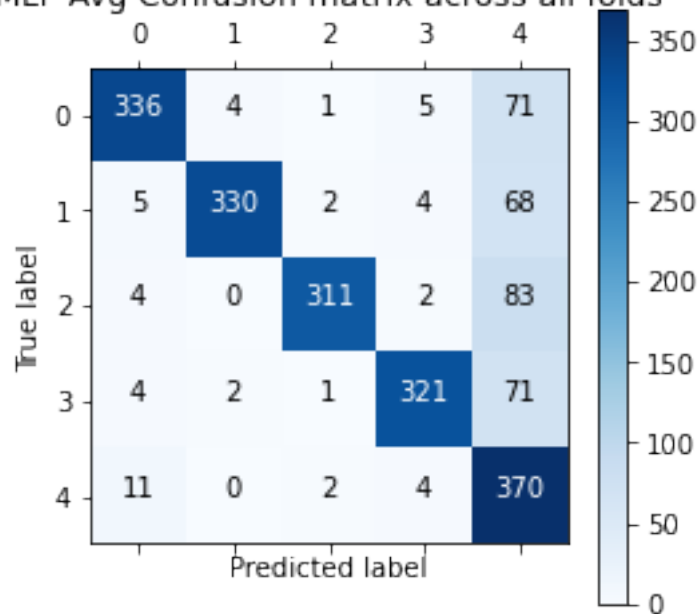
```

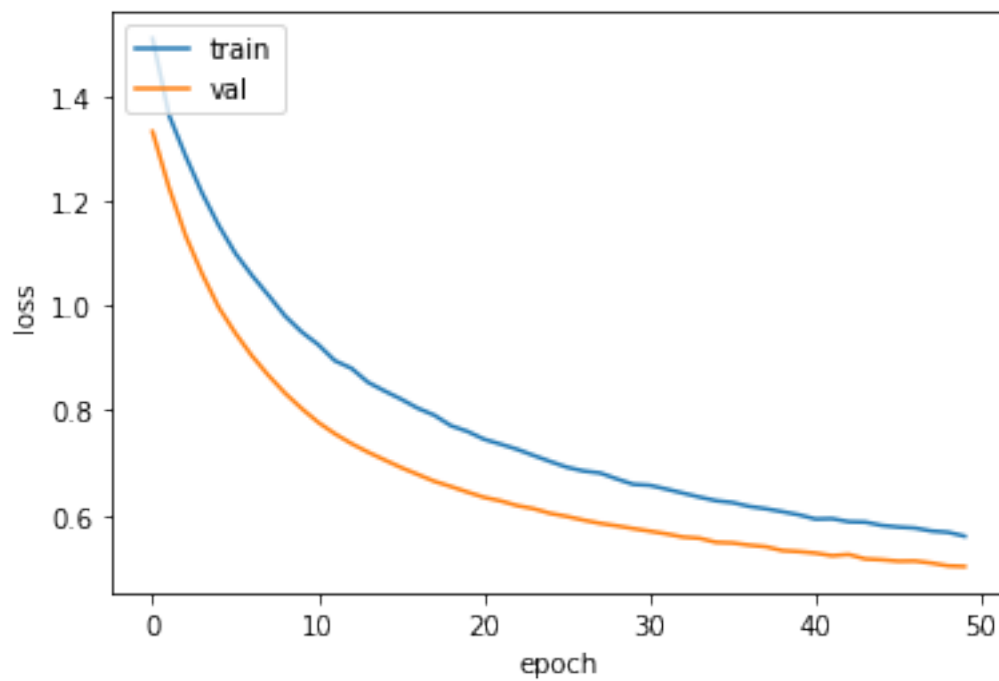
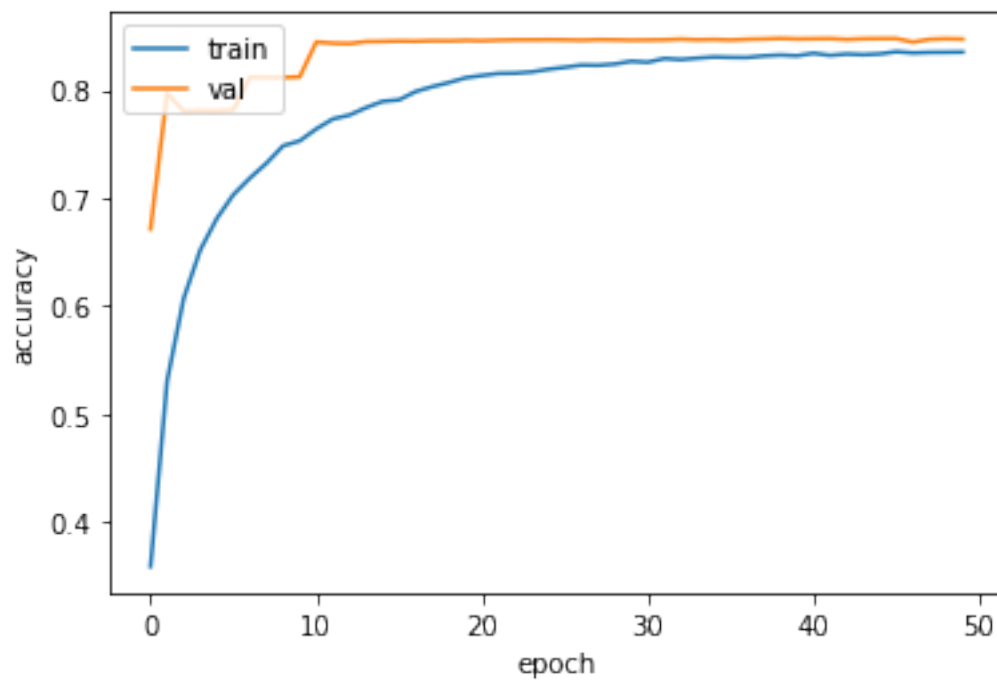
4854/4854 [=====] - 0s 54us/step - loss: 0.5824 -
accuracy: 0.8321 - val_loss: 0.5094 - val_accuracy: 0.8549
Epoch 39/50
4854/4854 [=====] - 0s 68us/step - loss: 0.5824 -
accuracy: 0.8282 - val_loss: 0.5062 - val_accuracy: 0.8549
Epoch 40/50
4854/4854 [=====] - 0s 47us/step - loss: 0.5792 -
accuracy: 0.8286 - val_loss: 0.4975 - val_accuracy: 0.8541
Epoch 41/50
4854/4854 [=====] - 0s 27us/step - loss: 0.5708 -
accuracy: 0.8309 - val_loss: 0.5006 - val_accuracy: 0.8549
Epoch 42/50
4854/4854 [=====] - 0s 40us/step - loss: 0.5698 -
accuracy: 0.8294 - val_loss: 0.4912 - val_accuracy: 0.8549
Epoch 43/50
4854/4854 [=====] - 0s 51us/step - loss: 0.5622 -
accuracy: 0.8313 - val_loss: 0.4968 - val_accuracy: 0.8533
Epoch 44/50
4854/4854 [=====] - 0s 65us/step - loss: 0.5755 -
accuracy: 0.8255 - val_loss: 0.4858 - val_accuracy: 0.8541
Epoch 45/50
4854/4854 [=====] - 0s 55us/step - loss: 0.5597 -
accuracy: 0.8321 - val_loss: 0.4836 - val_accuracy: 0.8541
Epoch 46/50
4854/4854 [=====] - 0s 45us/step - loss: 0.5664 -
accuracy: 0.8280 - val_loss: 0.4788 - val_accuracy: 0.8541
Epoch 47/50
4854/4854 [=====] - 0s 38us/step - loss: 0.5612 -
accuracy: 0.8323 - val_loss: 0.4850 - val_accuracy: 0.8500
Epoch 48/50
4854/4854 [=====] - 0s 46us/step - loss: 0.5552 -
accuracy: 0.8315 - val_loss: 0.4821 - val_accuracy: 0.8524
Epoch 49/50
4854/4854 [=====] - 0s 58us/step - loss: 0.5527 -
accuracy: 0.8298 - val_loss: 0.4772 - val_accuracy: 0.8524
Epoch 50/50
4854/4854 [=====] - 0s 61us/step - loss: 0.5434 -
accuracy: 0.8348 - val_loss: 0.4814 - val_accuracy: 0.8533
2023/2023 [=====] - 0s 137us/step

```



MLP Avg Confusion matrix across all folds

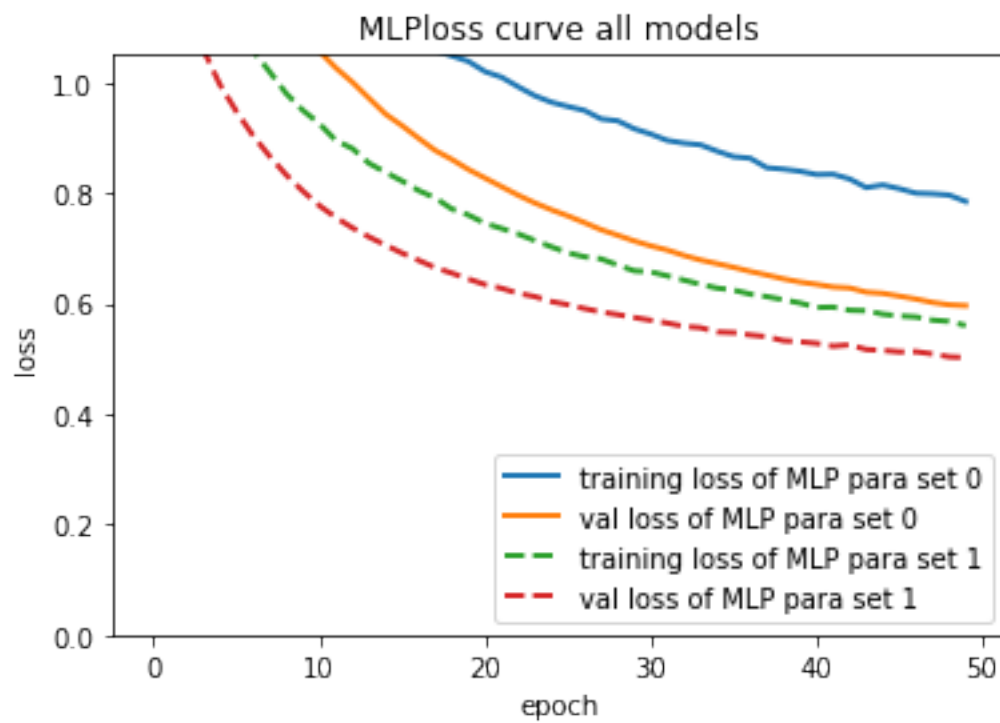
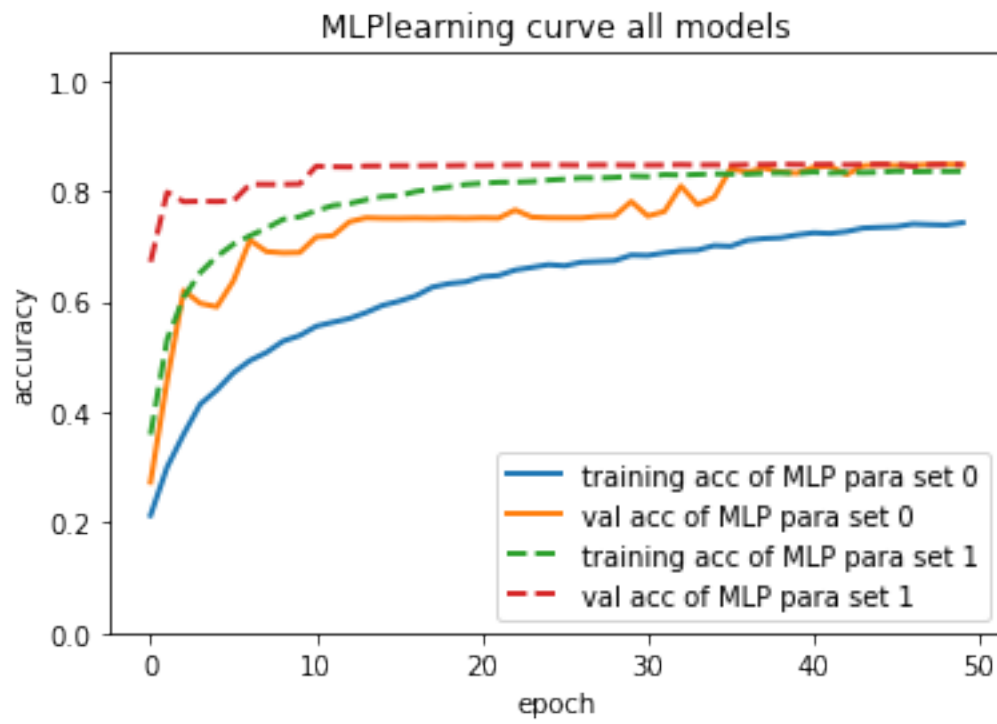




Average scores for pseudo test set across all folds:
 > Accuracy: 0.8255066752433777 (+- 0.0013981374057281189)
 > Loss: 0.5529865491172199

> Avg runtime per test instance: 0.001439320304519872

#####



Opt model parameter found on the pseudo test set:

```
{'num_hidden_layer': 3, 'hidden_layer_activation': ['relu', 'tanh', 'relu'],  
'dropout': [0.5, 0.25, 0.125], 'last_activation': 'softmax'}
```

Best average pseudo test set accuracy score with the opt model:

0.8255066752433777

Average runtime per test instance: 0.0011530807568658065

```
[20]: import importlib
```

```
[ ]: #----- read true test set Task_  
      ↪ A1-----
```

```
[24]: importlib.reload(A1_functions)  
      TaskA1_true_test_res_dict = A1_functions.get_A1_true_test_res('celeba_test',  
      ↪ 'gender', TaskA1_opt_models_dict)
```

(969,)

-----Task A1: True test performance with
LR-----

Prediction on true test set:

	precision	recall	f1-score	support
0.0	0.90	0.93	0.91	488
1.0	0.92	0.90	0.91	481
accuracy			0.91	969
macro avg	0.91	0.91	0.91	969
weighted avg	0.91	0.91	0.91	969

True test set Accuracy: 0.9112487100103199

Average runtime per test instance: 9.349748200061274e-07

-----Task A1: True test performance with
SVM-----

Prediction on true test set:

	precision	recall	f1-score	support
--	-----------	--------	----------	---------

0.0	0.90	0.93	0.91	488
1.0	0.92	0.90	0.91	481
accuracy			0.91	969
macro avg	0.91	0.91	0.91	969
weighted avg	0.91	0.91	0.91	969

True test set Accuracy: 0.913312693498452

Average runtime per test instance: 0.00021770888683842677

-----Task A1: True test performance with
RF-----

Prediction on true test set:

	precision	recall	f1-score	support
0.0	0.84	0.87	0.86	488
1.0	0.87	0.83	0.85	481
accuracy			0.85	969
macro avg	0.85	0.85	0.85	969
weighted avg	0.85	0.85	0.85	969

True test set Accuracy: 0.8534571723426213

Average runtime per test instance: 0.000554773214554762

-----Task A1: True test performance with
KNN-----

Prediction on true test set:

	precision	recall	f1-score	support
0.0	0.77	0.93	0.85	488
1.0	0.91	0.73	0.81	481
accuracy			0.83	969
macro avg	0.84	0.83	0.83	969
weighted avg	0.84	0.83	0.83	969

True test set Accuracy: 0.8286893704850361

Average runtime per test instance: 0.001915088748046119

```

-----Task A1: True test performance with
MLP-----
969/969 [=====] - 0s 345us/step
scores for true test set:
> Accuracy: 0.9205366373062134
> Loss: 0.37550388945514573
> Avg runtime per test instance: 0.0005101350561876169
-----

```

```

[25]: importlib.reload(A2_functions)

TaskA2_true_test_res_dict = A2_functions.get_A2_true_test_res('celeba_test',
↪ 'smiling', TaskA2_opt_models_dict)

(969,)

```

```

-----Task A2: True test performance with
LR-----

```

Prediction on true test set:

	precision	recall	f1-score	support
0.0	0.89	0.92	0.90	472
1.0	0.92	0.89	0.90	497
accuracy			0.90	969
macro avg	0.90	0.90	0.90	969
weighted avg	0.90	0.90	0.90	969

True test set Accuracy: 0.9029927760577915

Average runtime per test instance: 1.8669970879490778e-06

```

-----Task A2: True test performance with
SVM-----

```

Prediction on true test set:

	precision	recall	f1-score	support
0.0	0.90	0.92	0.91	472
1.0	0.92	0.90	0.91	497
accuracy			0.91	969
macro avg	0.91	0.91	0.91	969
weighted avg	0.91	0.91	0.91	969

True test set Accuracy: 0.9112487100103199

Average runtime per test instance: 0.0003592611220352913

-----Task A2: True test performance with
RF-----

Prediction on true test set:

	precision	recall	f1-score	support
0.0	0.88	0.90	0.89	472
1.0	0.91	0.88	0.89	497
accuracy			0.89	969
macro avg	0.89	0.89	0.89	969
weighted avg	0.89	0.89	0.89	969

True test set Accuracy: 0.8926728586171311

Average runtime per test instance: 0.00012063168150721689

-----Task A2: True test performance with
KNN-----

Prediction on true test set:

	precision	recall	f1-score	support
0.0	0.87	0.91	0.89	472
1.0	0.91	0.87	0.89	497
accuracy			0.89	969
macro avg	0.89	0.89	0.89	969
weighted avg	0.89	0.89	0.89	969

True test set Accuracy: 0.890608875128999

Average runtime per test instance: 0.002542159628695871

-----Task A2: True test performance with
MLP-----

969/969 [=====] - 1s 1ms/step

scores for true test set:

> Accuracy: 0.884416937828064

> Loss: 0.4281818089839475

> Avg runtime per test instance: 0.0012556738897742871

```
[26]: importlib.reload(B1_functions)

TaskB1_true_test_res_dict = B1_functions.
↳get_B1_true_test_res('cartoon_set_test', 'face_shape',
↳TaskB1_opt_models_dict)
```

(1939,)

-----Task B1: True test performance with
SVM-----

Prediction on true test set:

	precision	recall	f1-score	support
0	0.82	0.77	0.79	362
1	0.72	0.68	0.70	378
2	0.76	0.81	0.78	424
3	0.69	0.72	0.71	394
4	0.82	0.82	0.82	381
accuracy			0.76	1939
macro avg	0.76	0.76	0.76	1939
weighted avg	0.76	0.76	0.76	1939

True test set Accuracy: 0.7601856627127386

Average runtime per test instance: 0.0013159975186643556

-----Task B1: True test performance with
RF-----

Prediction on true test set:

	precision	recall	f1-score	support
0	0.81	0.70	0.75	362
1	0.65	0.57	0.61	378
2	0.72	0.82	0.76	424
3	0.64	0.68	0.66	394
4	0.80	0.83	0.81	381
accuracy			0.72	1939
macro avg	0.72	0.72	0.72	1939
weighted avg	0.72	0.72	0.72	1939

True test set Accuracy: 0.7209902011346054

Average runtime per test instance: 0.0010931789413932184

-----Task B1: True test performance with
KNN-----

Prediction on true test set:

	precision	recall	f1-score	support
0	0.52	0.55	0.54	362
1	0.41	0.35	0.38	378
2	0.55	0.70	0.61	424
3	0.46	0.45	0.46	394
4	0.76	0.61	0.68	381
accuracy			0.53	1939
macro avg	0.54	0.53	0.53	1939
weighted avg	0.54	0.53	0.53	1939

True test set Accuracy: 0.5348117586384734

Average runtime per test instance: 0.0036276740595014394

-----Task B1: True test performance with
MLP-----

1939/1939 [=====] - 2s 884us/step

scores for true test set:

> Accuracy: 0.7452294826507568

> Loss: 0.7304734601194923

> Avg runtime per test instance: 0.0012736920538238793

```
[27]: importlib.reload(B2_functions)
```

```
TaskB2_true_test_res_dict = B2_functions.
```

```
    ↳get_B2_true_test_res('cartoon_set_test', 'eye_color', TaskB2_opt_models_dict)
```

(2017,)

-----Task B2: True test performance with
SVM-----

Prediction on true test set:

	precision	recall	f1-score	support
--	-----------	--------	----------	---------

0	0.93	0.78	0.85	410
1	0.99	0.78	0.87	404
2	0.99	0.81	0.89	420
3	0.97	0.81	0.88	401
4	0.54	0.97	0.70	382
accuracy			0.83	2017
macro avg	0.88	0.83	0.84	2017
weighted avg	0.89	0.83	0.84	2017

True test set Accuracy: 0.8264749628160635

Average runtime per test instance: 6.300988147680749e-05

-----Task B2: True test performance with
RF-----

Prediction on true test set:

	precision	recall	f1-score	support
0	0.89	0.83	0.86	410
1	0.57	0.85	0.68	404
2	0.81	0.88	0.84	420
3	0.80	0.82	0.81	401
4	0.47	0.20	0.28	382
accuracy			0.72	2017
macro avg	0.71	0.72	0.69	2017
weighted avg	0.71	0.72	0.70	2017

True test set Accuracy: 0.7223599405057015

Average runtime per test instance: 4.75632653829776e-05

-----Task B2: True test performance with
KNN-----

Prediction on true test set:

	precision	recall	f1-score	support
0	0.78	0.89	0.83	410
1	0.79	0.84	0.82	404
2	0.95	0.85	0.90	420
3	0.58	0.82	0.68	401
4	0.49	0.23	0.32	382

accuracy			0.73	2017
macro avg	0.72	0.72	0.71	2017
weighted avg	0.72	0.73	0.71	2017

True test set Accuracy: 0.7312840852751611

Average runtime per test instance: 3.682249066376958e-05

-----Task B2: True test performance with
MLP-----

2017/2017 [=====] - 0s 132us/step

scores for true test set:

> Accuracy: 0.8235002756118774

> Loss: 0.5554206218675747

> Avg runtime per test instance: 0.0001169826704260732

[]: