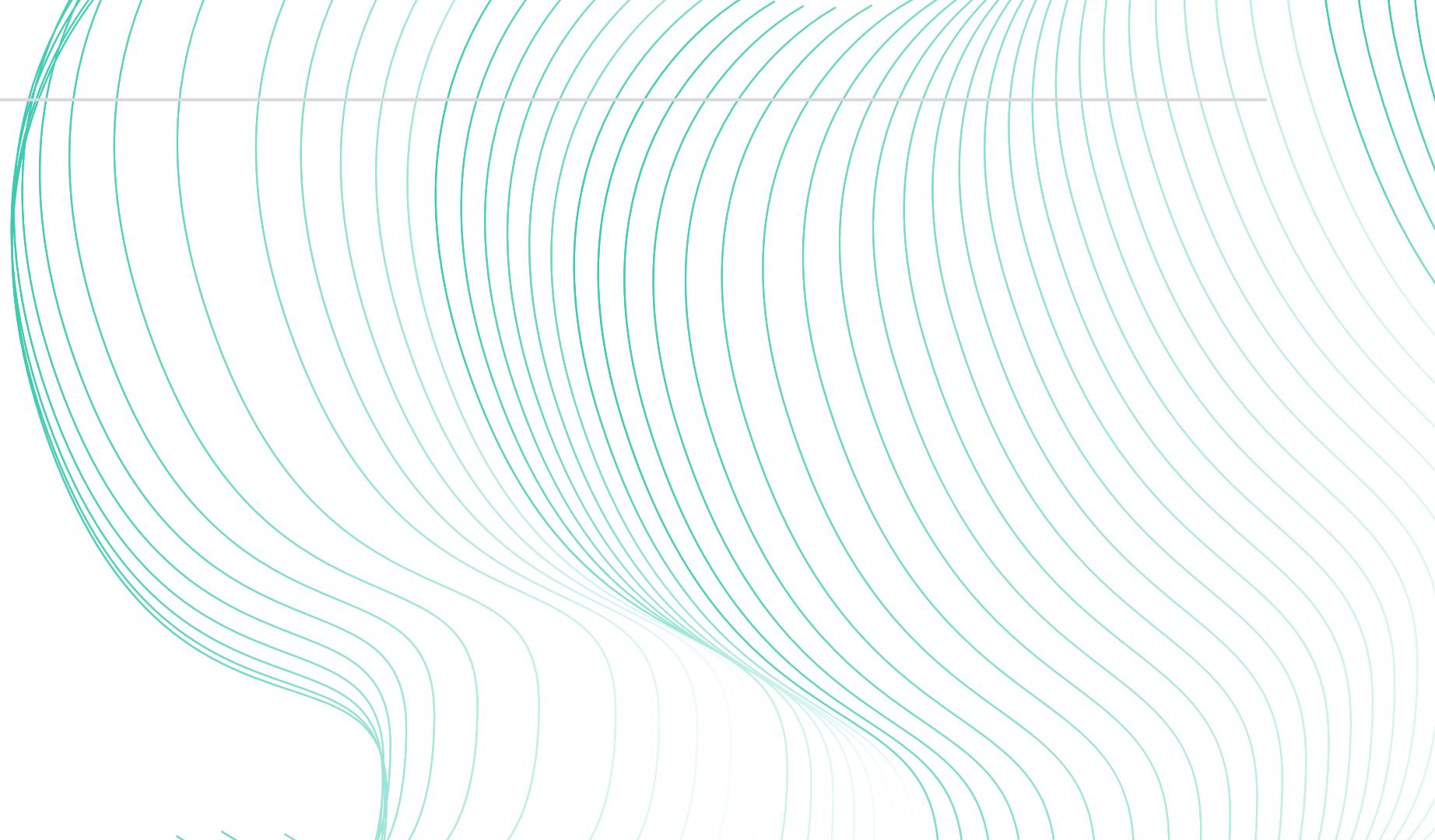




EEG Epileptic Seizure Classification

Laibah Ashfaq

Business Understanding



Stakeholders

- Columbia University
- Mount Sinai,
Department of
Neurology

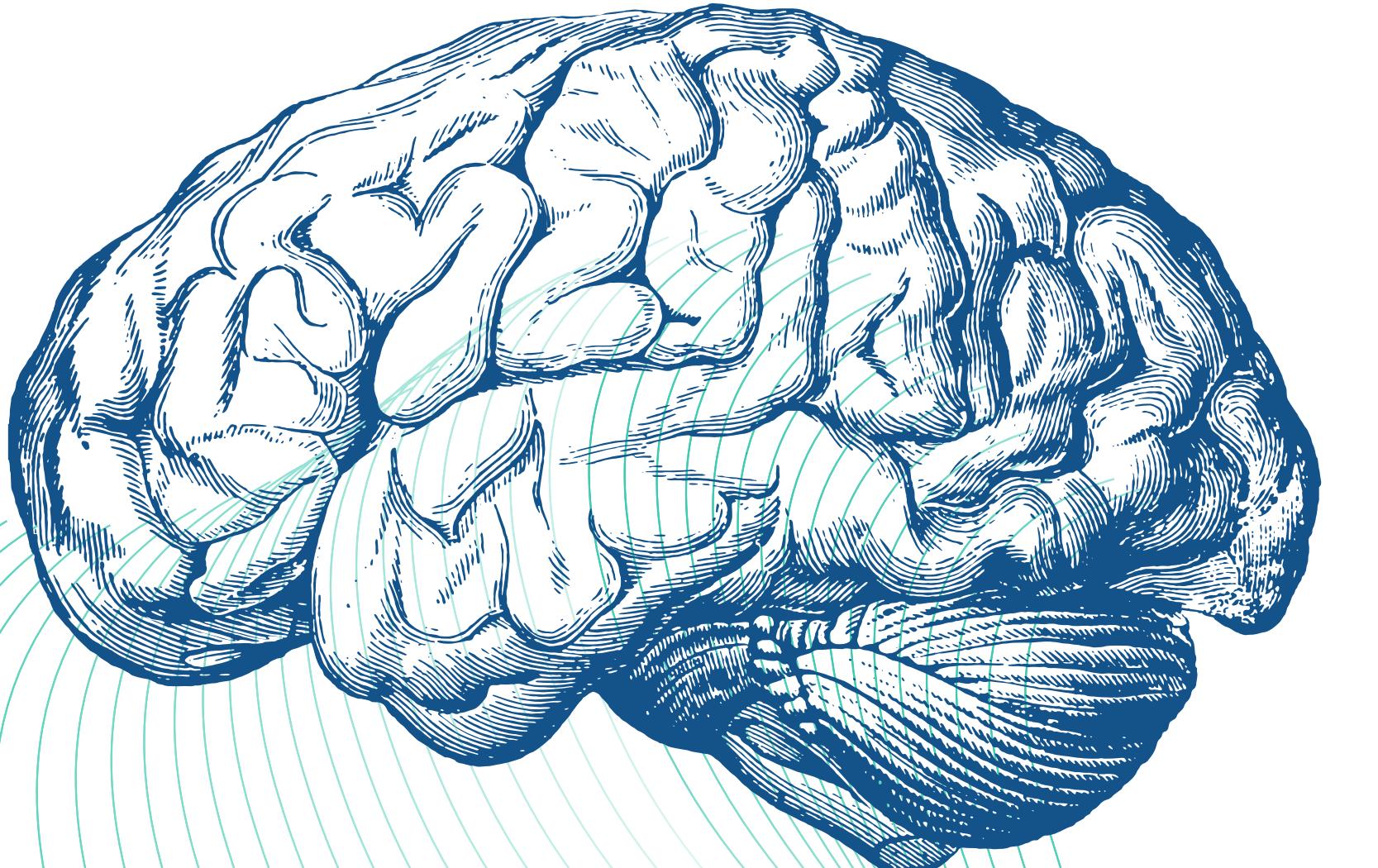
Problem

- How to increase the efficiency and automate EEG interpretation

Solutions

- Using Machine learning to deploy a model and create a tool that has high accuracy

What is Epilepsy ?

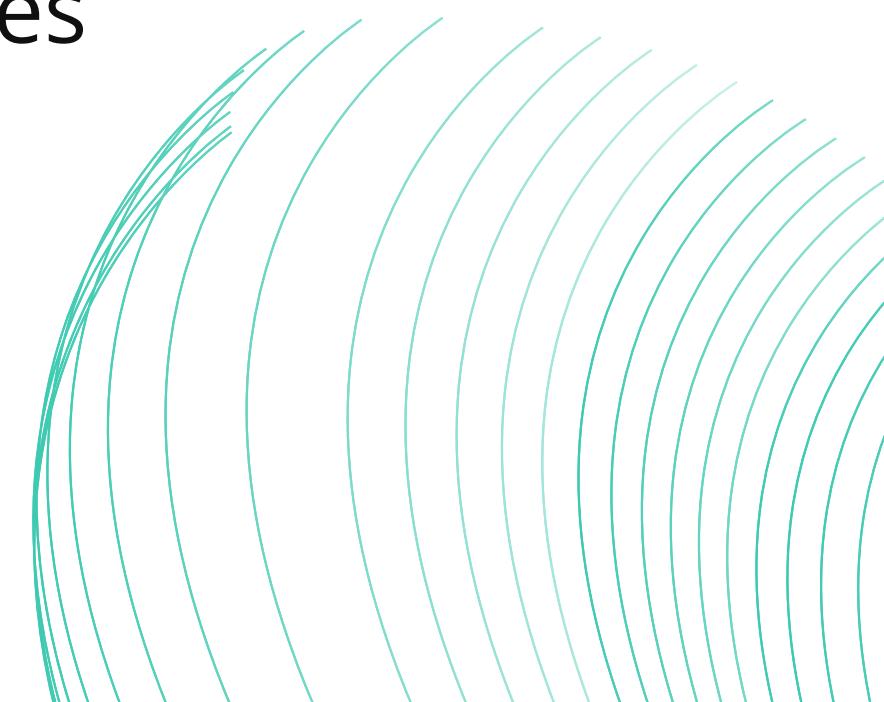


- A neurological disorder characterized by recurrent, unprovoked seizures
- The cause of epilepsy varies; there can be no cause or caused by brain injuries, infection, tumours, genetics, etc.
- Diagnosing epilepsy involves: neurological examination, and often EEG recordings to detect abnormal brain activity during or between seizures
- According to the World Health Organization (WHO), approximately 50 million people worldwide have epilepsy.

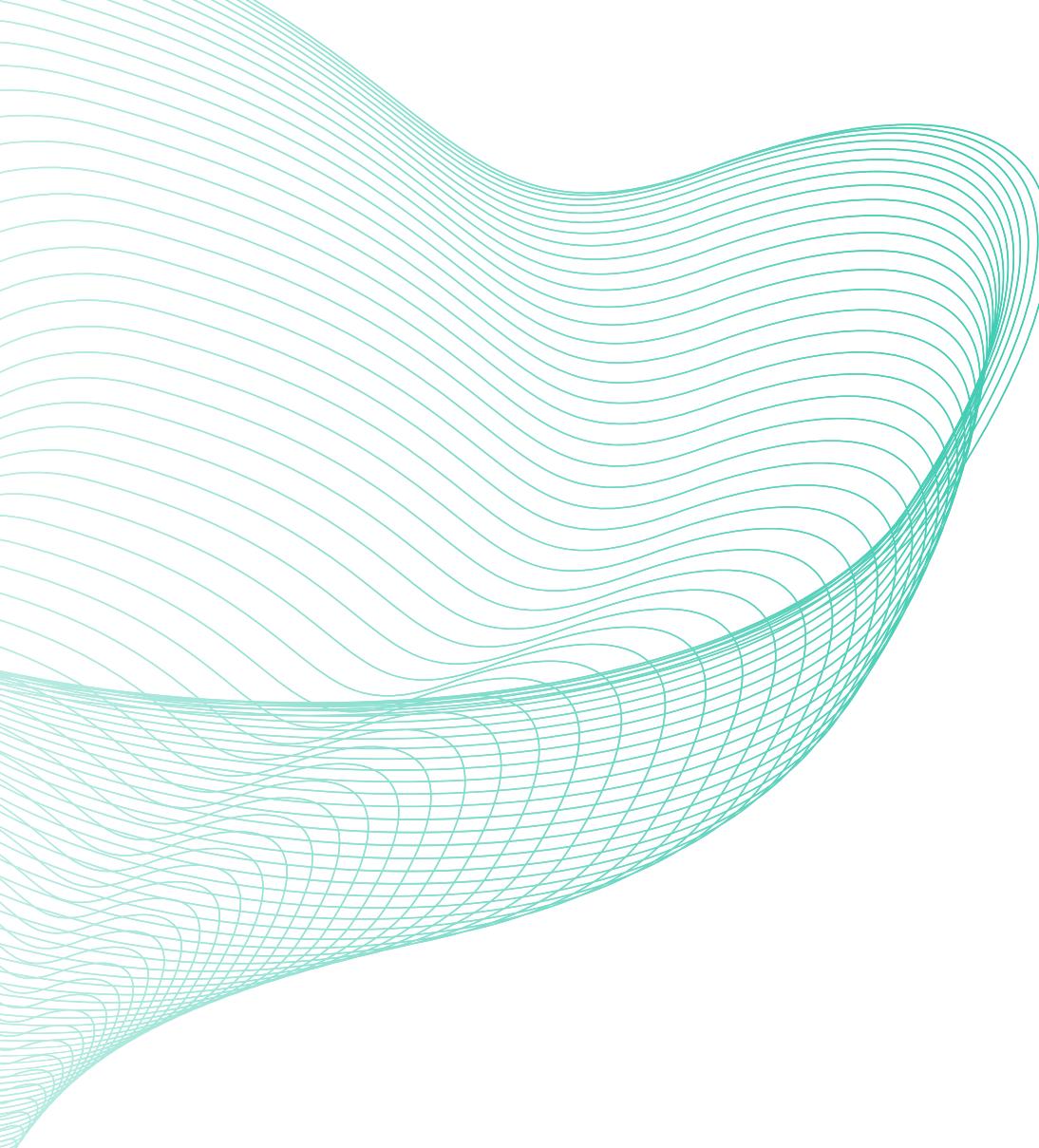


What are EEG Scans ?

- EEG signals record the electrical activity of the brain using EEG electrodes placed on the scalp
- raw EEG signal is simply a discrete time multivariate time-series



Data Acquisition



UCI Machine Learning data set

- pre-processed dataset
- 11500 rows
- 178 data points for 1 second (column)
- the last column represents the label y {1,2,3,4,5}.

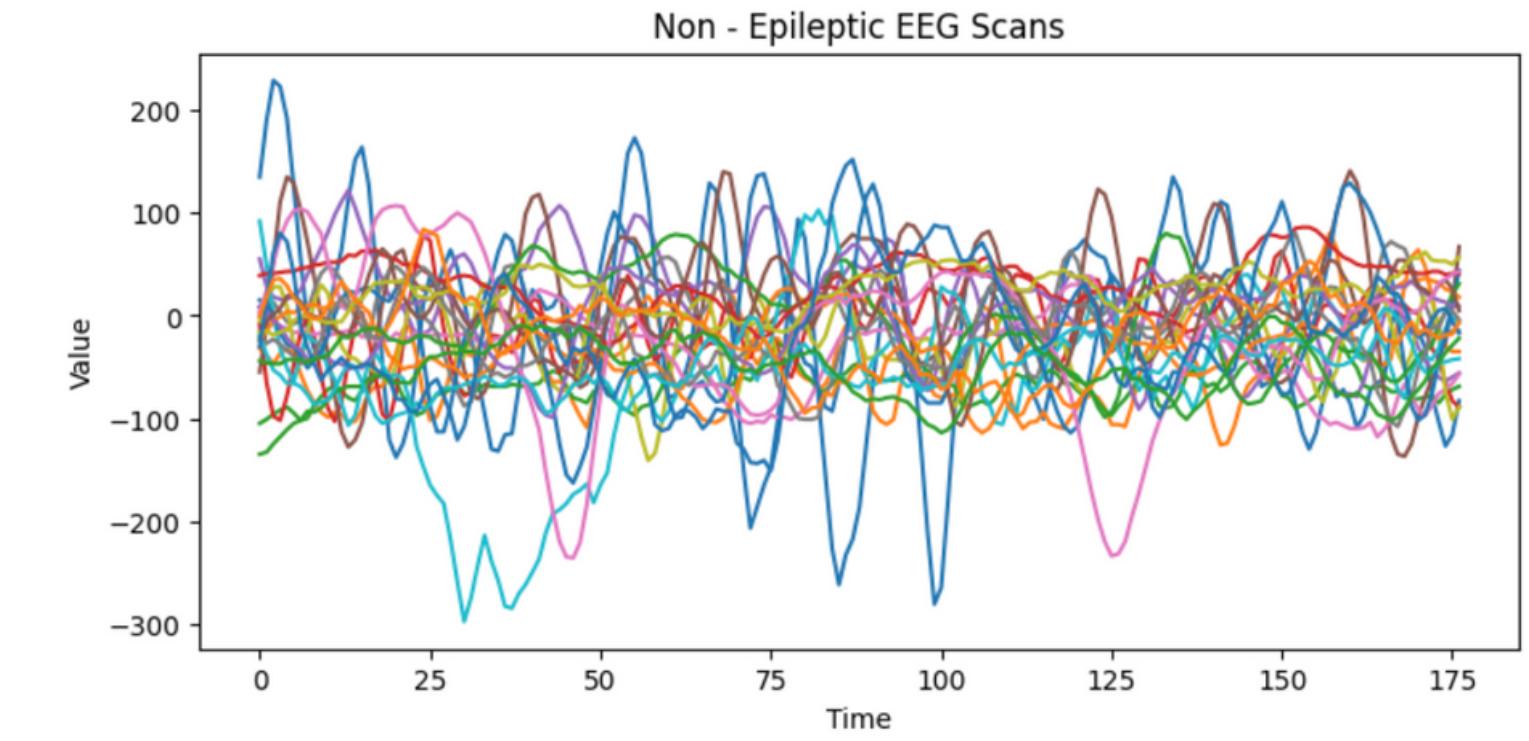
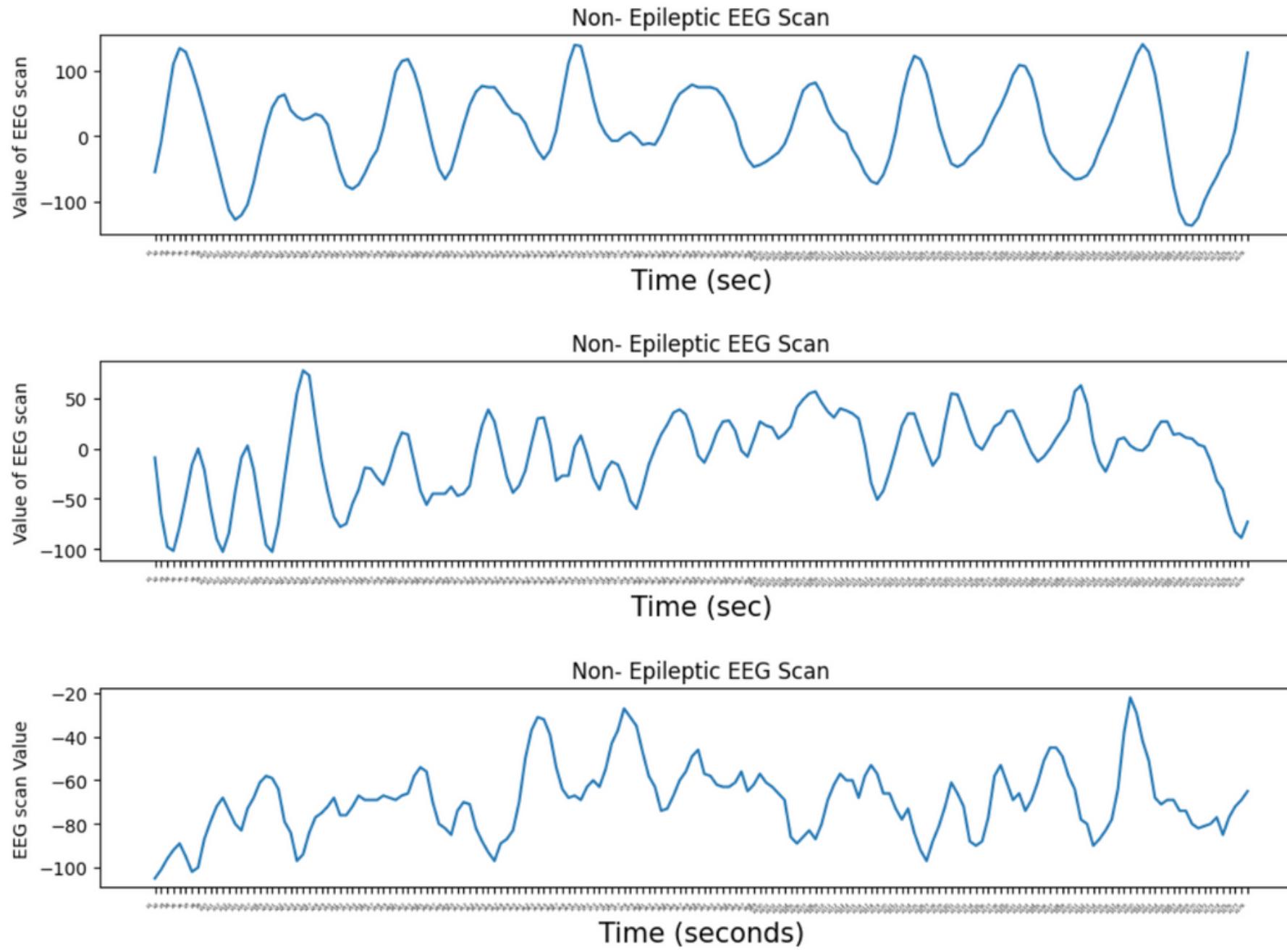
Feature extraction

- TSFRESH is a general time series feature extractor
- Some features extracted:
 - Spectral Entropy
 - local minima/ maxima
 - final dataset = ~ 370 features

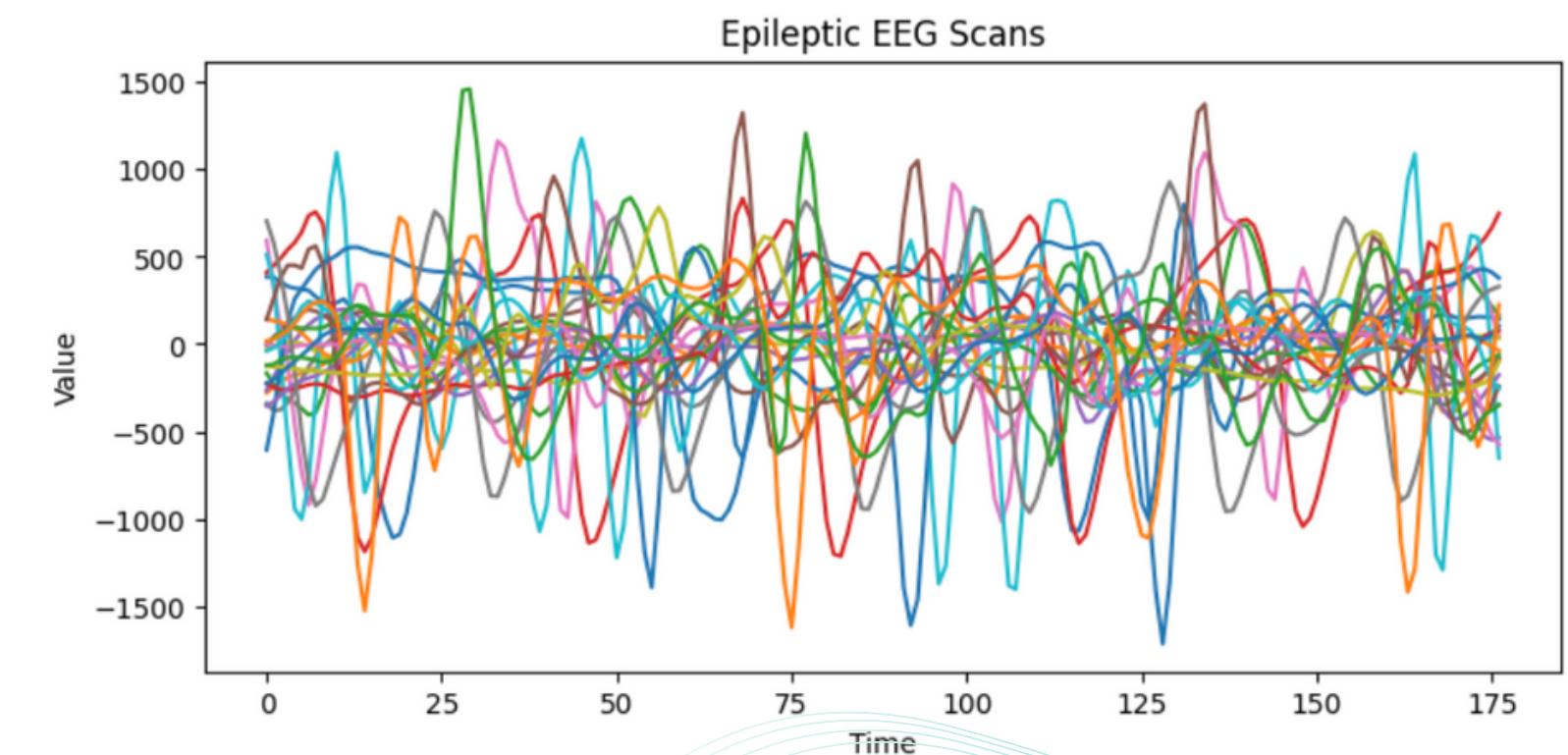
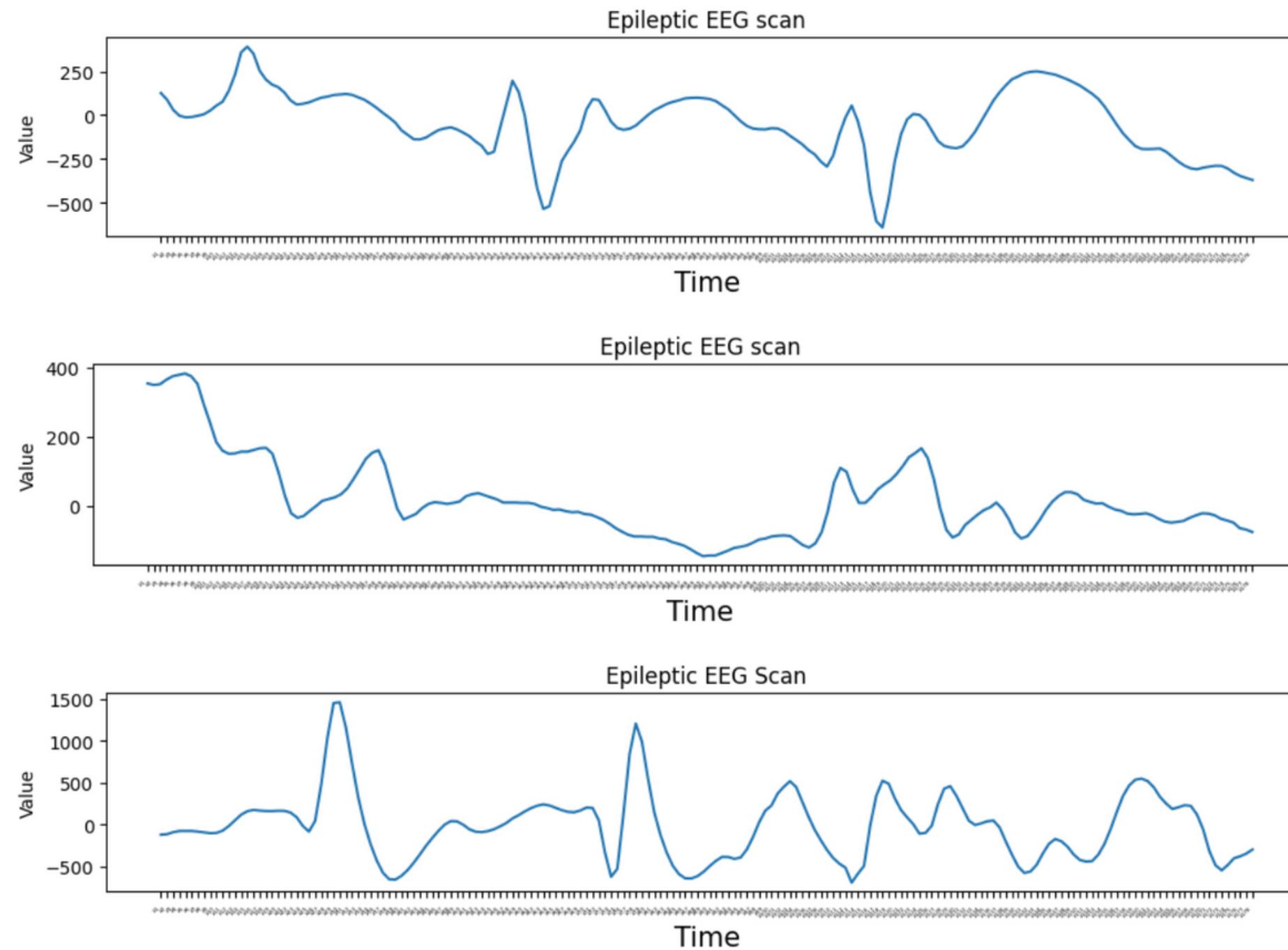
Next step: using domain specific feature extraction

- MNE
- PyEEG
- NeuroKit2

Non-Epileptic Scans



Epileptic Scans



MODELS MADE

Logistic Regression

- f1 with PCA = 0.967
- f1 with UMAP = 0.98

Decision Tree Classifier

- f1 with PCA + hypertuned = 0.94

Random Forest

- f1 with PCA = 0.94

Gaussian Naive Bayes

- f1 with PCA = 0.79

XGBoost

- f1 with PCA = 0.96

Artificial Neural Network

- Accuracy with 4 hidden layers + relu = 0.89
- Accuracy with 4 hidden layers + selu = 0.83

Dimensionality Reduction Techniques

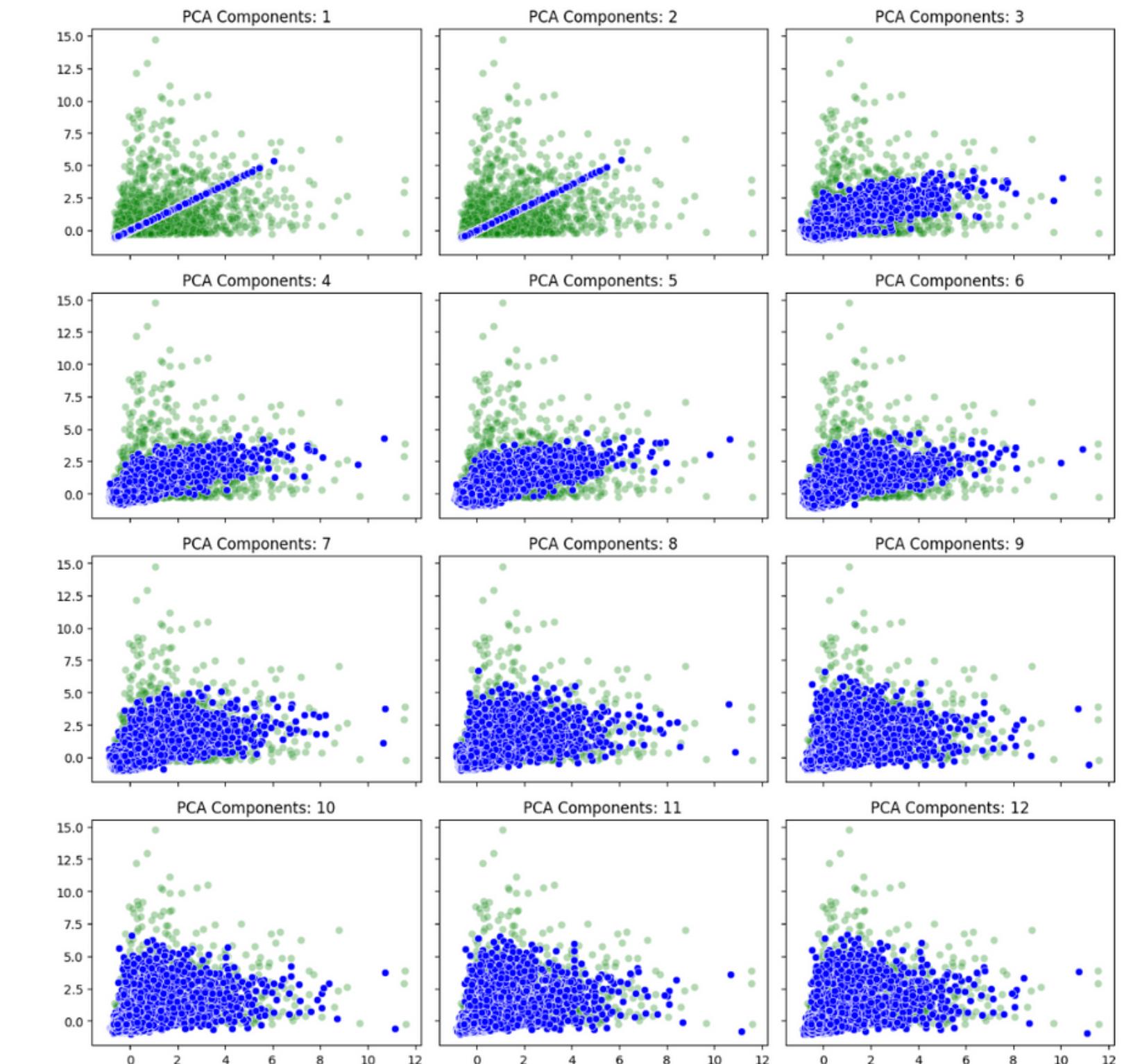


Without PCA

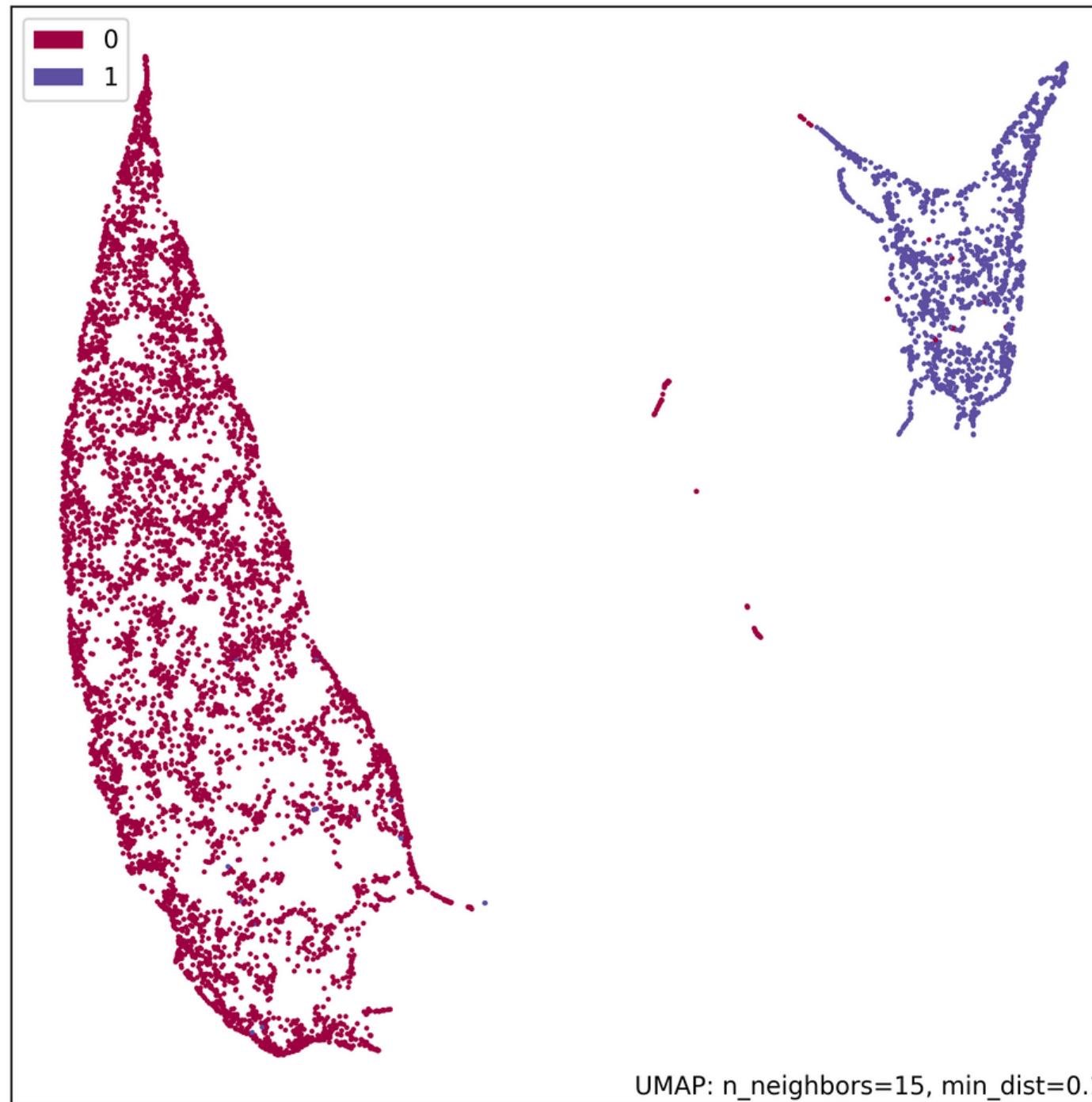
KNeighbors : Mean Accuracy: 0.982 and Standard Deviation:(0.003)
RandomForest : Mean Accuracy: 0.988 and Standard Deviation:(0.001)
LogisticReg : Mean Accuracy: 0.987 and Standard Deviation:(0.002)
Xgb : Mean Accuracy: 0.991 and Standard Deviation:(0.002)

With PCA

KNeighbors : Mean Accuracy: 0.966 and Standard Deviation:(0.002)
RandomForest : Mean Accuracy: 0.988 and Standard Deviation:(0.002)
LogisticReg : Mean Accuracy: 0.961 and Standard Deviation:(0.003)
Xgb : Mean Accuracy: 0.990 and Standard Deviation:(0.002)



Dimensionality Reduction Techniques



UMAP

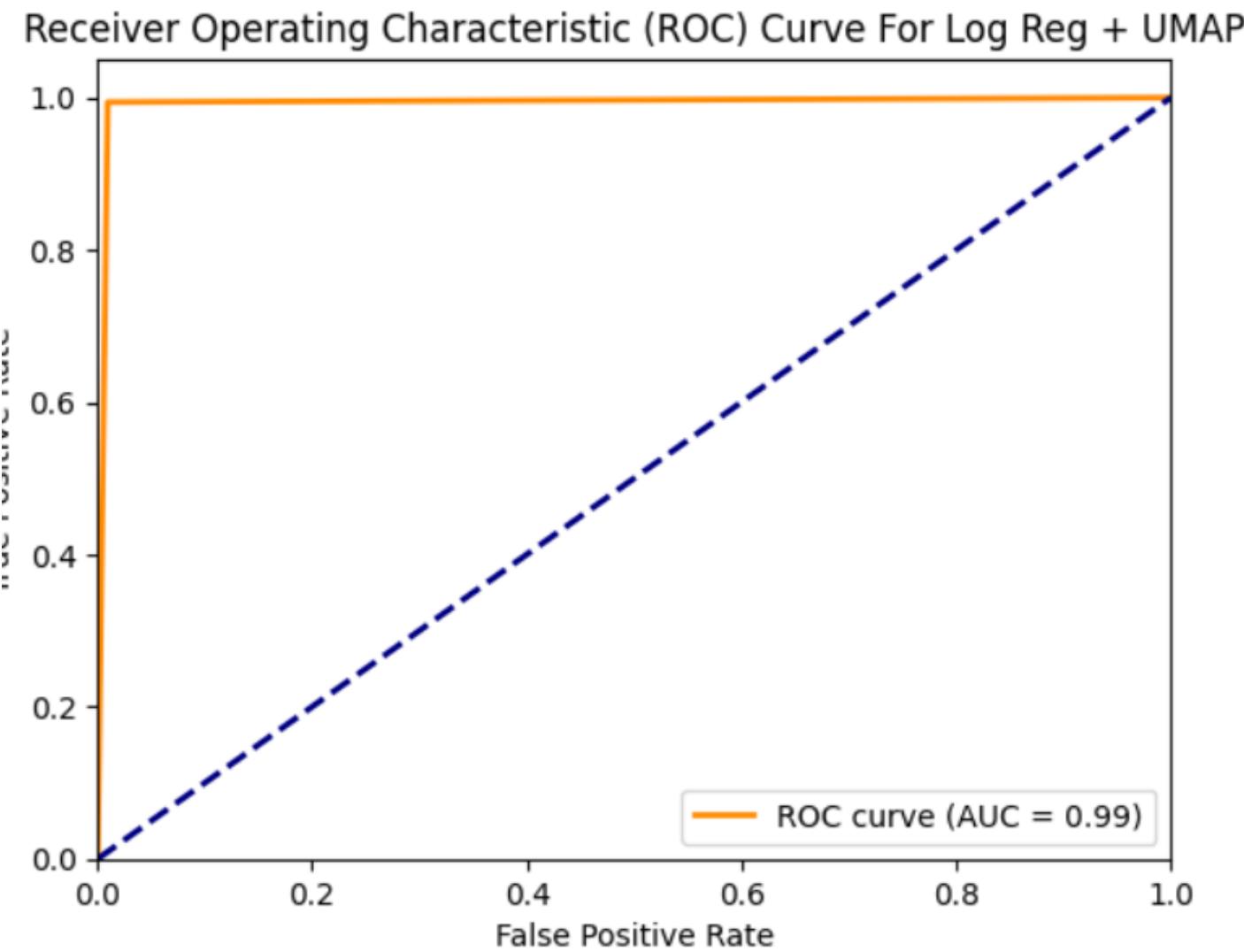
Without UMAP

KNeighbors : Mean Accuracy: 0.980 and Standard Deviation: (0.003)
RandomForest : Mean Accuracy: 0.989 and Standard Deviation: (0.002)
LogisticReg : Mean Accuracy: 0.988 and Standard Deviation: (0.002)
Xgb : Mean Accuracy: 0.990 and Standard Deviation: (0.002)

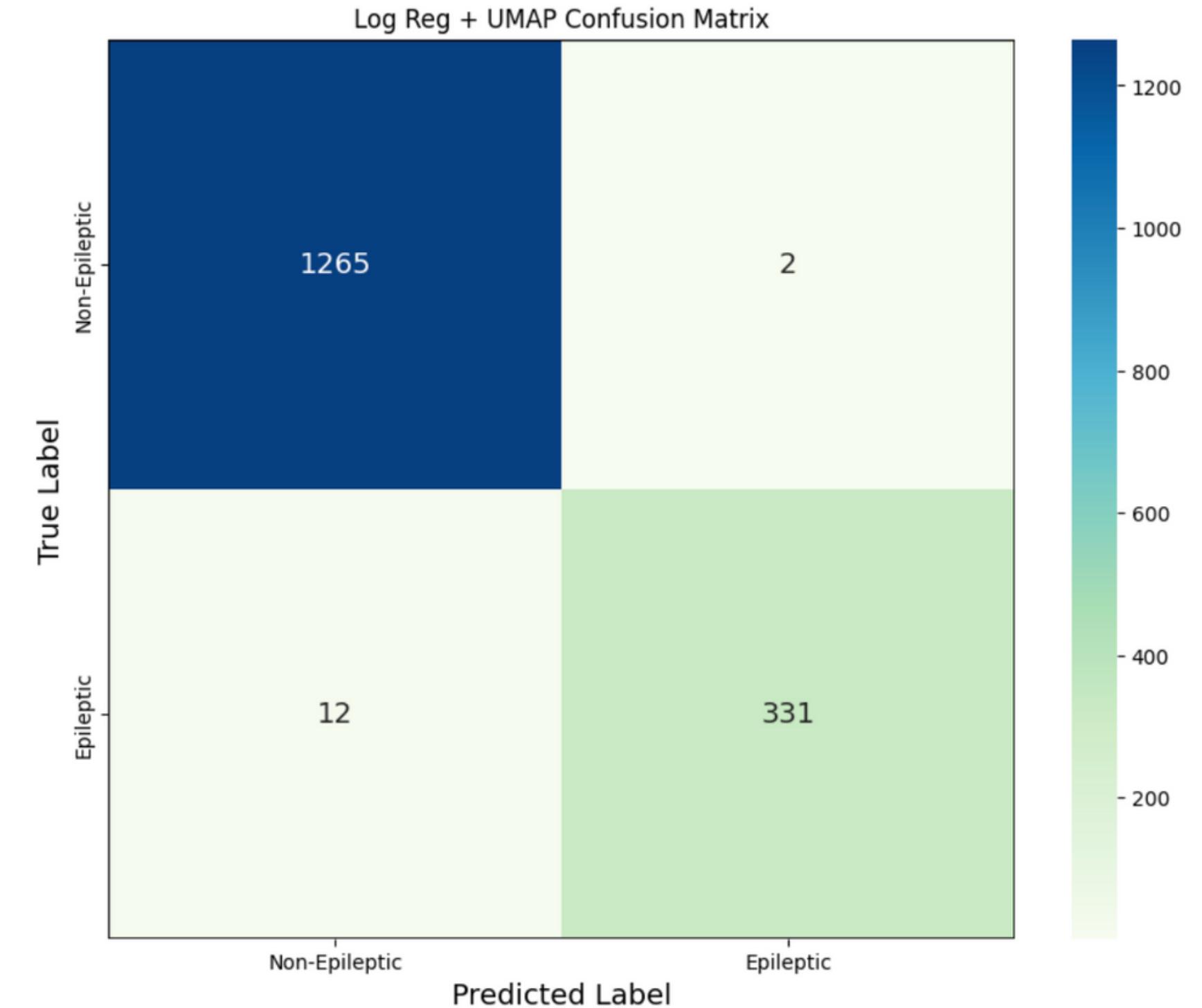
With UMAP

KNeighbors : Mean Accuracy: 0.986 and Standard Deviation: (0.002)
RandomForest : Mean Accuracy: 0.989 and Standard Deviation: (0.001)
LogisticReg : Mean Accuracy: 0.987 and Standard Deviation: (0.001)
Xgb : Mean Accuracy: 0.991 and Standard Deviation: (0.002)

Best Model: Logistic Regression with UMAP



	precision	recall	f1-score	support
0	1.00	0.99	0.99	1277
1	0.97	0.99	0.98	333
accuracy			0.99	1610
macro avg	0.98	0.99	0.99	1610
weighted avg	0.99	0.99	0.99	1610



Model Deployment

Epilepsy Classification

upload CSV file

Upload a file



Drag and drop file here

Limit 200MB per file

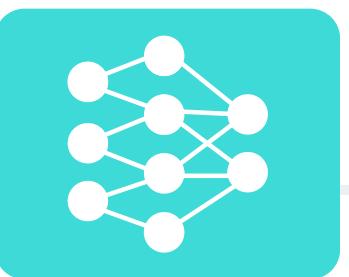
[Browse files](#)

[predict](#)

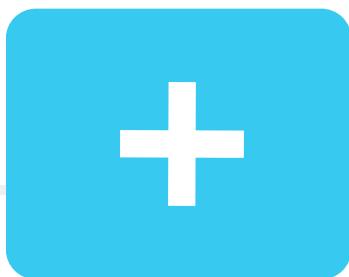
Next Steps



Use domain specific packages, or develop one for EEG Scans



Convolutional Neural Network Models for EEG Scan Classification



Use this model to predict sleep disorders



Create an app with more models to classify different disorders using EEG scans

Thank You

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