



EpiSenseAI

GROUP 3

SIGNAL AND IMAGING ACQUISITION AND MODELLING IN
HEALTHCARE 2023-2024

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WHAT IS EPILEPSY?

01

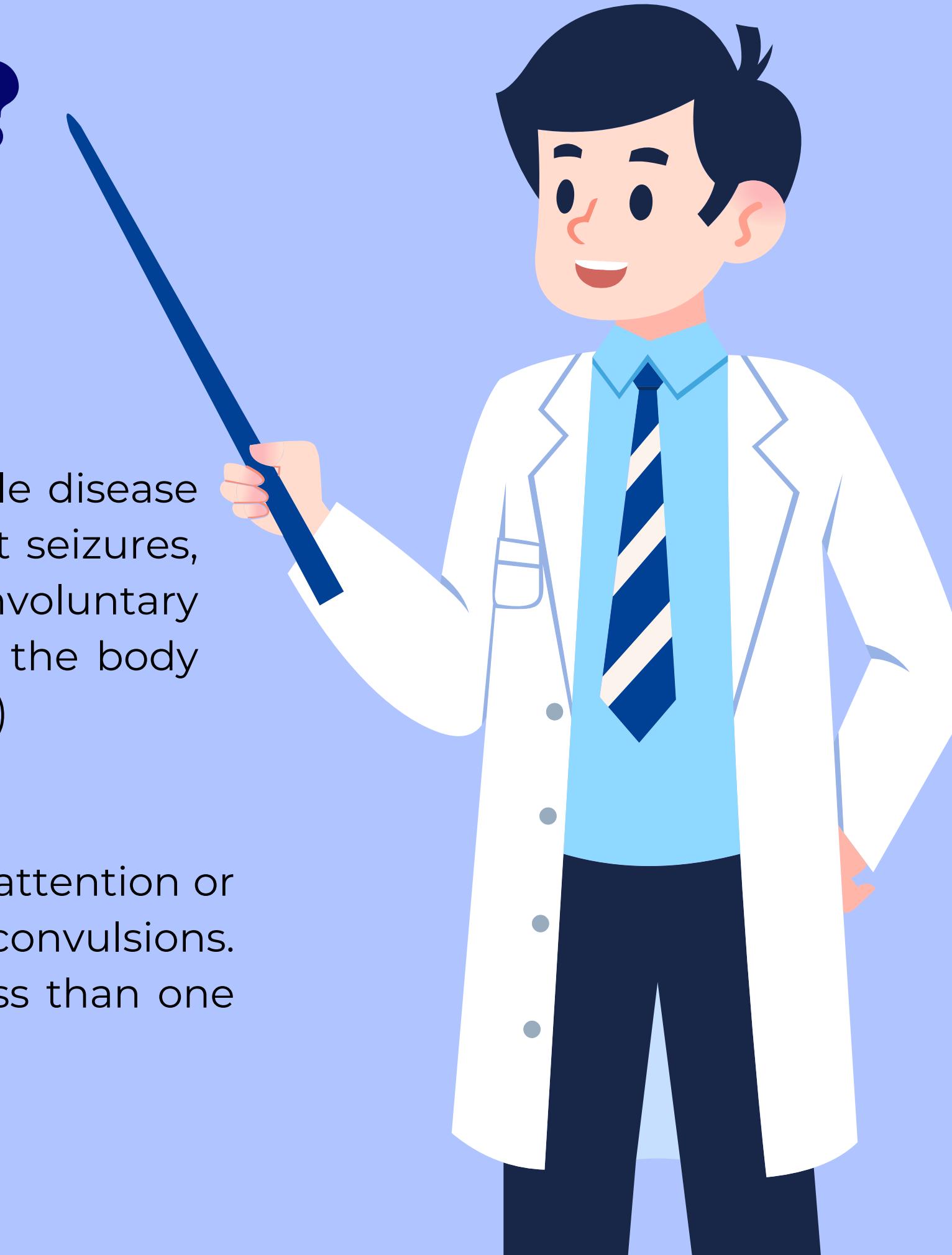
EPILEPSY

Epilepsy is a chronic noncommunicable disease of the brain characterized by recurrent seizures, which are brief episodes of involuntary movement that may involve a part of the body (partial) or the entire body (generalized)

02

SEIZURES

Seizures can vary from the briefest lapses of attention or muscle jerks to severe and prolonged convulsions. Seizures can also vary in frequency, from less than one per year to several per day.



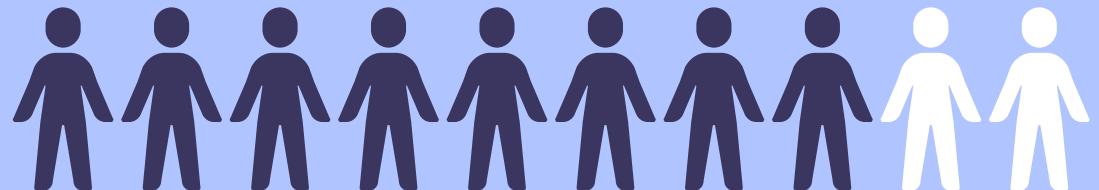
RATES OF DISEASE

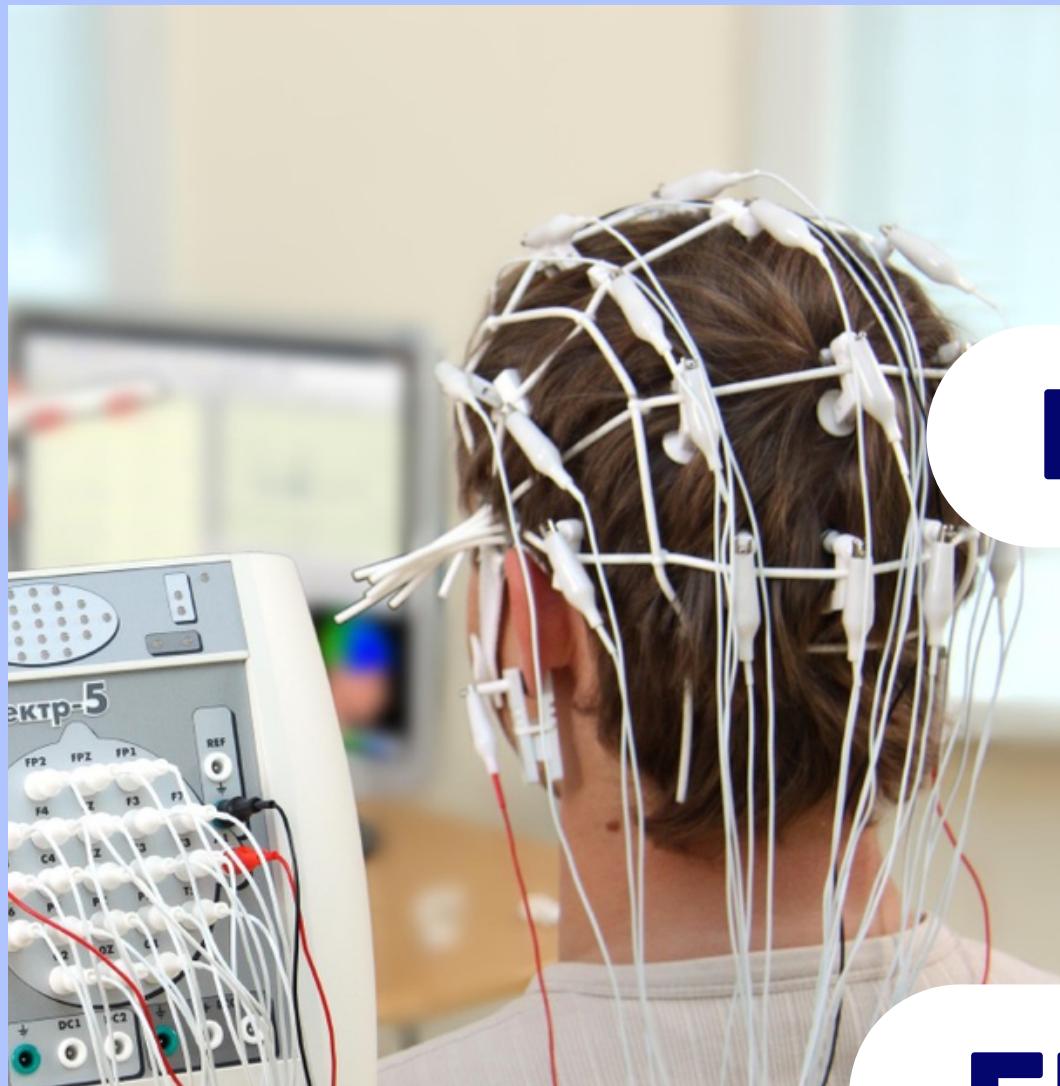
50M

Patients

80%

Lives in low - and mid income countries

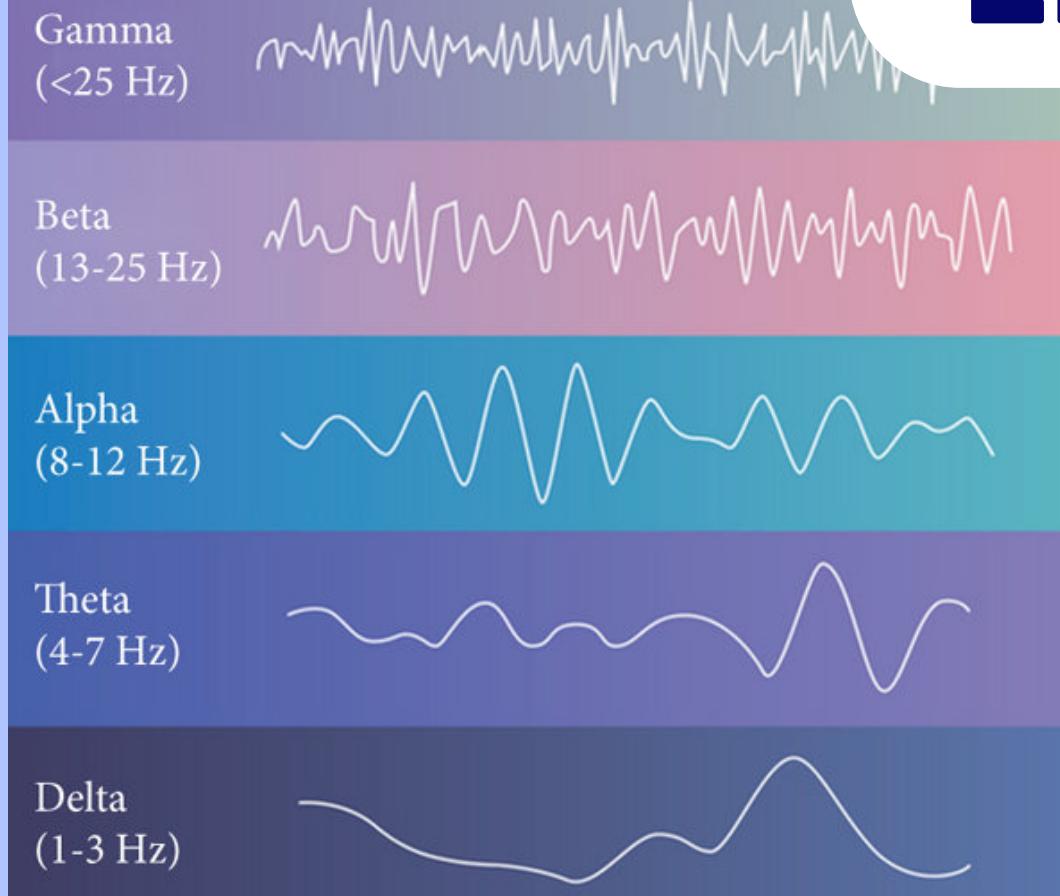




DIAGNOSIS

A documented etiology of the seizure and an abnormal electroencephalography (EEG) pattern are the two most consistent predictors of seizure recurrence.

EEG



There are four main types: Alpha, Beta, Delta, and Theta. Alpha waves (8.5-12 Hz) are associated with relaxed alertness, Beta waves (13-40 Hz) with active thinking, Delta waves (up to 4 Hz) with infancy and certain brain conditions, and Theta waves (4.5-8 Hz) with drowsiness and various induced states like hypnosis or meditation.



PIPELINE

1

Data Analysis

2

Preprocessing

3

Training phase

4

Test phase

1 Normalization

1 Models

1 Metrics

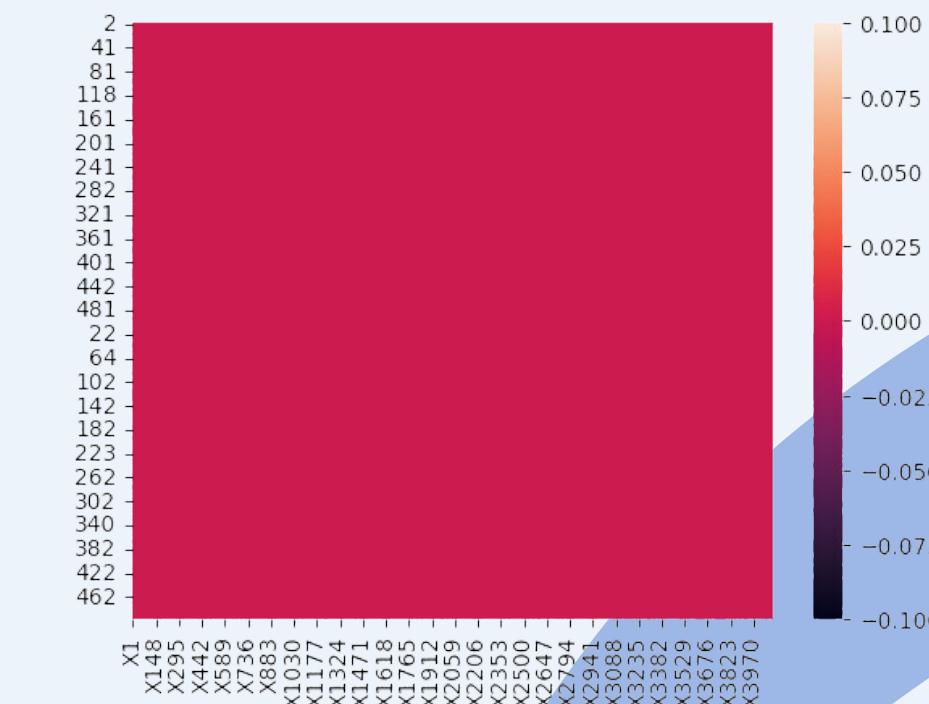
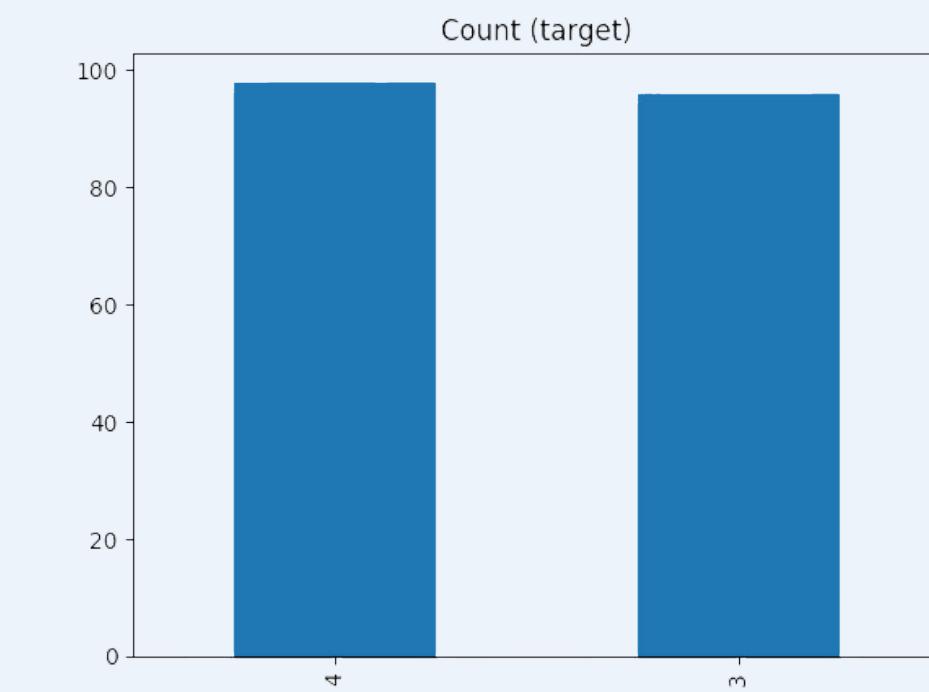
2 PCA

2 Cross validation

2 Comparison

DATA ANALYSIS

- **NO MISSING VALUES**
- **4095 FEATURES**
- **200 PATTERNS**
- **100 PATTERNS OF CLASS 3**
- **100 PATTERNS OF CLASS 4**



DATA PREPROCESSING

STANDARDIZATION - OUTLIERS

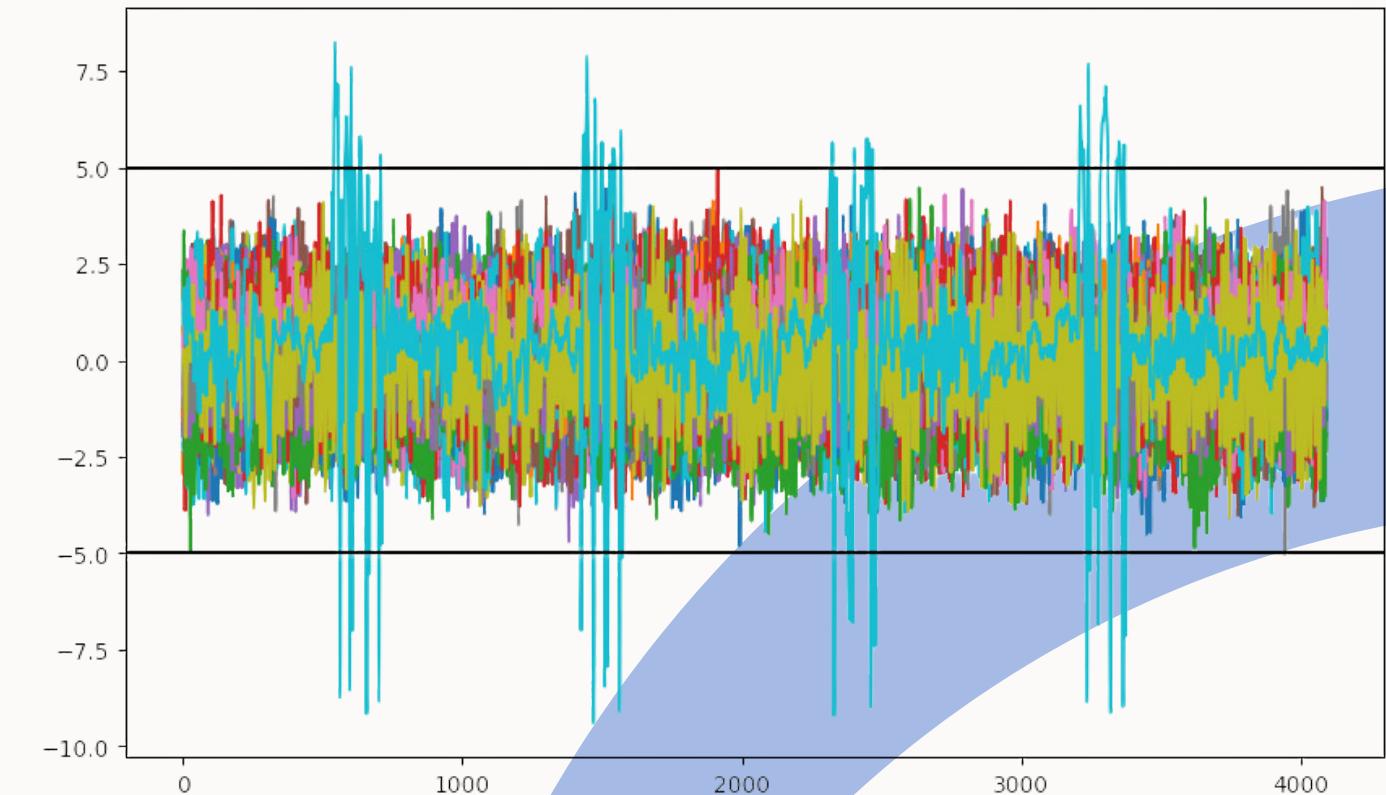
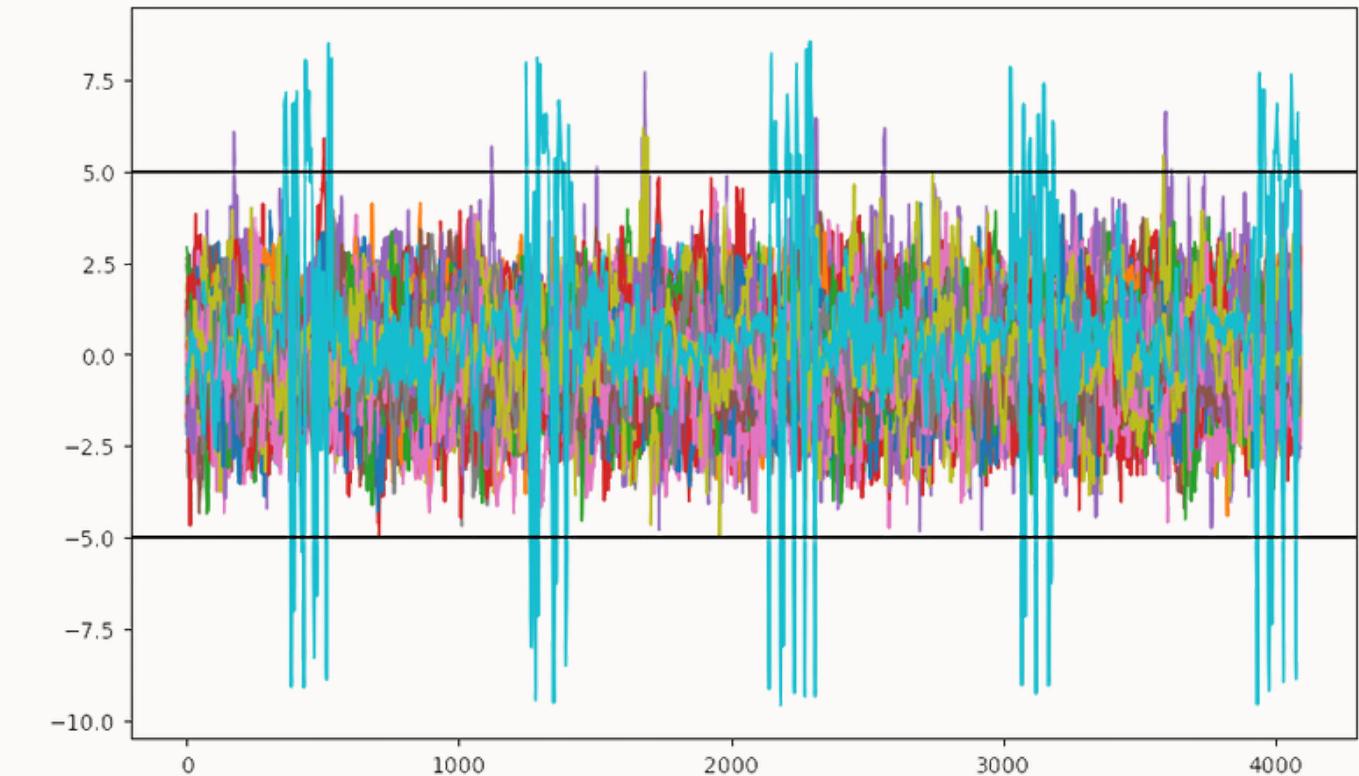
STANDARDIZATION

$$Z = \frac{x - \mu}{\sigma}$$

OUTLIERS

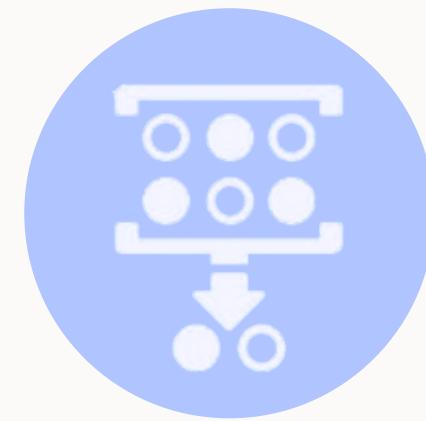
$$Z = \frac{x - \mu}{\sigma} > 5$$

- 2 OUTLIERS IN CLASS 3
- 4 OUTLIERS IN CLASS 4



DATA PREPROCESSING

PRINCIPAL COMPONENTS ANALYSIS



PCA

PCA is a statistical technique to reduce dimensionality while preserving important information in data through linear combination of initial features

KAISER RULE

The Kaiser rule in PCA suggests to choose as number of components (features) the number of eigenvalues greater than 1.

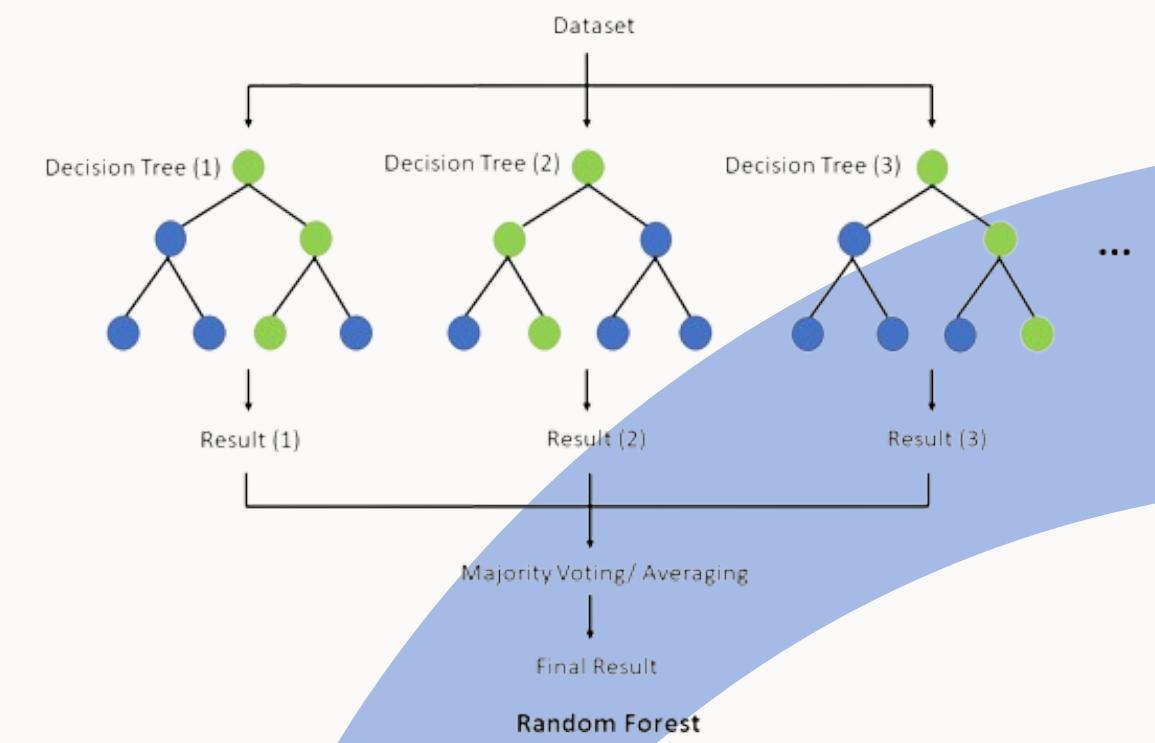
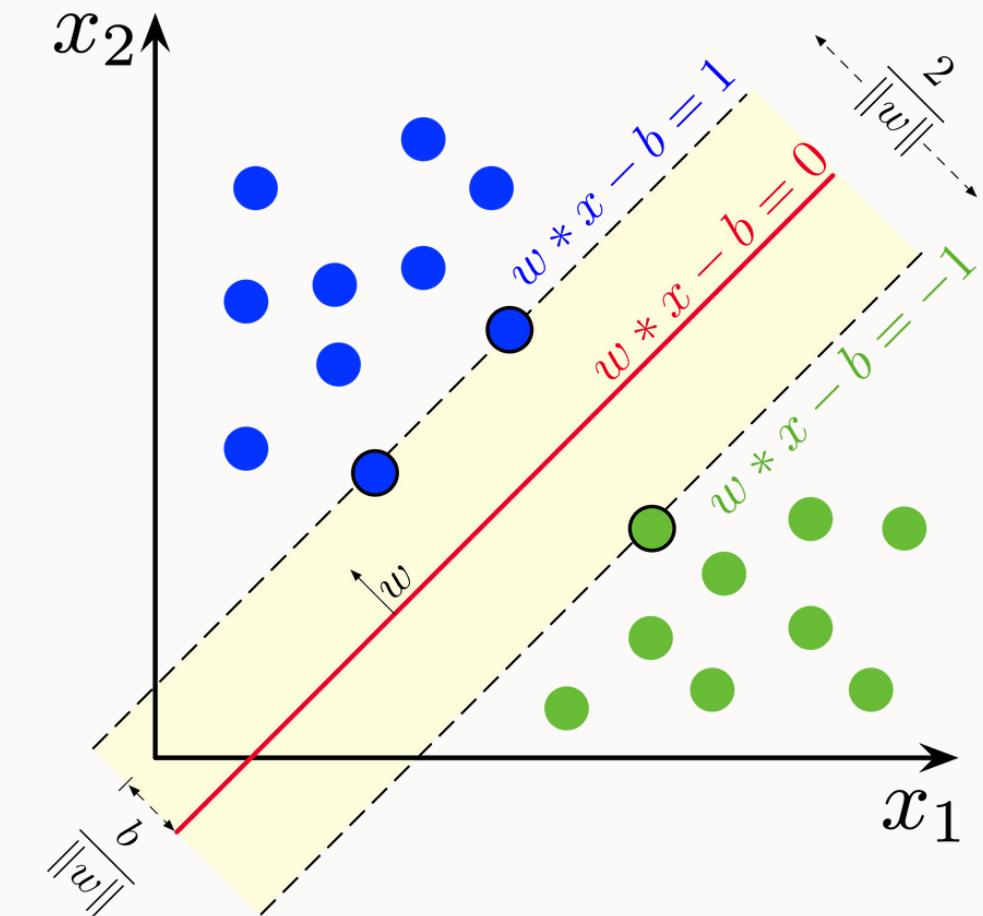
TRAINING PHASE MODELS

SVM

SVM is a supervised machine learning algorithm for classification and regression tasks. It finds an optimal hyperplane to separate data points into different classes by maximizing the margin between classes.

RANDOM FOREST

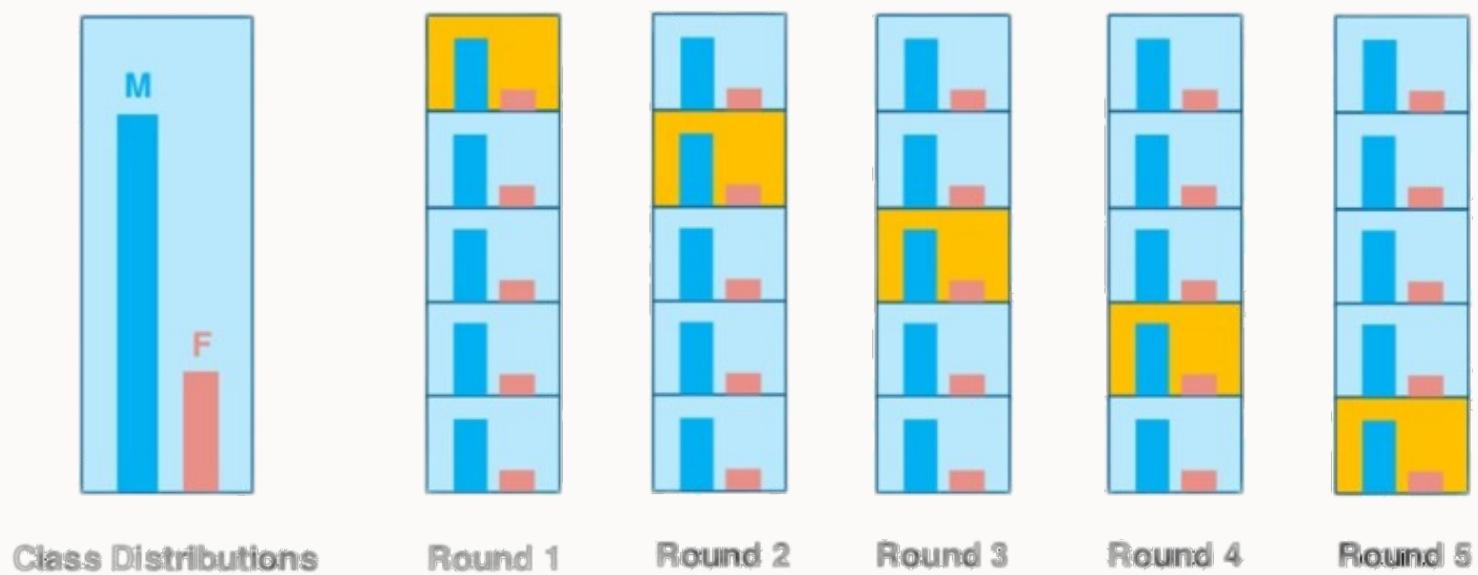
Random Forest (RF) is an ensemble learning method consisting of multiple decision trees. It combines their predictions to improve accuracy and handle overfitting, making it robust for classification and regression tasks.



TRAINING PHASE

CROSS VALIDATION

STRATIFIED CROSS VALIDATION



SVM: 500 MODELS - CV SCORE: 0.7029

RF: 360 MODELS - CV SCORE: 0.80

SVM (PCA) : 500 MODELS - CV SCORE: 0.7029

RF (PCA): 360 MODELS - CV SCORE: 0.8829

PARAM GRID SVM

Parameter	Values
C	0.1, 1, 10, 100, 1000
gamma	1, 0.1, 0.01, 0.001, 0.0001
kernel	'linear', 'rbf'

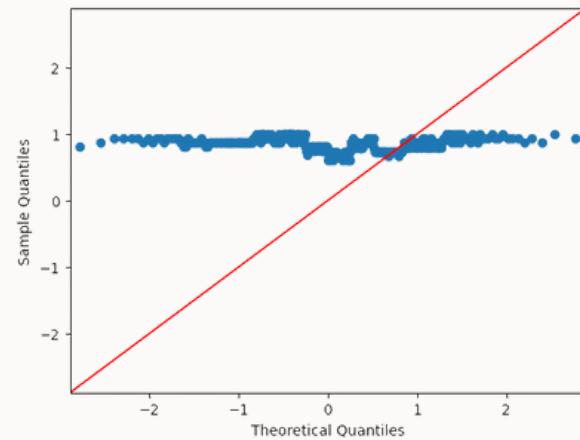
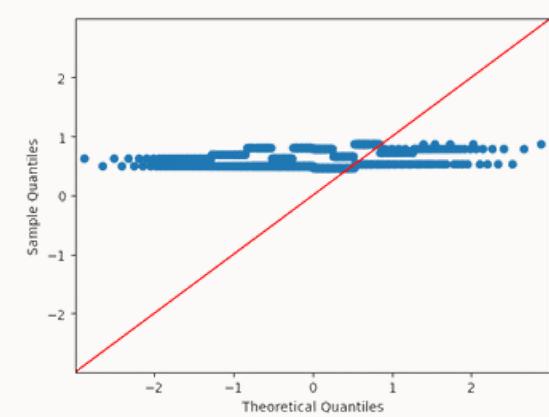
PARAM GRID RF

Parameter	Values
n_estimators	[100, 200, 300]
max_depth	[10, 20]
min_samples_split	[2, 5, 10]
bootstrap	[True, False]

TRAINING PHASE

STATISTICAL TESTS

NORMALITY ASSUMPTION



SHAPIRO WILK TEST

p-value << 0.05

FRIEDMAN TEST

$$\left[\frac{12}{nk(k+1)} \sum_{i=1}^k R_i^2 \right] - 3n(k+1)$$

H₀: there are no differences among all the models

H₁: there are differences among all the models

p-value << 0.05

TEST PHASE METRICS

SPECIFICITY

$$\frac{TN}{TN+FP}$$

SENSITIVITY

$$\frac{TP}{TP+FN}$$

ACCURACY

$$\frac{TP+TN}{TP+FP+TN+FN}$$

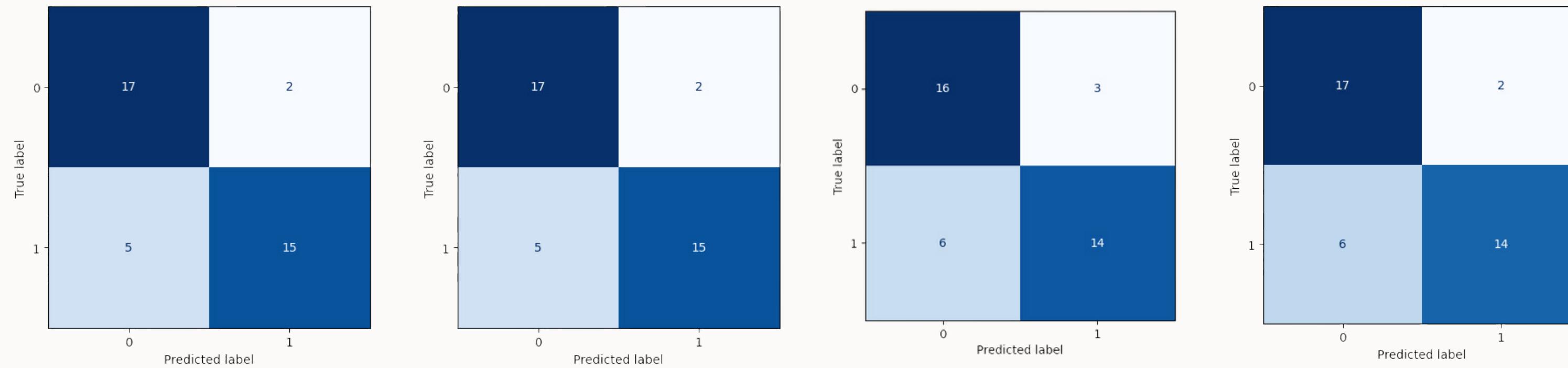
PRECISION

$$\frac{TP}{TP + FP}$$

RECALL

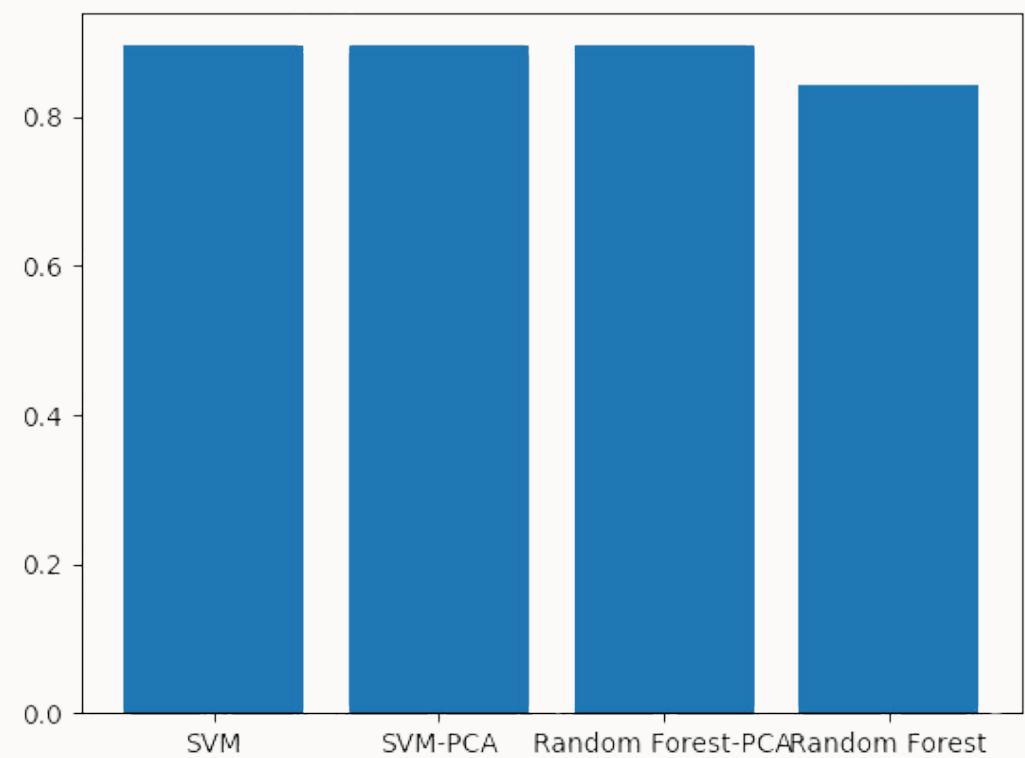
$$\frac{TP}{TP + FN}$$

TEST PHASE METRICS

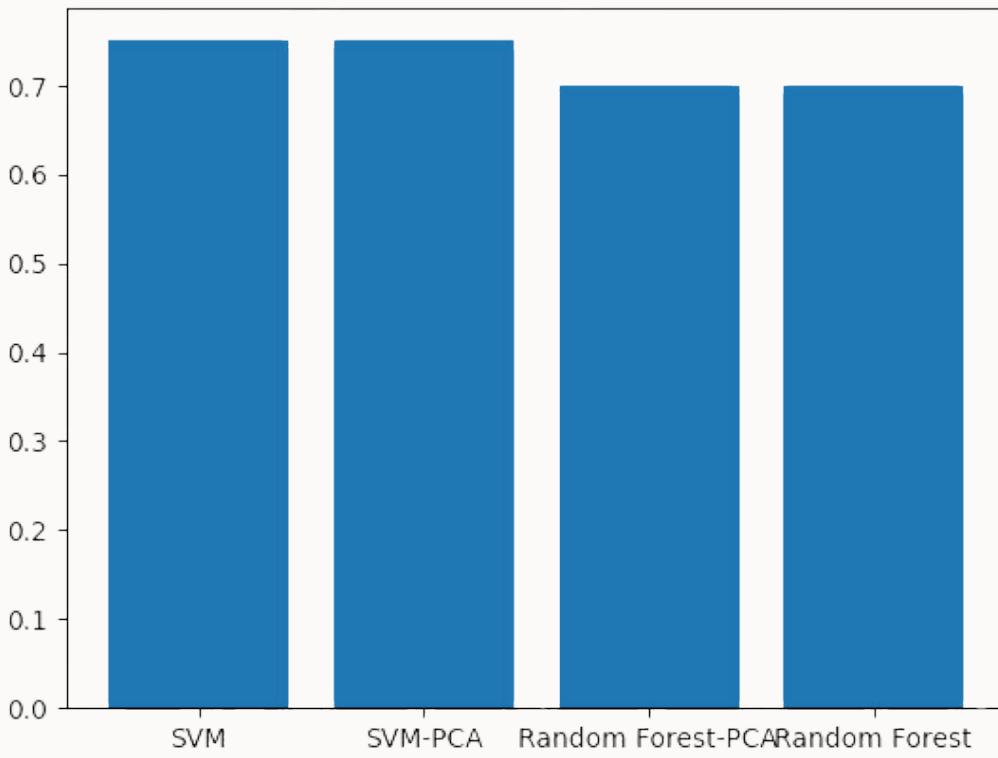


Model	Test Accuracy	Precision	Recall	F1	Specificity	Sensitivity
SVM	0.821	0.882	0.75	0.811	0.895	0.75
SVM-PCA	0.821	0.882	0.75	0.811	0.895	0.75
Random Forest-PCA	0.795	0.875	0.70	0.778	0.895	0.70
Random Forest	0.769	0.824	0.70	0.757	0.842	0.70

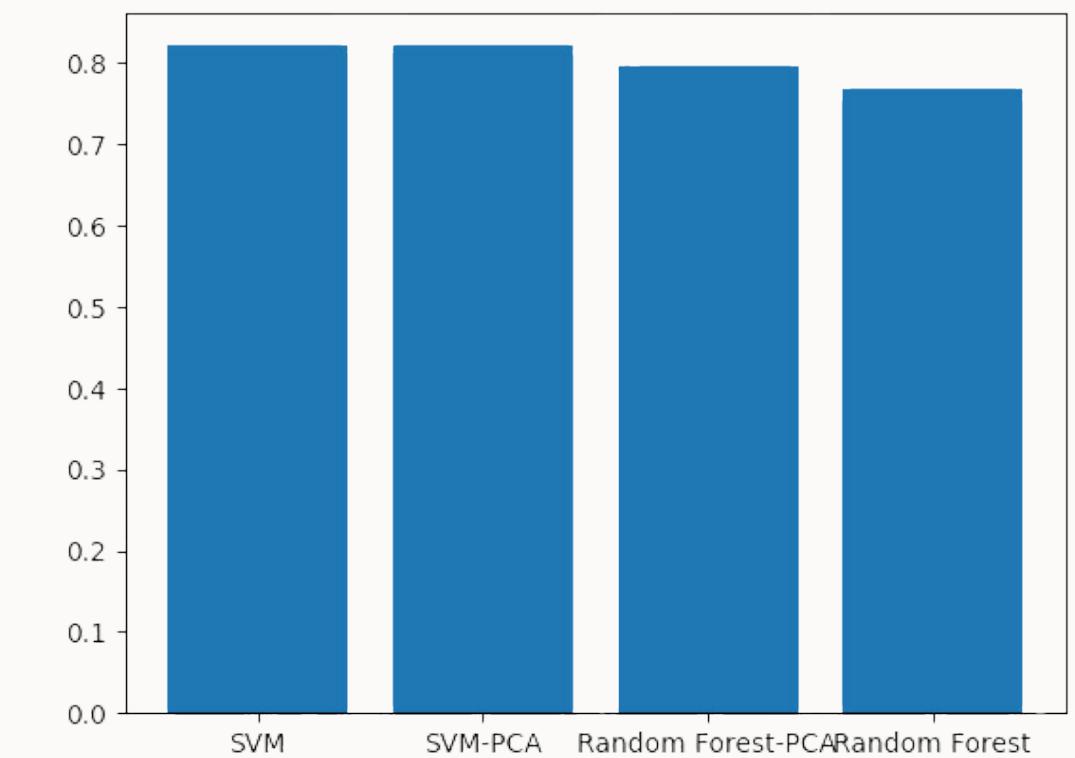
TEST PHASE RESULTS



SENSITIVITY



SPECIFICITY



ACCURACY



**THANKS FOR YOUR
ATTENTION**