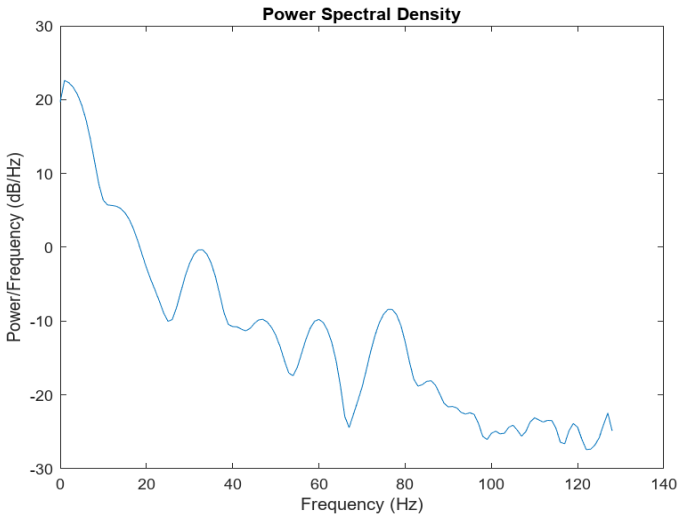
Signals and systems project phase 2

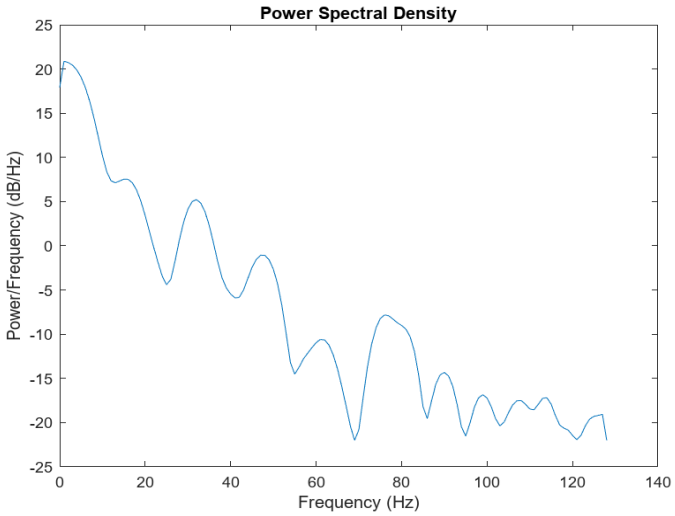
1) power spectral density plots:

```
edfData1 = edfread("chb01_03.edf");
edfData2 = edfread("chb01_04.edf");
edfData3 = edfread("chb01_15.edf");
edfData4 = edfread("chb01_16.edf");
edfData5 = edfread("chb01_18.edf");
edfData6 = edfread("chb01_26.edf");
edfData11 = table2array(edfData1);
edfData22 = table2array(edfData2);
edfData33 = table2array(edfData3);
edfData44 = table2array(edfData4);
edfData55 = table2array(edfData5);
edfData66 = table2array(edfData6);
% Calculate PSD using pwelch
[pxx, f] = pwelch(edfData11, [], [], [], 256); % Assuming a sampling frequency of 1000 Hz

% Plot the PSD
figure;
plot(f, 10*log10(pxx));
xlabel('Frequency (Hz)');
ylabel('Power/Frequency (dB/Hz)');
title('Power Spectral Density');

```

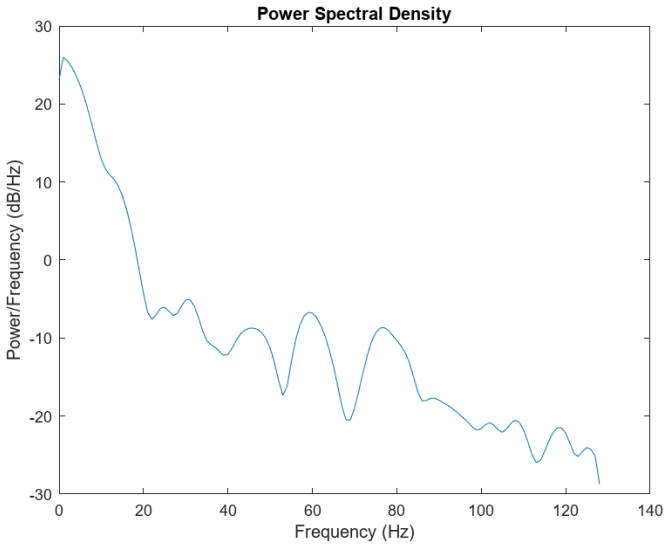
Code used for calculating PSD



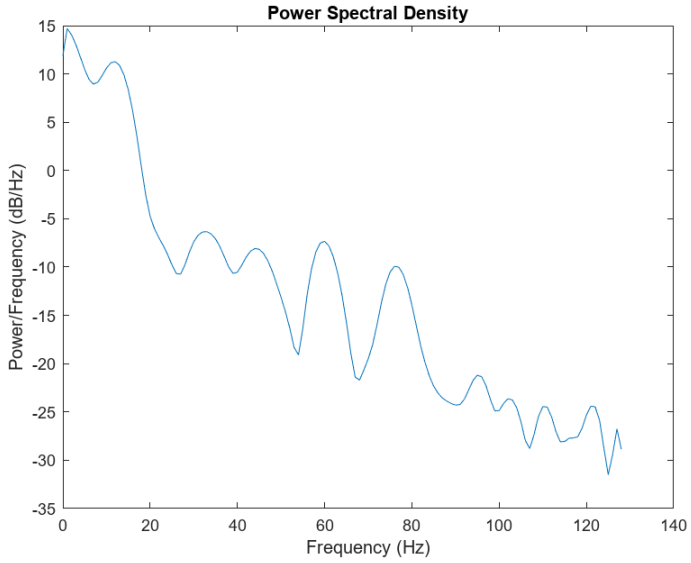
PSD for chb01_03



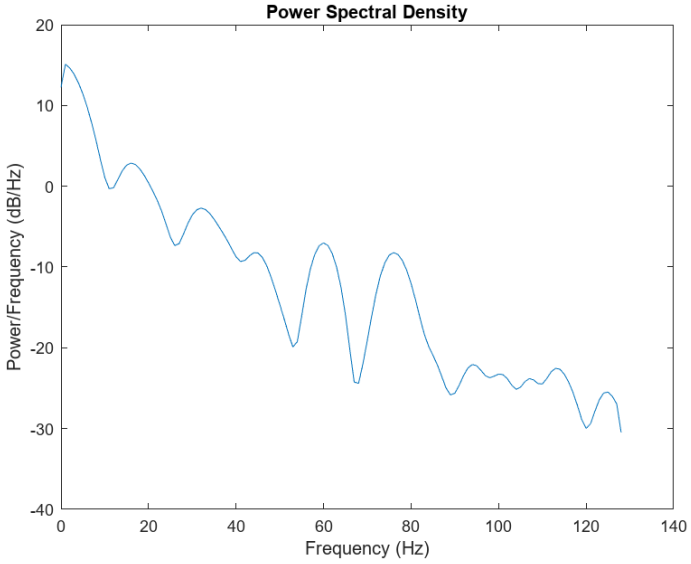
PSD for chb01_04



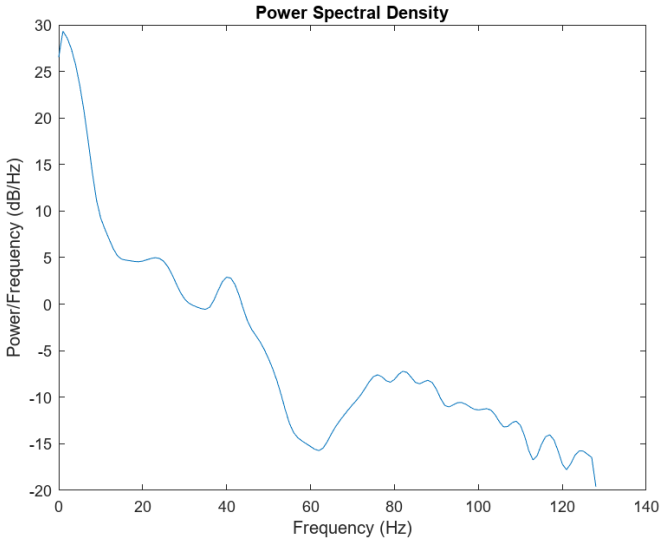
PSD for chb01_15



PSD for chb01_16



PSD for chb01_18

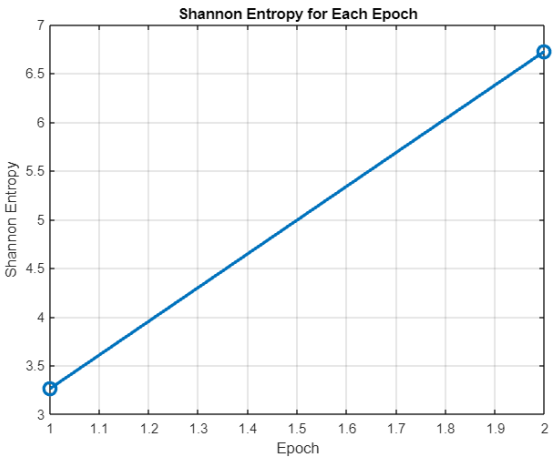


PSD for chb01_26

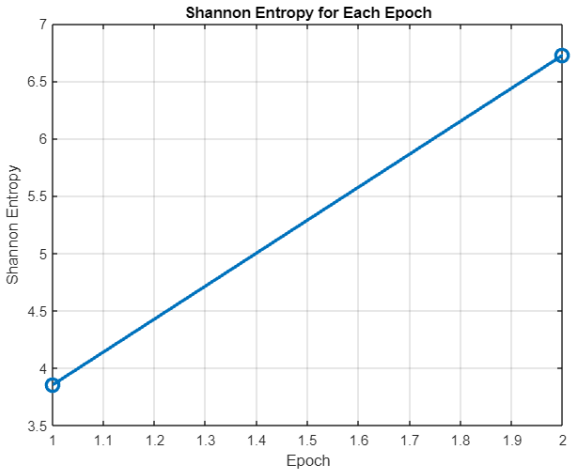
2)Shannon entropy

```
edfData1 = edfread("chb01_03.edf");
edfData11 = table2array(edfData1);
[pxx, f] = pwelch(edfData11, [], [], [], 256); % Assuming a sampling frequency of 1000 Hz
psd_data = [pxx, f] ; % Random data for illustration, 1000 data points across 10 epochs

% Calculate the Shannon Entropy for each epoch
entropy_values = zeros(1, size(psd_data, 2));

% Loop through each epoch to calculate the entropy
for epoch = 1:size(psd_data, 2)
    % Get the PSD values for the current epoch
    psd_epoch = psd_data(:, epoch);

    % Normalize the PSD values to represent probabilities
    p_xi = psd_epoch / sum(psd_epoch);

    % Calculate Shannon Entropy for the current epoch
    H_X = -sum(p_xi .* log2(p_xi + eps)); % Adding eps to avoid log(0)

    % Store the entropy value
    entropy_values(epoch) = H_X;
end

% Plot the Shannon entropy for each epoch
figure;
plot(entropy_values, '-o', 'LineWidth', 2, 'MarkerSize', 8);
title('Shannon Entropy for Each Epoch');
xlabel('Epoch');
ylabel('Shannon Entropy');
grid on;
```

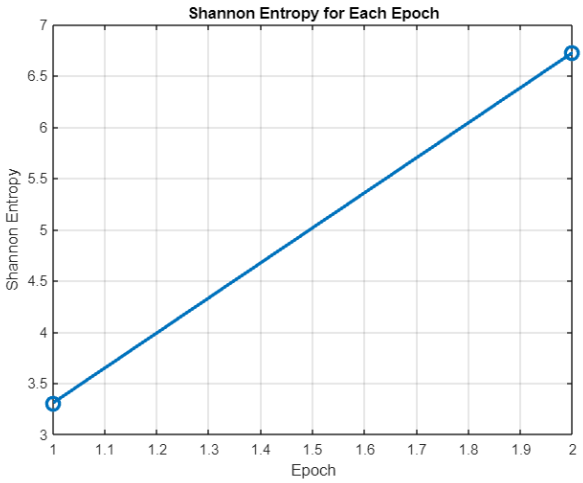
Code for plotting Shannon entropy



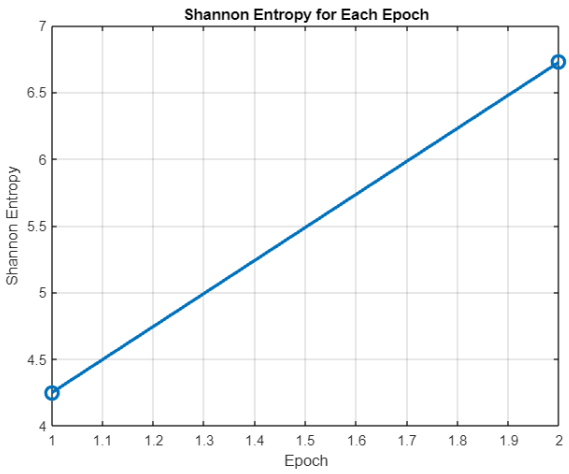
Shannon entropy for chb01_03



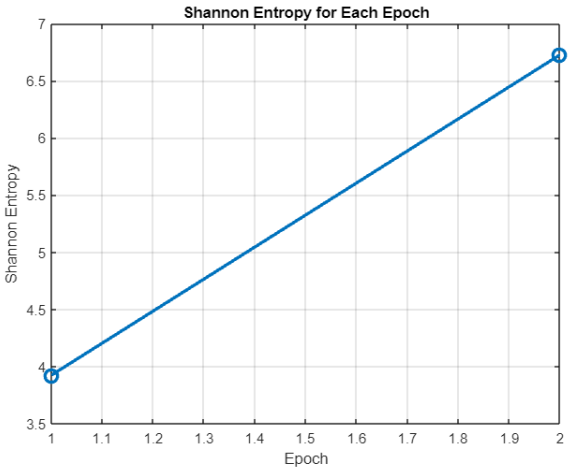
Shannon entropy for chb01_04



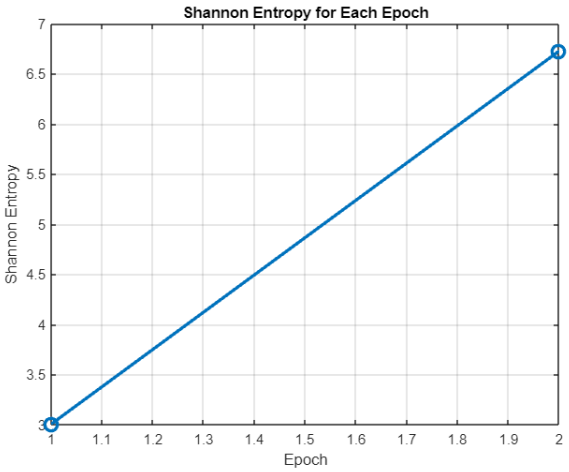
Shannon entropy for chb01_015



Shannon entropy for chb01_016



Shannon entropy for chb01_018

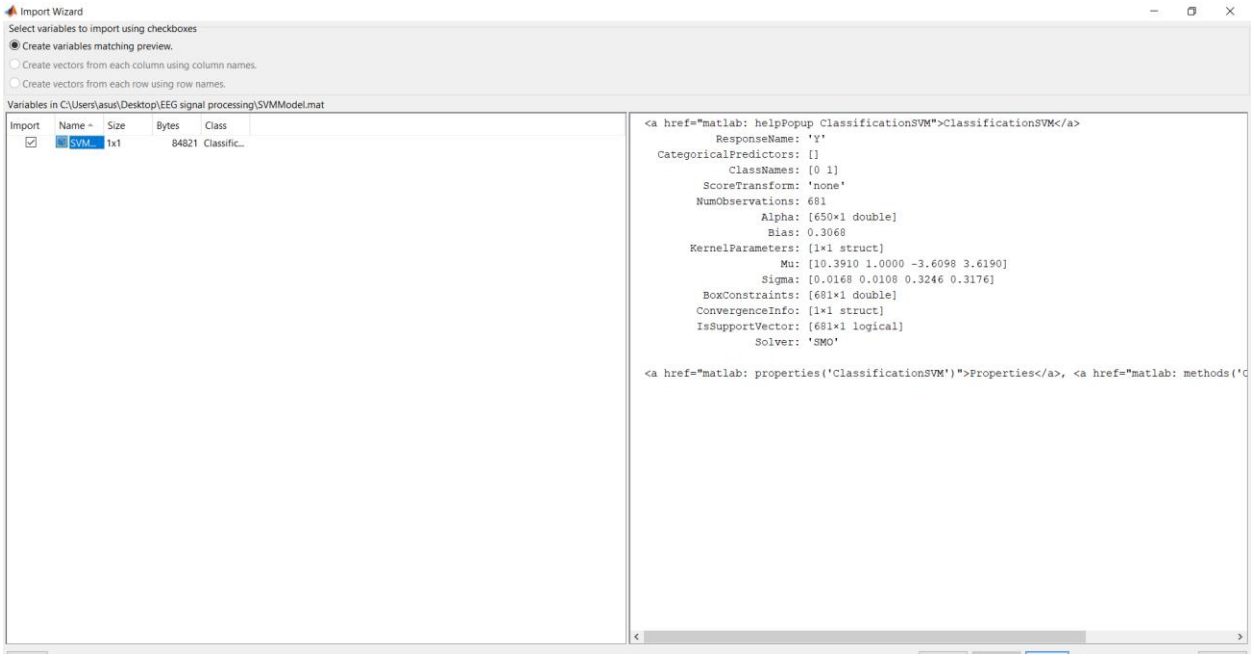


Shannon entropy for chb01_026

3) selected features

I saved selected features in 6 excel files as selected_eeg_features . from first to sixth 01 _ 04 _ 015 _ 016 _ 018 _ 026.

4)classifier performance



SVM model for chb01_03

I save this SVM model in a mat file. Just showing sample of chb01_03.the main information is model accuracy, confusion matrix

And a figure showing it.

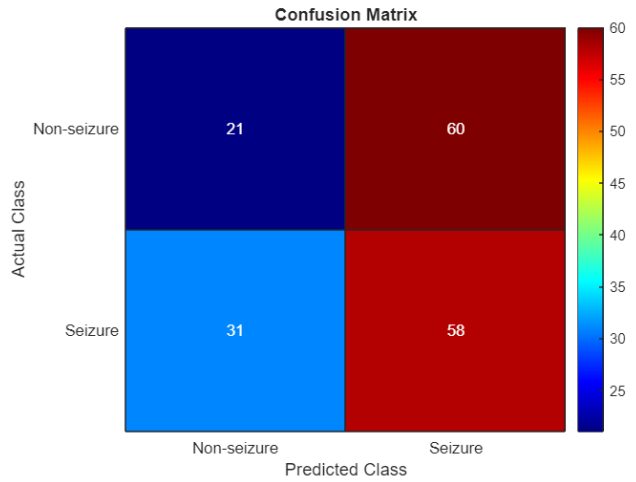
Model Accuracy: 46.47%

Model Accuracy: 46.47%

Confusion Matrix:

21 60

31 58



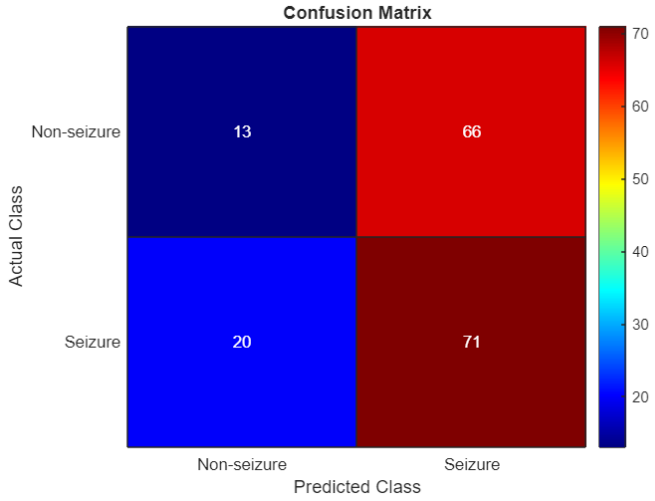
SVM model of chb01_04

Model Accuracy: 49.41%

Confusion Matrix:

13 66

20 71



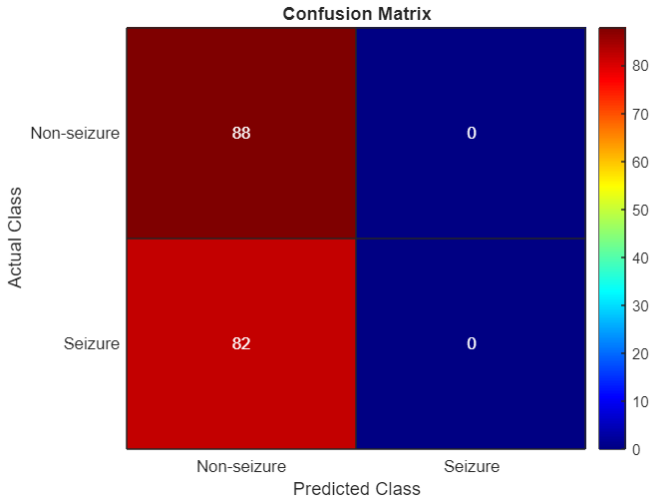
SVM model for chb01_015

Model Accuracy: 51.76%

Confusion Matrix:

88 0

82 0



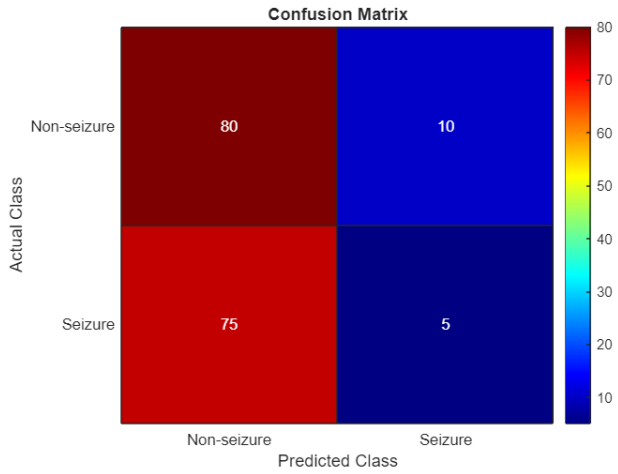
SVM model of chb01_016

Model Accuracy: 50.00%

Confusion Matrix:

80 10

75 5



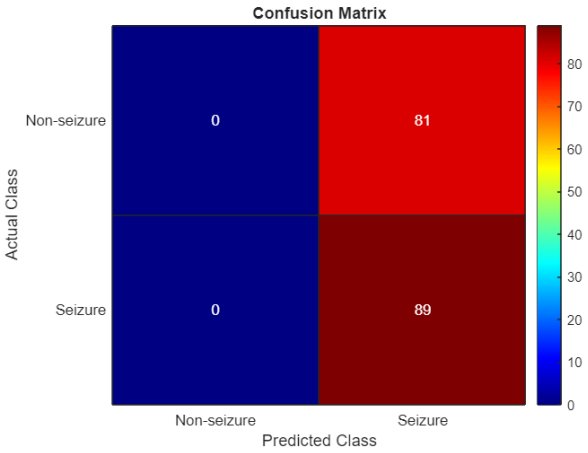
SVM model of chb01_018

Model Accuracy: 52.35%

Confusion Matrix:

0 81

0 89



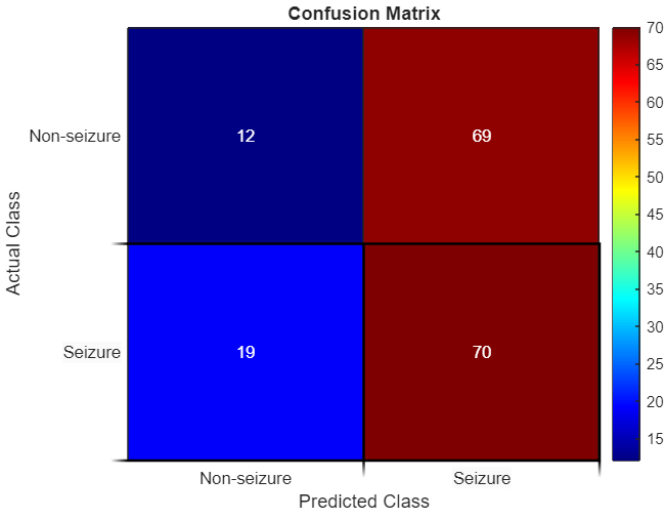
SVM model of chb01_026

Model Accuracy: 48.24%

Confusion Matrix:

12 69

19 70



Consider that with every running, confusion matrix an d model accuracy differs.

KNN classifier

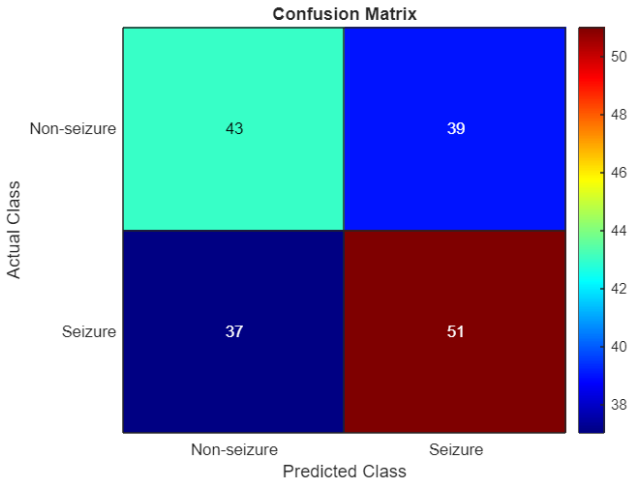
Chb01_03

Model Accuracy: 55.29%

Confusion Matrix:

43 39

37 51



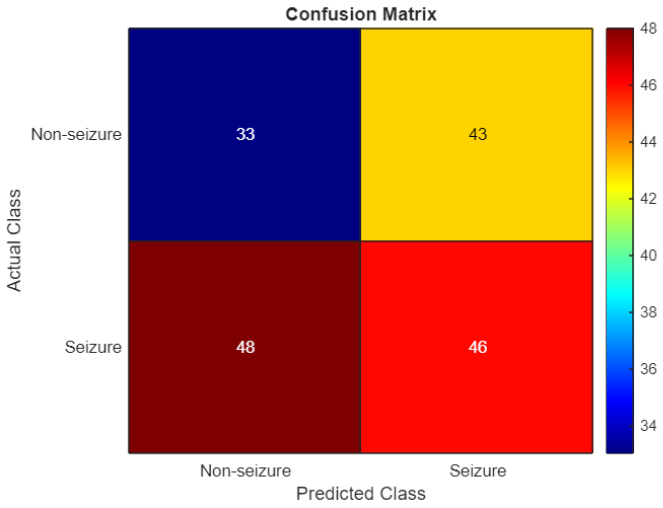
Chb01_04

Model Accuracy: 46.47%

Confusion Matrix:

33 43

48 46



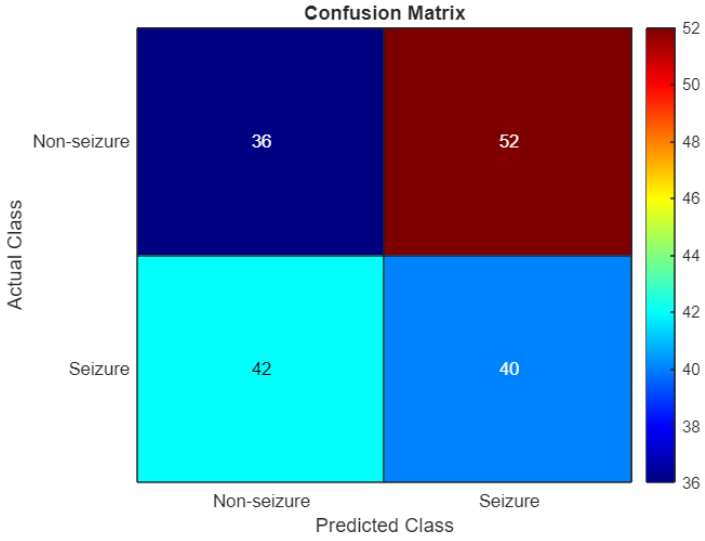
Chb01_015

Model Accuracy: 44.71%

Confusion Matrix:

36 52

42 40



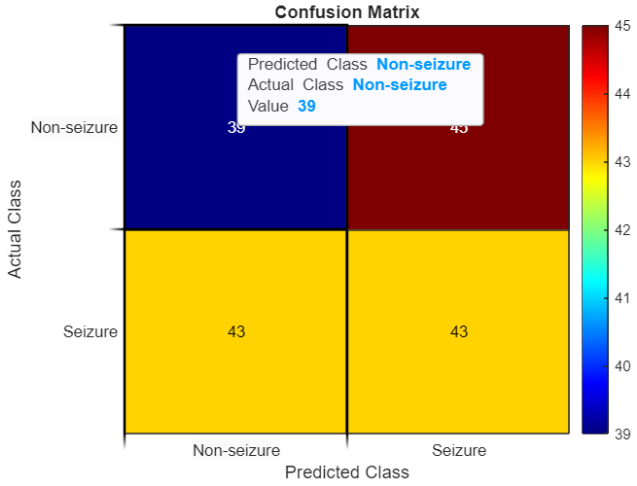
Chb01_016

Model Accuracy: 48.24%

Confusion Matrix:

39 45

43 43



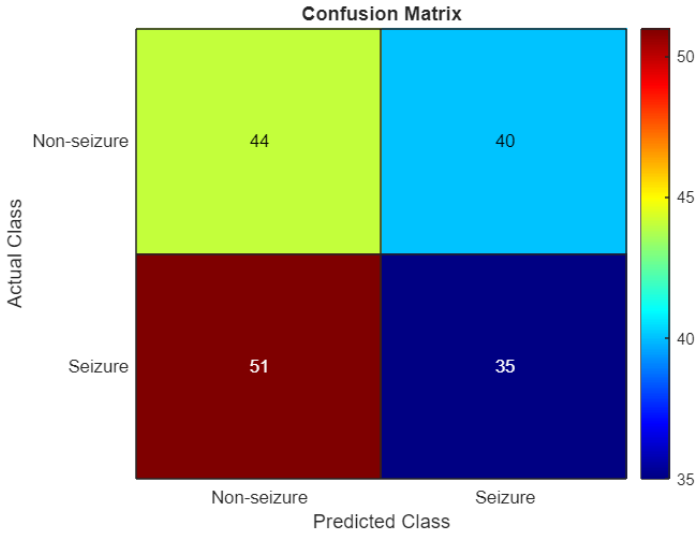
Chb01_018

Model Accuracy: 46.47%

Confusion Matrix:

44 40

51 35



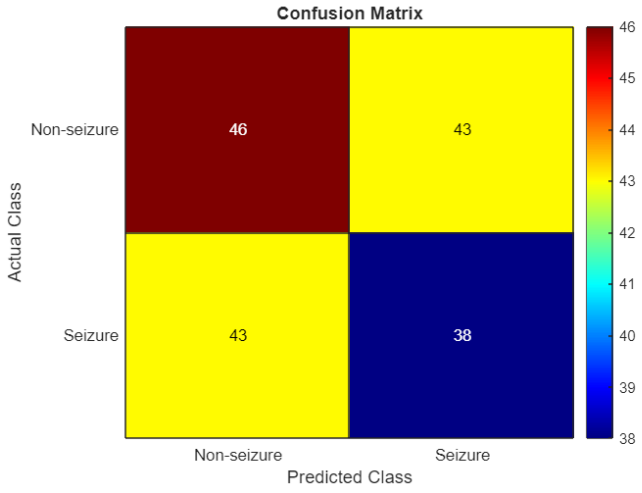
Chb01_026

Model Accuracy: 49.41%

Confusion Matrix:

46 43

43 38



Features of KNN classifier

Chb01_03

Model Accuracy: 50.59%

Sensitivity: 47.56%

Specificity: 53.41%

Latency: 0.0704 seconds

Chb01_04

Model Accuracy: 53.53%

Sensitivity: 63.74%

Specificity: 41.77%

Latency: 0.0416 seconds

Chb01_015

Model Accuracy: 51.18%

Sensitivity: 48.28%

Specificity: 54.22%

Latency: 0.0203 seconds

Chb01_016

Model Accuracy: 48.24%

Sensitivity: 48.78%

Specificity: 47.73%

Latency: 0.0034 seconds

Chb01_018

Model Accuracy: 51.76%

Sensitivity: 45.12%

Specificity: 57.95%

Latency: 0.0055 seconds

Chb0_26

Model Accuracy: 50.59%

Sensitivity: 53.33%

Specificity: 47.50%

Latency: 0.0040 seconds

Specificity: Specificity itself can be described as the algorithm/model's ability to predict a true negative of each category Available.

Sensitivity: it is a metric used for evaluating a model's ability to predict the true positives of each available category.

Latency: the time delay between when a system receives an input and generates the corresponding output

Features of SVM classifier

Chb01_03

Model Accuracy: 50.59%

Sensitivity: 48.24%

Specificity: 52.94%

Latency: 0.0499 seconds

Chb01_04

Model Accuracy: 51.76%

Sensitivity: 63.04%

Specificity: 38.46%

Latency: 0.0039 seconds

Chb01_015

Model Accuracy: 52.35%

Sensitivity: 49.38%

Specificity: 55.06%

Latency: 0.0058 seconds

Chb01_016

Model Accuracy: 52.35%

Sensitivity: 54.65%

Specificity: 50.00%

Latency: 0.0065 seconds

Chb0_018

Model Accuracy: 45.29%

Sensitivity: 43.53%

Specificity: 47.06%

Latency: 0.0032 seconds

Chb01_026

Model Accuracy: 40.00%

Sensitivity: 40.24%

Specificity: 39.77%

Latency: 0.0030 seconds

K_Fold report

Chb01_03

Average Model Accuracy: 53.93%n

Average Sensitivity: 31.60%n

Average Specificity: 74.50%n

Average Latency: 0.0287 secondsn

Chb01_04

Average Model Accuracy: 50.65%n

Average Sensitivity: 68.32%n

Average Specificity: 32.71%n

Average Latency: 0.0026 secondsn

Chb01_015

Average Model Accuracy: 49.47%n

Average Sensitivity: 47.76%n

Average Specificity: 51.18%n

Average Latency: 0.0010 secondsn

Chb01_016

Average Model Accuracy: 51.00%n

Average Sensitivity: 83.99%n

Average Specificity: 15.41%n

Average Latency: 0.0011 secondsn

Chb01_018

Average Model Accuracy: 53.12%n

Average Sensitivity: 48.00%n

Average Specificity: 58.17%n

Average Latency: 0.0013 secondsn

Chb01_026

Average Model Accuracy: 51.12%n

Average Sensitivity: 0.00%n

Average Specificity: 100.00%n

Average Latency: 0.0011 secondsn