- Faculty of Computer and Information Sciences –

- AIN Shams University -

HCI - SC

ECG-BASED-AUTHENTICATION-INTERFACE

TEAM INFROMATION: SC-35

الأســـــم	رقـــم الجلوس	القسم
عبدالرحمن محمد عزازى محمد	20201700483	SC
جنه ايمن طلعت مصطفي	20201700204	SC
اسراء سعد عبدالحميد سعيد	20201701055	SC

- Under Supervision -

Dr. Manal Tantawi

TA. Manar Sultan

Main idea

Ecg-Based-Authentication-Interface that can recognize Authorized Persons from its ECG After result from Classifier based on fiducial features extracted from Signal ..

ECG signals have 11 main points differ from person to each other ..

Data Preparation

- **dataset**

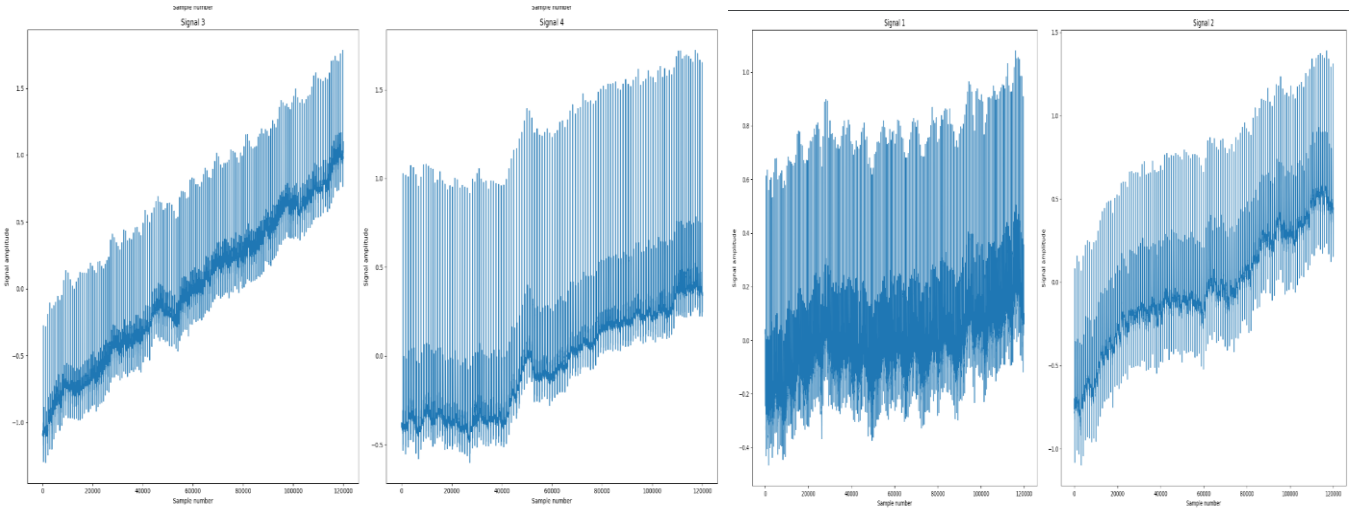
  We have obtained 4 ECG signals for 4 different healthy subjects from PTB database. The data is split into 80% for training and 20% for testing, The description of the data is:

Number of signals	**4**
Sampling frequency	**1000**
Signal Length	**120012**
Number of channels	**15**

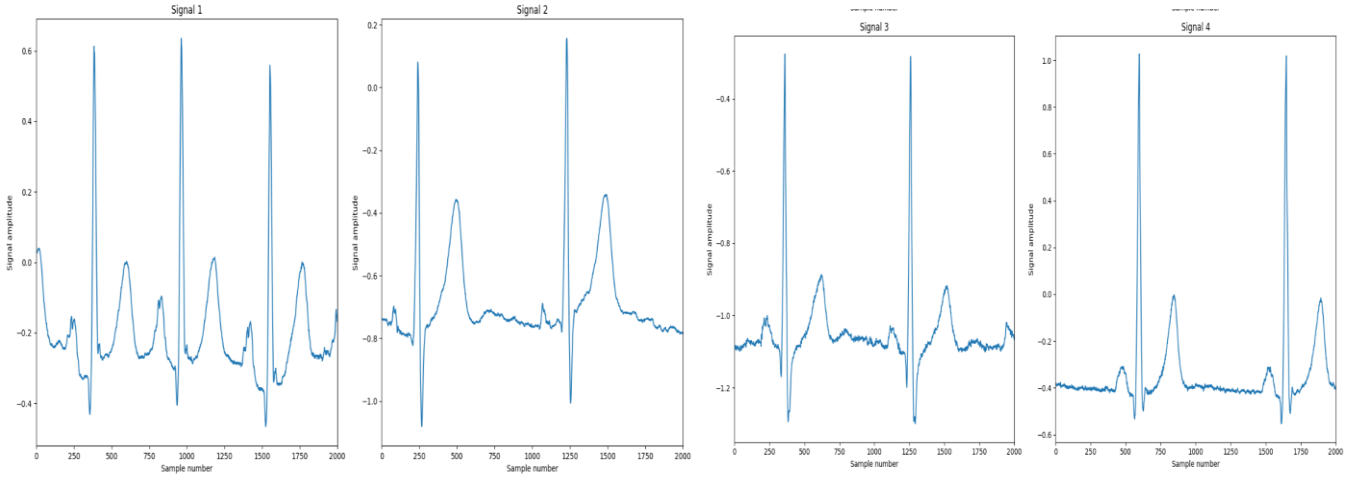
Data Preprocessing :

READ DATA:

Records was in types of ".atr , .dat , .hea", so we used **wfdb.rdsamp** method in **wfdb** library that take location of all signals and range of samples from 0 to "Specific Range=1000" and number of channels=15 ''in case our data read channel[1]" and is signals and before preprocessing:



And this is plot after 1.5 second :

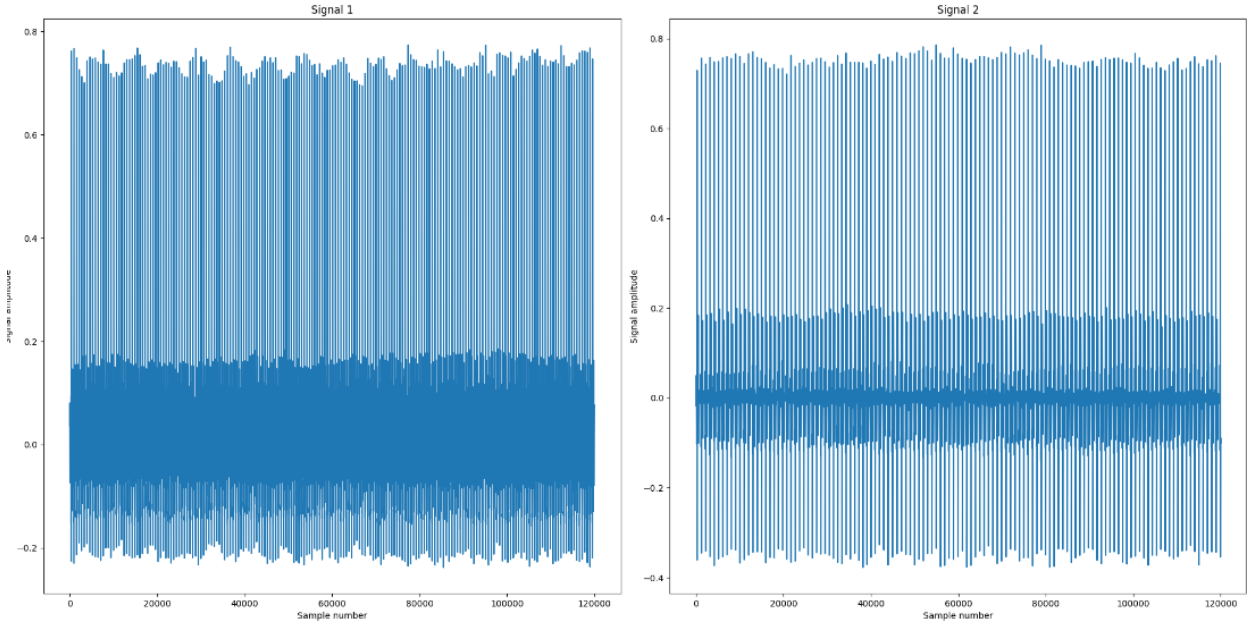


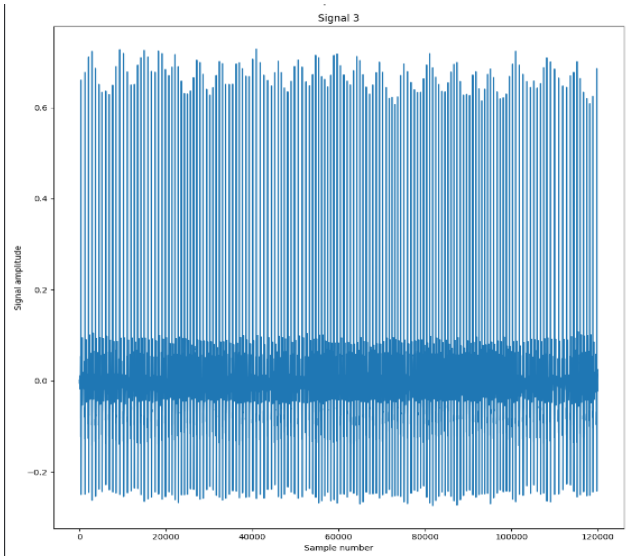
- # Preprocessing

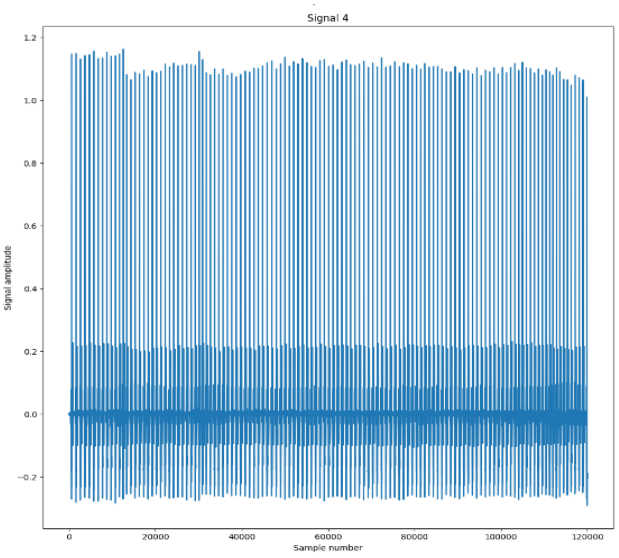
We have worked on only one channel (ii).

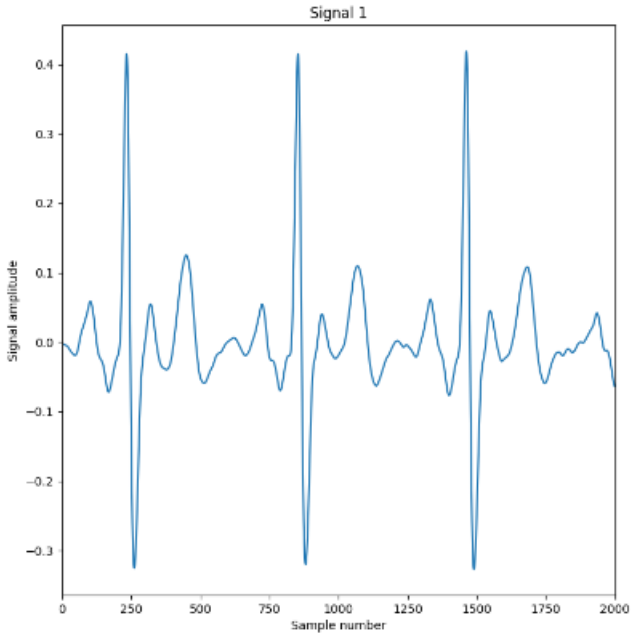
- **Filtering**
  ECG data contains noise from multiple sources (e.g., Baseline wander, Power line interface).
- **Differentiation**
- **Squaring**
- **Moving-window integration**
- **Thresholding**
  We have used a simple Butterworth filter with cut-off frequencies between [1 – 40] Hz, which is the ECG spectrum, to remove the noise.

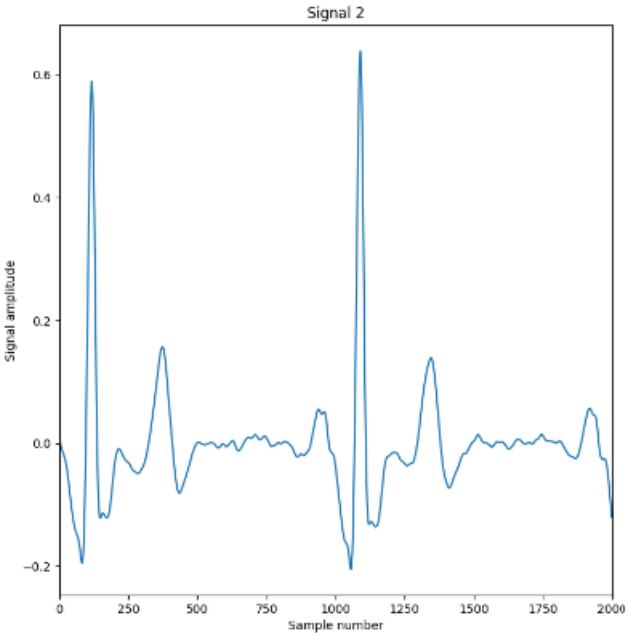
After Preprocessing:

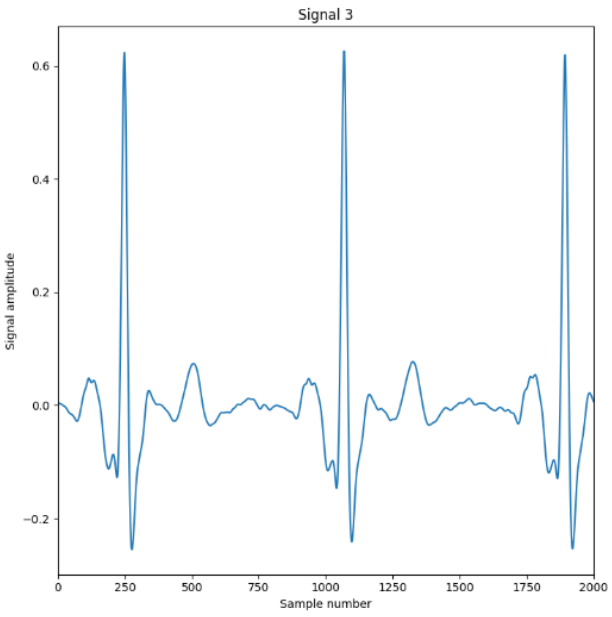


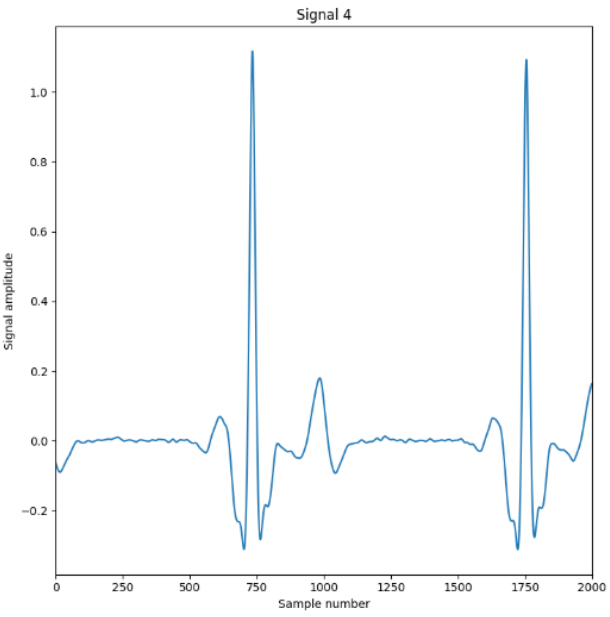

Signal 3
Signal amplitude
Sample number


Signal 4
Signal amplitude
Sample number


Signal 1
Signal amplitude
Sample number


Signal 2
Signal amplitude
Sample number


Signal 3
Signal amplitude
Sample number


Signal 4
Signal amplitude
Sample number

Features Extraction:

Function: fiducial_features_extraction(filtered_signals)

Description:

This function extracts fiducial features from ECG signals to characterize heartbeat patterns.

Parameters:

filtered_signals: List of filtered ECG signals.

Returns:

features: Extracted fiducial features.

classes: Corresponding beat classes.

Feature Extraction Process:

-R Peak Detection: Locate R peaks in each ECG signal.

-S Peak Detection: Find S peaks in each ECG signal.

-Q Peak Detection: Identify Q peaks in each ECG signal.

-T Peak Detection: Identify T peaks in each ECG signal.

-P Peak Detection: Find P peaks in each ECG signal.

*Calculate Waves Onset and Offset: Determine onset and offset of each wave (P, Q, R, S, T) in each ECG signal.

*Extract Features: Calculate various features from fiducial points (P, Q, R, S, T) for each beat:

-QT duration

-PQ duration

-PR duration

-PS duration

-PT duration

-QS duration

-QR duration

-RS duration

-RT duration

-RP amplitude

-RT amplitude

-TP amplitude

Classifcation :

We have tried multiple classifiers with different parameters for each of them to get the best results for each class：

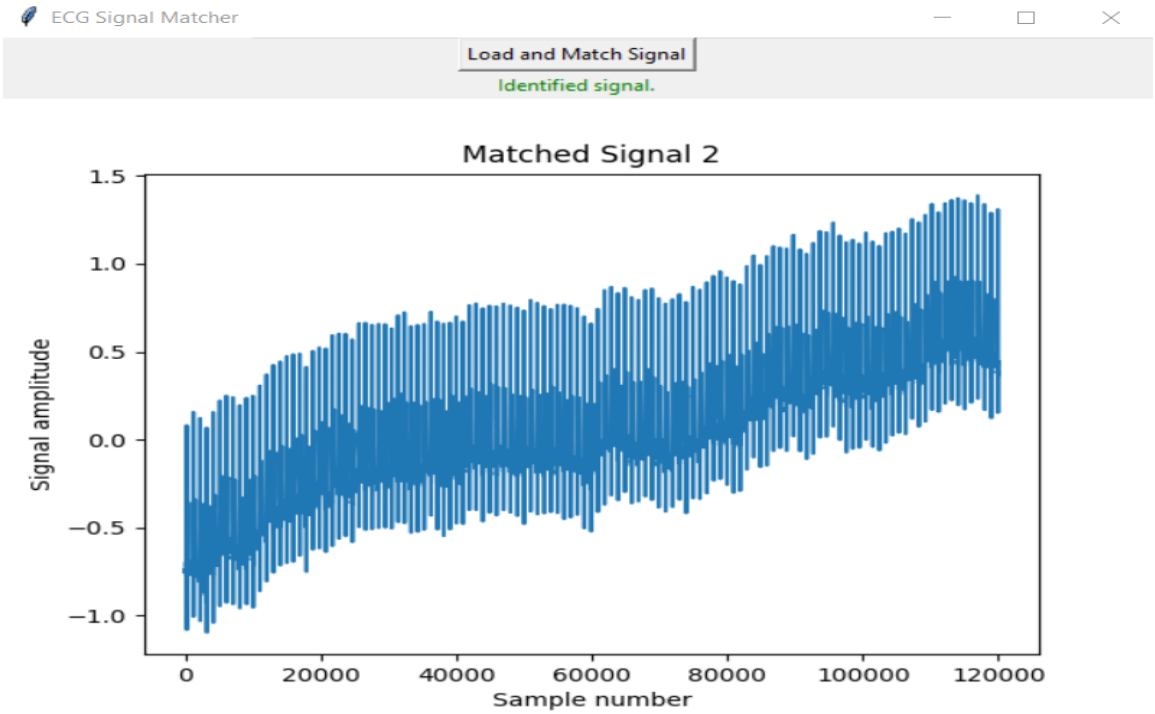
```
Accuracy of Logistic Regression =  99.16666666666667
Accuracy of SVM =  100.0
Accuracy of LDA =  99.16666666666667
Best Logistic Regression Model: LogisticRegression(C=100, penalty='l1', solver='liblinear')
Best SVM Model: SVC(C=100, gamma=0.1, kernel='linear')
```

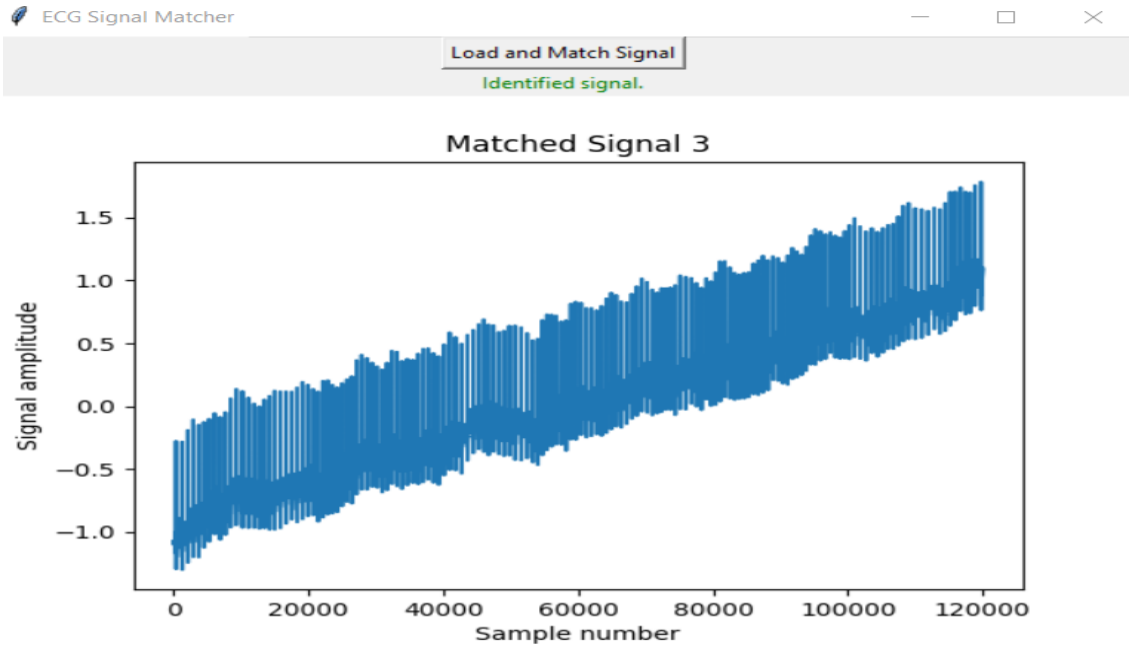
And The best classifer and best parameters is SVM : SVC(C=100, gamma=0.1, kernel='linear')

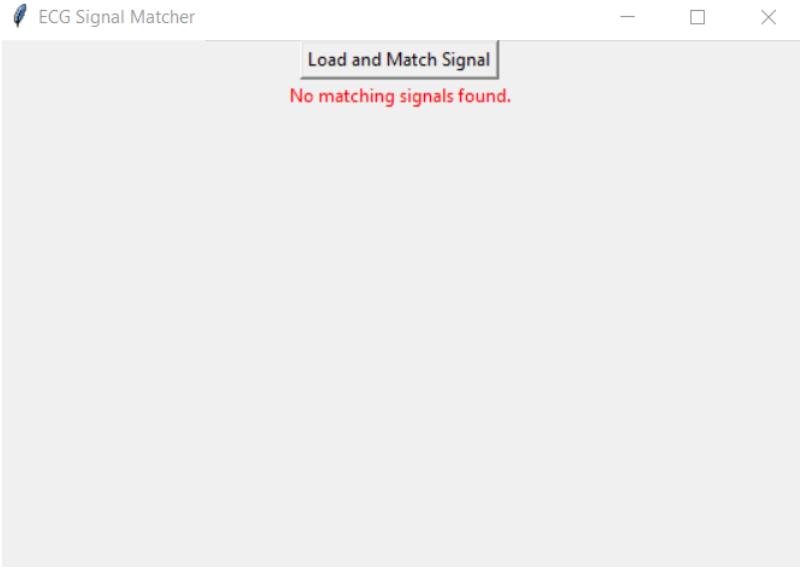
GUI :

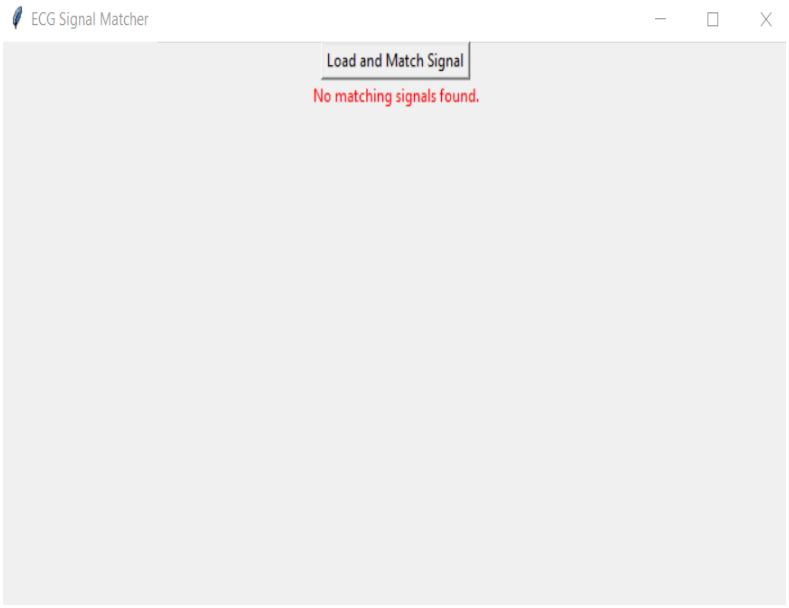
We have tried unseen data to test similarty of input singals and the four our patients :

And we test four Patients “3 is already must matched and another 3 must unmatched”




ECG Signal Matcher
Load and Match Signal
Identified signal.
Matched Signal 3
Signal amplitude
1.5
1.0
0.5
0.0
−0.5
−1.0
0
20000
40000
60000
80000
100000
120000
Sample number


ECG Signal Matcher
Load and Match Signal
No matching signals found.


ECG Signal Matcher
Load and Match Signal
No matching signals found.