ECG Classification

Using ECG time series data to identify heart status

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Business Problem

- Task: classify heart status based on ECG readings

- Early detection of potentially problematic heart status possible via relatively cheap and painless ECG

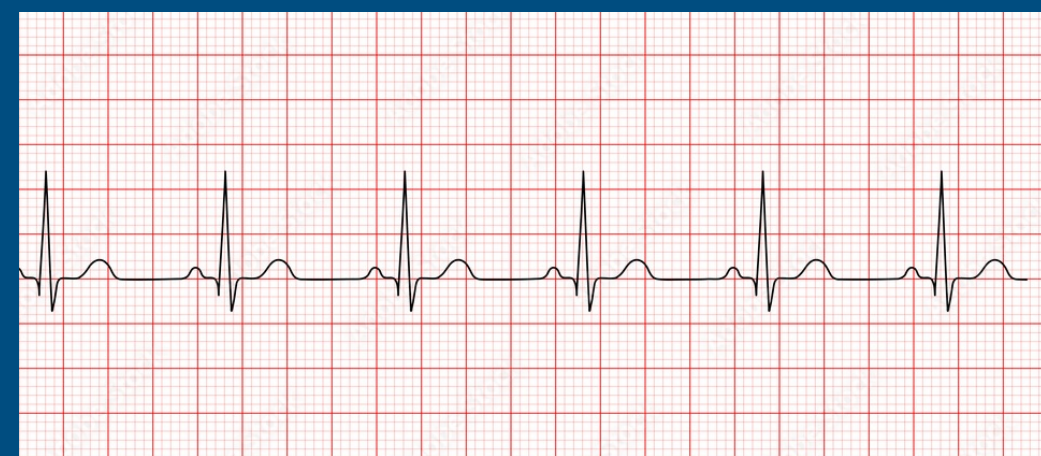- Early detection —> lifesaving preventative measures

Data

- from MIT-BIH Arrhythmia Database

- ECG measures electrical impulse level over time
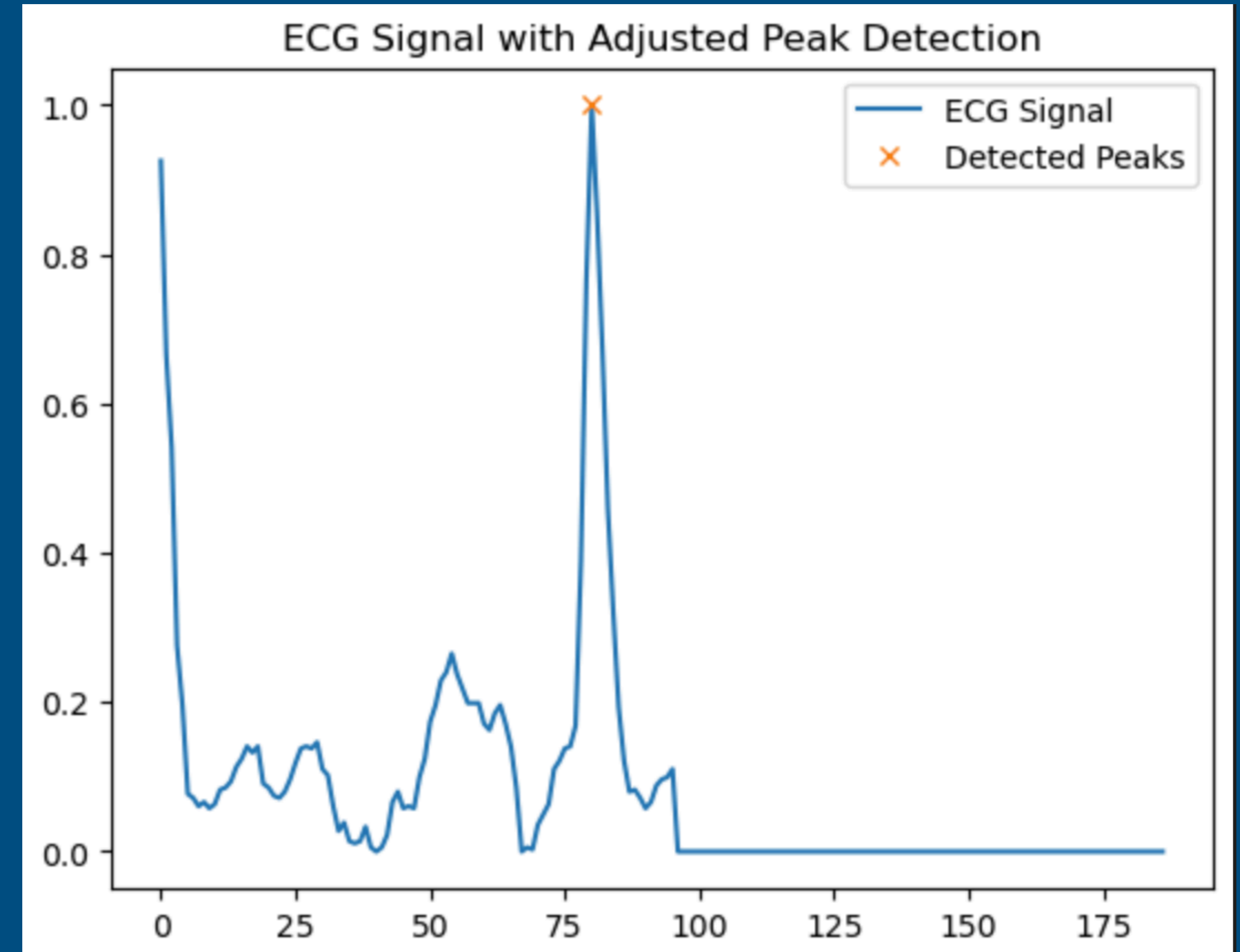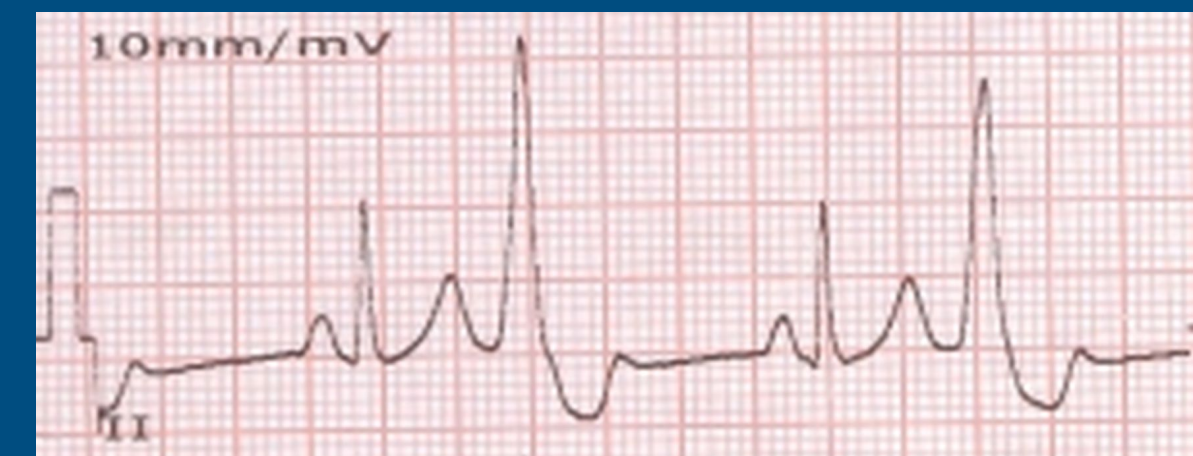
Classifications (target pt. 1)

- Normal (0)

- Supraventricular Ectopic Beat (1)
  - can be assc. w/ atrial fibrillation, atrial flutter

- Ventricular Ectopic Beat (2)
  - ventricular tachycardia, cardiomyopathy, ischemic heart disease

Normal Beat

Supraventricular
Ectopic Beat

Ventricular
Ectopic Beat

Classifications (target pt. 2)

- <u>Fusion</u> of Ventricular and Normal Beat (3)
  - ventricular tachycardia or other ventricular arrhythmias

- Unknown Beat (4)
  - arrhythmic events that don't fall into the standard classifications
 - could result from artifacts or errors in ECG recording

Features

- ECG reading is traditionally somewhat of an art, practiced by people trined to visually inspect ECG features

- A model identifying borderline cases could alert humans to inspect ECG

- Neural Networks can recognize and train on time series features they uncover to predict classes accurately and consistently
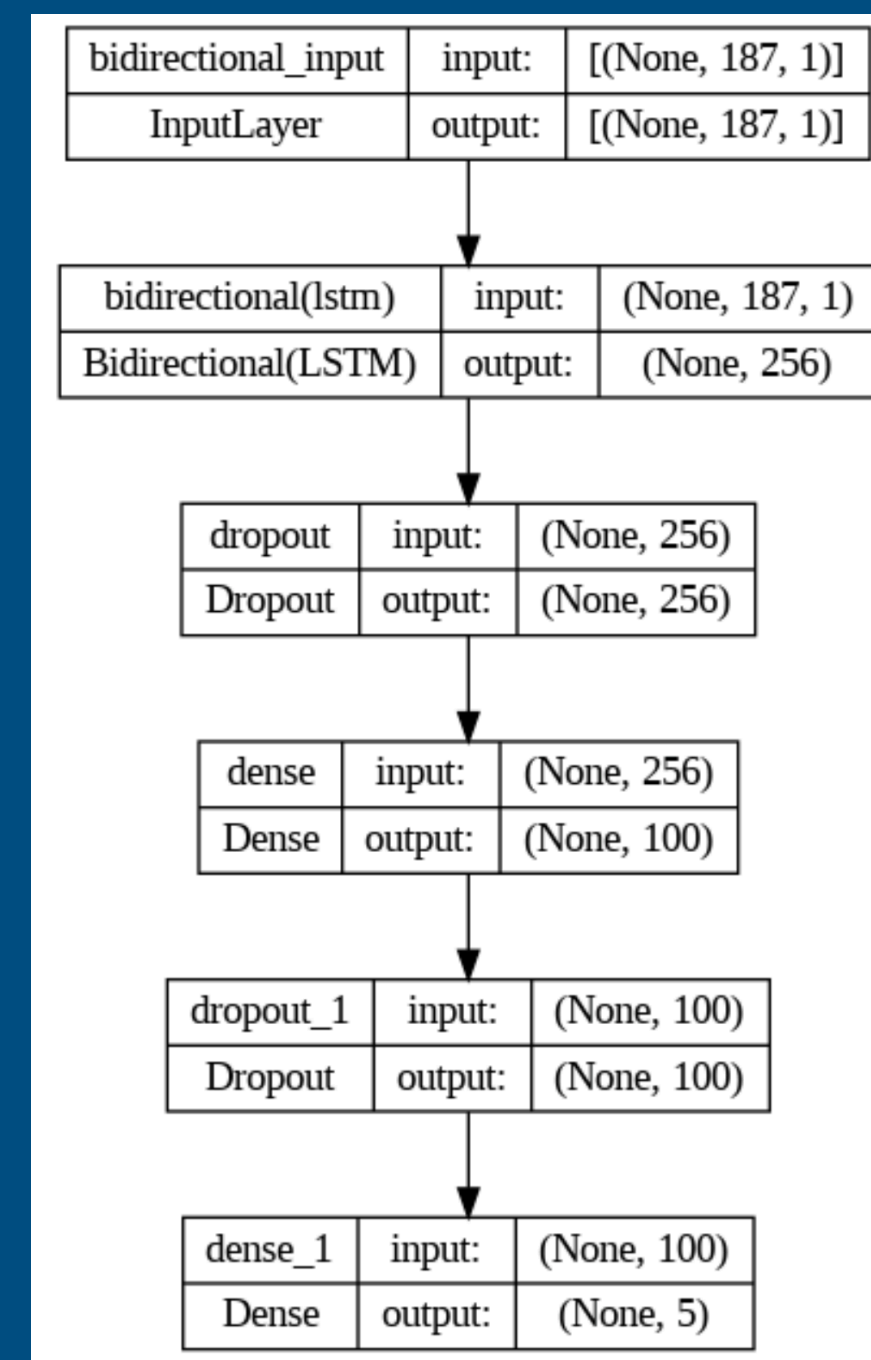

iStock
Credit: Eik Scott
1352253374

Features

- Shown: sampling of top features extracted for visualization using tsfresh
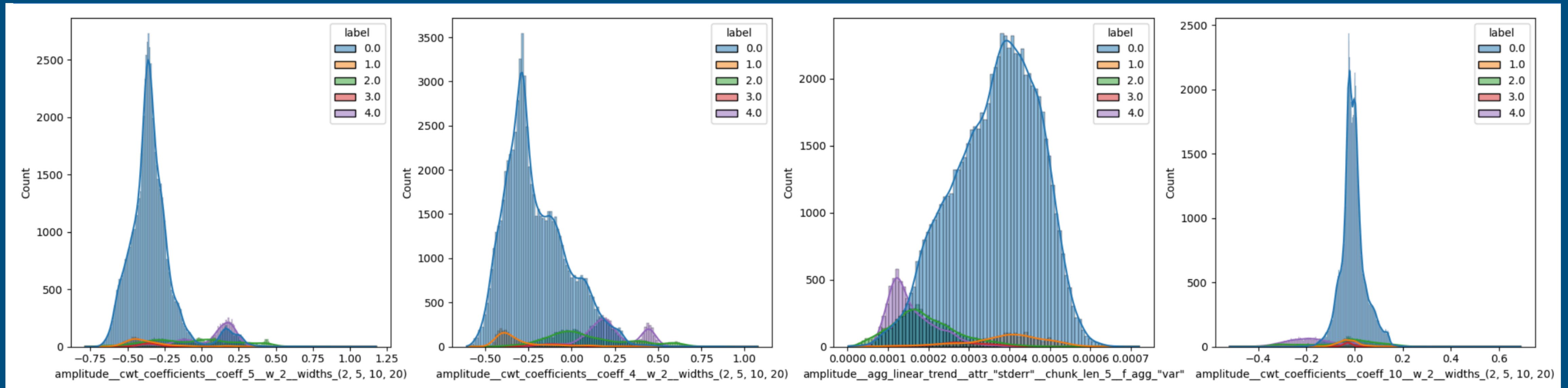
Model Creation

- Time series classification problem

- Neural network trained on ECG time series electrical impulse measurements

- Bidirectional LSTM structure

  - time series ECG   —>   —>   classification output

Current Best Model

- Bidirectional LSTM Neural Network with Dense layers and Dropouts

```
Classification Report:
              precision    recall  f1-score   support

           0       0.99      1.00      0.99     14579
           1       0.95      0.81      0.87       426
           2       0.95      0.97      0.96      1112
           3       0.93      0.73      0.82       145
           4       0.99      0.99      0.99      1249

    accuracy                           0.99     17511
   macro avg       0.96      0.90      0.93     17511
weighted avg       0.99      0.99      0.99     17511
```


Confusion Matrix
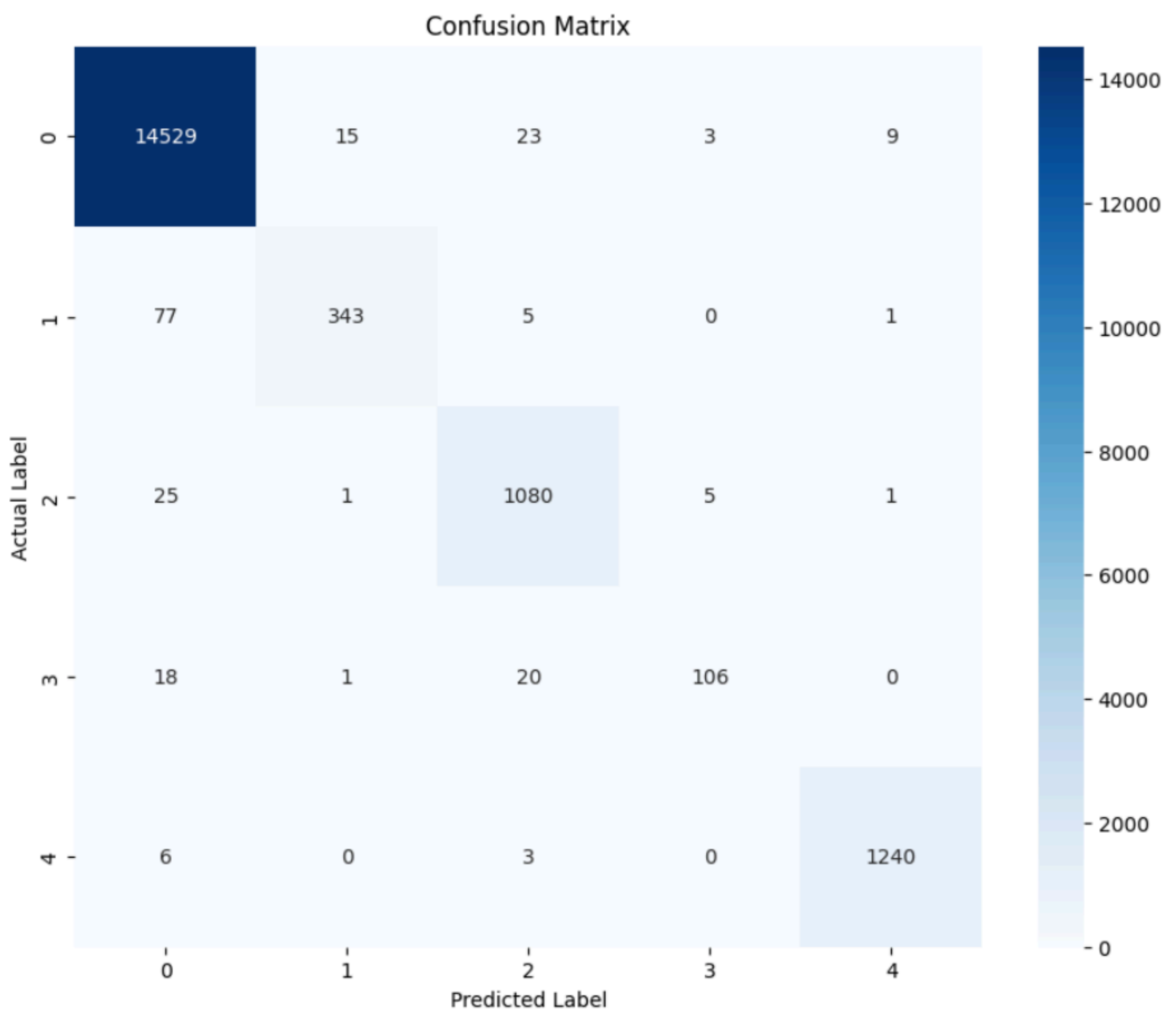
Next Steps

- Further refine and simplify code to deploy in portable ECG reader tethered to smartphone iOS app

    - further tune model to eliminate false negatives

    - quickly read your ECG and warn you if you should get a cardiologist screening