Electrocardiogram Classification by Convolutional Neural Networks

Arsi Ikäheimonen
Maryam Kiashemshaki

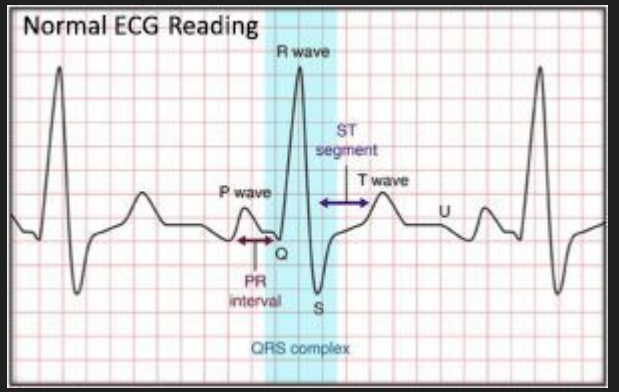
Fig:https://scopeblog.stanford.edu/2016/09/21/electrocardiogram-blog-chronicles-value-of-old-but-still-vital-cardiac-test/

Content:

- What are Electrocardiogram and Atrial Fibrillation?
- Dataset:
  - Data Augmentation
  - Data preprocessing
- Models:
  - Convolutional neural network
  - Combination of convolutional layers and long-short term memory (LSTM) layers

Electrocardiogram

- Measures heart's electrical activity.
- Can reveal signs of heart disease and help to predict a heart attack.
- Read by experienced cardiologists.



https://www.englewoodhealthphysicians.org/medical-services/heart-care/heart-disease-diagnosis-screening/electrocardiogram/

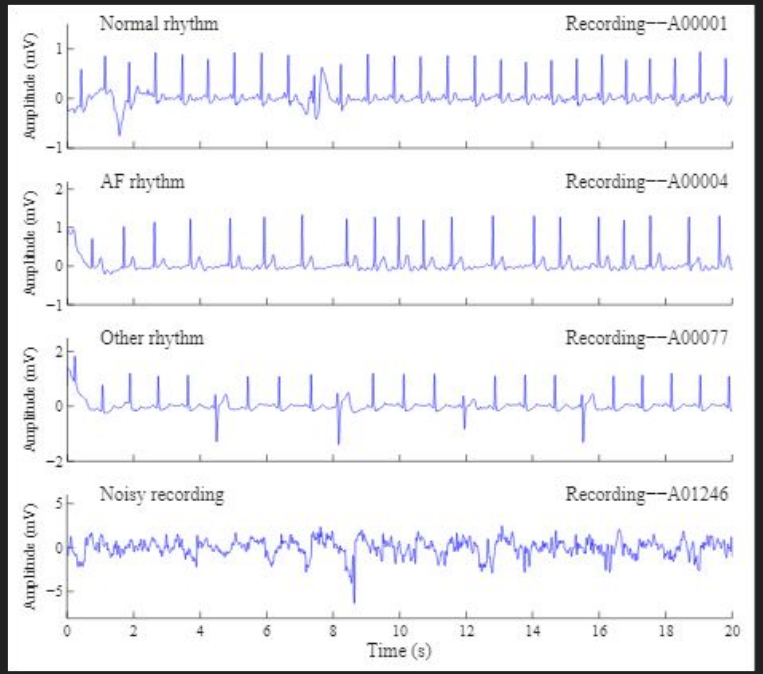
Atrial Fibrillation (AF):

- is a common heart rhythm disorder.
- occurs in 1-2% of the population.
- is associated with significant mortality and morbidity.
- AF detection is problematic:
    - It may be episodic.
    - Can be masked by other rhythms.

Project goal:

Classifying electrocardiogram (ECG) recordings from a single-channel handheld ECG device into four distinct categories:

- Normal sinus rhythm (N)
- Atrial fibrillation (A)
- Other rhythm (O)
- too noisy to be classified (~)



https://physionet.org/files/challenge-2017/1.0.0/example_waveforms.svg

Dataset

Provided by the PhysioNet Challenge 2017

- The training set contains 8,528 single lead ECG recordings lasting from 9 s to just over 60 s
- Data are provided in MATLAB V4 WFDB-compliant format.

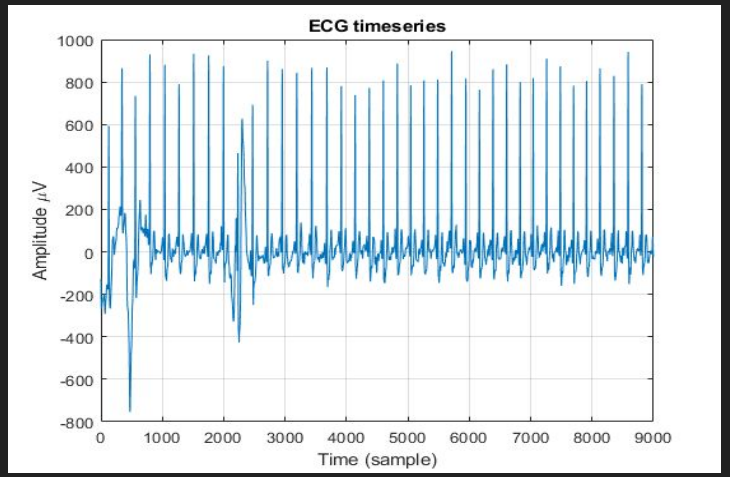
Label	Cases	Percentage
A	738	9
N	5050	59
O	2456	28
~	284	3

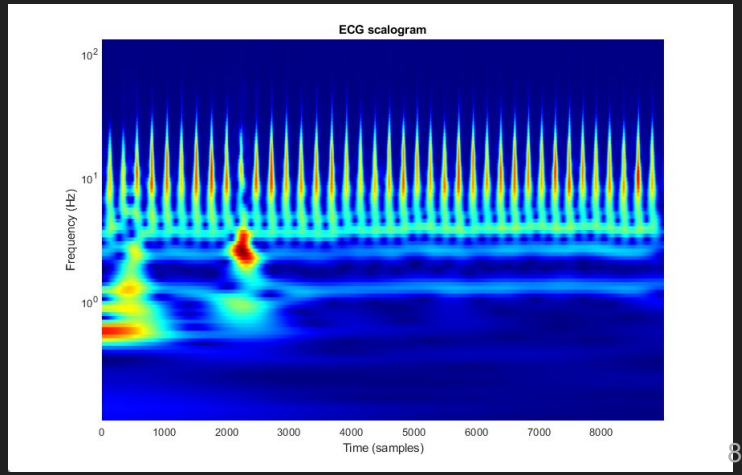
Method:

- Pre-processing of data
- Pre-trained neural network / Transfer learning
- Evaluation

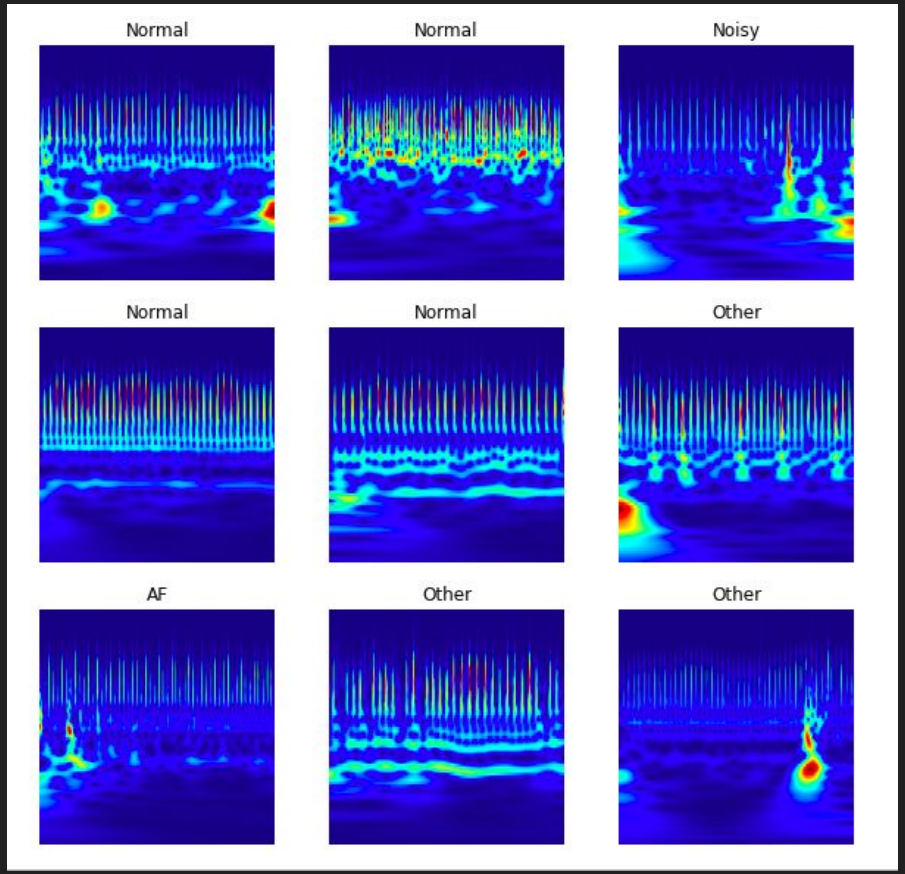
Pre-processing of data:

- Filtering ???
- Data augmentation
  - 5050 (9 seconds) / class
- Normalization
- Wavelet transform
- Scalogram





Scalogram samples



Model

Transfer learning

- Efficientnetb0 (trained on imagenet
- LSTM layers (not implemented)

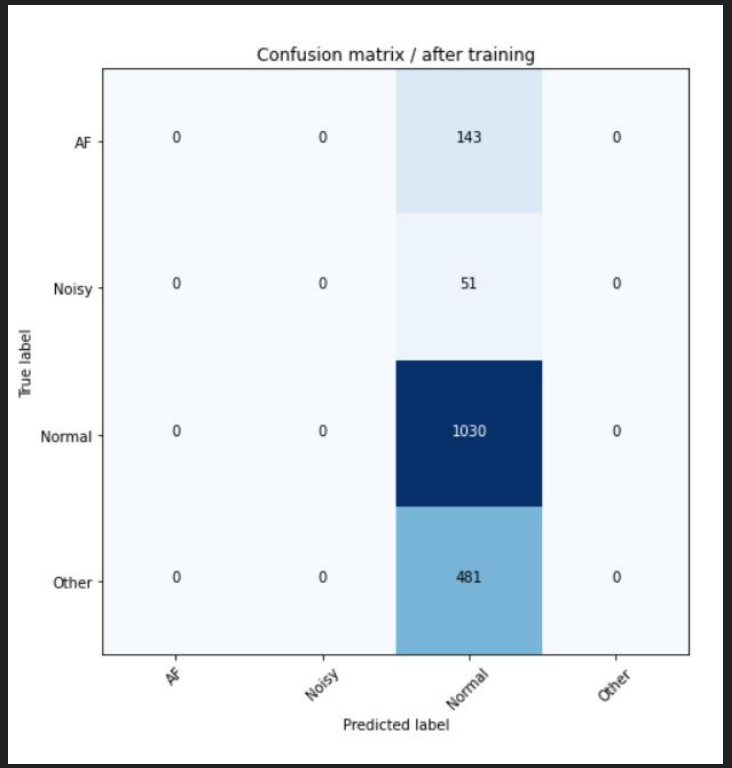
```
Model: "functional_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_2 (InputLayer)         [(None, 180, 180, 3)]     0
_________________________________________________________________
efficientnetb0 (Functional)  (None, 6, 6, 1280)        4049571
_________________________________________________________________
global_average_pooling2d (Gl (None, 1280)              0
_________________________________________________________________
dropout (Dropout)            (None, 1280)              0
_________________________________________________________________
dense (Dense)                (None, 4)                 5124
=================================================================
Total params: 4,054,695
Trainable params: 5,124
Non-trainable params: 4,049,571
_________________________________________________________________
```

Evaluation

Confusion matrix

ROC curve (not implemented yet)

Validation accuracy ~ 60%



Results

~60%

Thank you!

Any question?

References:

1. https://physionet.org/content/challenge-2017/1.0.0/
2. http://www.cinc.org/archives/2017/pdf/070-060.pdf
3. https://github.com/awerdich/physionet