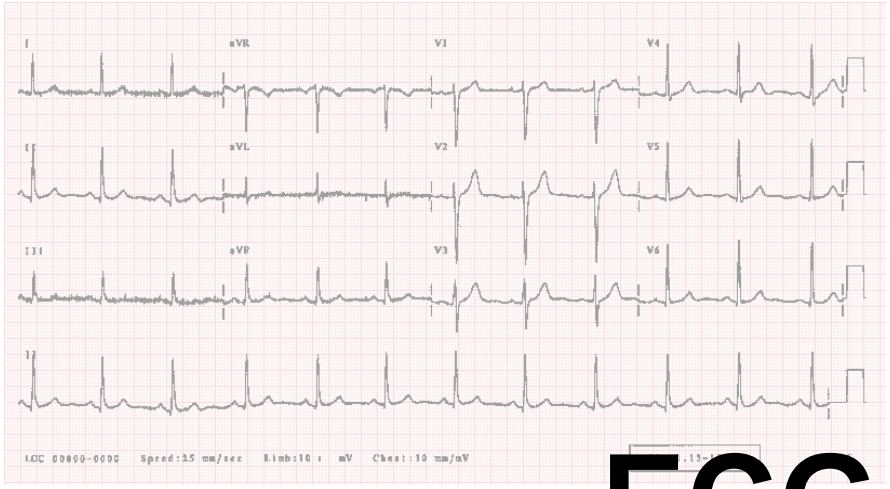
Project 2: time-series classification

Alina Dubatovka

November 17 - 19
Advanced Machine Learning, Autumn 2021

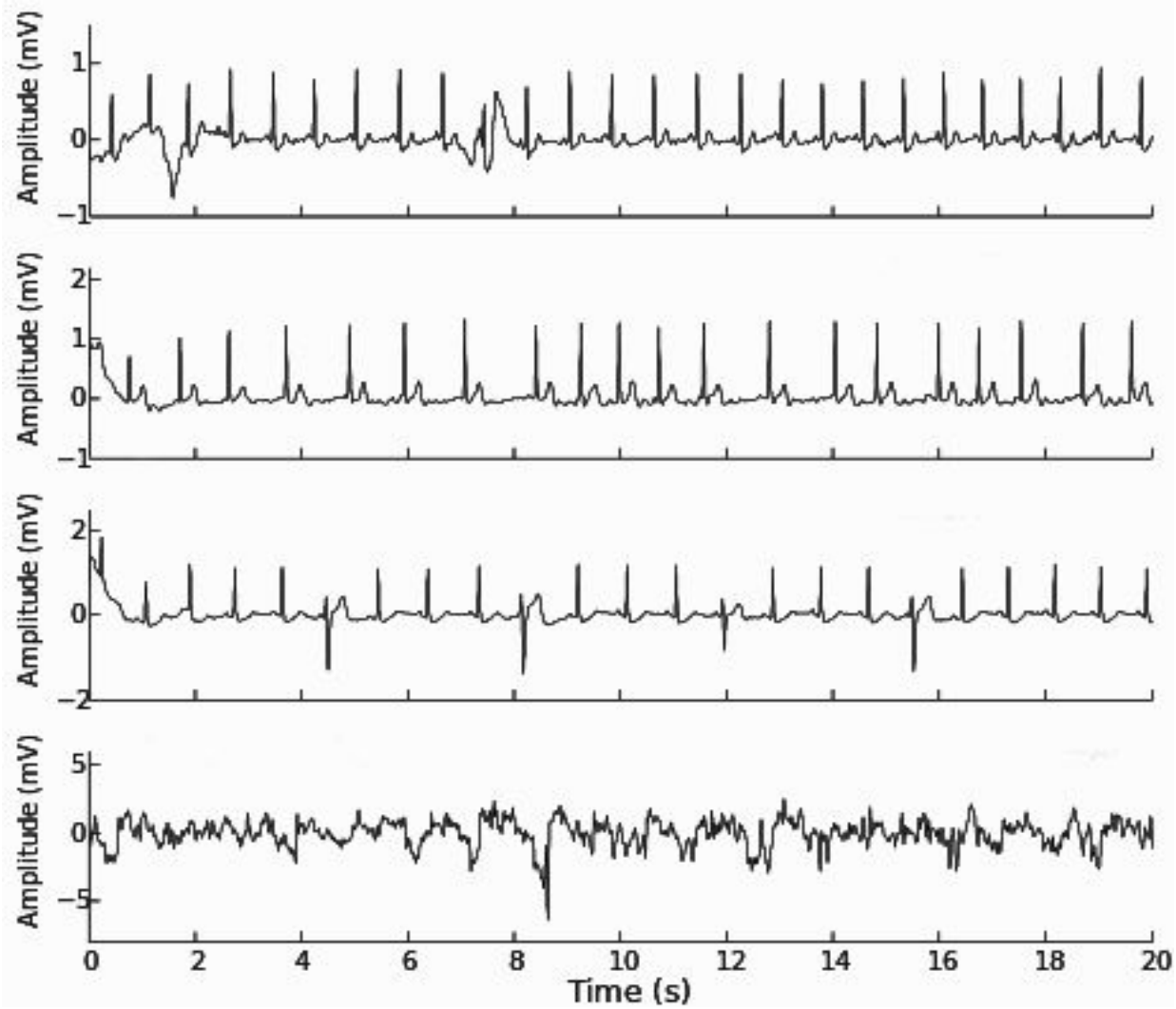

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
Speed:25 mm/sec
Limb:10 mm/mV
Chest:10 mm/mV


Record EKG
How are you feeling?
Kardia

ECG signal


CheckMe
10s
68
%SpO2 98


10:09
Back
Normal
64
BPM

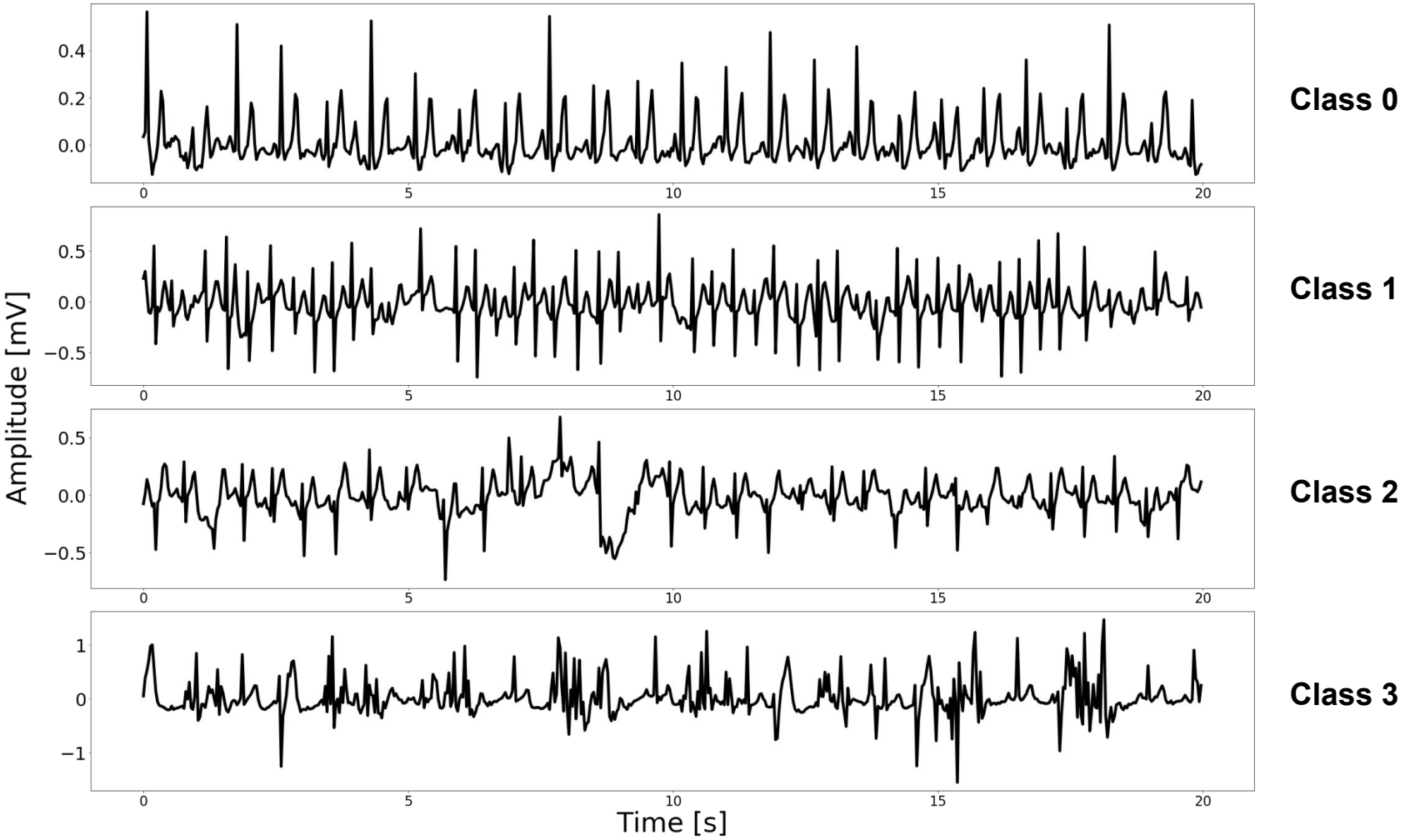


Class 0

Class 1

Class 2

Class 3


Amplitude [mV]
Time [s]
Class 0
Class 1
Class 2
Class 3

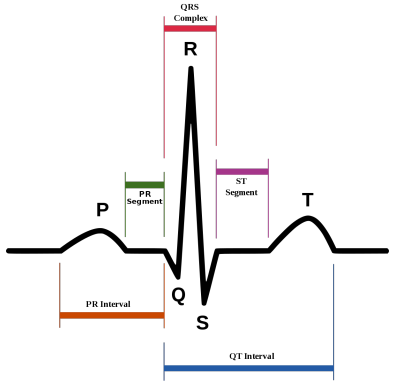
Data profile

Label	Number of recordings	Time length (s)				
		Mean	SD	Max	Median	Min
Class 0	3030	29.8	9.4	59.5	27.9	8.3
Class 1	443	29.7	11.8	58.5	27.8	9.0
Class 2	1474	31.9	11.0	58.9	28.0	8.6
Class 3	170	22.2	10.0	57.2	24.9	9.3
Total	5117	30.1	10.3	59.5	27.9	8.3

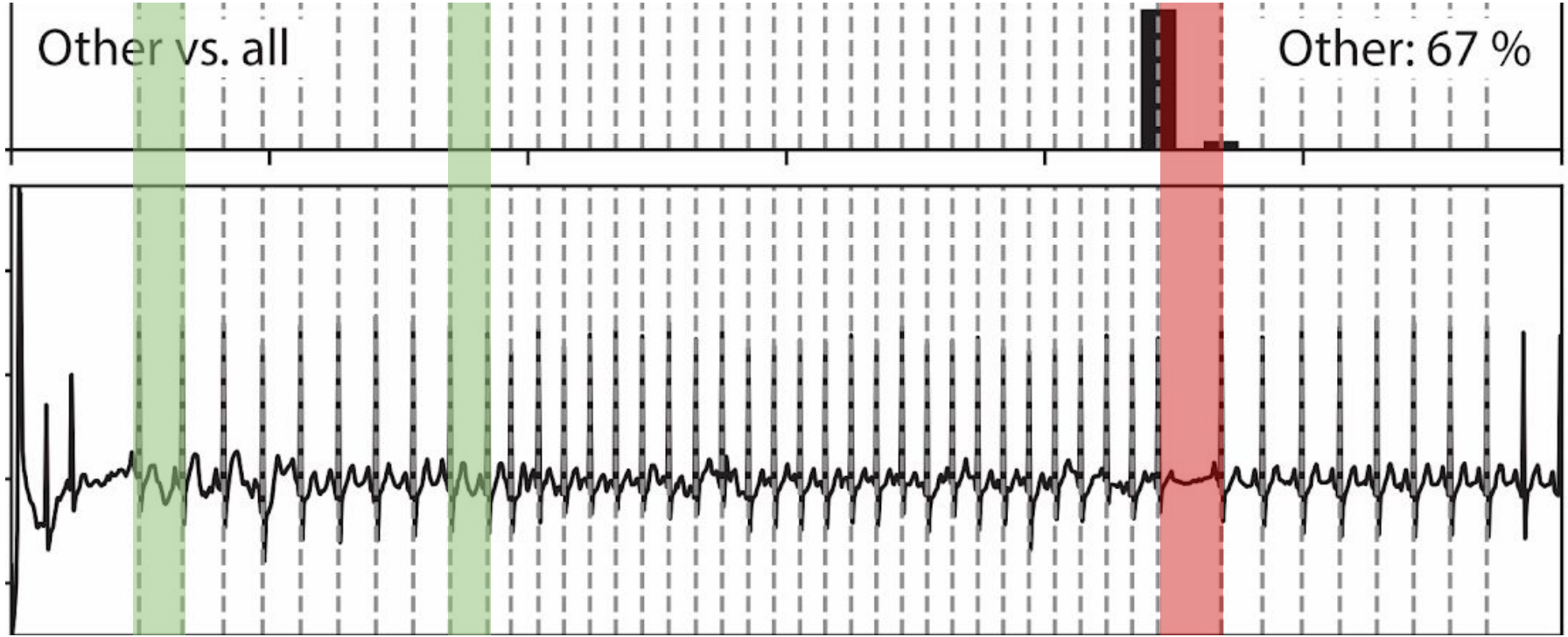
ECG is a sequence…

… of Data points

… of Heartbeats

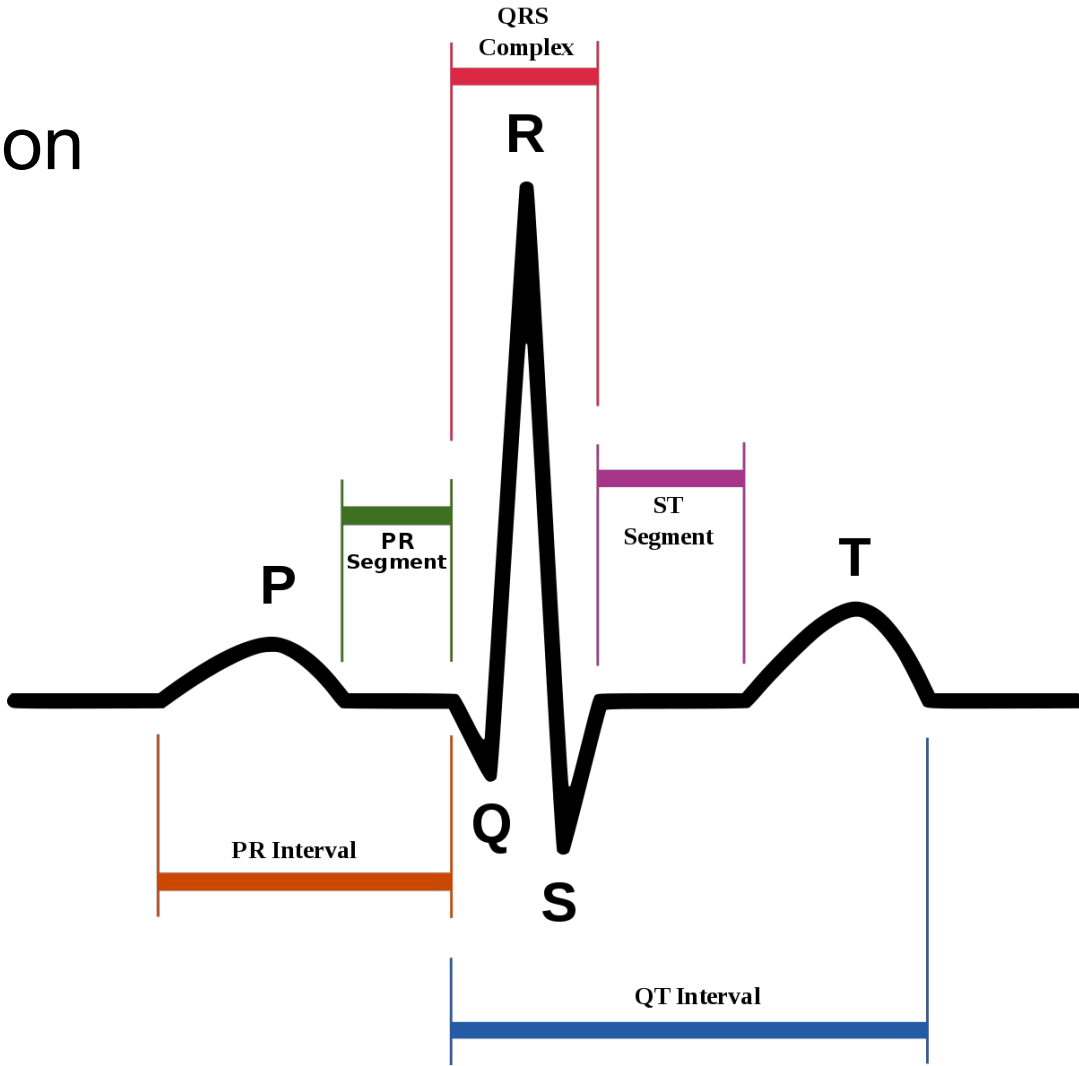


Splitting into Heartbeats

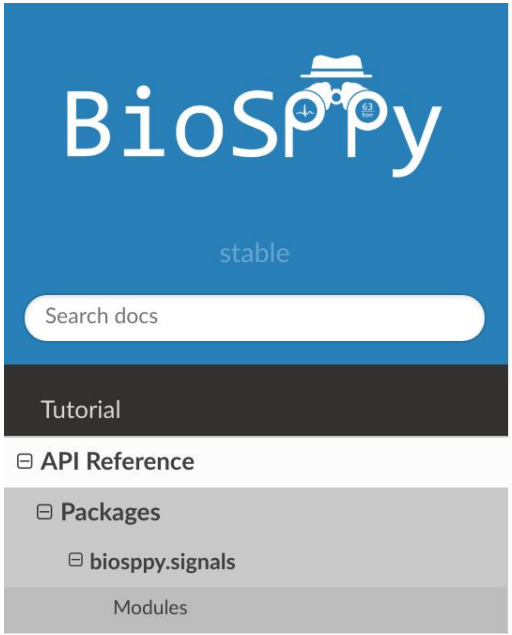


Manual feature extraction

- **RR** interval
- **R** amplitude
- **Q** amplitude
- **QRS** duration
- Heart rate variability
- Frequency domain



import biosppy.signals.ecg **as** ecg



biosppy.signals.ecg.extract_heartbeats(*signal=None, rpeaks=None, sampling_rate=1000.0, before=0.2, after=0.4*)

Extract heartbeat templates from an ECG signal, given a list of R-peak locations.

Parameters:

- **signal** (*array*) – Input ECG signal.
- **rpeaks** (*array*) – R-peak location indices.
- **sampling_rate** (*int*, *float*, *optional*) – Sampling frequency (Hz).
- **before** (*float*, *optional*) – Window size to include before the R peak (seconds).
- **after** (*int*, *optional*) – Window size to include after the R peak (seconds).

Returns:

- **templates** (*array*) – Extracted heartbeat templates.
- **rpeaks** (*array*) – Corresponding R-peak location indices of the extracted heartbeat templates.

https://biosppy.readthedocs.io/en/stable/biosppy.signals.html#biosppy.signals.ecg.extract_heartbeats

Some other Python libraries: `neurokit`, `pyhrv`, `hrv`, `heartpy`, etc…

Wave extraction: `ecg-kit` (Matlab/Octave), `ecgpuwave` (Fortran, partially ported to Matlab/Octave)

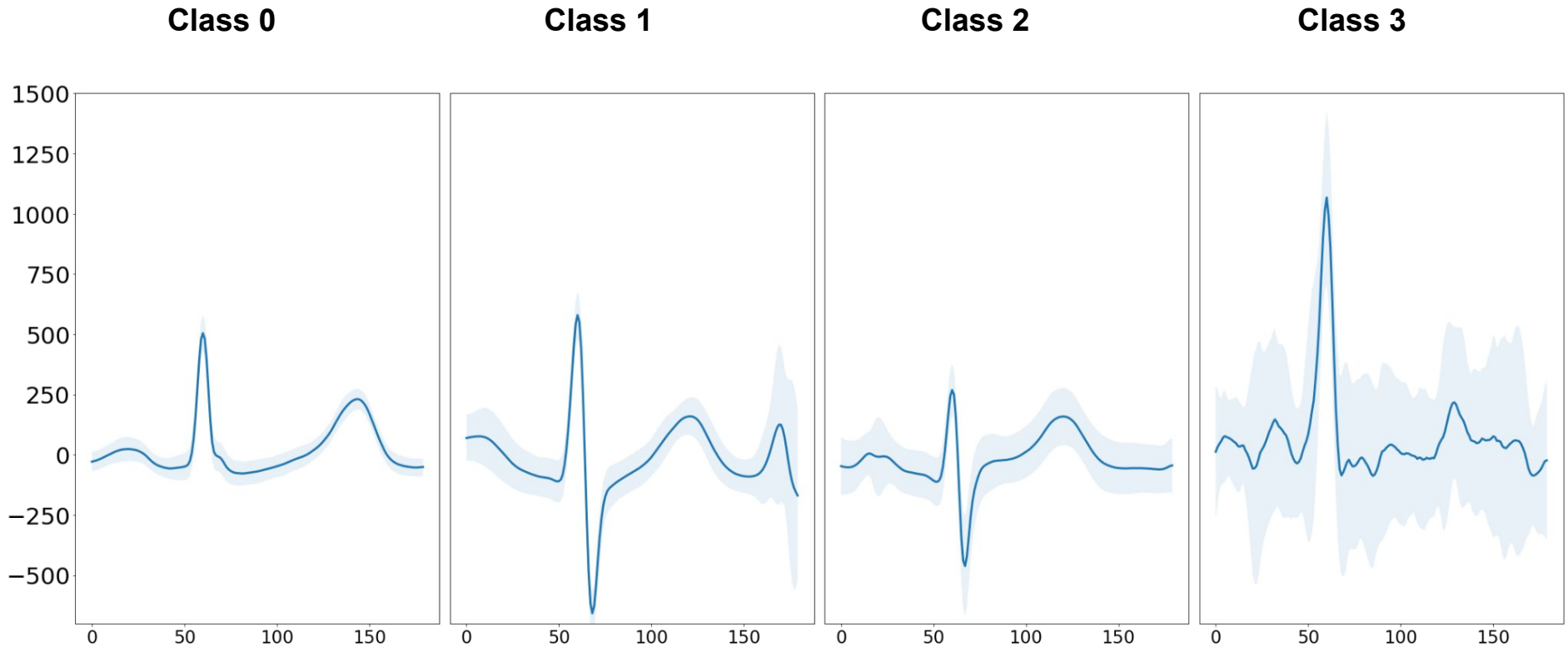
DOs and DON'Ts

- Use suggested libraries
- Think (!) which features might be helpful to extract
- Document what and how was extracted in the hand-in description

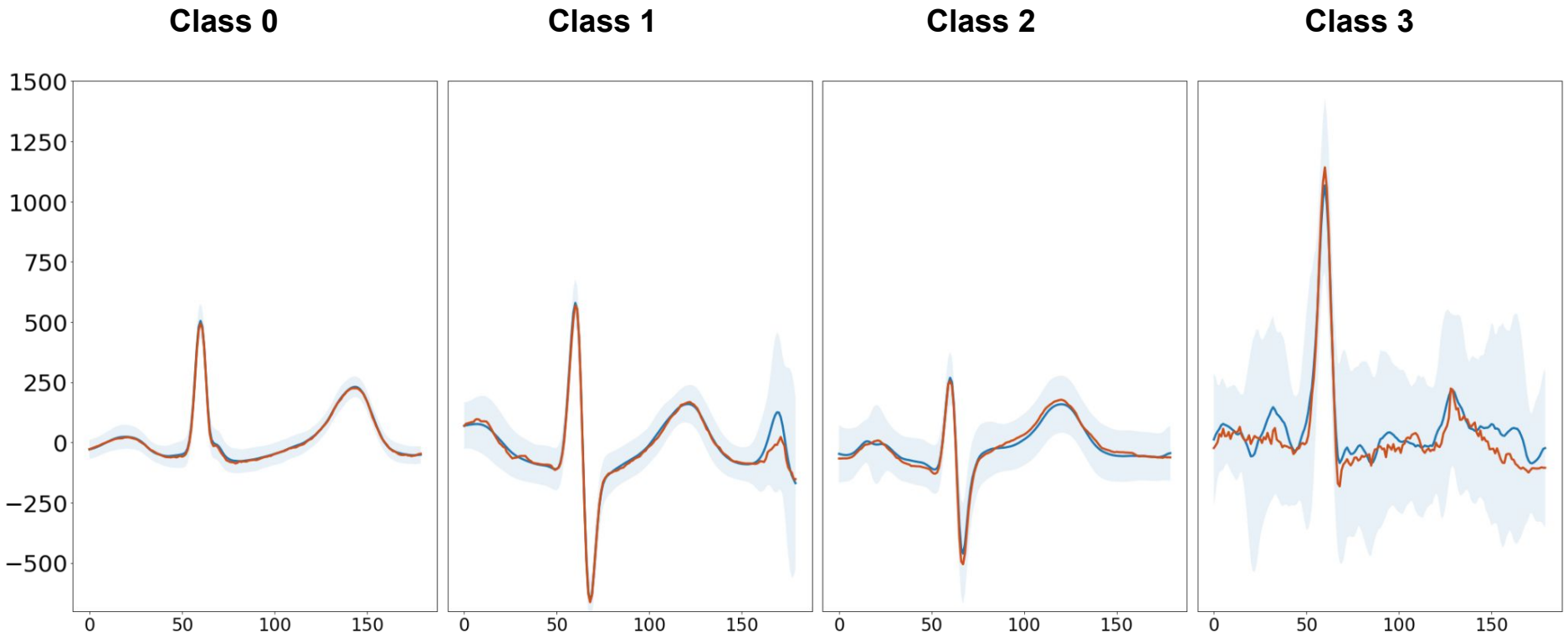
- Usage of external data
- Transfer learning
- Apply external pre-trained models
- Borrow third party models / code
- AutoML
- Send such submissions to the system "just for fun/out of curiosity"

Reason: not only neural networks should learn something!

Mean heartbeat with variance



Mean heartbeat with variance and median



Questions?