Machine Learning for Healthcare – Homework 1

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Instructions

The main document with the summary is “main.ipynb”. The adjacent conda environment is the file “jannik_gut.yaml”. The visualizations attached to this document are created in that document. Running the main.ipynb again recreates those visualizations and may choose different beats for the visualizations of one beat per category. Some models/parameters were imported from other indicated notebooks, which have not finished, but gave some information (disucssion in “Problems” section). The notebook called “Healthcare_GPU.ipynb” was originally run on Google Colab, but should run on the local machine as well.

Experiments

Next to the clearly given models as baseline and the transferral learning exercise, we were told to do some hyperparameter tuning on RNNs. I did that with the help of Keras Tuner, which is not in Conda (yet) and has to be get with pip. Next to the normal hyperparameters I was also curios if results change with (a priori sensible) modifications to the data. One modification is only looking at differences and the other is centring the data around their peaks (there is a good visualization for that). I also wanted to “lower bound” my experiments with a “simple” SVC, as an easy baseline.

Visualisations

There are plots for a beat of each category, to better illustrate the data. The next plot is the Histogram of the different beats to see if the data is balanced. Following is a plot centred around the peaks to better compare the different averages of beats by eye. The window is 15 on each side of the peak, bigger would give problems with the padding at the end of the beat. From that visualisation we can see that the different beats are similar, but it seems like there can be made a good classification by eye. The last set of visualisations is a histogram of changes. There are three histograms for each data set, which intersect on one bin (the y-axis and the values do not match, because of normalization). I was surprised with how many changes are really small, even after cutting the padding at the end.

Problems

It was my first time working with a dataset that had more than a couple of features and I underestimated the time and memory it takes to (hyper)tune models to that. The 2GB of my graphics card did not suffice to tune the RNN model. Also, what I assumed to be a simple SVC took more than a day to hypertune. That is the reason why not every dataset has their own hyperparameters but had to be shared with similar data. (Given that transferral learning seems appropriate for this task, I would argue that hypertuning each model would come to similar results.) I chose the hyperparameters from the trial with the best score and the least layers, to keeping training low.

Results

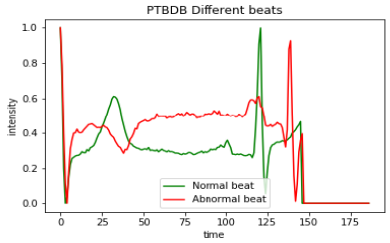
The results of my RNNs and the transferral task are absolutely abysmal and for each model the same, so I am quite sure I did an error in training them, but the error is not obvious (to me) and time is running out for investigating. If you find the error, please tell me what I did wrong.

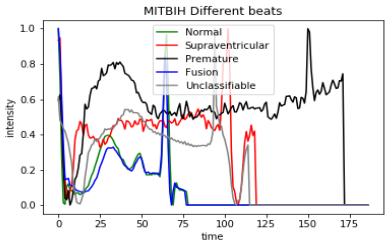
The next surprise was that the SVCs did so well, well enough for me to double check and I could not find a bug in training them. To answer my question only based on those SVCs, we can see that normal data and differences have around the same results, which is as expected. To my surprise peaks did not do better, but even worse than the datasets with more features.

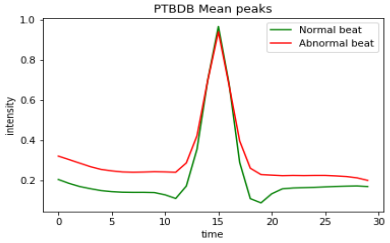
PTBDB	Accuracy	AUC	AUPRC
Baseline	0.9893507385778083	0.9983308027318735	0.9992689170662377
RNN normal	0.2779113706630024	0.5	0.8610443146684987
RNN peaks	0.2779113706630024	0.5	0.8610443146684987
RNN differences	0.2779113706630024	0.5	0.8610443146684987
SVC normal	0.9529371350051529	0.9786612079378166	0.9886240971271106
SVC peaks	0.9148059086224665	0.9516173895248388	0.9766256606219932
SVC differences	0.9495018893850911	0.9783965826883337	0.9900106687736172
Transferral 1	0.2779113706630024	0.5	0.8610443146684987
Transferral 2	0.2779113706630024	0.5	0.8610443146684987
Transferral 3	0.2779113706630024	0.5	0.8610443146684987

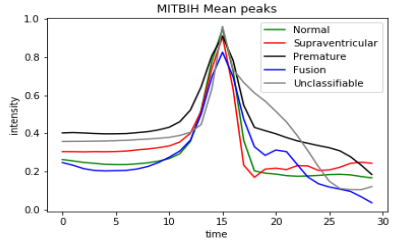
MITBIH	Accuracy
Baseline	0.9834186004019734
RNN normal	0.8276082587246483
RNN peaks	0.8276082587246483
RNN differences	0.8276082587246483
SVC normal	0.9774346793349169
SVC peaks	0.9513064133016627
SVC differences	0.9766581399598027

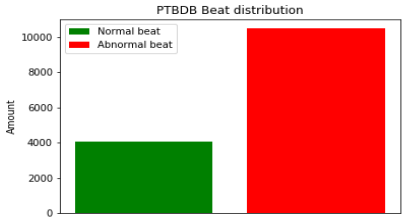
(The visualizations can also be viewed in the file “visualizations.png”)

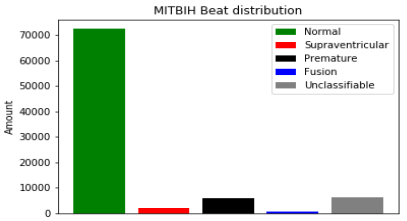

PTBDB Different beats
intensity
time
Normal beat
Abnormal beat


MITBIH Different beats
intensity
time
Normal
Supraventricular
Premature
Fusion
Unclassifiable

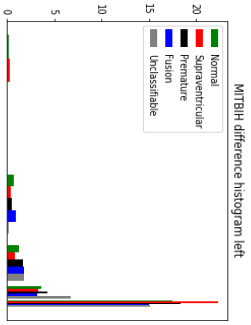

PTBDB Mean peaks
intensity
time
Normal beat
Abnormal beat

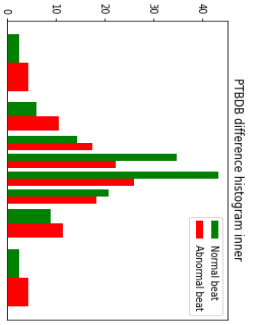

MITBIH Mean peaks
intensity
time
Normal
Supraventricular
Premature
Fusion
Unclassifiable

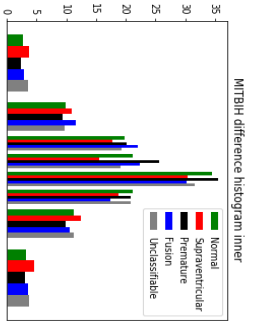

PTBDB Beat distribution
Amount
Normal beat
Abnormal beat

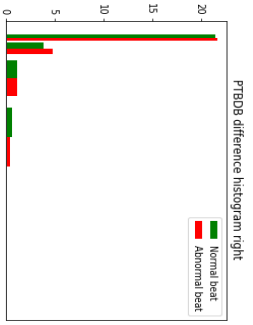

MITBIH Beat distribution
Amount
Normal
Supraventricular
Premature
Fusion
Unclassifiable

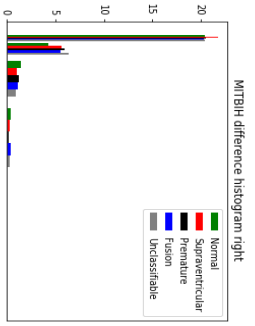

PTBDB difference histogram left
Normal beat
Abnormal beat


MITBIH difference histogram left
Normal
Supraventricular
Premature
Fusion
Unclassifiable


PTBDB difference histogram inner
Normal beat
Abnormal beat


MITBIH difference histogram inner
Normal
Supraventricular
Premature
Fusion
Unclassifiable


PTBDB difference histogram right
Normal beat
Abnormal beat


MITBIH difference histogram right
Normal
Supraventricular
Premature
Fusion
Unclassifiable