Report on ECG hearbeat classification

Tran The Trung

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1 Introduction

The heart is a organ that primarily in charge of pumping blood throughout the body, providing oxygen and nutrients to various tissues and organs. The heart is basically recognized as the living source for every live beings in the planet and human is obviously not an exception.

The heartbeat, on the other hand, refers to one complete pulsation of a heart It is the regular movement of your heart as it sends blood around the body and it happens from birth till death .

And with the ever-increasing pace of AI or more specifically Machine Learning, people have been able to enhance diagnosis, improve treatment and streamline healthcare. And if we take a closer look into heartbeat classification, ML algorithms have been employed to classify heartbeats into different categories, making foundation for solution of various problems.

2 Background

The data is about ECG heartbeat which composes of two hearbeat signals derived from two famous datasets in heartbeat classification, the MIT-BIH Arrhythmia Dataset and the PTB Diagnostic ECG Database. The signals correspond to electrocardiogram (ECG) shapes of heartbeats for the normal case and the cases affected by different arrhythmias and myocardial infarction. These signals are preprocessed and segmented, with each segment corresponding to a heartbeat.

In this day, Convolutional Neural Network is one of the most popular Deep Learning model which is primarily used in Computer Vision domain to extract features from visual data such as images or videos. However, many reasearchs have shown that CNN also work well on 1D data or in this case, the classification of ECG heartbeat.

3 Method

Type	# Channels	Kernel Size	Stride	Padding
Convolution 1d	32	3	1	1
Max Pool		2	2	0
Convolution 1d	64	3	1	1
Max Pool		2	2	0
3 FC layers				

I use a convolutional neural network with two convolution layers followed with a max pool layer and a ReLU activation function. After extracting features, I use fully connected layers to classify the signal.

To explain the choice of architecture, using convolution helps scan the input signal with small, trainable filter and this acts as feature detectors. This type of layers play the same purpose as the original 2d convolution where it identifies basic patterns. The pooling layers are used to reduce the size of the signal or more specifically its channels. This is crucial to reduce the amount of parameters and computation while increase the robustness of the model. And ReLU activation function is there to add some non-linearity to the model which is the main purpose of a Deep Learning model.At the end of the network, fully connected layers perform high-level reasoning by combine these features and make the final decision about the class of the objec

4 Evaluation

4.1 Dataset

In this practical section, I will only focus on the first data which is the MITBIH data. This data contains the total of 109446 samples which are then divided into 87554 and 21892 sample for training and test set, respectively. There are in total 5 classes: N, S, V, F, and Q. All the samples in the data have already been cropped, downsampled and padded with zeros if necessary so that each of them has a fixed dimension of 188, with the latest column being the class.

First, we need to visualize some aspects regarding the data.

The figure 1 below show that the data is highly imbalanced so we need to make steps to balance out the data. I have done this by over-sampling the data using SMOTE technique which increase the sample from all the minor class to be equal to the majority one.

4.2 Result

The model achieve a 98 % accuracy which is very high for 5-class classification problem. This show how powerful CNN model is to 1D data since it enables the ability of learning neighbor relationship between features in the data.

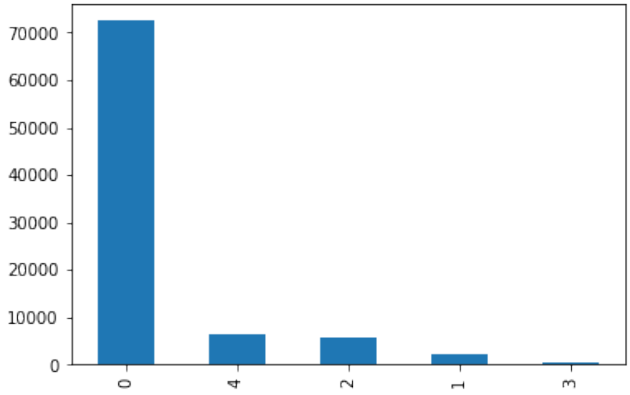

Figure 1: Data distribution before over-sampling

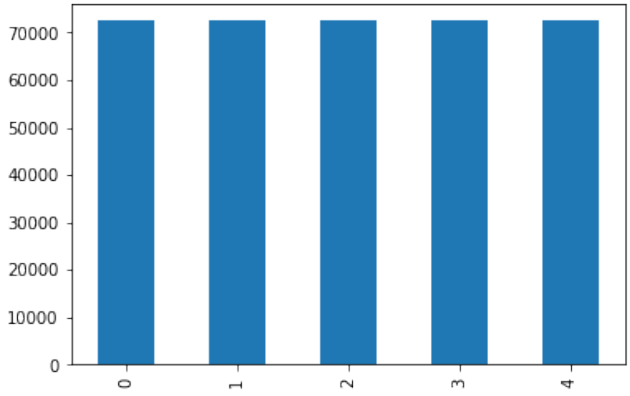

Figure 2: Data distribution after over-sampling

From the confusion matrix, it is seen that the model perform well on every classes except for the the class 3. This shows that our model performs quite good overall and the 98 % is not a result of a over-sampling procedure

5 Discussion

The extremely high accuracy might not be that great since there's might be some problems in training like overfit, imbalanced data or it might simply due to errors in code and I need to conduct further investigation on this.

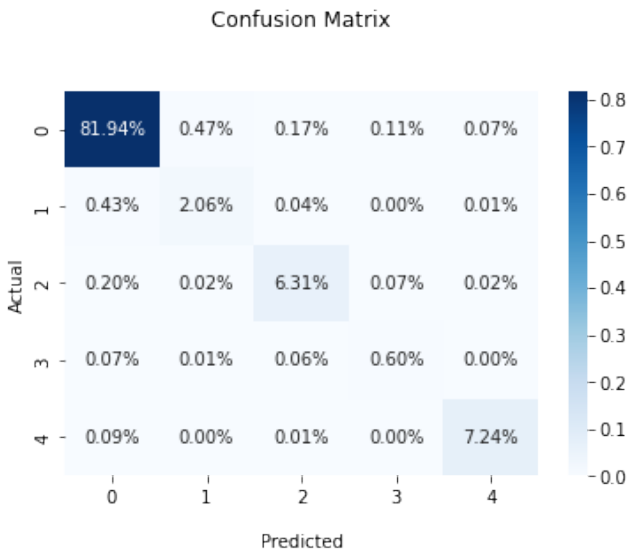

Figure 3: Confusion Matrix