University of St Andrews

Machine Learning

CS5014

Classification

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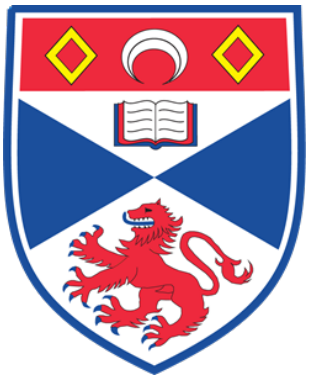

Goal

The goal of this practical is to analyse a dataset in order to produce a classification model that can make predictions based on a set of inputs.

Contents

1 Loading Data

To load the data, the paths to the relevant files are supplied as arguments to the *__main__.py* script. The *pandas* module was used to load the file contents into *DataFrames*.

A test set was isolated from the original data using an 80%-20% split. Stratification was used to ensure that all classes were represented in the training data.

2 Cleaning Data

When originally loading the CSV files the parameter to raise an exception on missing or extra columns was included, and so it could be assumed that all rows had the same number of columns. The dtype=**float** argument was also passed when loading the data to ensure that each column contained the expected numerical data. Any rows containing empty or NaN values were dropped from the dataset.

3 Data Visualisation and Analysis

The input CSV was understood to have the structure shown in figure 1. Each value is either the mean, minimum, or maximum reading from 100 radar pulses, and these values are referred to as components.

The mean, min, and max values were plotted for each channel for each sensor. The plots of the means of each channel for the book and plastic case objects are shown in figures 2 and 3 respectively. The difference between the resulting signals from the two objects are very clear.

In the binary dataset, the minimum and maximum components observed all followed a similiar shape as the average, but the book class did contain one severe outlier in two plots. The full plots are included in the submission under `plots/binarybook.png` and `plots/binaryplasticcase`, in which the plot of the minimum components in channel one and the maximum components in channel three both include one row of outliers. Since the average did not deviate from other components for that class, it seemed fair to say that these maximum and minimum readings were outliers. Instead of removing them and risking producing a biased model, the row was left in the data set. The

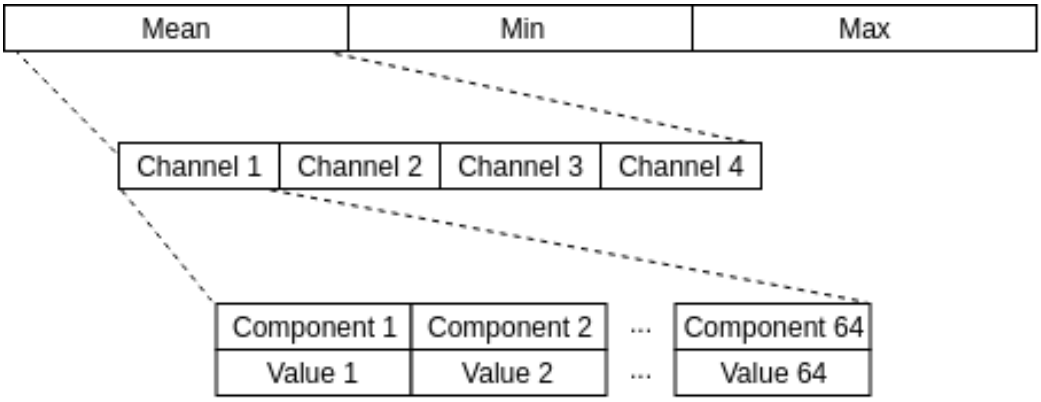

Figure 1: The structure of each row of the CSV file which is repeated for minimum and maximum values.

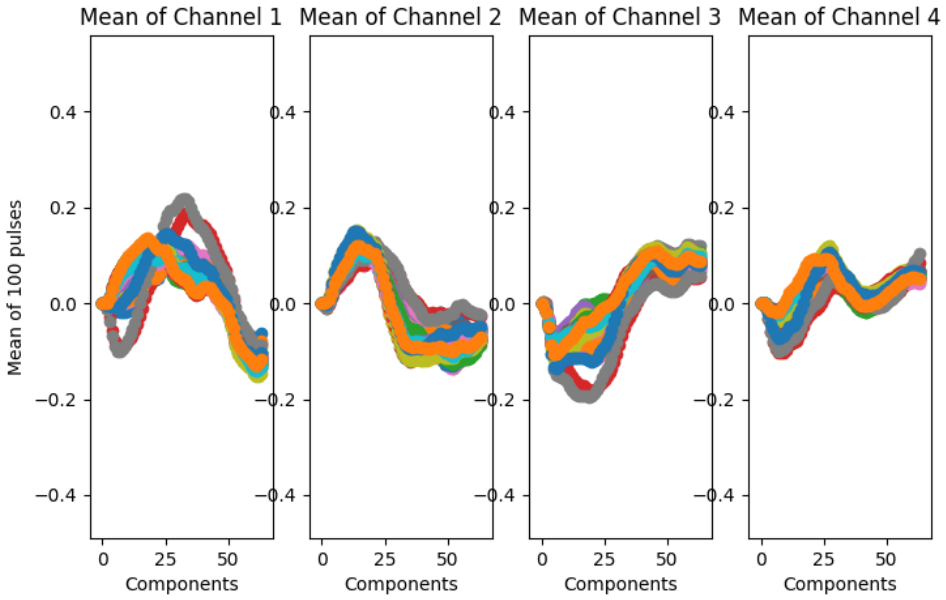

Figure 2: Mean of each channel measured for the book

existence of these outliers were noted when choosing a cost function however to try and minimise their affect.

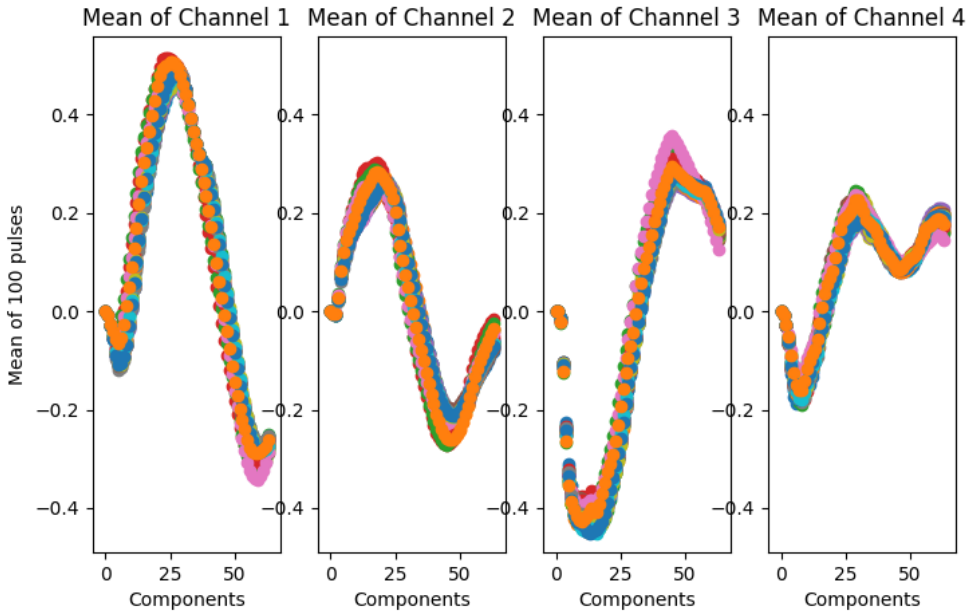

Figure 3: Mean of each channel measured for the plastic case

3.1 Distributions

3.2 Relationships

4 Feature Selection

5 Model Selection and Training

Since each dataset contains an equal number of samples for each classes, the probability of a random classifier guessing correctly is equal to

$$\frac{1}{Number\ of\ Classes}$$

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