Machine Learning for IOT - Homework 1

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Exercise 1

In this exercise we first must collect the raw data using the sensors and Raspberry pi. After data being collected, we need to turn the raw .txt file into a .csv file using Pandas library. At the beginning the .csv files, contains 4 columns but based on the required columns for TFRecord we create a timestamp from date and time columns and after converting these two columns we can create our TFRecord dataset. Then we code the normalization function and use the data in the technical data sheet to find the minimum and maximum values for temperature and humidity in order to use in the normalization function. In the final part of the code, we demonstrate the values for the size of the TFRecord dataset file which will be shown by the script at the end of the code, and it is obvious that the size of the file after the normalization process with the data we used for our code as the sample is smaller than the size of the TFRecord file before the normalization process but we also see that the TFRecord dataset is larger than the .csv file. The size of the TFRecord files is available in table 1

Size before Normalization	Size after Normalization
672 bytes	540 bytes

Table 1

Exercise 2

For this exercise, we first read the audio files using TensorFlow library. after that we need to specify the required information for STFT and MFCC such as frame length, frame steps etc. based on the instructions in the homework file, afterwards we implement the code to calculate the STFT. Based on the STFT result, we compute the spectrogram and use some of its properties in order to subsequently compute the MFCC. The obtained execution time is the time for the so called slow MFCC. Then we must experience with different values for the number of bins in order to achieve the required threshold but also, we have considered a tradeoff between the execution time and the SNR value since they are related to each other, and we don't want to violate the constrains. Also, for the value of frame step and frame length we need to convert the values from milliseconds to number of samples (for that matter we first convert them to second and the multiply them by the sampling rate) because considering TensorFlow's documentations, we need to specify the inputs like that.
We ran a script in order to find the right value for the variable that represents the number of bins. The output of fast MFCC based on different values for the number of bins is shown in table 2.

Number of bins	Average execution time (ms)	SNR (db)
5	17	N/A
10	18	7.890239953994751
13	18	10.464013814926147
15	18	12.289001941680908

Table 2

Due to the shape of the output matrix for the MFCC, we cannot compute SNR for bins less than 10, and we must consider that fact that we need an SNR value larger than 10.40dB so the best value we can get for the number of bins is equal to 13.