Angular contact with TensorFlow

Rocco Malisi

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Abstract

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3.1 Performing an EDA on dataset #1

To get a better understanding of dataset #1, an EDA is performed. The objective is to identify patterns and relationships in the data. The insights gained by this analysis will be used in building and improving the model.
The dataset consists of three columns and 1365 rows. The columns are 'Fr' (radial force in N[Newton]), 'n' (rotational speed in rpm[revolutions per minute]) and 'Lifetime' (lifetime in h[hours]). The dataset does not contain any empty or null values and therefore does not require cleaning.
Figure 1 shows a plot of column Fr. The value of Fr starts at 200 and is increased by 100 every 35 rows throughout the whole dataset. The final and highest value of Fr is 4000.
The column Lifetime is shown in figure 3. The highest value at the first row is 88445568 but it drops rapidly throughout the dataset to just 116 in the last row. Every 35 rows the value has a local peak but then quickly drops again. Figure 2 is a plot of rows 1000 and up which shows that this trend continues all the way throughout the dataset even though it can't be seen when plotting all rows.
The column n is shown in figure 4. The value of n follows a pattern which repeats every 35 rows for 39 times. From the starting value of 100, n is increased linearly to its peak value of 3500, after which it drops back to 100 and the next iteration begins.
These findings already give insights about potential relationships of the variables. The peaks in the value of lifetime appear when n is at its lowest at 100. When n increases, the peak in lifetime drops sharply. This could be due to the increased load on the bearing system as n increases. As Fr steadily increases throughout the dataset, the peaks of lifetime become smaller even though n follow the same pattern. Therefore Fr must also have a negative correlation with lifetime.
Figure 5 shows the correlation matrix of the dataset. Both Fr and n show a weak negative correlation with lifetime of -0.21 and -0.12, respectively.

3.2 Building the first model on dataset #1

This chapter is about building the first model on dataset #1. It will predict the lifetime of the bearing system using Fr and n as input features. The EDA already showed that the dataset does not require cleaning or further preprocessing.
This first model will be a simple neural network. To improve the models accuracy, the number of hidden layers and the number of neurons per hidden

Figure 1: Plot of Fr

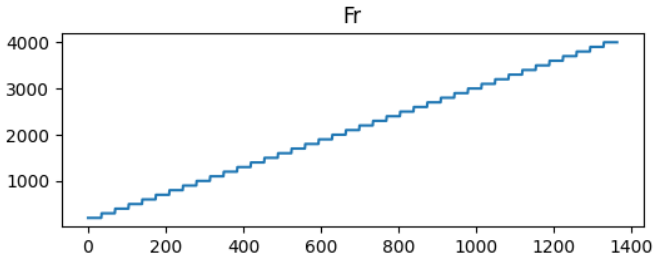
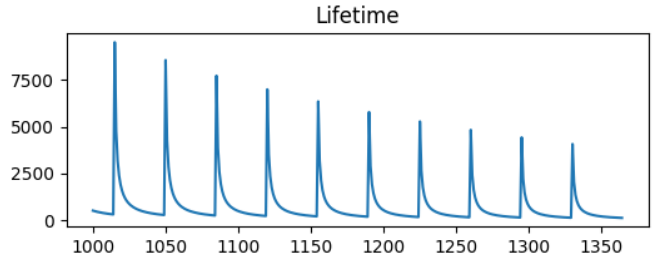


Figure 2: Plot of Lifetime



layer were tested in different combinations. The best accuracy in predicting the lifetime was achieved with the following configuration:

- Input layer with 2 neurons for features Fr and n
- First hidden layer with 512 neurons and activation function ReLU
- Second hidden layer with 512 neurons and activation function ReLU
- Output layer with 1 neuron predicting the value of lifetime

The code used to create a model with this architecture in TensorFlow:

```
model = tf.keras.Sequential([
layers.Dense(512, activation='relu', input_shape=[2]),
layers.Dense(512, activation='relu'),
layers.Dense(1)
])
```

Figure 3: Plot of Lifetime

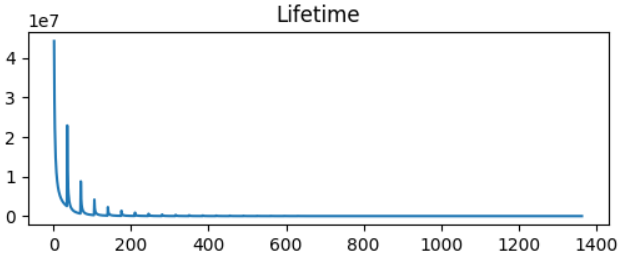


Figure 4: Plot of n

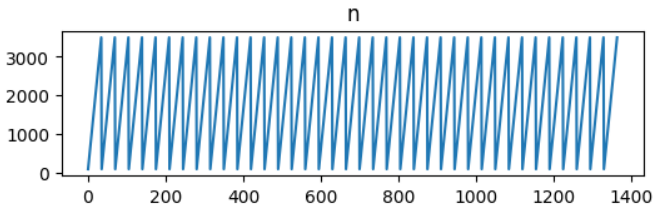
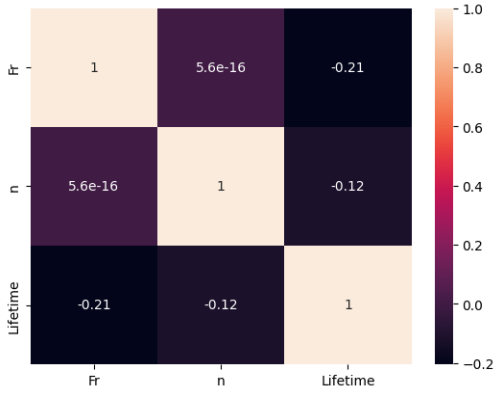


Figure 5: Correlation matrix of dataset #1



References