Delft University of Technology

Sustainable Air Transport
AE4465

Tutorial 1 of Assignment: eXplainable Artificial Intelligence (XAI) for the Maintenance of a Turbofan Engine

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Introduction

This is a coding tutorial (01) to support the 2024 assignment. This tutorial is meant to help develop the assignment in an easy and reproducible manner.

Goal

The overall goal of this tutorial is to get acquainted with the CMAPSS data, compute the target RUL feature, and explore some visualizations.

Data

You can find the assignment data at: https://www.nasa.gov/content/prognostics-center-of-excellence-data-set-repository (Turbofan Engine Degradation Simulation - 6)

You should download the "train_FD001.txt" dataset. This is a dataset of engines that exhibit only one fault mode and one operational condition. The other datasets, which you can also use, are more complex. The "test_FD001.txt" file and the other test files have smaller trajectories and should **not** preferably be used.

Instructions

1. Download the "train_FD001.txt" dataset from the link above.
2. Create a Jupyter notebook at Google Colab at https://colab.google/ or at PyCharm
3. Import the necessary libraries (numpy, pandas, matplotlib, etc.)

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
# import other libraries
```

4. Import the data to a dataframe and print the first 5 lines.

```
df = pd.read_csv(<filename to be replaced>)
print(df.head(n=5))
```

5. Print the columns of the dataframe.

```
print(df.columns)
```

6. Plot the evolution of one sensor for a given engine id from the beginning of the life of the equipment until its end.
7. Add a RUL column to the dataframe

```
# Illustrative example (needs to be adapted to your needs)
def add_rul(g):
    g['RUL'] = max(g['Cycle']) - g['Cycle']
    return g

df1 = df1.groupby('Equipment').apply(add_rul)
df1.head()
```

Extra Instructions

1. Check which sensors convey useful information. In other words, identify the non-flat signals.
2. Check the Pearson and Spearman correlations of the sensor data. Please refer to Seaborn correlation heatmap.

3. Calcute the monotonicity, trendability and prognosability of each engine for each sensor trajectory. Please refer to Feature selection