01

Prediction Modeling

Serival Tree Team

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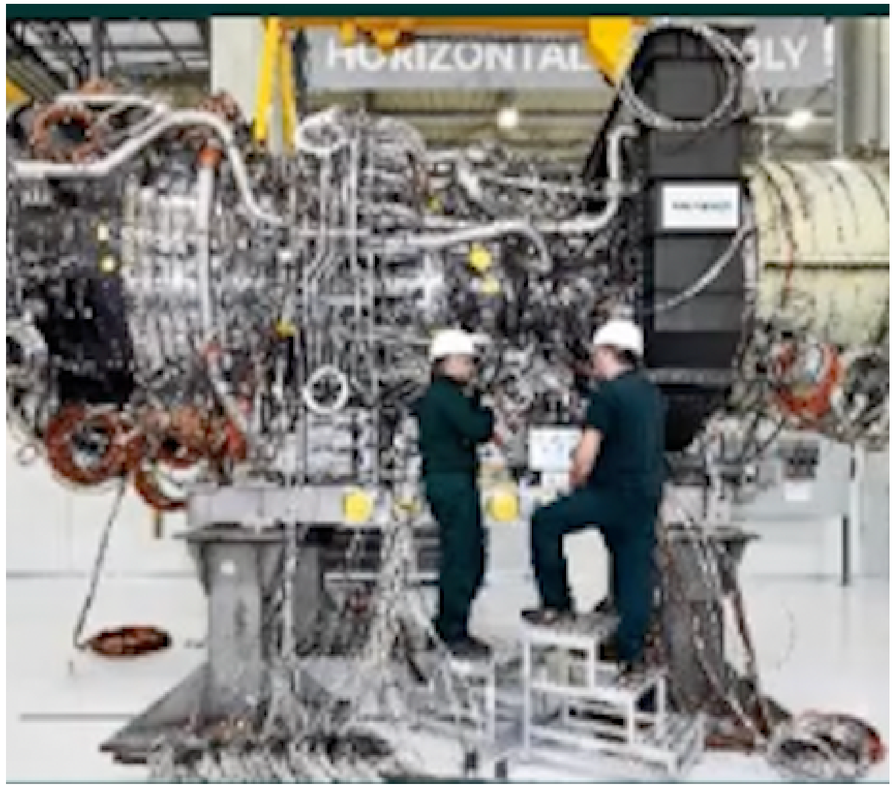
Image of a representation of an Artificial Neural Network

02

What is the Challenge ?

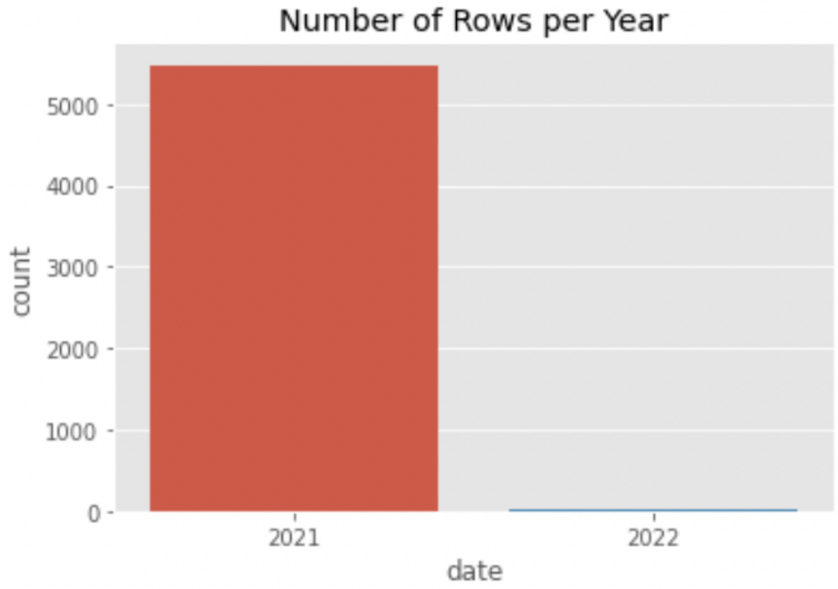
- Worked with synthetic data that simulates the historic behavior of Gas Turbine engines.
- Supporting metadata about the engines and sites is also given.
- **Predict the Low Pressure Turbine (LPT) POWER** output for a single engine under certain given conditions



	POWER	CMP_SPEED	CDP
count	4337.000000	5490.000000	5490.000000
mean	11730.214760	6417.889466	6.265058
std	3991.630810	3793.082652	3.616029
min	2720.133922	0.000000	0.843212
25%	8185.832753	4499.382563	3.137928
50%	13473.368134	7823.908803	6.674973
75%	14972.032226	9658.852062	9.616167
max	17616.227967	10000.000000	12.390310

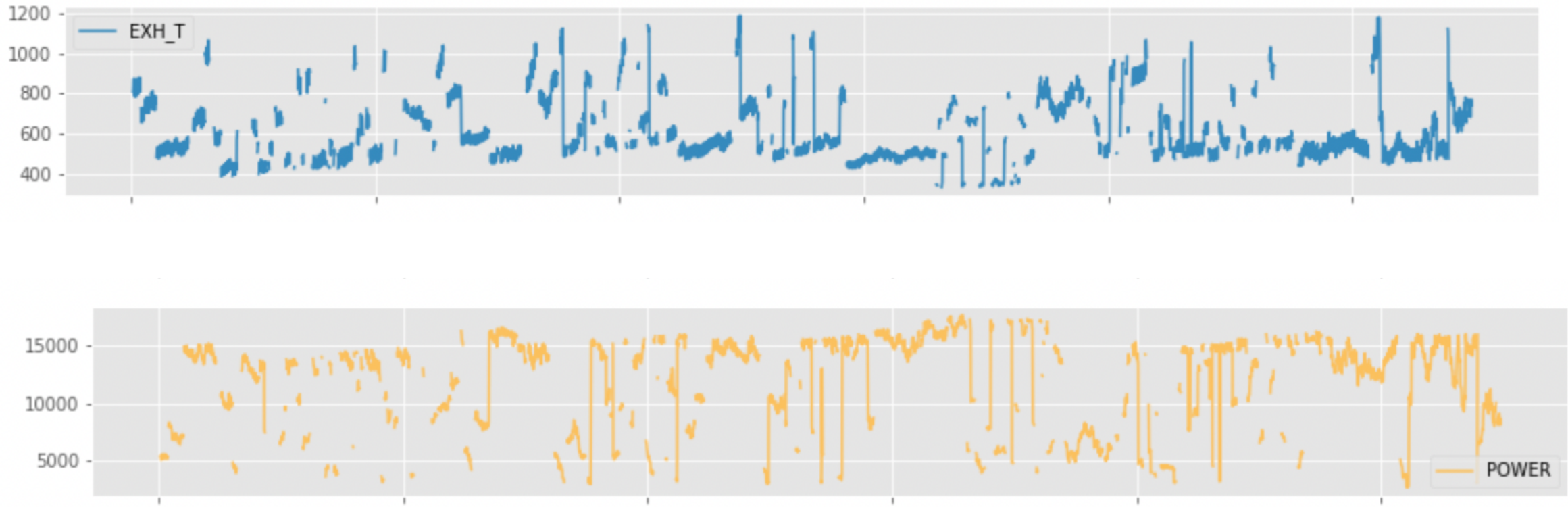
	ELEVATION	HPT_IT	EXH_T
count	5490.000000	4337.000000	4337.000000
mean	310.903213	1182.098329	612.324913
std	416.506341	118.879552	156.132793
min	-29.000000	878.785407	332.933559
25%	14.458365	1106.295284	503.424955
50%	130.987930	1157.928077	554.500718
75%	567.625122	1253.712362	705.181564
max	1552.426025	1600.690748	1188.563234

The train data itself is interesting



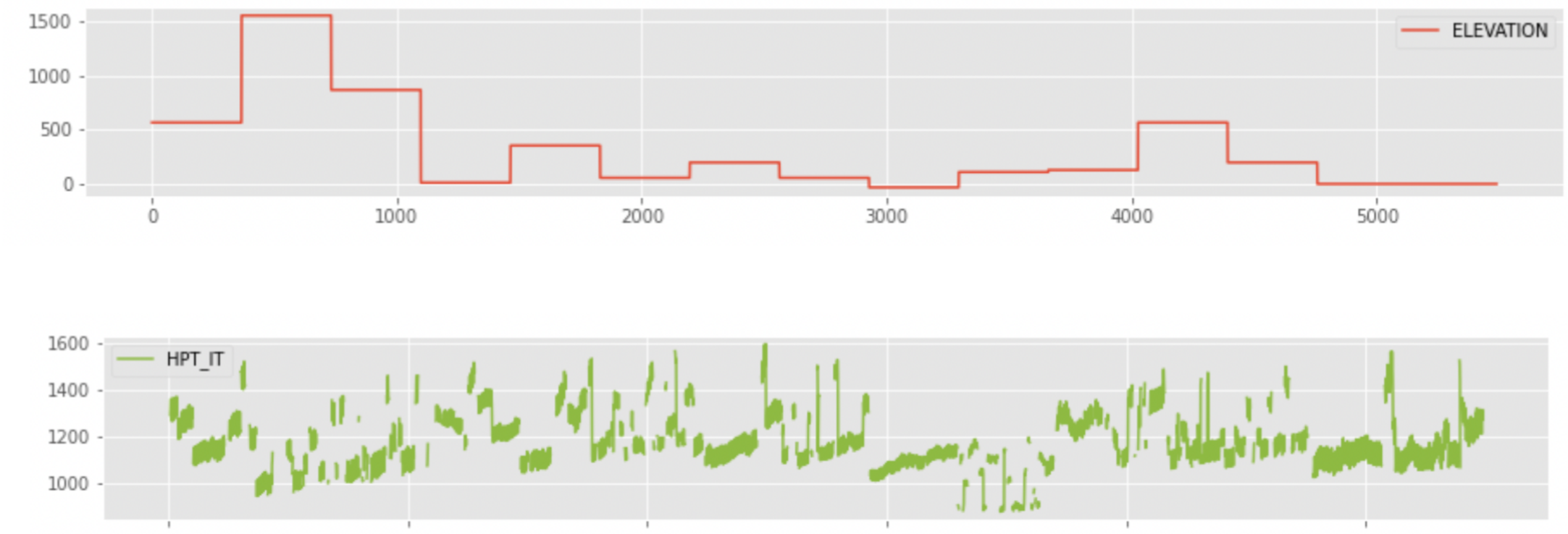
How do variables change ?

04



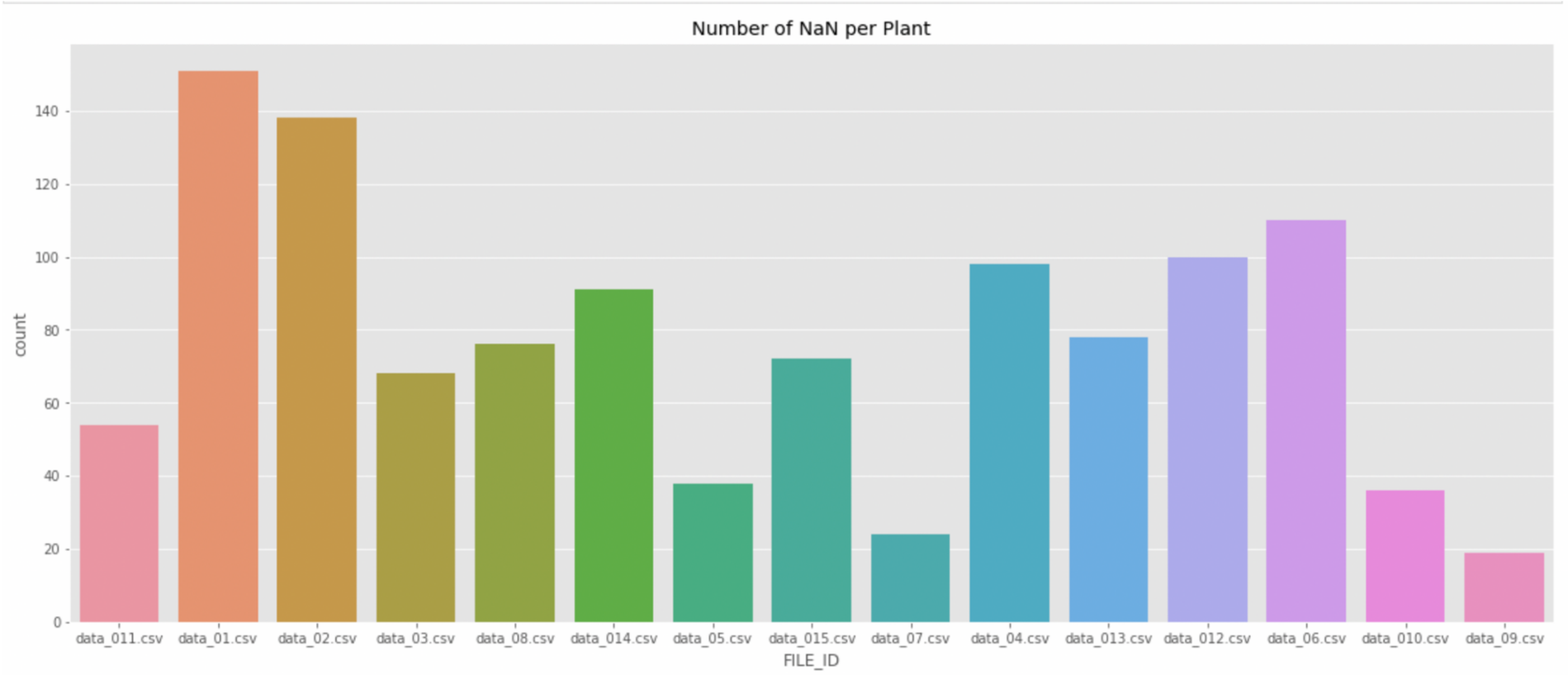
04

How do variables change ?



04

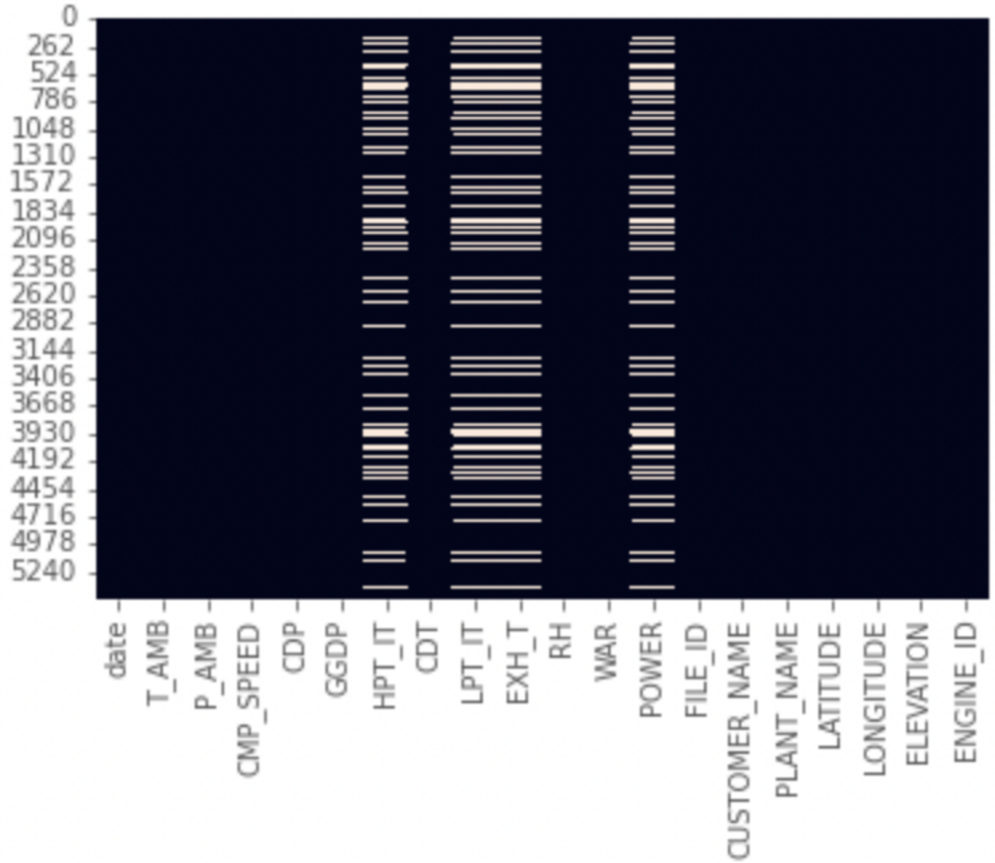
Is There Any Missing Value ?



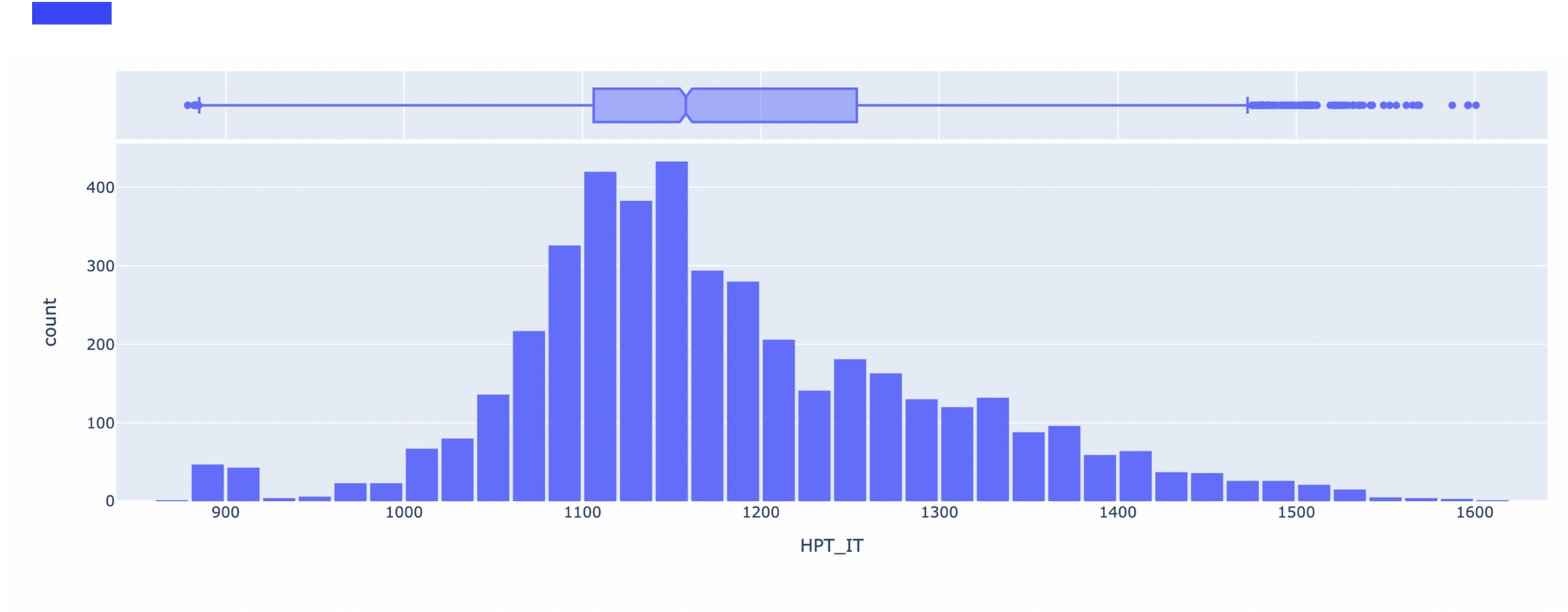
What Percentage of them are?

date	0.000000
T_AMB	0.000000
P_AMB	0.000000
CMP_SPEED	0.000000
CDP	0.000000
GGDP	0.000000
HPT_IT	21.001821
CDT	0.000000
LPT_IT	21.001821
EXH_T	21.001821
RH	0.000000
WAR	0.000000
POWER	21.001821
FILE_ID	0.000000
CUSTOMER_NAME	0.000000
PLANT_NAME	0.000000
LATITUDE	0.000000
LONGITUDE	0.000000
ELEVATION	0.000000
ENGINE_ID	0.000000

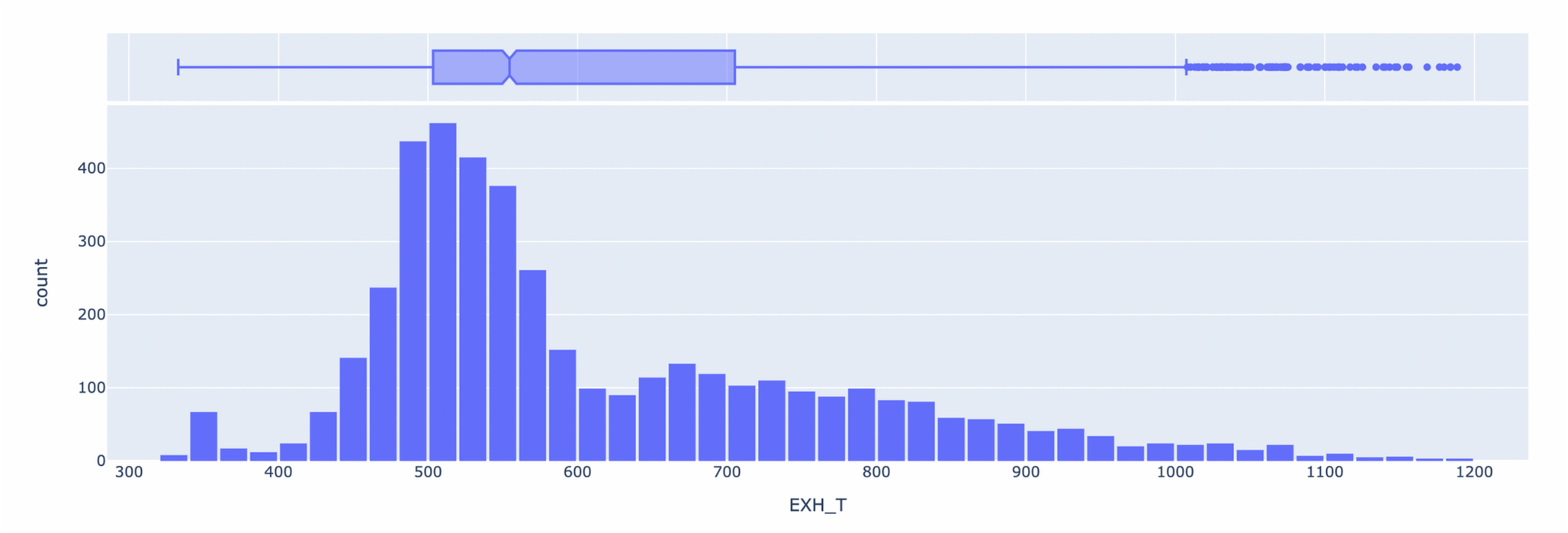
Does NaN values are related ?



Are there Atypical Values ?

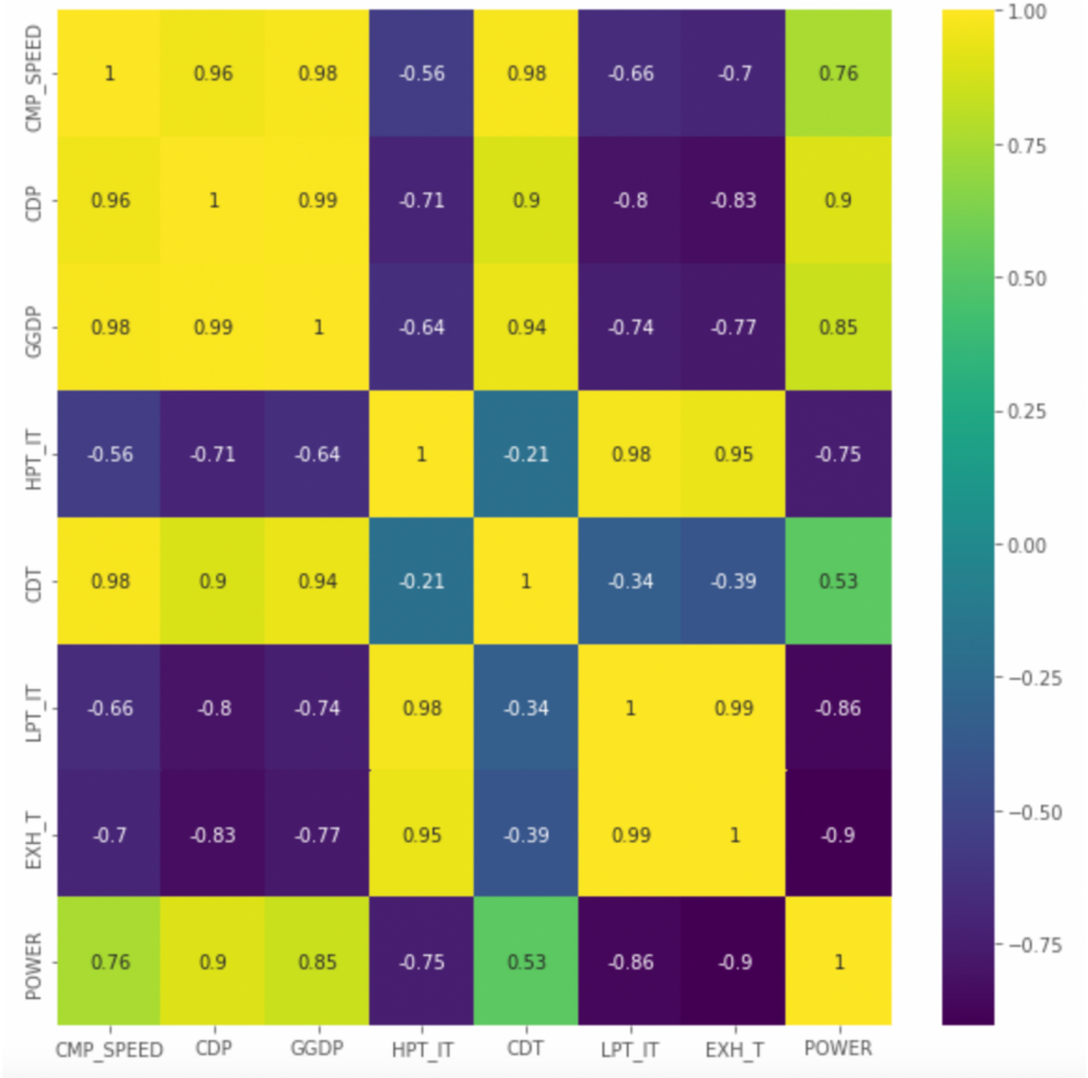


Are there Atypical Values ?

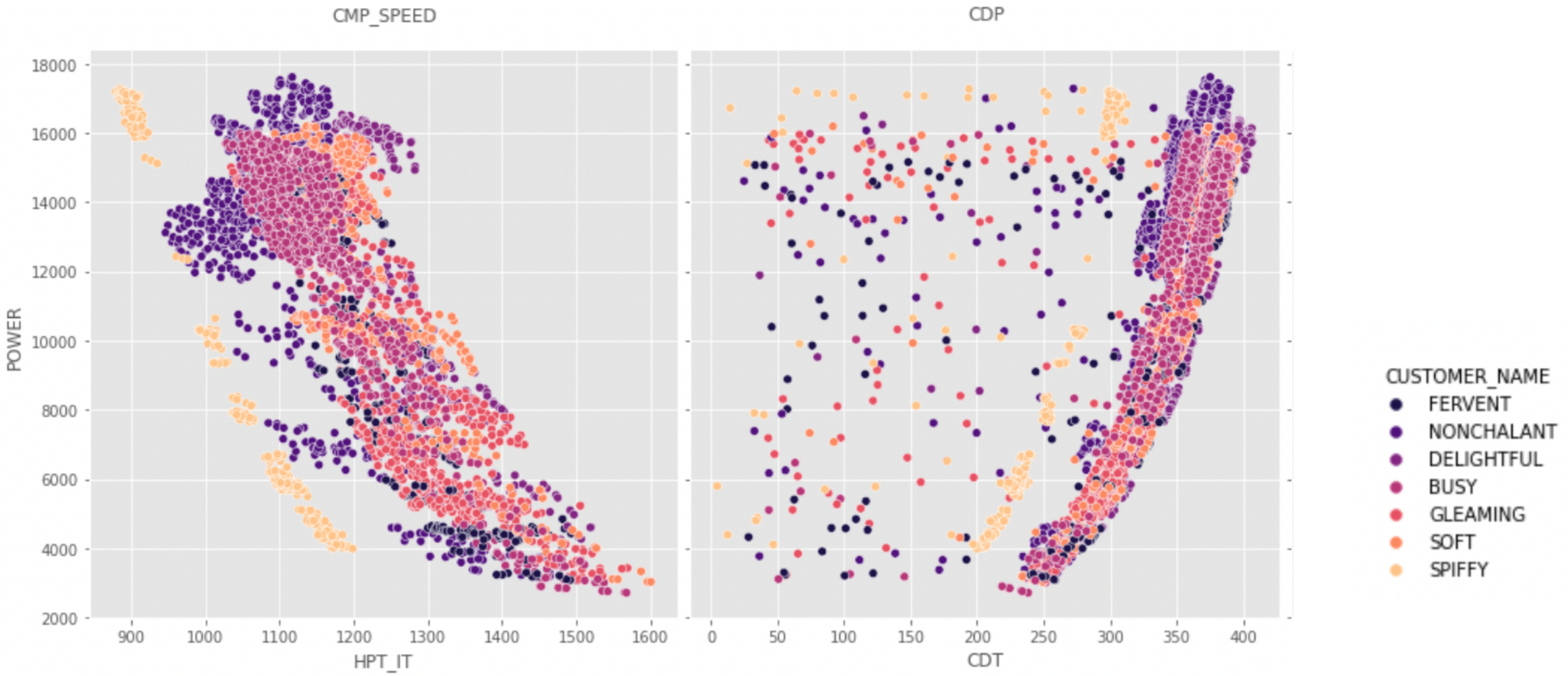


¿How the variables influence on POWER ? The **Correlation** is here to help.

T_AMB	-0.004338
P_AMB	0.155483
CMP_SPEED	0.758151
CDP	0.898743
GGDP	0.846911
HPT_IT	-0.746706
CDT	0.525526
LPT_IT	-0.863357
EXH_T	-0.903272
RH	0.017927
WAR	-0.049835
POWER	1.000000
LATITUDE	0.048687
LONGITUDE	0.034754
ELEVATION	-0.152488



The Correlation in graphs



Model Selection

1

ANN

2

Random Forest

Data Preprocessing

The variables used are :

- 'CMP_SPEED',
- 'CDP'
- 'GGDP'
- 'HPT_IT'
- 'CDT'
- 'LPT_IT'
- 'EXH_T'

Standardize the data:

- MinMaxScaler for Random Forest and ANN
- Normalization for ANN

Variable selection is based on EDA.

We use 'atypical values' and all the datas provided in the training

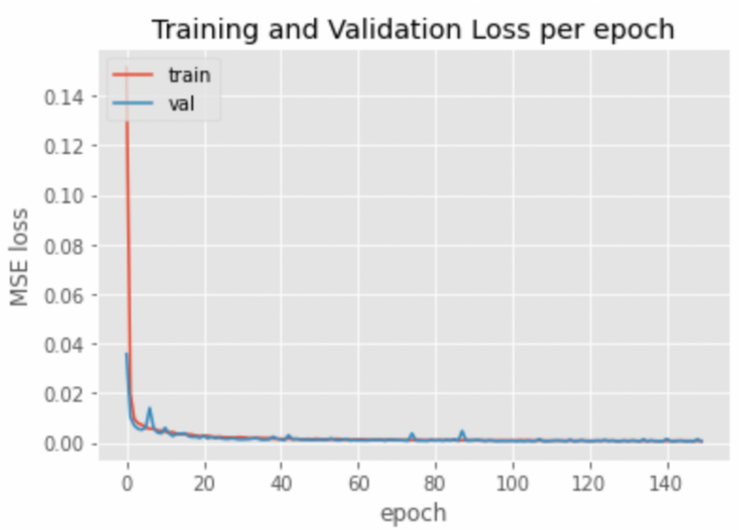
Don't use NaN for training because it gives better results in our models

ANN with pytorch

It is an Artificial Neural Network with :

- 3 linear layers .
- Sigmoid and ELU activation functions.
- SGD optimizer

Let's look how well is the training



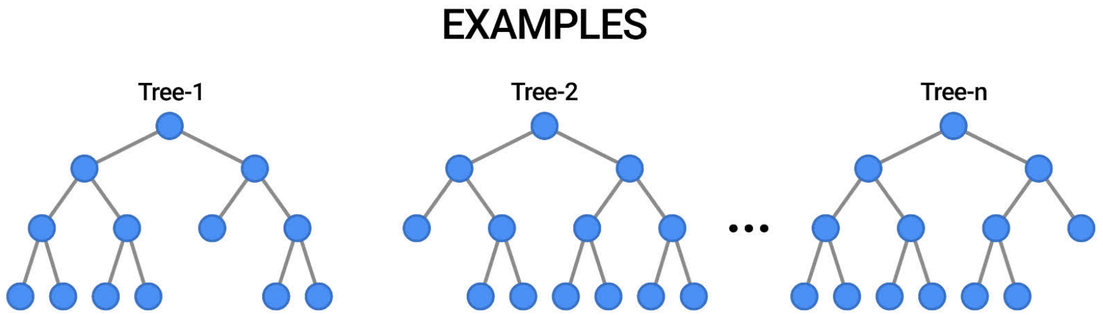
What about Kaggle Score ?

Best
Score: 1209.98

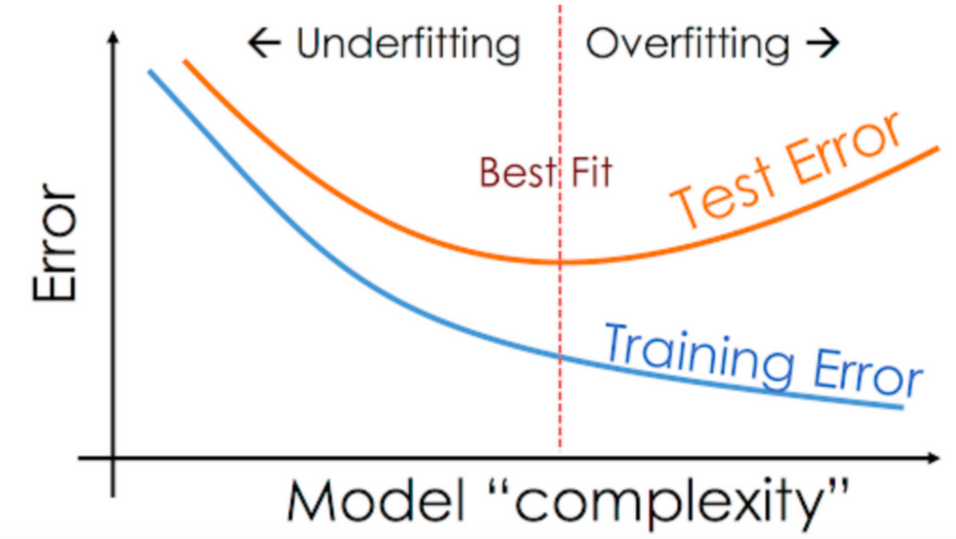
Worst
Score: 1561.72

Random Forest Regression

- High accuracy
- Scales well
- Interpretable
- Easy to use



Results



1

Base
RMSE: 328
Kaggle Score: 809.9

2

Best
RMSE: 341
Kaggle Score: 782.6

3

Compressor discharge pressure ↑
Exhaust temperature

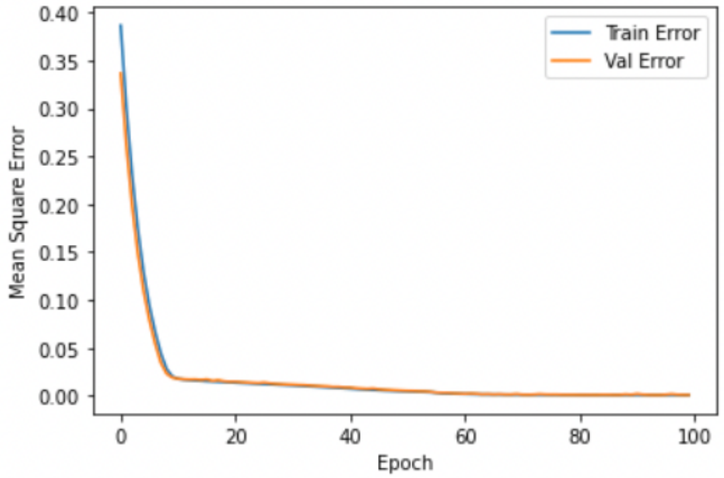
Compressor speed ↓
Gas generator discharge pressure

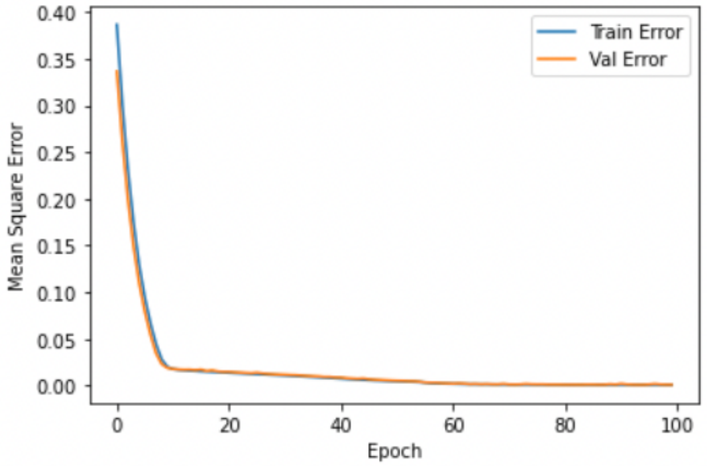
ANN with sklearn

It is an Artificial Neural Network with :

- 4 layers
- SGD optimizer

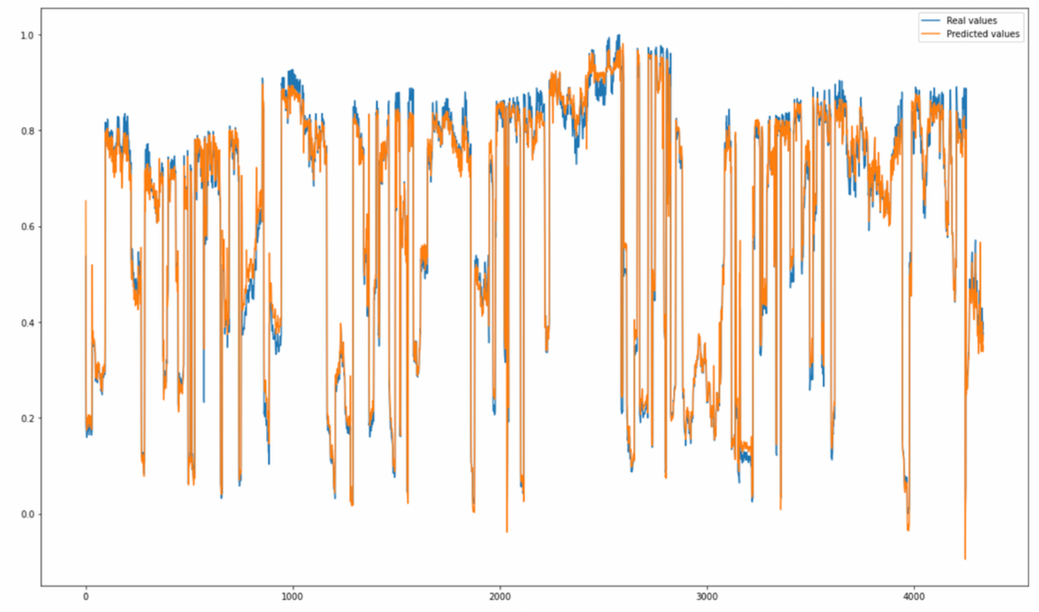
Let's look how well is the training





08

Real vs prediction in the training data



What about Kaggle scores?

Best

Score: **362.42**

Worst

Score: 1141.85

Average

Score: 847.85

What can we improve ?

Make better implementations

Look for different algorithms

and ..