Alpha Hack

KRAFTHACK

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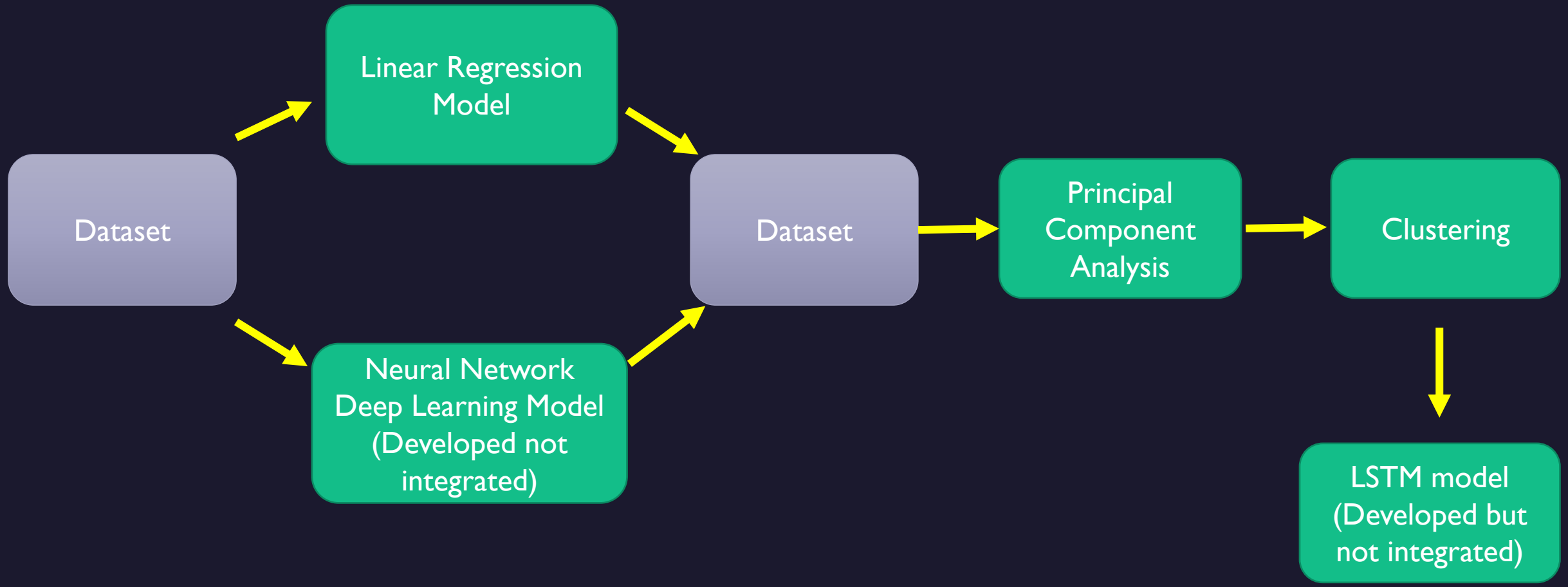
Initial findings

In the provided input_dataset-2 time series data; time gaps were observed. Linear Interpolation was performed to fill the missing data.

Developed Model



Linear Regression Model

Purpose

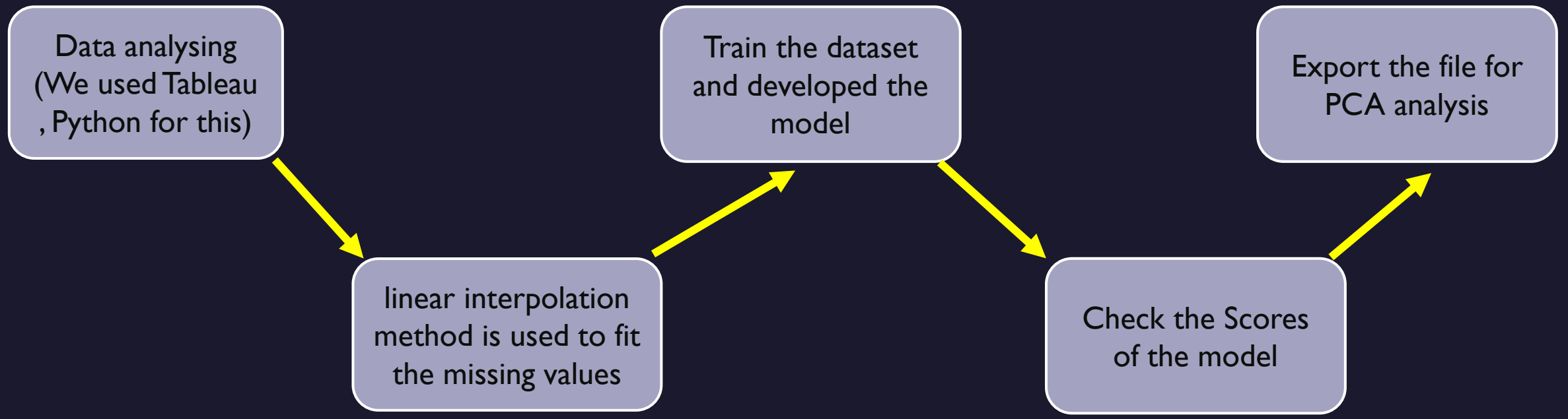
Predicting tensile values for given operating conditions (1-6) at operating conditions

Trained model and Results

In the developed model we used the linear regression method to train the data and generate the predicted outcomes. The file is taken in to CSV and the results are passed for the purpose PCA analysis

Linear Regression Model

Developed Path

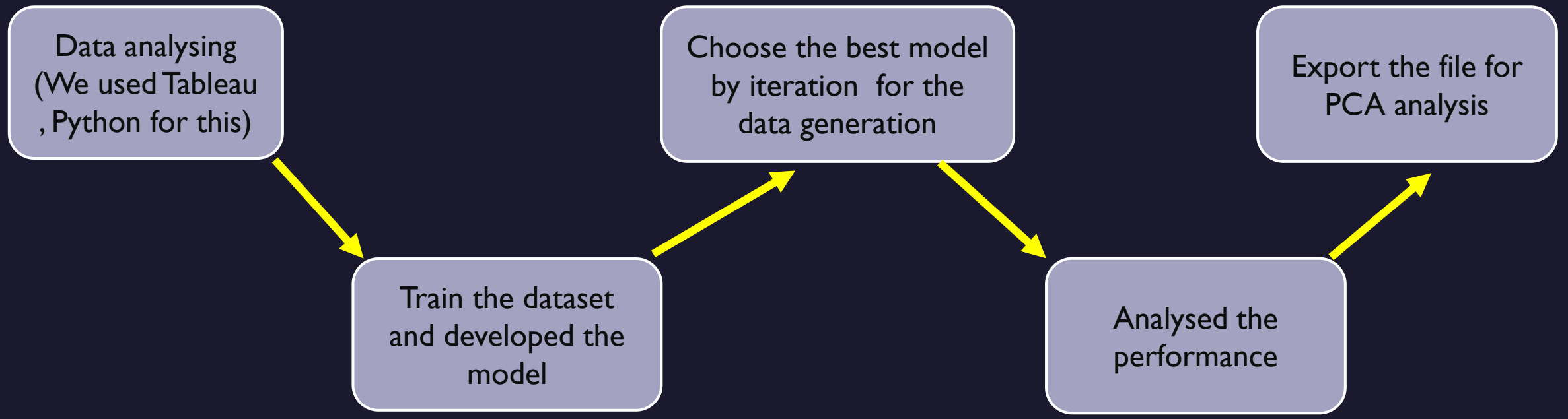


Result

	Bolt_1_Steel tmp	Bolt_1_Tensile	Bolt_2_Tensile	Bolt_3_Tensile
0	3.052472	1609.299170	1488.049187	1688.599455
1	3.052427	1609.298701	1488.049137	1688.599013
2	3.052375	1609.298107	1488.049109	1688.598498
3	3.052323	1609.297512	1488.049081	1688.597984
4	3.052276	1609.296864	1488.049104	1688.597485
5	3.052244	1609.296111	1488.049255	1688.597046
6	3.052271	1609.296435	1488.049219	1688.597229
7	3.052325	1609.297272	1488.049092	1688.597704
8	3.052379	1609.298109	1488.048964	1688.598180
9	3.052431	1609.298968	1488.048784	1688.598644
10	3.052476	1609.299858	1488.048474	1688.599068
11	3.052491	1609.299879	1488.048472	1688.599205
12	3.052489	1609.299466	1488.048628	1688.599201
13	3.052488	1609.299052	1488.048784	1688.599198
14	3.052485	1609.298652	1488.048985	1688.599201
15	3.052479	1609.298286	1488.049308	1688.599224
16	3.052473	1609.297922	1488.049637	1688.599247

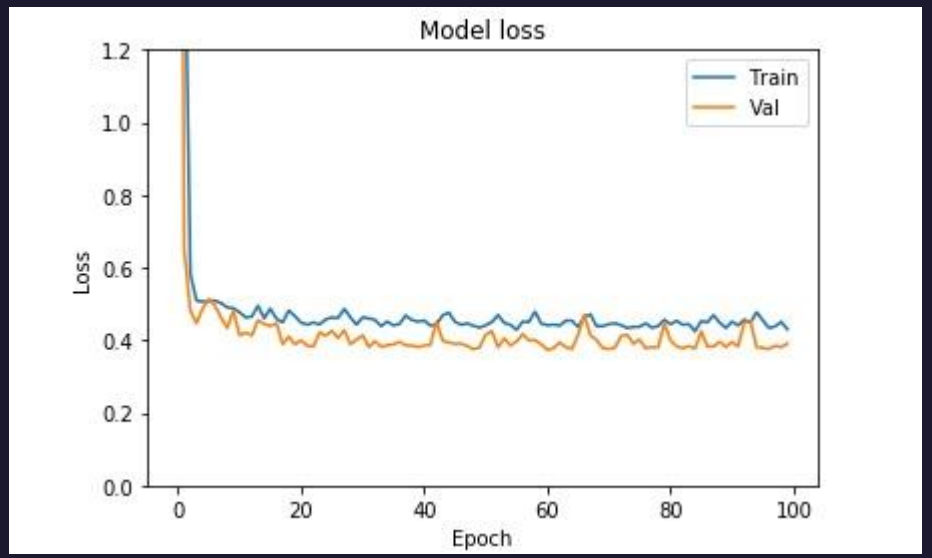
Neural Network Model – Deep learning

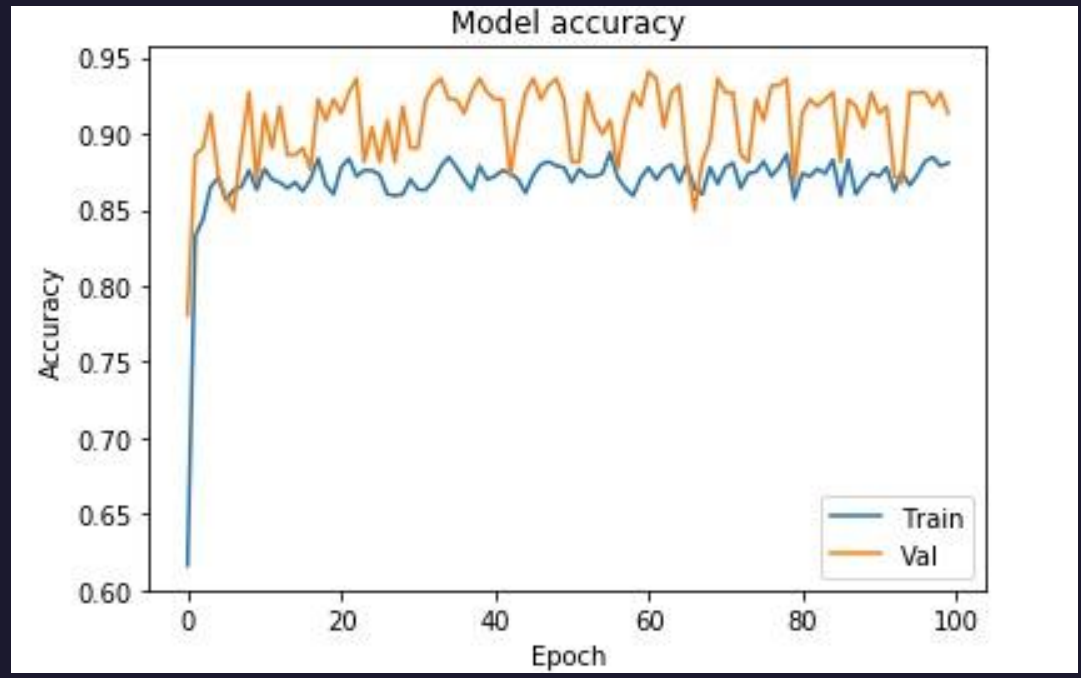
Developed Path



Result

```
          batch_size=32, epochs=100,
          validation_data=(X_val, Y_val))
Epoch 18/100
1022/1022 [==============================] - 2s - loss: 0.4495 - acc: 0.8836 - val_loss: 0.3892 - val_acc: 0.9224
Epoch 19/100
1022/1022 [==============================] - 2s - loss: 0.4818 - acc: 0.8659 - val_loss: 0.4099 - val_acc: 0.9087
Epoch 20/100
1022/1022 [==============================] - 2s - loss: 0.4661 - acc: 0.8601 - val_loss: 0.3892 - val_acc: 0.9224
Epoch 21/100
1022/1022 [==============================] - 2s - loss: 0.4482 - acc: 0.8777 - val_loss: 0.3997 - val_acc: 0.9132
Epoch 22/100
1022/1022 [==============================] - 2s - loss: 0.4430 - acc: 0.8836 - val_loss: 0.3850 - val_acc: 0.9269
Epoch 23/100
1022/1022 [==============================] - 2s - loss: 0.4489 - acc: 0.8718 - val_loss: 0.3824 - val_acc: 0.9361
Epoch 24/100
1022/1022 [==============================] - 2s - loss: 0.4435 - acc: 0.8757 - val_loss: 0.4219 - val_acc: 0.8813
Epoch 25/100
1022/1022 [==============================] - 2s - loss: 0.4572 - acc: 0.8757 - val_loss: 0.4125 - val_acc: 0.9041
Epoch 26/100
1022/1022 [==============================] - 2s - loss: 0.4626 - acc: 0.8728 - val_loss: 0.4261 - val_acc: 0.8813
Epoch 27/100
1022/1022 [==============================] - 2s - loss: 0.4611 - acc: 0.8601 - val_loss: 0.4061 - val_acc: 0.9087
```





PCA Analysis

Purpose

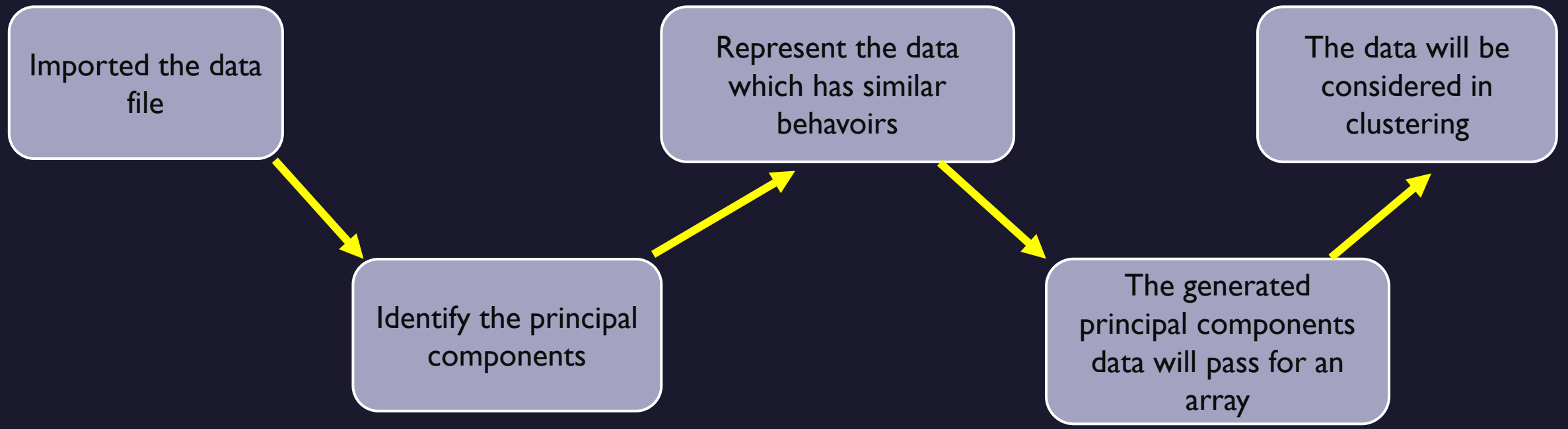
Reducing the multivariable data into 3 analysing dimension to get he behavioural patterns of the Turbine, sensors and power parameters

Trained model and Results

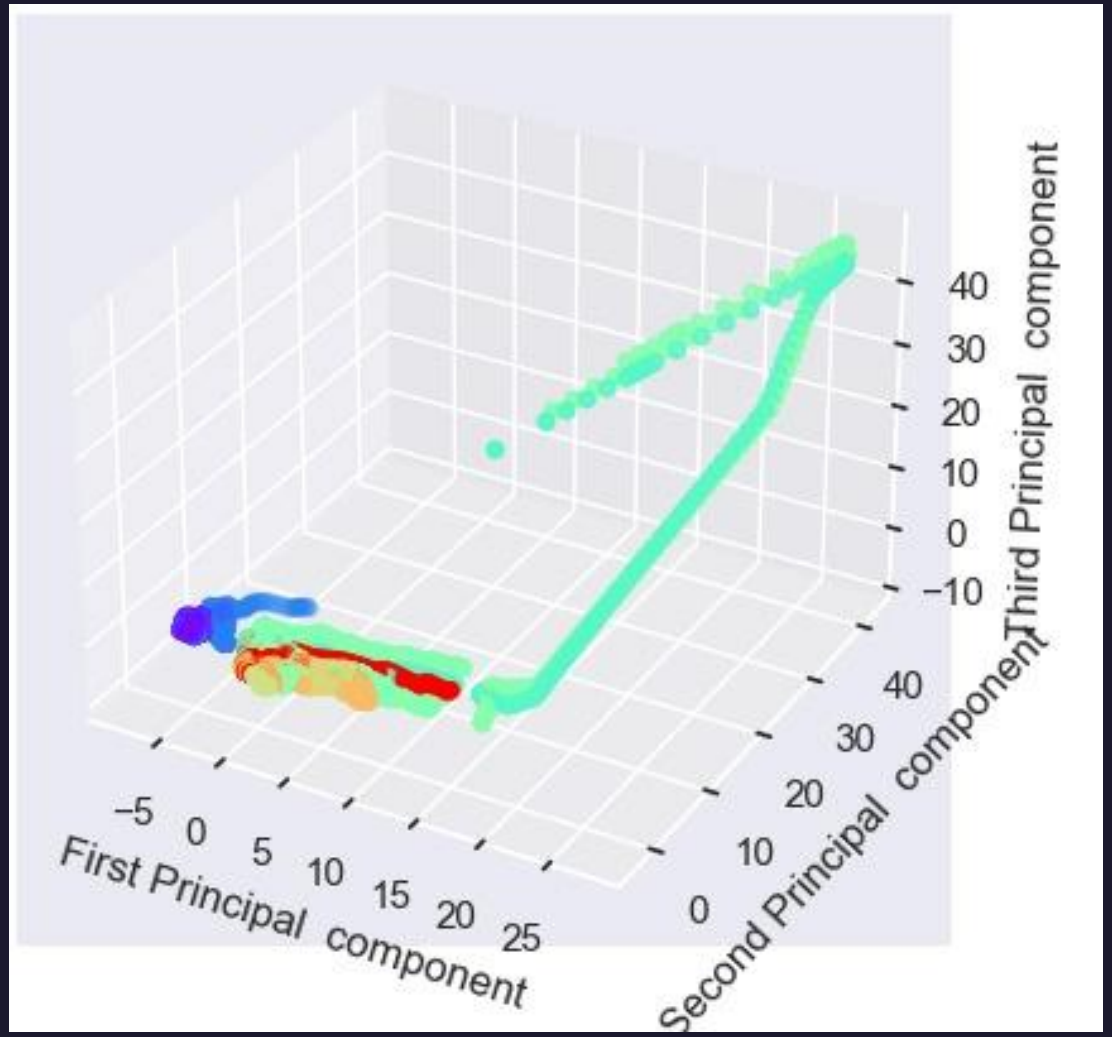
The sklearn.decomposition library has been used for the PCA analysis. For this the behavioural patten of the dataset is taken into consideration in many operating and starting conditions. This will give a overall understanding in the failures and misbehaviours of the whole operation.

PCA Analysis

Developed Path



Result


First Principal component
Second Principal component
Third Principal component
−5
0
5
10
15
20
25
0
10
20
30
40
−10
0
10
20
30
40

Clustering

Purpose

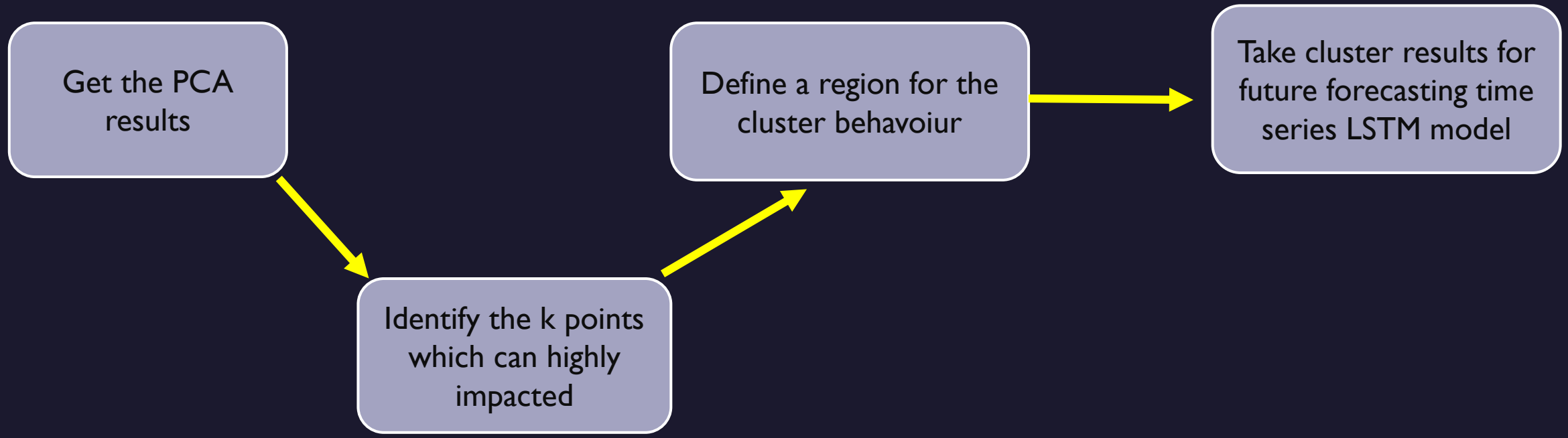
Identify the main data cluster centroids and analyse the whole operation behaviours of the plant

Trained model and Results

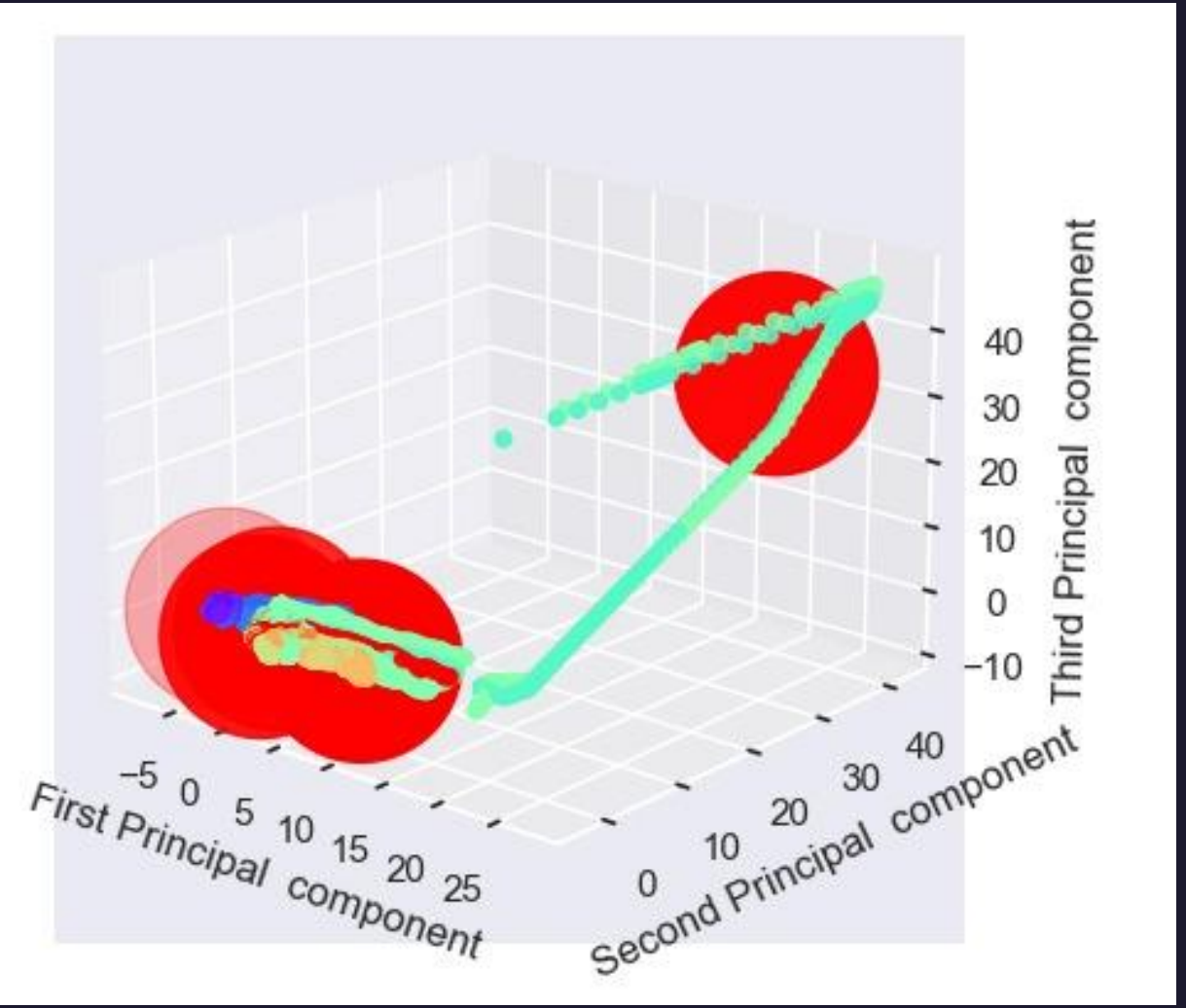
The k values of each cluster has been considered for analyzing the dataset. For each operation mode the cluster region has to be defined and identify the limits have to be considered. If there is a crack in turbine, vibrations, bolt tensile, torsion can be identified by the moving behaviour of the cluster K (centroid) points

Clustering

Developed Path



Result


Third Principal component
40
30
20
10
0
−10
−5
0
5
10
15
20
25
First Principal component
0
10
20
30
40
Second Principal component

LSTM model development

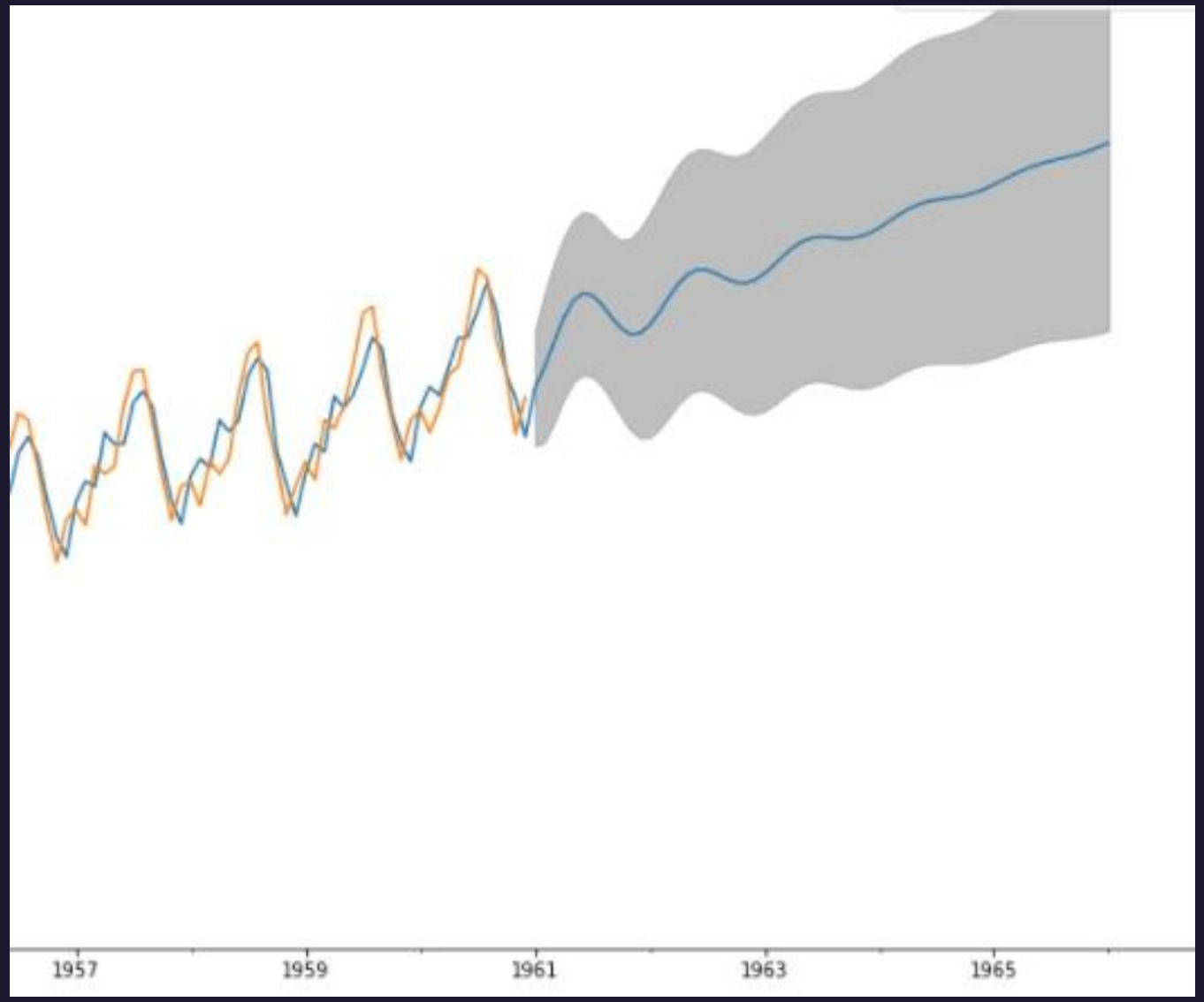
Purpose

Identify the misbehaviour of the dataset and future prediction to define the lifetime of the operation and maintenance

Trained model and Results

Get the forecasting of the developed model predictions. Therefore it can identify the future failures and misbehaviours also tensile values

Result



Scalability and transferability

These two Models can used in many similar aspects:

- **Wind turbine**
- **Jet Engine**
- **Power Plant Exhaust System etc.**

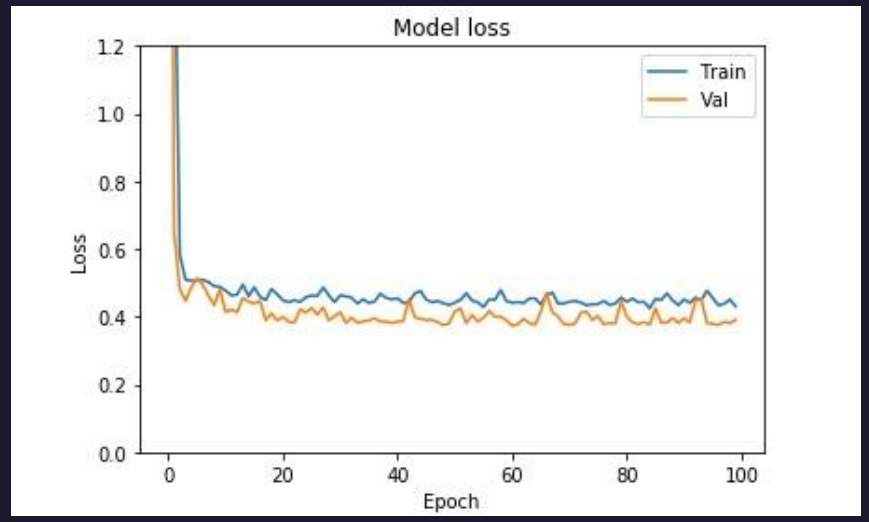
With some modifications, they can be used for finding tensions, tensile and temperature etc parameters of different components of a turbine.

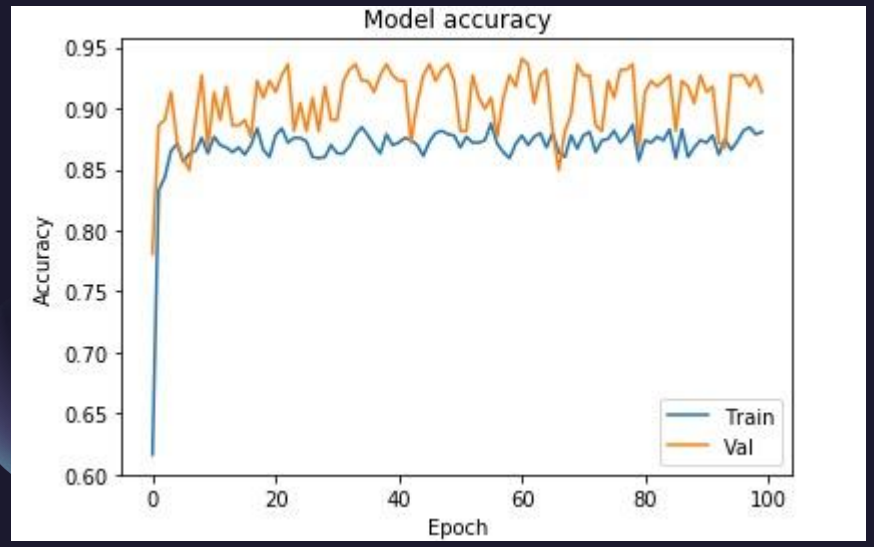
Code Availability and Understanding

The code has been made available in a GitHub repository: https://github.com/AbdurRahmaneee/Alpha_HACK-Hackaton2022.git

The code is written in an organized way. But it lacks the touch of comments due to time shortage while developing them.

Model Performance





Real-world Application

- The developed model can be put to real world by integrating and developing a dashboard. Currently we haven't developed the dashboard. But the graphs are generated and showed in the plot.

Thank You