Import neccessery libraries

In [25]:

```
from keras.models import Sequential
from scipy import stats
import numpy as np
import warnings
warnings.filterwarnings('ignore')
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.preprocessing import StandardScaler
import seaborn as sns
from datetime import datetime
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix
from keras.models import Sequential
from keras.layers import Dense,Flatten, Activation,Layer,Lambda
from keras.layers.normalization import batch_normalization_v1
import seaborn as sns
from sklearn import preprocessing
from keras.layers import Dropout
from keras import regularizers
from sklearn.model_selection import train_test_split
from matplotlib import pyplot as plt
from sklearn.decomposition import PCA
from mlxtend.plotting import plot_decision_regions
from tensorflow import keras
```

Problem

predicting turbine energy yield (TEY) using ambient variables as features.

Import data

In [2]:

```
turbine_data = pd.read_csv('turbines.csv')
turbine_data
```

Out[2]:

	AT	AP	AH	AFDP	GTEP	TIT	TAT	TEY	CDP	CO	NOX
0	6.8594	1007.9	96.799	3.5000	19.663	1059.2	550.00	114.70	10.605	3.1547	82.722
1	6.7850	1008.4	97.118	3.4998	19.728	1059.3	550.00	114.72	10.598	3.2363	82.776
2	6.8977	1008.8	95.939	3.4824	19.779	1059.4	549.87	114.71	10.601	3.2012	82.468
3	7.0569	1009.2	95.249	3.4805	19.792	1059.6	549.99	114.72	10.606	3.1923	82.670
4	7.3978	1009.7	95.150	3.4976	19.765	1059.7	549.98	114.72	10.612	3.2484	82.311
...	...	...	...	...	...	...	...	...	...	...	...
1334	14.4370	1015.1	65.684	4.6007	24.389	1085.3	550.00	132.73	11.930	1.3280	75.591
1335	13.3520	1014.8	69.204	4.6293	24.733	1087.2	549.91	134.53	12.033	1.0722	76.679
1336	12.5340	1014.5	71.264	4.4290	23.485	1078.9	549.43	128.98	11.531	1.4281	80.377
1337	11.0070	1014.2	75.717	3.8417	19.570	1047.7	544.29	111.22	10.472	3.2378	79.306
1338	10.8940	1013.5	76.652	3.8635	19.635	1045.2	542.60	110.15	10.480	5.2465	86.022

1339 rows × 11 columns

In [94]:
```
df1=turbine_data.copy()
```

In [95]:
```
df1.head()
```

Out[95]:

	AT	AP	AH	AFDP	GTEP	TIT	TAT	TEY	CDP	CO	NOX
0	6.8594	1007.9	96.799	3.5000	19.663	1059.2	550.00	114.70	10.605	3.1547	82.722
1	6.7850	1008.4	97.118	3.4998	19.728	1059.3	550.00	114.72	10.598	3.2363	82.776
2	6.8977	1008.8	95.939	3.4824	19.779	1059.4	549.87	114.71	10.601	3.2012	82.468
3	7.0569	1009.2	95.249	3.4805	19.792	1059.6	549.99	114.72	10.606	3.1923	82.670
4	7.3978	1009.7	95.150	3.4976	19.765	1059.7	549.98	114.72	10.612	3.2484	82.311

Data understanding

In [96]:
```
df1.shape
```

Out[96]:
```
(1339, 11)
```

In [97]:
```
df1.dtypes
```

Out[97]:
```
AT      float64
AP      float64
AH      float64
AFDP    float64
GTEP    float64
TIT     float64
TAT     float64
TEY     float64
CDP     float64
CO      float64
NOX     float64
dtype: object
```

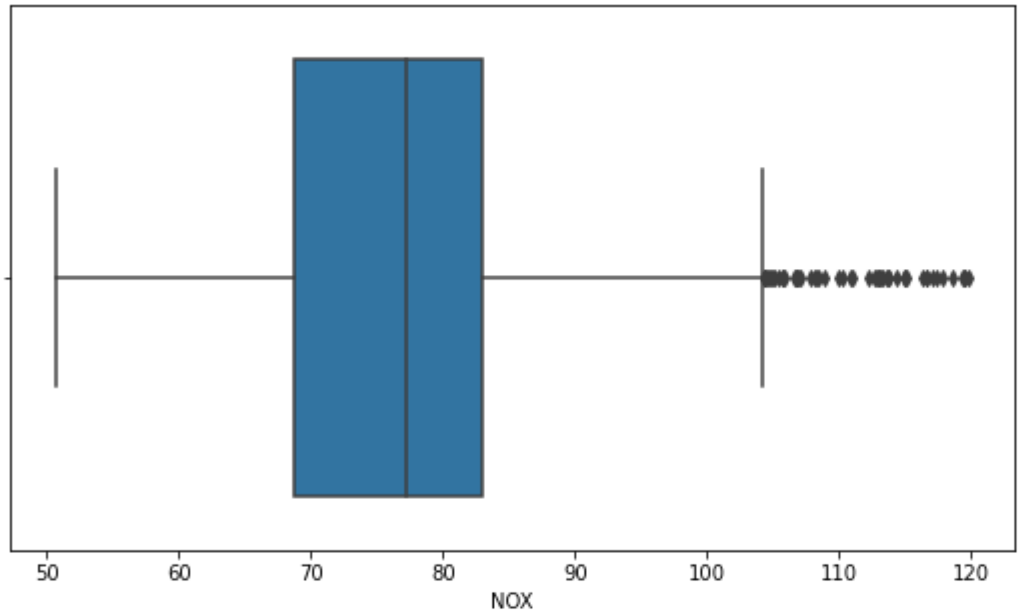
In [98]:
```
df1.isna().sum()
```

Out[98]:
```
AT      0
AP      0
AH      0
AFDP    0
GTEP    0
TIT     0
TAT     0
TEY     0
CDP     0
CO      0
NOX     0
dtype: int64
```

Outlier Check

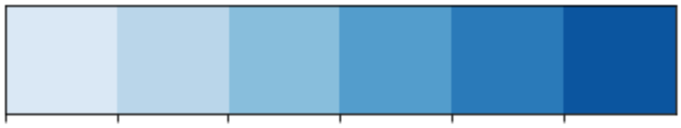
In [99]:

```
ax = sns.boxplot(df1['NOX'])
```



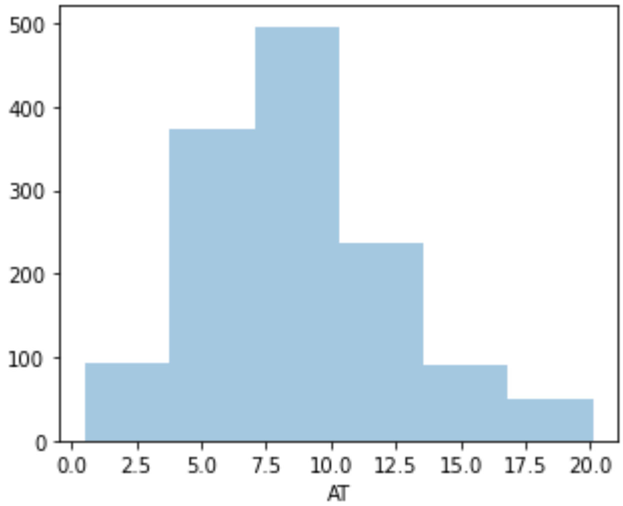
In [100…

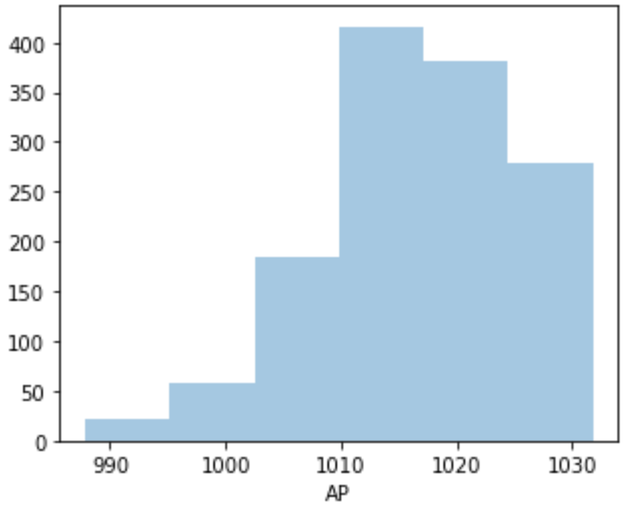
```
A = sns.palplot(sns.color_palette("Blues"))
```

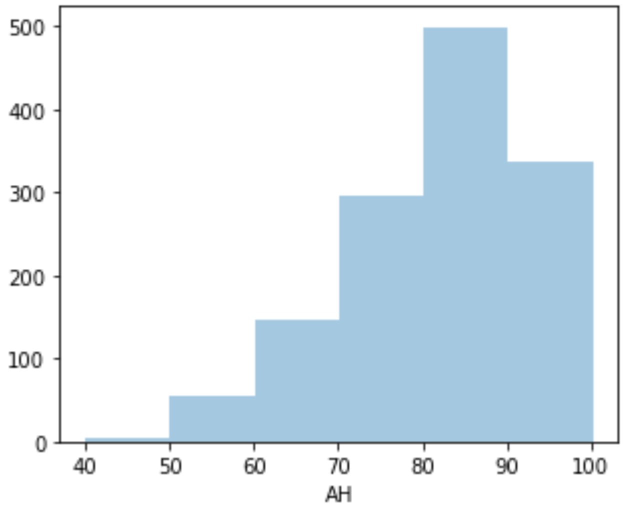


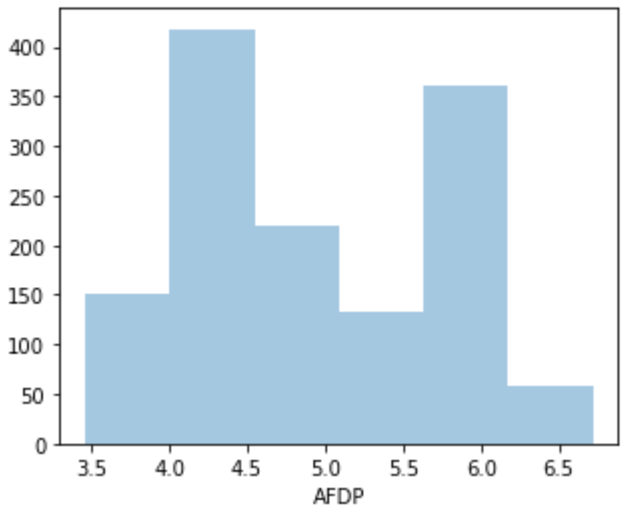
In [101…

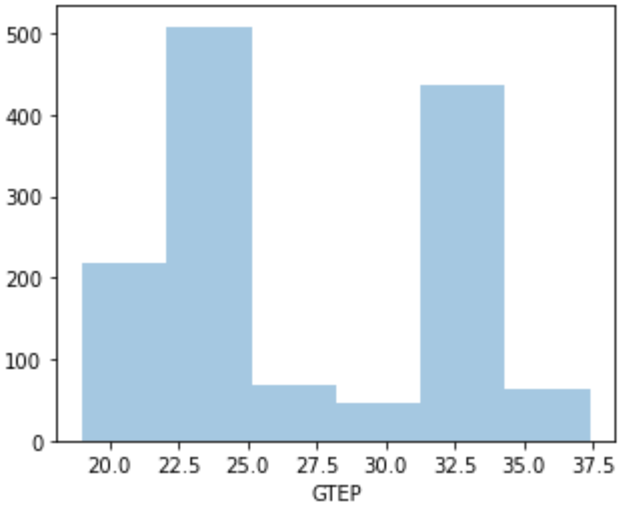
```
for column in turbine_data.columns[0:]:
    plt.figure(figsize=(5, 4))
    plt.ticklabel_format(style='plain', axis='y')
    sns.distplot(df1[column], color = A, kde=False, bins=6, hist_kws={'alph
```

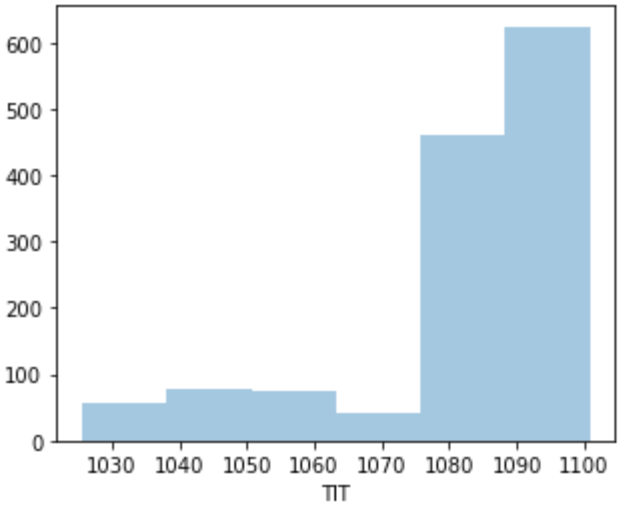


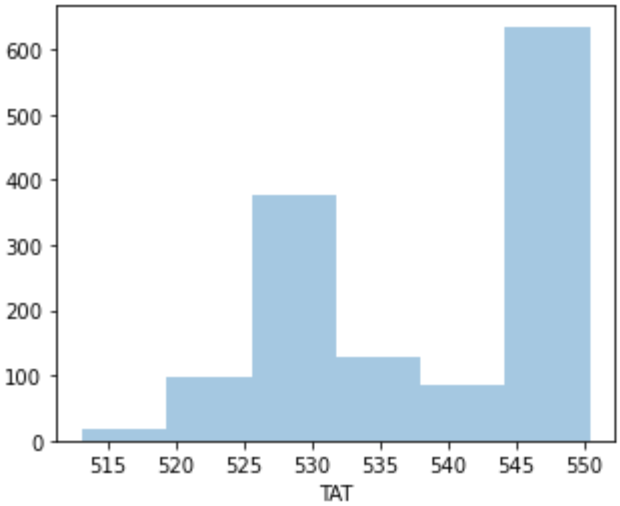

0
50
100
150
200
250
300
350
400
990
1000
1010
1020
1030
AP

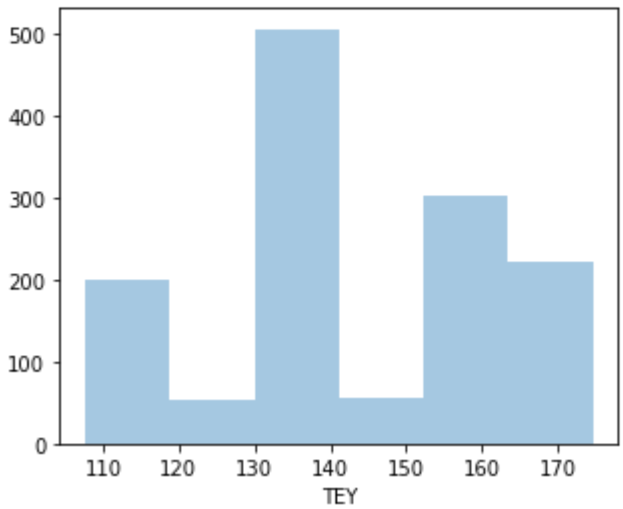

0
100
200
300
400
500
40
50
60
70
80
90
100
AH

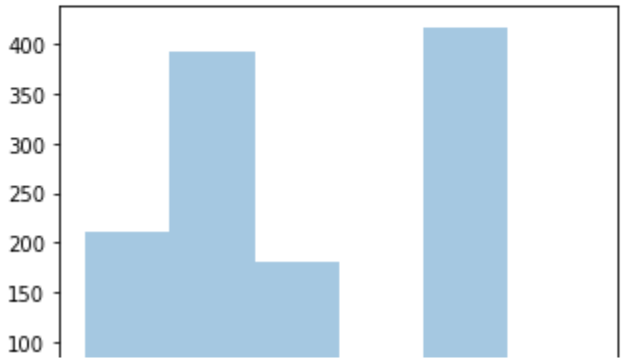

0
50
100
150
200
250
300
350
400
3.5
4.0
4.5
5.0
5.5
6.0
6.5
AFDP


500
400
300
200
100
0
20.0
22.5
25.0
27.5
30.0
32.5
35.0
37.5
GTEP


600
500
400
300
200
100
0
1030
1040
1050
1060
1070
1080
1090
1100
TIT


600
500
400
300
200
100
0
515
520
525
530
535
540
545
550
TAT





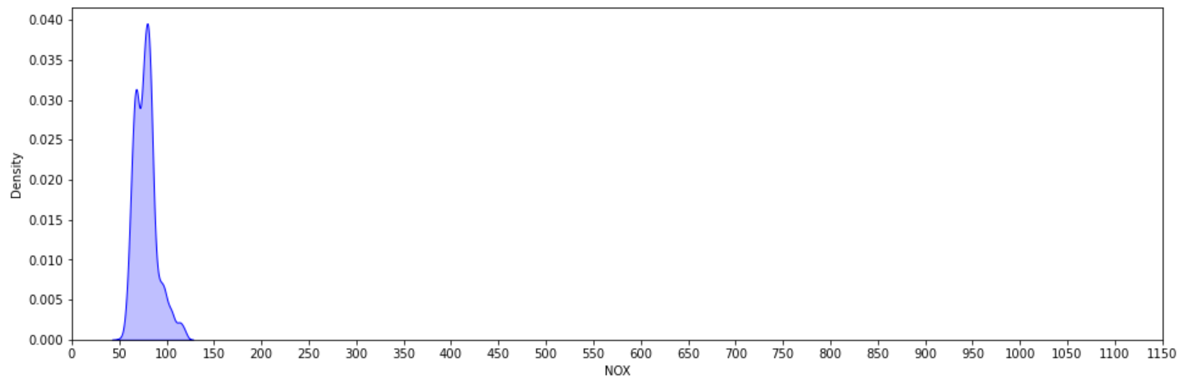
In [9]:

```
plt.rcParams["figure.figsize"] = 9,5
```

In [102…

```
plt.figure(figsize=(16,5))
print("Skew: {}".format(df1['NOX'].skew()))
print("Kurtosis: {}".format(df1['NOX'].kurtosis()))
ax = sns.kdeplot(df1['NOX'],shade=True,color='b')
plt.xticks([i for i in range(0,1200,50)])
plt.show()
```

```
Skew: 0.9425348708035359
Kurtosis: 1.169825110704103
```



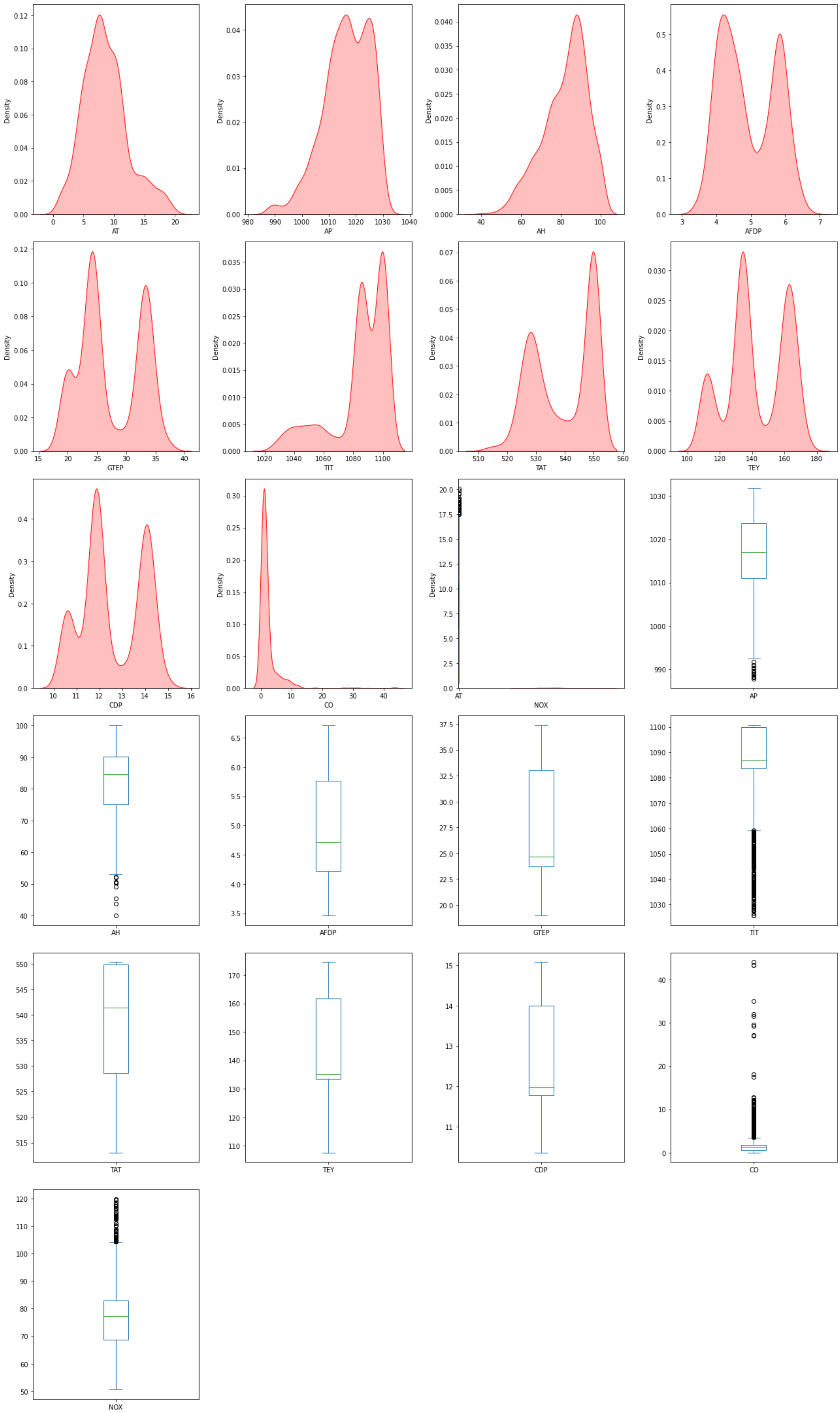
The Data is highly skewed and has large kurtosis value.

In [103…

```
num_columns = df1.select_dtypes(exclude='object').columns.tolist()
```

In [104…

```
plt.figure(figsize=(18,40))
for i,col in enumerate(num_columns,1):
    plt.subplot(8,4,i)
    sns.kdeplot(df1[col],color='r',shade=True)
    plt.subplot(8,4,i+10)
    df1[col].plot.box()
plt.tight_layout()
plt.show()
num_data = df1[num_columns]
pd.DataFrame(data=[num_data.skew(),num_data.kurtosis()],index=['skewness',
```



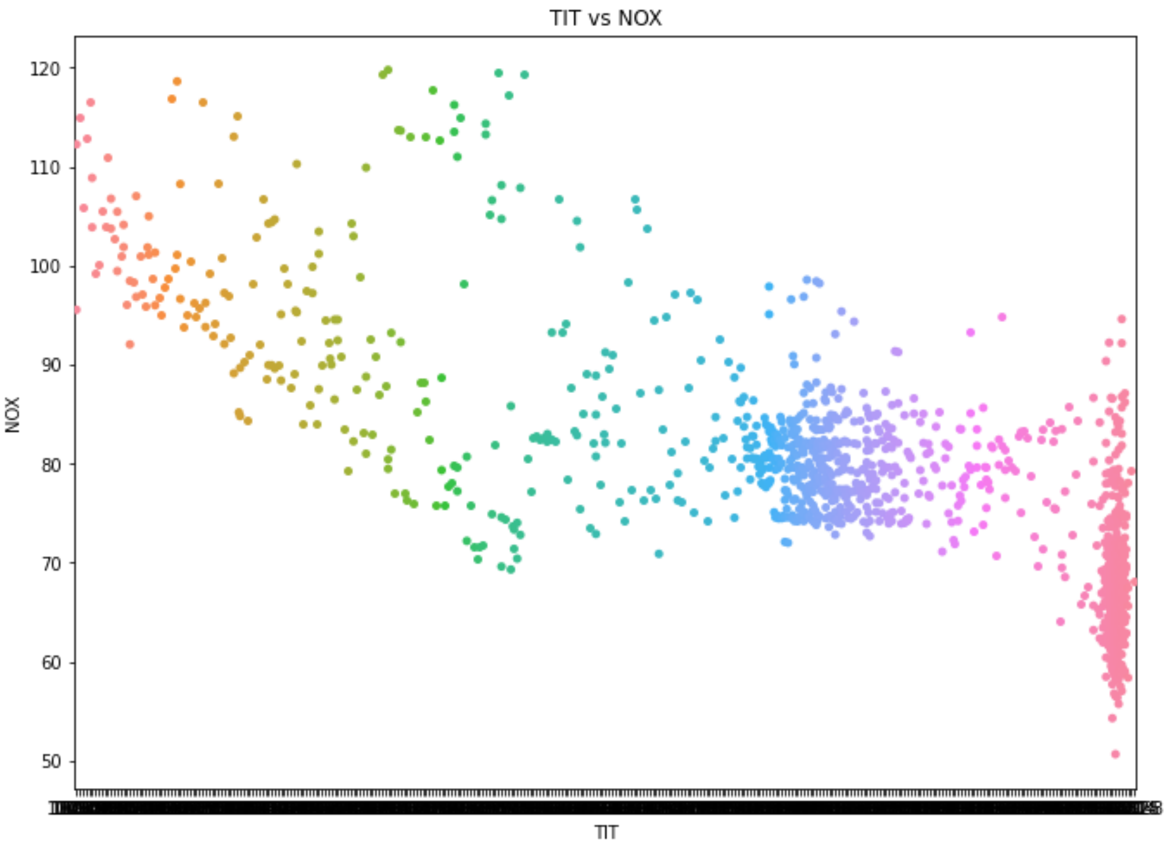
Out[104…

	AT	AP	AH	AFDP	GTEP	TIT	TAT	TEY

	AT	AP	AH	AFDP	GTEP	TIT	TAT	TEY
skewness	0.630017	-0.647498	-0.659149	0.204136	0.173703	-1.430709	-0.279163	-0.137519

In [156…

```
plt.figure(figsize=(11,8))
plt.title('TIT vs NOX')
sns.swarmplot(x ='TIT',y='NOX',data = df1,size = 5)
plt.show()
```



correlation

In [105…

```
corr = df1[turbine_data.columns[0:11]].corr()
```

In [106…

```
plt.figure(figsize=(10,10))
sns.heatmap(corr,annot=True)
```

Out[106…

```
<AxesSubplot:>
```

Neural Network Model

In [107…

```
df1.columns
```

Out[107…

```
Index(['AT', 'AP', 'AH', 'AFDP', 'GTEP', 'TIT', 'TAT', 'TEY', 'CDP', 'CO',
       'NOX'],
      dtype='object')
```

In [114…

```
dataset = df1.values
```

In [115…

```
dataset
```

Out[115…

```
array([[   6.8594, 1007.9   ,   96.799 , ...,   10.605 ,    3.1547,
          82.722 ],
       [   6.785 , 1008.4   ,   97.118 , ...,   10.598 ,    3.2363,
          82.776 ],
       [   6.8977, 1008.8   ,   95.939 , ...,   10.601 ,    3.2012,
          82.468 ],
       ...,
       [  12.534 , 1014.5   ,   71.264 , ...,   11.531 ,    1.4281,
          80.377 ],
       [  11.007 , 1014.2   ,   75.717 , ...,   10.472 ,    3.2378,
          79.306 ],
       [  10.894 , 1013.5   ,   76.652 , ...,   10.48  ,    5.2465,
          86.022 ]])
```

In [116…

```
min_max_scaler = preprocessing.MinMaxScaler()
X_scale = min_max_scaler.fit_transform(X)
```

In [117…

```
X_scale
```

Out[117…

```
array([[0.32383858, 0.45632393, 0.94382695, ..., 0.1058209 , 0.05249788,
        0.07118405],
       [0.32003659, 0.46769791, 0.94912692, ..., 0.1061194 , 0.05101609,
```

```
        0.07303496],
       [0.32579579, 0.47679709, 0.92953862, ..., 0.10597015, 0.05165114,
        0.0722388 ],
       ...,
       [0.61382207, 0.60646042, 0.51957999, ..., 0.31895522, 0.2485182 ,
        0.03202019],
       [0.5357893 , 0.59963603, 0.59356361, ..., 0.0538806 , 0.02434378,
        0.07306898],
       [0.53001477, 0.58371247, 0.60909801, ..., 0.03791045, 0.02603726,
```

In [139…

```
X_train, X_val_and_test, Y_train, Y_val_and_test = train_test_split(X_scale
```

In [140…

```
X_val, X_test, Y_val, Y_test = train_test_split(X_val_and_test, Y_val_and_t
print(X_train.shape, X_val.shape, X_test.shape, Y_train.shape, Y_val.shape,
```

```
(937, 10) (201, 10) (201, 10) (937,) (201,) (201,)
```

In [141…

```
model = Sequential([
    Dense(32, activation='relu', input_shape=(10,)),
    Dense(32, activation='relu'),
    Dense(1, activation='sigmoid'),
])
```

In [121…

```
model.compile(optimizer='sgd',
              loss='binary_crossentropy',
              metrics=['accuracy'])
```

In [122…

```
hist = model.fit(X_train, Y_train,
          batch_size=32, epochs=100,
          validation_data=(X_val, Y_val))
```

```
Epoch 1/100
30/30 [==============================] - 0s 4ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 2/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 3/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 4/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 5/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 6/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 7/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 8/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 9/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
```

```
Epoch 10/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 11/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 12/100
30/30 [==============================] - 0s 953us/step - loss: nan - accura
cy: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 13/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 14/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 15/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 16/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 17/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 18/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 19/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 20/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 21/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 22/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 23/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 24/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 25/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 26/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 27/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 28/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 29/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 30/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
```

```
Epoch 31/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 32/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 33/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 34/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 35/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 36/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 37/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 38/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 39/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 40/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 41/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 42/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 43/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 44/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 45/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 46/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 47/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 48/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 49/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 50/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 51/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
```

```
Epoch 52/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 53/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 54/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 55/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 56/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 57/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 58/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 59/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 60/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 61/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 62/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 63/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 64/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 65/100
30/30 [==============================] - 0s 867us/step - loss: nan - accura
cy: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 66/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 67/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 68/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 69/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 70/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 71/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 72/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
```

```
Epoch 73/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 74/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 75/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 76/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 77/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 78/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 79/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 80/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 81/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 82/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 83/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 84/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 85/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 86/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 87/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 88/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 89/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 90/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 91/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 92/100
30/30 [==============================] - 0s 953us/step - loss: nan - accura
cy: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 93/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
```

```
Epoch 94/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 95/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 96/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 97/100
30/30 [==============================] - 0s 2ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 98/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 99/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
y: 0.0000e+00 - val_loss: nan - val_accuracy: 0.0000e+00
Epoch 100/100
30/30 [==============================] - 0s 1ms/step - loss: nan - accurac
```

In [123…

```
model.evaluate(X_test, Y_test)[1]
```

```
7/7 [==============================] - 0s 0s/step - loss: nan - accuracy:
0.0000e+00
```

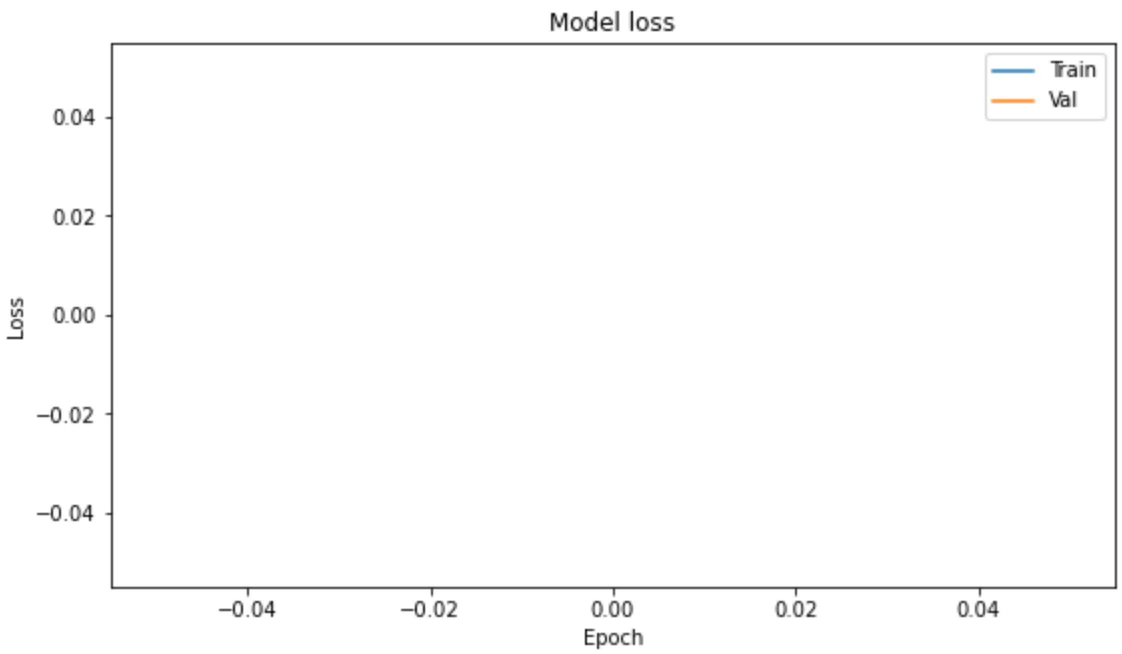
Out[123…

```
0.0
```

Visualizing Loss and Accuracy

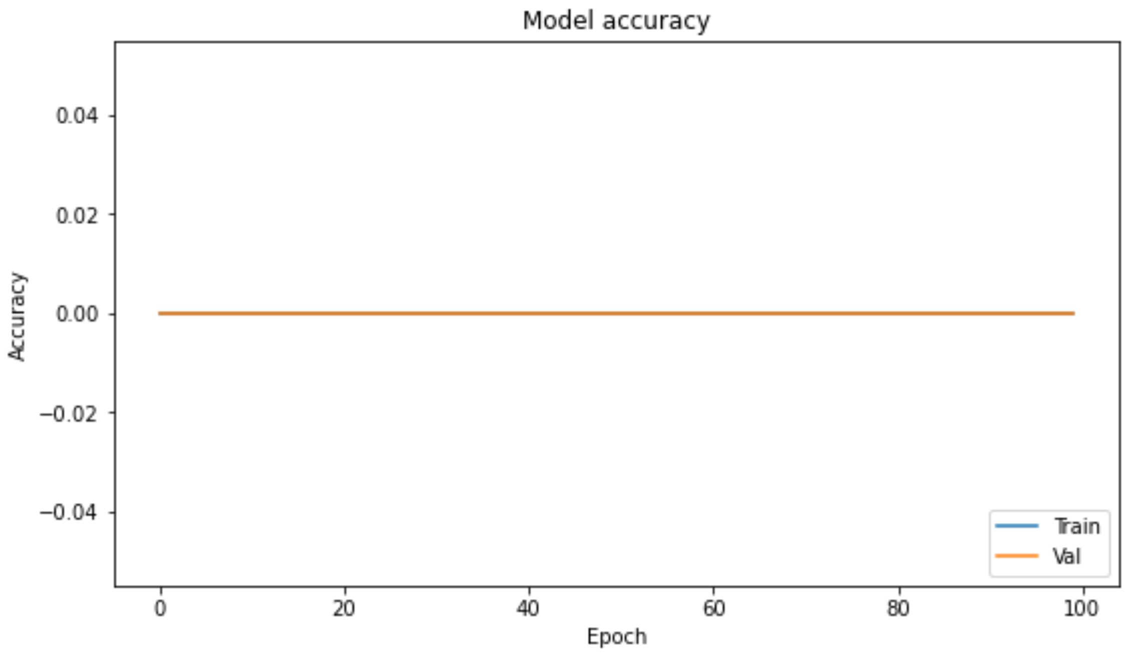
In [124…

```
plt.plot(hist.history['loss'])
plt.plot(hist.history['val_loss'])
plt.title('Model loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Train', 'Val'], loc='upper right')
plt.show()
```



In [125…

```
plt.plot(hist.history['accuracy'])
plt.plot(hist.history['val_accuracy'])
plt.title('Model accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train', 'Val'], loc='lower right')
plt.show()
```



Adding Regularization to our Neural Network

In [126…

```
model_2 = Sequential([
    Dense(1000, activation='relu', input_shape=(10,)),
    Dense(1000, activation='relu'),
    Dense(1000, activation='relu'),
    Dense(1000, activation='relu'),
    Dense(1, activation='sigmoid'),
])

model_2.compile(optimizer='adam',
              loss='binary_crossentropy',
              metrics=['accuracy'])

hist_2 = model_2.fit(X_train, Y_train,
          batch_size=32, epochs=100,
          validation_data=(X_val, Y_val))
```

```
Epoch 1/100
30/30 [==============================] - 1s 24ms/step - loss: -294721.4062
- accuracy: 0.0000e+00 - val_loss: -2317941.7500 - val_accuracy: 0.0000e+00
Epoch 2/100
30/30 [==============================] - 1s 23ms/step - loss: -35800740.000
0 - accuracy: 0.0000e+00 - val_loss: -150233904.0000 - val_accuracy: 0.0000
e+00
Epoch 3/100
30/30 [==============================] - 1s 25ms/step - loss: -753909760.00
00 - accuracy: 0.0000e+00 - val_loss: -2201394432.0000 - val_accuracy: 0.00
00e+00
Epoch 4/100
```

```
30/30 [==============================] - 1s 23ms/step - loss: -6600784896.0
000 - accuracy: 0.0000e+00 - val_loss: -15202729984.0000 - val_accuracy: 0.
0000e+00
Epoch 5/100
30/30 [==============================] - 1s 25ms/step - loss: -34207166464.
0000 - accuracy: 0.0000e+00 - val_loss: -67042340864.0000 - val_accuracy:
0.0000e+00
Epoch 6/100
30/30 [==============================] - 1s 24ms/step - loss: -12613135564
8.0000 - accuracy: 0.0000e+00 - val_loss: -220411002880.0000 - val_accurac
y: 0.0000e+00
Epoch 7/100
30/30 [==============================] - 1s 24ms/step - loss: -36824121344
0.0000 - accuracy: 0.0000e+00 - val_loss: -590872444928.0000 - val_accurac
y: 0.0000e+00
Epoch 8/100
30/30 [==============================] - 1s 22ms/step - loss: -90678801203
2.0000 - accuracy: 0.0000e+00 - val_loss: -1365430894592.0000 - val_accurac
y: 0.0000e+00
Epoch 9/100
30/30 [==============================] - 1s 21ms/step - loss: -196847245721
6.0000 - accuracy: 0.0000e+00 - val_loss: -2818406350848.0000 - val_accurac
y: 0.0000e+00
Epoch 10/100
30/30 [==============================] - 1s 22ms/step - loss: -386949709824
0.0000 - accuracy: 0.0000e+00 - val_loss: -5323555864576.0000 - val_accurac
y: 0.0000e+00
Epoch 11/100
30/30 [==============================] - 1s 22ms/step - loss: -703962546176
0.0000 - accuracy: 0.0000e+00 - val_loss: -9379433676800.0000 - val_accurac
y: 0.0000e+00
Epoch 12/100
30/30 [==============================] - 1s 22ms/step - loss: -120378926039
04.0000 - accuracy: 0.0000e+00 - val_loss: -15601166712832.0000 - val_accur
acy: 0.0000e+00
Epoch 13/100
30/30 [==============================] - 1s 22ms/step - loss: -195392700416
00.0000 - accuracy: 0.0000e+00 - val_loss: -24780193398784.0000 - val_accur
acy: 0.0000e+00
Epoch 14/100
30/30 [==============================] - 1s 22ms/step - loss: -303753152430
08.0000 - accuracy: 0.0000e+00 - val_loss: -37769011265536.0000 - val_accur
acy: 0.0000e+00
Epoch 15/100
30/30 [==============================] - 1s 22ms/step - loss: -455231049564
16.0000 - accuracy: 0.0000e+00 - val_loss: -55696770990080.0000 - val_accur
acy: 0.0000e+00
Epoch 16/100
30/30 [==============================] - 1s 23ms/step - loss: -661059220275
20.0000 - accuracy: 0.0000e+00 - val_loss: -79749372182528.0000 - val_accur
acy: 0.0000e+00
Epoch 17/100
30/30 [==============================] - 1s 22ms/step - loss: -934053381406
72.0000 - accuracy: 0.0000e+00 - val_loss: -111288214618112.0000 - val_accu
racy: 0.0000e+00
Epoch 18/100
30/30 [==============================] - 1s 23ms/step - loss: -128898746548
224.0000 - accuracy: 0.0000e+00 - val_loss: -151915191074816.0000 - val_acc
uracy: 0.0000e+00
Epoch 19/100
30/30 [==============================] - 1s 22ms/step - loss: -174283816960
000.0000 - accuracy: 0.0000e+00 - val_loss: -203289576603648.0000 - val_acc
uracy: 0.0000e+00
```

```
Epoch 20/100
30/30 [==============================] - 1s 22ms/step - loss: -231256289705
984.0000 - accuracy: 0.0000e+00 - val_loss: -267588491804672.0000 - val_acc
uracy: 0.0000e+00
Epoch 21/100
30/30 [==============================] - 1s 23ms/step - loss: -301944153309
184.0000 - accuracy: 0.0000e+00 - val_loss: -346491587657728.0000 - val_acc
uracy: 0.0000e+00
Epoch 22/100
30/30 [==============================] - 1s 22ms/step - loss: -388292692410
368.0000 - accuracy: 0.0000e+00 - val_loss: -442610606931968.0000 - val_acc
uracy: 0.0000e+00
Epoch 23/100
30/30 [==============================] - 1s 22ms/step - loss: -492965877252
096.0000 - accuracy: 0.0000e+00 - val_loss: -558215624392704.0000 - val_acc
uracy: 0.0000e+00
Epoch 24/100
30/30 [==============================] - 1s 23ms/step - loss: -618010091978
752.0000 - accuracy: 0.0000e+00 - val_loss: -695941132713984.0000 - val_acc
uracy: 0.0000e+00
Epoch 25/100
30/30 [==============================] - 1s 23ms/step - loss: -766476977963
008.0000 - accuracy: 0.0000e+00 - val_loss: -858514704564224.0000 - val_acc
uracy: 0.0000e+00
Epoch 26/100
30/30 [==============================] - 1s 23ms/step - loss: -941129004482
560.0000 - accuracy: 0.0000e+00 - val_loss: -1049328223256576.0000 - val_ac
curacy: 0.0000e+00
Epoch 27/100
30/30 [==============================] - 1s 22ms/step - loss: -114500821634
2528.0000 - accuracy: 0.0000e+00 - val_loss: -1270932630929408.0000 - val_a
ccuracy: 0.0000e+00
Epoch 28/100
30/30 [==============================] - 1s 21ms/step - loss: -138161366971
1872.0000 - accuracy: 0.0000e+00 - val_loss: -1527369827352576.0000 - val_a
ccuracy: 0.0000e+00
Epoch 29/100
30/30 [==============================] - 1s 21ms/step - loss: -165409310585
6512.0000 - accuracy: 0.0000e+00 - val_loss: -1821197398441984.0000 - val_a
ccuracy: 0.0000e+00
Epoch 30/100
30/30 [==============================] - 1s 21ms/step - loss: -196549434094
3872.0000 - accuracy: 0.0000e+00 - val_loss: -2157035252613120.0000 - val_a
ccuracy: 0.0000e+00
Epoch 31/100
30/30 [==============================] - 1s 21ms/step - loss: -232041567433
5232.0000 - accuracy: 0.0000e+00 - val_loss: -2537612707364864.0000 - val_a
ccuracy: 0.0000e+00
Epoch 32/100
30/30 [==============================] - 1s 22ms/step - loss: -272236904710
1440.0000 - accuracy: 0.0000e+00 - val_loss: -2968374304833536.0000 - val_a
ccuracy: 0.0000e+00
Epoch 33/100
30/30 [==============================] - 1s 21ms/step - loss: -317555735317
7088.0000 - accuracy: 0.0000e+00 - val_loss: -3451648588382208.0000 - val_a
ccuracy: 0.0000e+00
Epoch 34/100
30/30 [==============================] - 1s 21ms/step - loss: -368353253051
5968.0000 - accuracy: 0.0000e+00 - val_loss: -3994606811217920.0000 - val_a
ccuracy: 0.0000e+00
Epoch 35/100
30/30 [==============================] - 1s 20ms/step - loss: -425187239945
8304.0000 - accuracy: 0.0000e+00 - val_loss: -4597935362801664.0000 - val_a
```

```
ccuracy: 0.0000e+00
Epoch 36/100
30/30 [==============================] - 1s 21ms/step - loss: -488383469269
8112.0000 - accuracy: 0.0000e+00 - val_loss: -5270418793431040.0000 - val_a
ccuracy: 0.0000e+00
Epoch 37/100
30/30 [==============================] - 1s 21ms/step - loss: -558595071331
5328.0000 - accuracy: 0.0000e+00 - val_loss: -6014716224733184.0000 - val_a
ccuracy: 0.0000e+00
Epoch 38/100
30/30 [==============================] - 1s 23ms/step - loss: -636162502819
8400.0000 - accuracy: 0.0000e+00 - val_loss: -6834514349260800.0000 - val_a
ccuracy: 0.0000e+00
Epoch 39/100
30/30 [==============================] - 1s 22ms/step - loss: -721583443070
1568.0000 - accuracy: 0.0000e+00 - val_loss: -7737028175200256.0000 - val_a
ccuracy: 0.0000e+00
Epoch 40/100
30/30 [==============================] - 1s 22ms/step - loss: -815440880205
8240.0000 - accuracy: 0.0000e+00 - val_loss: -8727006862639104.0000 - val_a
ccuracy: 0.0000e+00
Epoch 41/100
30/30 [==============================] - 1s 22ms/step - loss: -918254988453
4784.0000 - accuracy: 0.0000e+00 - val_loss: -9809462638411776.0000 - val_a
ccuracy: 0.0000e+00
Epoch 42/100
30/30 [==============================] - 1s 22ms/step - loss: -103042933367
76704.0000 - accuracy: 0.0000e+00 - val_loss: -10990478786822144.0000 - val
_accuracy: 0.0000e+00
Epoch 43/100
30/30 [==============================] - 1s 22ms/step - loss: -115268139016
51968.0000 - accuracy: 0.0000e+00 - val_loss: -12273867628216320.0000 - val
_accuracy: 0.0000e+00
Epoch 44/100
30/30 [==============================] - 1s 22ms/step - loss: -128545311005
08160.0000 - accuracy: 0.0000e+00 - val_loss: -13667263466962944.0000 - val
_accuracy: 0.0000e+00
Epoch 45/100
30/30 [==============================] - 1s 21ms/step - loss: -142929993998
00832.0000 - accuracy: 0.0000e+00 - val_loss: -15175930859225088.0000 - val
_accuracy: 0.0000e+00
Epoch 46/100
30/30 [==============================] - 1s 21ms/step - loss: -158515410260
45952.0000 - accuracy: 0.0000e+00 - val_loss: -16804242081710080.0000 - val
_accuracy: 0.0000e+00
Epoch 47/100
30/30 [==============================] - 1s 22ms/step - loss: -175319544967
98720.0000 - accuracy: 0.0000e+00 - val_loss: -18565286047252480.0000 - val
_accuracy: 0.0000e+00
Epoch 48/100
30/30 [==============================] - 1s 21ms/step - loss: -193433472902
10304.0000 - accuracy: 0.0000e+00 - val_loss: -20455657920528384.0000 - val
_accuracy: 0.0000e+00
Epoch 49/100
30/30 [==============================] - 1s 22ms/step - loss: -212924249239
71584.0000 - accuracy: 0.0000e+00 - val_loss: -22490267680505856.0000 - val
_accuracy: 0.0000e+00
Epoch 50/100
30/30 [==============================] - 1s 21ms/step - loss: -233849480229
68320.0000 - accuracy: 0.0000e+00 - val_loss: -24672061674749952.0000 - val
_accuracy: 0.0000e+00
Epoch 51/100
30/30 [==============================] - 1s 21ms/step - loss: -256240390284
```

```
24704.0000 - accuracy: 0.0000e+00 - val_loss: -27007293375643648.0000 - val
_accuracy: 0.0000e+00
Epoch 52/100
30/30 [==============================] - 1s 21ms/step - loss: -280218183380
50048.0000 - accuracy: 0.0000e+00 - val_loss: -29498105971867648.0000 - val
_accuracy: 0.0000e+00
Epoch 53/100
30/30 [==============================] - 1s 22ms/step - loss: -305808844070
58432.0000 - accuracy: 0.0000e+00 - val_loss: -32159993557942272.0000 - val
_accuracy: 0.0000e+00
Epoch 54/100
30/30 [==============================] - 1s 21ms/step - loss: -333103661884
37504.0000 - accuracy: 0.0000e+00 - val_loss: -34995337693233152.0000 - val
_accuracy: 0.0000e+00
Epoch 55/100
30/30 [==============================] - 1s 21ms/step - loss: -362140346634
73152.0000 - accuracy: 0.0000e+00 - val_loss: -38020175785623552.0000 - val
_accuracy: 0.0000e+00
Epoch 56/100
30/30 [==============================] - 1s 21ms/step - loss: -393074547936
46080.0000 - accuracy: 0.0000e+00 - val_loss: -41224105424322560.0000 - val
_accuracy: 0.0000e+00
Epoch 57/100
30/30 [==============================] - 1s 21ms/step - loss: -425882987066
81856.0000 - accuracy: 0.0000e+00 - val_loss: -44619350086254592.0000 - val
_accuracy: 0.0000e+00
Epoch 58/100
30/30 [==============================] - 1s 21ms/step - loss: -460654398050
14016.0000 - accuracy: 0.0000e+00 - val_loss: -48223068165767168.0000 - val
_accuracy: 0.0000e+00
Epoch 59/100
30/30 [==============================] - 1s 21ms/step - loss: -497528281424
19968.0000 - accuracy: 0.0000e+00 - val_loss: -52041152357990400.0000 - val
_accuracy: 0.0000e+00
Epoch 60/100
30/30 [==============================] - 1s 22ms/step - loss: -536509275753
67680.0000 - accuracy: 0.0000e+00 - val_loss: -56085250614231040.0000 - val
_accuracy: 0.0000e+00
Epoch 61/100
30/30 [==============================] - 1s 21ms/step - loss: -577779272903
55712.0000 - accuracy: 0.0000e+00 - val_loss: -60342336298680320.0000 - val
_accuracy: 0.0000e+00
Epoch 62/100
30/30 [==============================] - 1s 21ms/step - loss: -621245673378
93888.0000 - accuracy: 0.0000e+00 - val_loss: -64844982443311104.0000 - val
_accuracy: 0.0000e+00
Epoch 63/100
30/30 [==============================] - 1s 21ms/step - loss: -667120949211
95520.0000 - accuracy: 0.0000e+00 - val_loss: -69579054310752256.0000 - val
_accuracy: 0.0000e+00
Epoch 64/100
30/30 [==============================] - 1s 22ms/step - loss: -715403811912
41728.0000 - accuracy: 0.0000e+00 - val_loss: -74566310205325312.0000 - val
_accuracy: 0.0000e+00
Epoch 65/100
30/30 [==============================] - 1s 21ms/step - loss: -766256525344
76800.0000 - accuracy: 0.0000e+00 - val_loss: -79807965602775040.0000 - val
_accuracy: 0.0000e+00
Epoch 66/100
30/30 [==============================] - 1s 24ms/step - loss: -819619604211
95776.0000 - accuracy: 0.0000e+00 - val_loss: -85325048662982656.0000 - val
_accuracy: 0.0000e+00
Epoch 67/100
```

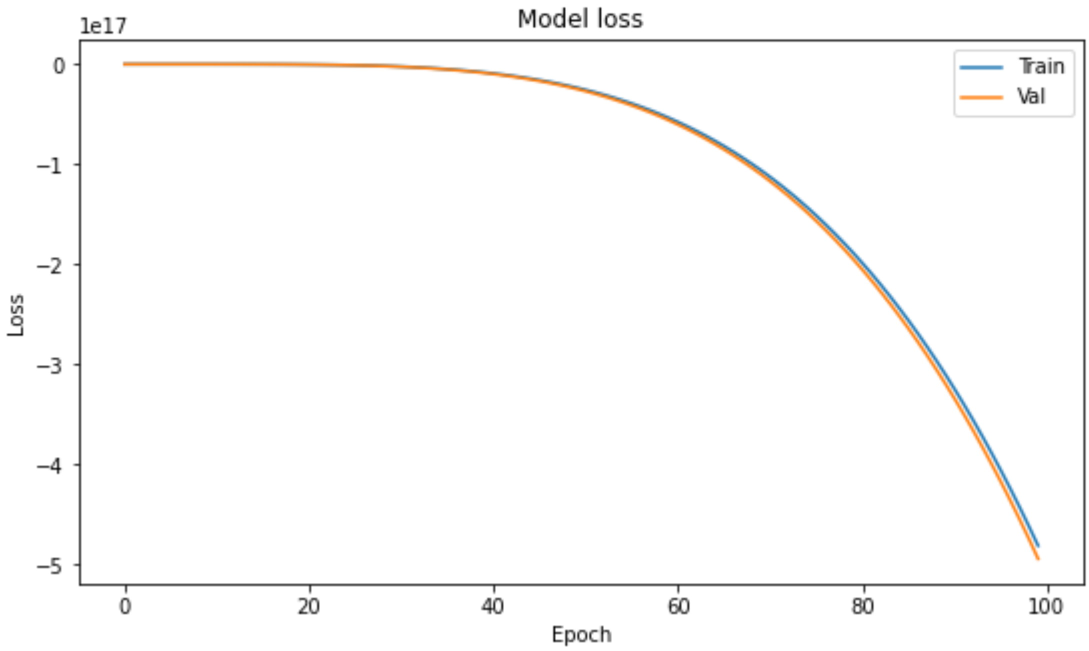
```
30/30 [==============================] - 1s 21ms/step - loss: -875763330805
92384.0000 - accuracy: 0.0000e+00 - val_loss: -91106083233333248.0000 - val
_accuracy: 0.0000e+00
Epoch 68/100
30/30 [==============================] - 1s 23ms/step - loss: -934628090980
59776.0000 - accuracy: 0.0000e+00 - val_loss: -97176641549107200.0000 - val
_accuracy: 0.0000e+00
Epoch 69/100
30/30 [==============================] - 1s 22ms/step - loss: -996370908740
32128.0000 - accuracy: 0.0000e+00 - val_loss: -103531329131380736.0000 - va
l_accuracy: 0.0000e+00
Epoch 70/100
30/30 [==============================] - 1s 22ms/step - loss: -106094934980
820992.0000 - accuracy: 0.0000e+00 - val_loss: -110187987274301440.0000 - v
al_accuracy: 0.0000e+00
Epoch 71/100
30/30 [==============================] - 1s 23ms/step - loss: -112859087565
225984.0000 - accuracy: 0.0000e+00 - val_loss: -117149081289097216.0000 - v
al_accuracy: 0.0000e+00
Epoch 72/100
30/30 [==============================] - 1s 21ms/step - loss: -119934350400
684032.0000 - accuracy: 0.0000e+00 - val_loss: -124427504667590656.0000 - v
al_accuracy: 0.0000e+00
Epoch 73/100
30/30 [==============================] - 1s 23ms/step - loss: -127327045679
054848.0000 - accuracy: 0.0000e+00 - val_loss: -132038083636887552.0000 - v
al_accuracy: 0.0000e+00
Epoch 74/100
30/30 [==============================] - 1s 23ms/step - loss: -135044225736
638464.0000 - accuracy: 0.0000e+00 - val_loss: -139954309658836992.0000 - v
al_accuracy: 0.0000e+00
Epoch 75/100
30/30 [==============================] - 1s 24ms/step - loss: -143094016651
558912.0000 - accuracy: 0.0000e+00 - val_loss: -148225935634595840.0000 - v
al_accuracy: 0.0000e+00
Epoch 76/100
30/30 [==============================] - 1s 22ms/step - loss: -151492258263
203840.0000 - accuracy: 0.0000e+00 - val_loss: -156867375474409472.0000 - v
al_accuracy: 0.0000e+00
Epoch 77/100
30/30 [==============================] - 1s 22ms/step - loss: -160252514078
294016.0000 - accuracy: 0.0000e+00 - val_loss: -165870640539107328.0000 - v
al_accuracy: 0.0000e+00
Epoch 78/100
30/30 [==============================] - 1s 23ms/step - loss: -169386260249
444352.0000 - accuracy: 0.0000e+00 - val_loss: -175235404411174912.0000 - v
al_accuracy: 0.0000e+00
Epoch 79/100
30/30 [==============================] - 1s 22ms/step - loss: -178880543155
290112.0000 - accuracy: 0.0000e+00 - val_loss: -184995013216698368.0000 - v
al_accuracy: 0.0000e+00
Epoch 80/100
30/30 [==============================] - 1s 21ms/step - loss: -188750068763
852800.0000 - accuracy: 0.0000e+00 - val_loss: -195121807366291456.0000 - v
al_accuracy: 0.0000e+00
Epoch 81/100
30/30 [==============================] - 1s 21ms/step - loss: -199014542385
086464.0000 - accuracy: 0.0000e+00 - val_loss: -205649218885386240.0000 - v
al_accuracy: 0.0000e+00
Epoch 82/100
30/30 [==============================] - 1s 22ms/step - loss: -209681609060
777984.0000 - accuracy: 0.0000e+00 - val_loss: -216590493453123584.0000 - v
al_accuracy: 0.0000e+00
```

```
Epoch 83/100
30/30 [==============================] - 1s 22ms/step - loss: -220757694062
002176.0000 - accuracy: 0.0000e+00 - val_loss: -227933656700682240.0000 - v
al_accuracy: 0.0000e+00
Epoch 84/100
30/30 [==============================] - 1s 24ms/step - loss: -232249463178
002432.0000 - accuracy: 0.0000e+00 - val_loss: -239712329632055296.0000 - v
al_accuracy: 0.0000e+00
Epoch 85/100
30/30 [==============================] - 1s 21ms/step - loss: -244164011694
751744.0000 - accuracy: 0.0000e+00 - val_loss: -251917544355528704.0000 - v
al_accuracy: 0.0000e+00
Epoch 86/100
30/30 [==============================] - 1s 22ms/step - loss: -256499518546
116608.0000 - accuracy: 0.0000e+00 - val_loss: -264545469760274432.0000 - v
al_accuracy: 0.0000e+00
Epoch 87/100
30/30 [==============================] - 1s 21ms/step - loss: -269291717859
999744.0000 - accuracy: 0.0000e+00 - val_loss: -277652026320486400.0000 - v
al_accuracy: 0.0000e+00
Epoch 88/100
30/30 [==============================] - 1s 22ms/step - loss: -282549388549
554176.0000 - accuracy: 0.0000e+00 - val_loss: -291209812144816128.0000 - v
al_accuracy: 0.0000e+00
Epoch 89/100
30/30 [==============================] - 1s 21ms/step - loss: -296270245692
178432.0000 - accuracy: 0.0000e+00 - val_loss: -305260436876427264.0000 - v
al_accuracy: 0.0000e+00
Epoch 90/100
30/30 [==============================] - 1s 21ms/step - loss: -310464219252
260864.0000 - accuracy: 0.0000e+00 - val_loss: -319800069404491776.0000 - v
al_accuracy: 0.0000e+00
Epoch 91/100
30/30 [==============================] - 1s 21ms/step - loss: -325154828470
714368.0000 - accuracy: 0.0000e+00 - val_loss: -334817714612731904.0000 - v
al_accuracy: 0.0000e+00
Epoch 92/100
30/30 [==============================] - 1s 20ms/step - loss: -340335957314
109440.0000 - accuracy: 0.0000e+00 - val_loss: -350356837570183168.0000 - v
al_accuracy: 0.0000e+00
Epoch 93/100
30/30 [==============================] - 1s 20ms/step - loss: -356021384037
531648.0000 - accuracy: 0.0000e+00 - val_loss: -366387923261587456.0000 - v
al_accuracy: 0.0000e+00
Epoch 94/100
30/30 [==============================] - 1s 19ms/step - loss: -372235572774
699008.0000 - accuracy: 0.0000e+00 - val_loss: -382964160561938432.0000 - v
al_accuracy: 0.0000e+00
Epoch 95/100
30/30 [==============================] - 1s 21ms/step - loss: -388964779630
264320.0000 - accuracy: 0.0000e+00 - val_loss: -400065174146383872.0000 - v
al_accuracy: 0.0000e+00
Epoch 96/100
30/30 [==============================] - 1s 19ms/step - loss: -406225256760
475648.0000 - accuracy: 0.0000e+00 - val_loss: -417685088499662848.0000 - v
al_accuracy: 0.0000e+00
Epoch 97/100
30/30 [==============================] - 1s 20ms/step - loss: -424020852456
030208.0000 - accuracy: 0.0000e+00 - val_loss: -435866063020752896.0000 - v
al_accuracy: 0.0000e+00
Epoch 98/100
30/30 [==============================] - 1s 19ms/step - loss: -442387713161
691136.0000 - accuracy: 0.0000e+00 - val_loss: -454627167364448256.0000 - v
```

```
al_accuracy: 0.0000e+00
Epoch 99/100
30/30 [==============================] - 1s 21ms/step - loss: -461322265464
668160.0000 - accuracy: 0.0000e+00 - val_loss: -473960258272755712.0000 - v
al_accuracy: 0.0000e+00
Epoch 100/100
```

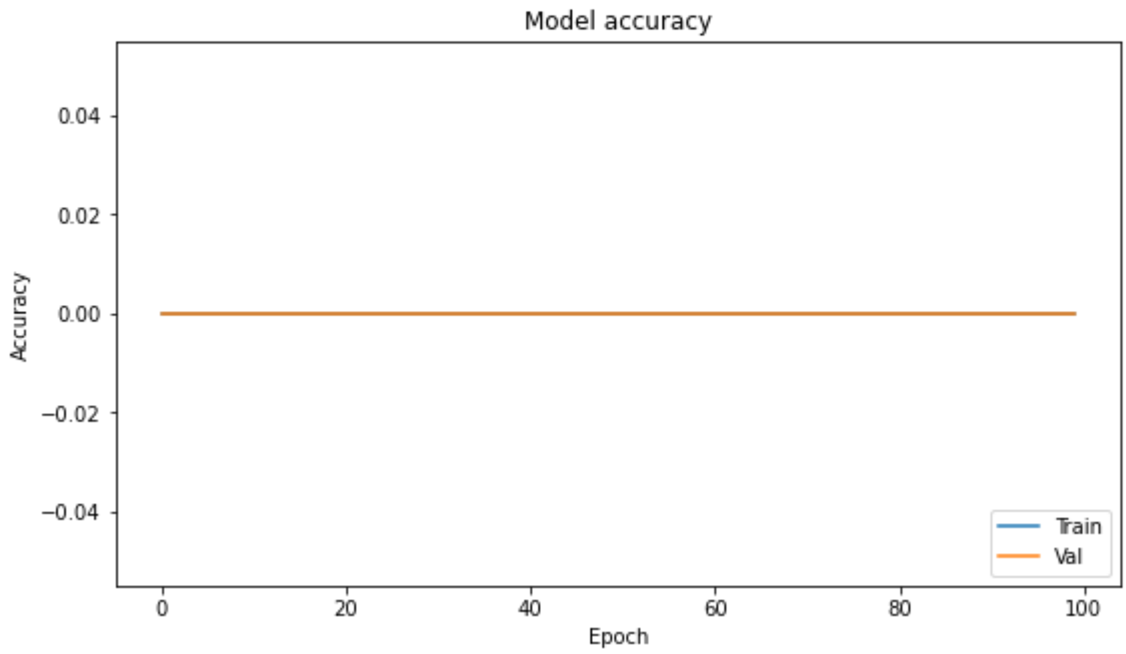
In [127…

```
plt.plot(hist_2.history['loss'])
plt.plot(hist_2.history['val_loss'])
plt.title('Model loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Train', 'Val'], loc='upper right')
plt.show()
```



In [41]:

```
plt.plot(hist_2.history['accuracy'])
plt.plot(hist_2.history['val_accuracy'])
plt.title('Model accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train', 'Val'], loc='lower right')
plt.show()
```



In [128…

```
_, accuracy = model.evaluate(X_train, Y_train)
print('Accuracy: %.2f' % (accuracy*100))
```

```
30/30 [==============================] - 0s 538us/step - loss: nan - accura
cy: 0.0000e+00
Accuracy: 0.00
```

In [137…

```
y_pred = model.predict(x_train)
pd.DataFrame(y_pred)
```

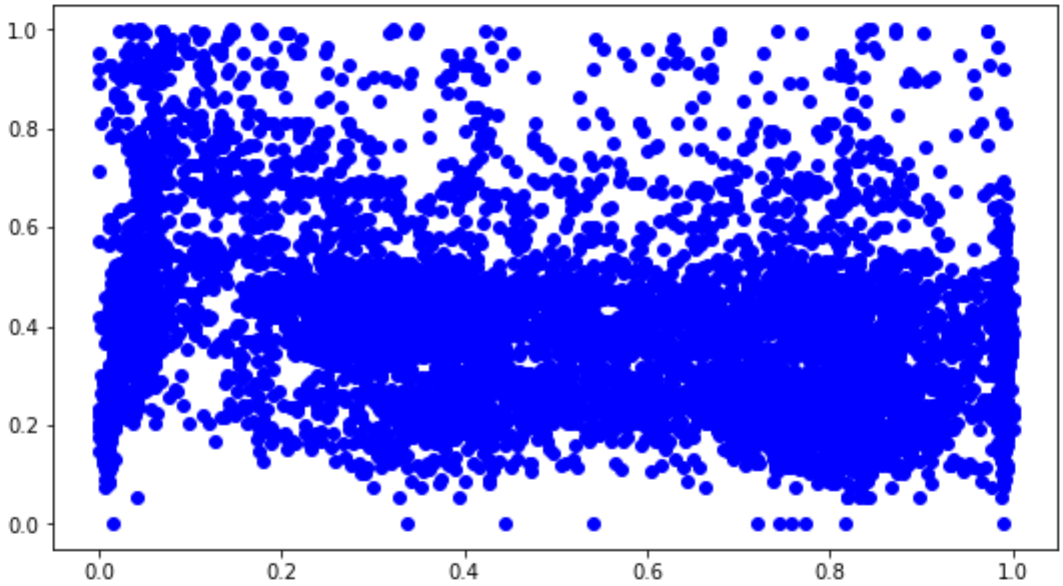
Out[137…

	0
0	NaN
1	NaN
2	NaN
3	NaN
4	NaN
...	...
932	NaN
933	NaN
934	NaN
935	NaN
936	NaN

937 rows × 1 columns

In [148…

```
plt.plot(x_train,y_train,"bo")
plt.show()
```



In [ ]:

In [ ]: