```
!pip install tensorflow
```

```
    uirement already satisfied: tensorflow in /usr/local/lib/python3.7/dist-packages (2.7.0)
    uirement already satisfied: wheel<1.0,>=0.32.0 in /usr/local/lib/python3.7/dist-packages
    uirement already satisfied: gast<0.5.0,>=0.2.1 in /usr/local/lib/python3.7/dist-packages
    uirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.7/dist-packages (f
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    uirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.7/dist-packages (from t
    uirement already satisfied: wrapt>=1.11.0 in /usr/local/lib/python3.7/dist-packages (fron
    uirement already satisfied: keras-preprocessing>=1.1.1 in /usr/local/lib/python3.7/dist-p
    uirement already satisfied: tensorboard~=2.6 in /usr/local/lib/python3.7/dist-packages (f
    uirement already satisfied: keras<2.8,>=2.7.0rc0 in /usr/local/lib/python3.7/dist-package
    uirement already satisfied: tensorflow-io-gcs-filesystem>=0.21.0 in /usr/local/lib/python
    uirement already satisfied: protobuf>=3.9.2 in /usr/local/lib/python3.7/dist-packages (fr
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    uirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist-packages
    uirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist-packages
    uirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/lib/pyt
    uirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (from
    uirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.7/dist-packages (fr
```

```
from google.colab import drive
```

```
drive.mount('/content/drive')
```

```
     Mounted at /content/drive
```

```
import pandas as pd
import tensorflow as tf
from tensorflow import keras
from sklearn.model_selection import train_test_split
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Activation, Dense, BatchNormalization, Dropout
from tensorflow.keras import optimizers
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.feature_selection import SelectKBest
from sklearn.feature_selection import mutual_info_regression
```

```
gas=pd.read_csv('/content/drive/MyDrive/gas_turbines.csv')
gas
```

	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
...	...	...	...	...	...	...	...	...	...	...	...
15034	9.0301	1005.6	98.460	3.5421	19.164	1049.7	546.21	111.61	10.400	4.5186	79.559
15035	7.8879	1005.9	99.093	3.5059	19.414	1046.3	543.22	111.78	10.433	4.8470	79.917
15036	7.2647	1006.3	99.496	3.4770	19.530	1037.7	537.32	110.19	10.483	7.9632	90.912
15037	7.0060	1006.8	99.008	3.4486	19.377	1043.2	541.24	110.74	10.533	6.2494	93.227
15038	6.9279	1007.2	97.533	3.4275	19.306	1049.9	545.85	111.58	10.583	4.9816	92.498

15039 rows × 11 columns

```
gas.shape
```

```
(15039, 11)
```

```
gas.isna().sum()
```

```
AT      0
AP      0
AH      0
AFDP    0
```

```
GTEP    0
TIT     0
TAT     0
TEY     0
CDP     0
CO      0
NOX     0
dtype: int64
```

```
gas.dtypes
```

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

```
gas.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 15039 entries, 0 to 15038
Data columns (total 11 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   AT      15039 non-null  float64
 1   AP      15039 non-null  float64
 2   AH      15039 non-null  float64
 3   AFDP    15039 non-null  float64
 4   GTEP    15039 non-null  float64
 5   TIT     15039 non-null  float64
 6   TAT     15039 non-null  float64
 7   TEY     15039 non-null  float64
 8   CDP     15039 non-null  float64
 9   CO      15039 non-null  float64
 10  NOX     15039 non-null  float64
dtypes: float64(11)
memory usage: 1.3 MB
```

```
gas.describe(include='all')
```

	AT	AP	AH	AFDP	GTEP	
count	15039.000000	15039.00000	15039.000000	15039.000000	15039.000000	15039.00
mean	17.764381	1013.19924	79.124174	4.200294	25.419061	1083.79
std	7.574323	6.41076	13.793439	0.760197	4.173916	16.52
min	0.522300	985.85000	30.344000	2.087400	17.878000	1000.80
25%	11.408000	1008.90000	69.750000	3.723900	23.294000	1079.60

```
corr=gas.corr()
corr
```

	AT	AP	AH	AFDP	GTEP	TIT	TAT	TEY
AT	1.000000	-0.412953	-0.549432	-0.099333	-0.049103	0.093067	0.338569	-0.207495
AP	-0.412953	1.000000	0.042573	0.040318	0.078575	0.029650	-0.223479	0.146939
AH	-0.549432	0.042573	1.000000	-0.119249	-0.202784	-0.247781	0.010859	-0.110272
AFDP	-0.099333	0.040318	-0.119249	1.000000	0.744251	0.627254	-0.571541	0.717995
GTEP	-0.049103	0.078575	-0.202784	0.744251	1.000000	0.874526	-0.756884	0.977042
TIT	0.093067	0.029650	-0.247781	0.627254	0.874526	1.000000	-0.357320	0.891587
TAT	0.338569	-0.223479	0.010859	-0.571541	-0.756884	-0.357320	1.000000	-0.720356
TEY	-0.207495	0.146939	-0.110272	0.717995	0.977042	0.891587	-0.720356	1.000000
CDP	-0.100705	0.131198	-0.182010	0.727152	0.993784	0.887238	-0.744740	0.988473
CO	-0.088588	0.041614	0.165505	-0.334207	-0.508259	-0.688272	0.063404	-0.541751
NOX	-0.600006	0.256744	0.143061	-0.037299	-0.208496	-0.231636	0.009888	-0.102631

```
X = gas.drop(['TEY'],axis=1)
y=gas['TEY']
```

```
from sklearn.preprocessing import StandardScaler
scaler=StandardScaler()
```

```
scaler.fit(X)
```

```
StandardScaler()
```

```
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.20,random_state=12)
```

```
X_train.shape,y_train.shape
```

```
((12031, 10), (12031,))
```

```
X_test.shape,y_test.shape
```

```
((3008, 10), (3008,))
```

Artificial Neural Network Model

```
model=Sequential()
model.add(Dense(units = 20, activation = 'relu'))
model.add(Dense(units = 40, activation='tanh'))
model.add(Dense(units = 10,activation='softmax'))
```

```
model.compile(loss='mean_squared_error', optimizer ='adam', metrics = ['mse'])
```

```
model.fit(X_train, y_train, epochs = 10)
```

```
Epoch 1/10
376/376 [==============================] - 1s 2ms/step - loss: 18232.6875 - mse: 18232.6
Epoch 2/10
376/376 [==============================] - 1s 2ms/step - loss: 18232.6973 - mse: 18232.6
Epoch 3/10
376/376 [==============================] - 1s 2ms/step - loss: 18232.6914 - mse: 18232.6
Epoch 4/10
376/376 [==============================] - 1s 2ms/step - loss: 18232.6855 - mse: 18232.6
Epoch 5/10
376/376 [==============================] - 1s 2ms/step - loss: 18232.6875 - mse: 18232.6
Epoch 6/10
376/376 [==============================] - 1s 2ms/step - loss: 18232.6875 - mse: 18232.6
Epoch 7/10
376/376 [==============================] - 1s 2ms/step - loss: 18232.6914 - mse: 18232.6
Epoch 8/10
376/376 [==============================] - 1s 2ms/step - loss: 18232.6934 - mse: 18232.6
Epoch 9/10
376/376 [==============================] - 1s 2ms/step - loss: 18232.6973 - mse: 18232.6
Epoch 10/10
376/376 [==============================] - 1s 2ms/step - loss: 18232.6953 - mse: 18232.6
<keras.callbacks.History at 0x7fe843189790>
```

```
scores = model.evaluate(X_test, y_test)
scores
```

```
94/94 [==============================] - 0s 1ms/step - loss: 18220.6270 - mse: 18220.627
[18220.626953125, 18220.626953125]
```

✓ 0s completed at 12:17 AM