In [1]:
```
import numpy as np
import pandas as pd
import tensorflow as tf
```

In [2]:
```
data=pd.read_csv("C:\\Users\\Admin\\Downloads\\Assignment 8\\gas_turbines.csv")
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
...	...	...	...	...	...	...	...	...	...	...	...
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

In [3]:
```
X=data.iloc[:,3:-1].values
```

In [4]:
```
Y=data.iloc[:,-4].values
```

In [5]:
```
from sklearn.preprocessing import LabelEncoder
LE1 = LabelEncoder()
X[:,2] = np.array(LE1.fit_transform(X[:,2]))
```

In [6]:
```
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
ct=ColumnTransformer(transformers=[('encoder',OneHotEncoder(),[1])],remainder="passthrough")
```

In [7]:
```
from sklearn.model_selection import train_test_split
X_train,X_test,Y_train,Y_test=train_test_split(X,Y,test_size=0.2,random_state=0)
```

In [8]:
```
from sklearn.preprocessing import StandardScaler
sc=StandardScaler()
Y = np.array(Y).reshape(-4,1)
Y = sc.fit_transform(Y)
```

In [9]:
```
ann=tf.keras.models.Sequential()
```

In [10]:
```
ann.add(tf.keras.layers.Dense(units=16,activation="relu"))
```

In [11]:
```
ann.add(tf.keras.layers.Dense(units=16,activation="relu"))
```

In [12]:
```
ann.add(tf.keras.layers.Dense(units=1,activation="tanh"))
```

In [13]:
```
ann.compile(optimizer="adam",loss="binary_crossentropy",metrics=['accuracy'])
```

In [14]:
```
ann.fit(X_train,Y_train,batch_size=32,epochs=100)
```

```
Epoch 1/100
376/376 [==============================] - 4s 3ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 2/100
376/376 [==============================] - 1s 3ms/step - loss: -2032.0624 - accuracy: 0.0000e+00
Epoch 3/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 4/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0645 - accuracy: 0.0000e+00
```

```
Epoch 5/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0640 - accuracy: 0.0000e+00
Epoch 6/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 7/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 8/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0637 - accuracy: 0.0000e+00
Epoch 9/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0640 - accuracy: 0.0000e+00
Epoch 10/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 11/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0645 - accuracy: 0.0000e+00
Epoch 12/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 13/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 14/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 15/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 16/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 17/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0635 - accuracy: 0.0000e+00
Epoch 18/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0638 - accuracy: 0.0000e+00
Epoch 19/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0625 - accuracy: 0.0000e+00
Epoch 20/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 21/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0635 - accuracy: 0.0000e+00
Epoch 22/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 23/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 24/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 25/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 26/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0638 - accuracy: 0.0000e+00
Epoch 27/100
```

```
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 28/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0640 - accuracy: 0.0000e+00
Epoch 29/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0620 - accuracy: 0.0000e+00
Epoch 30/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 31/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 32/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 33/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 34/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 35/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 36/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 37/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 38/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0624 - accuracy: 0.0000e+00
Epoch 39/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0637 - accuracy: 0.0000e+00
Epoch 40/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0624 - accuracy: 0.0000e+00
Epoch 41/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 42/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0635 - accuracy: 0.0000e+00
Epoch 43/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0635 - accuracy: 0.0000e+00
Epoch 44/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0638 - accuracy: 0.0000e+00
Epoch 45/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 46/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 47/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0637 - accuracy: 0.0000e+00
Epoch 48/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 49/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0637 - accuracy: 0.0000e+00
```

```
Epoch 50/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0637 - accuracy: 0.0000e+00
Epoch 51/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0621 - accuracy: 0.0000e+00
Epoch 52/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0640 - accuracy: 0.0000e+00
Epoch 53/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 54/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 55/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 56/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 57/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0640 - accuracy: 0.0000e+00
Epoch 58/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 59/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 60/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0637 - accuracy: 0.0000e+00
Epoch 61/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 62/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 63/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0625 - accuracy: 0.0000e+00
Epoch 64/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 65/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0621 - accuracy: 0.0000e+00
Epoch 66/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0635 - accuracy: 0.0000e+00
Epoch 67/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 68/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 69/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 70/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 71/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 72/100
```

```
376/376 [==============================] - 1s 2ms/step - loss: -2032.0640 - accuracy: 0.0000e+00
Epoch 73/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 74/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 75/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0642 - accuracy: 0.0000e+00
Epoch 76/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0642 - accuracy: 0.0000e+00
Epoch 77/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 78/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 79/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0635 - accuracy: 0.0000e+00
Epoch 80/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 81/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0621 - accuracy: 0.0000e+00
Epoch 82/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 83/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 84/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 85/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0637 - accuracy: 0.0000e+00
Epoch 86/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 87/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 88/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0647 - accuracy: 0.0000e+00
Epoch 89/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0638 - accuracy: 0.0000e+00
Epoch 90/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0625 - accuracy: 0.0000e+00
Epoch 91/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0631 - accuracy: 0.0000e+00
Epoch 92/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0626 - accuracy: 0.0000e+00
Epoch 93/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0629 - accuracy: 0.0000e+00
Epoch 94/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0638 - accuracy: 0.0000e+00
```

```
Epoch 95/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0621 - accuracy: 0.0000e+00
Epoch 96/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0648 - accuracy: 0.0000e+00
Epoch 97/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 98/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
Epoch 99/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0634 - accuracy: 0.0000e+00
Epoch 100/100
376/376 [==============================] - 1s 2ms/step - loss: -2032.0630 - accuracy: 0.0000e+00
```

Out[14]:
```
<keras.callbacks.History at 0x1512daabe20>
```

In [15]:
```
scores=ann.evaluate(X,Y)
print("%s: %0.2f%%" % (ann.metrics_names[1], scores[1]*100))
```

```
470/470 [==============================] - 1s 2ms/step - loss: 15.2492 - accuracy: 0.0000e+00
accuracy: 0.00%
```

In [ ]:
```

```