Assignment -2

Team ID	PNT2022TMID15174
Student Name	RanjithKumar
Student Roll Number	7179KCTKCTKCTKCTKCTKCT19BEC120
Maximum Marks	2 Marks

1. Download the dataset: Dataset

Dataset Sucessfully download and uploaded in colab.

2 LOADING DATASET.

```
import numpy as np
import pandas as pd
```

```
ds=pd.read_csv("/content/Churn_Modelling.csv")
ds.head()
```

Output

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	1	101348.88	1
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	1	112542.58	0
2	3	15619304	Onio	502	France	Female	42	8	159660.80	3	1	0	113931.57	1
3	4	15701354	Boni	699	France	Female	39	1	0.00	2	0	0	93826.63	0
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	1	1	1	79084.10	0

3. Perform Below Visualizations.

● Univariate Analysis ● Bi - Variate Analysis ● Multi - Variate Analysis

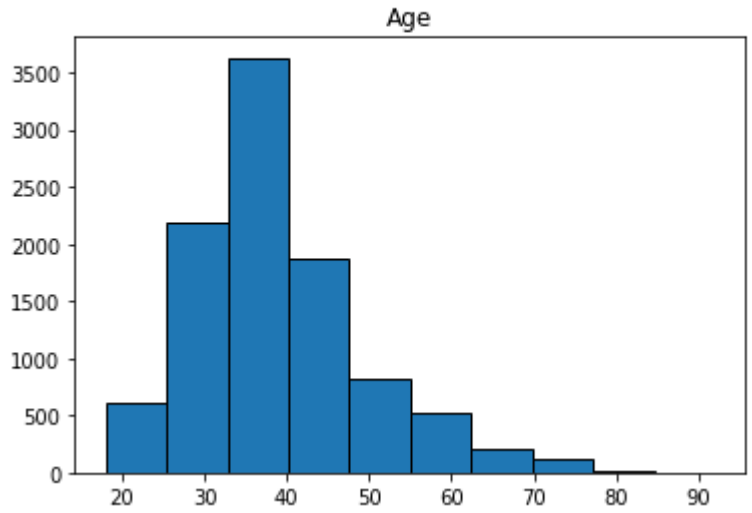
```
import matplotlib.pyplot as plt
import seaborn as sns
```

● Univariate Analysis

```
ds.hist(column='Age',grid=False,edgecolor='black')
```

Output

```
array([[]],
      dtype=object)
```

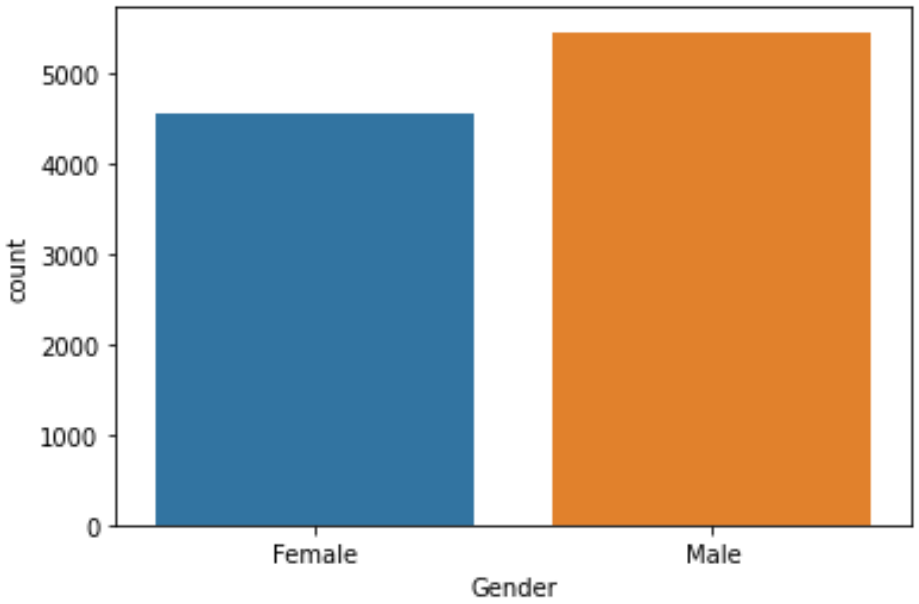


● Bi - Variate Analysis

Output

```
[5]: sns.countplot(x='Gender',data=ds)
```

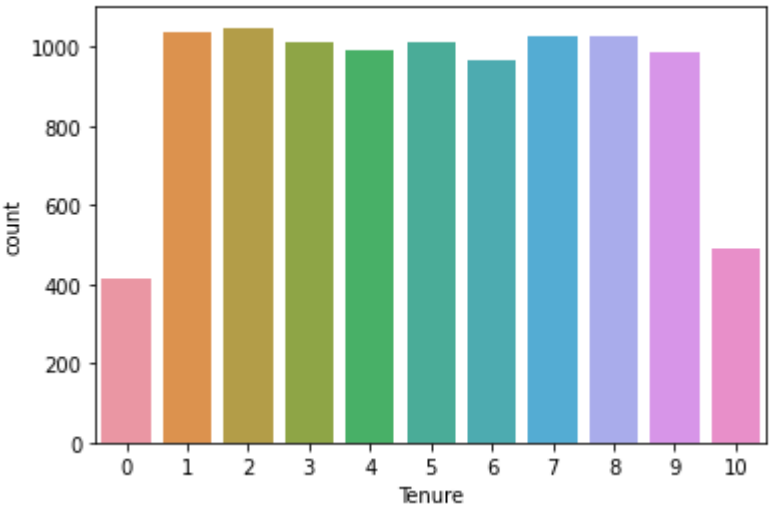
[5]:



● Multi - Variate Analysis

```
sns.countplot(x="Tenure",data=ds)
```

Output



4. Perform descriptive statistics on the dataset.

```
ds.describe()
```

Output

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.00000	10000.000000	10000.000000	10000.000000
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800	76485.889288	1.530200	0.70550	0.515100	100090.239881	0.203700
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174	62397.405202	0.581654	0.45584	0.499797	57510.492818	0.402769
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	0.000000	1.000000	0.00000	0.000000	11.580000	0.000000
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	0.000000	1.000000	0.00000	0.000000	51002.110000	0.000000
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000	1.000000	1.00000	1.000000	100193.915000	0.000000
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000	127644.240000	2.000000	1.00000	1.000000	149388.247500	0.000000
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000	250898.090000	4.000000	1.00000	1.000000	199992.480000	1.000000

5. Handle the Missing values.

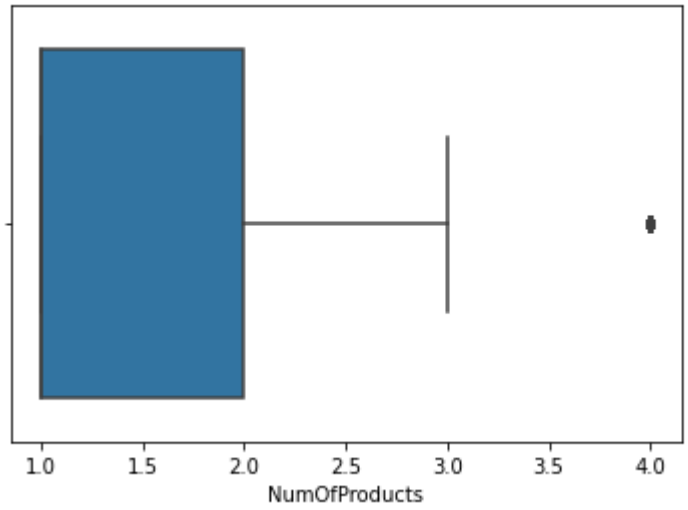
```
ds.info()
```

```
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 14 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   RowNumber        10000 non-null  int64  
 1   CustomerId       10000 non-null  int64  
 2   Surname          10000 non-null  object 
 3   CreditScore      10000 non-null  int64  
 4   Geography        10000 non-null  object 
 5   Gender           10000 non-null  object 
 6   Age              10000 non-null  int64  
 7   Tenure           10000 non-null  int64  
 8   Balance          10000 non-null  float64
 9   NumOfProducts    10000 non-null  int64  
 10  HasCrCard        10000 non-null  int64  
 11  IsActiveMember   10000 non-null  int64  
 12  EstimatedSalary  10000 non-null  float64
 13  Exited           10000 non-null  int64  
dtypes: float64(2), int64(9), object(3)
memory usage: 1.1+ MB
```

6. Find the outliers and replace the outliers

```
sns.boxplot(ds['NumOfProducts'])
```

Output



```
# Values above 3 are outliers
outliers=np.where(ds['NumOfProducts']>3)
outliers
```

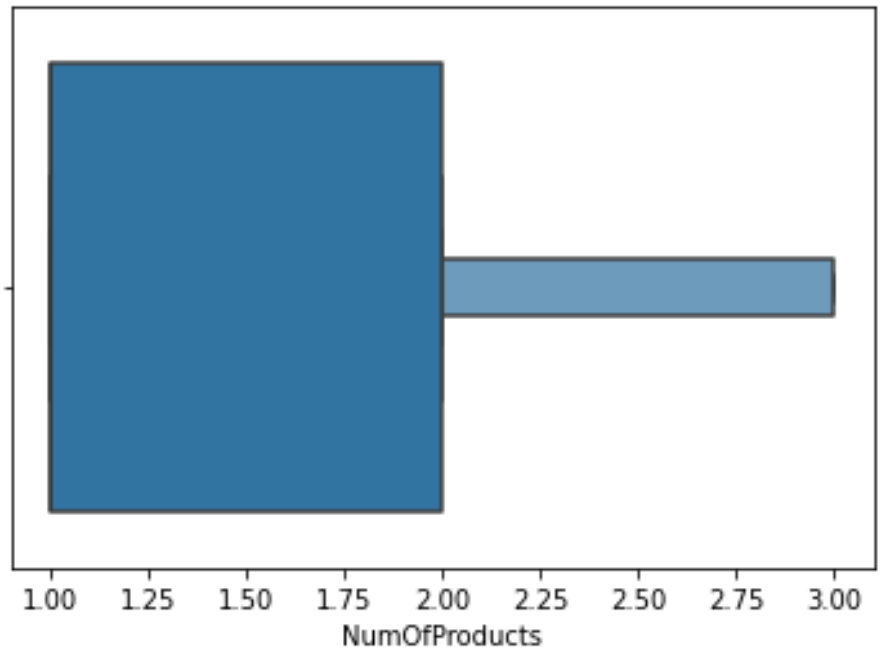
Output

```
(array([   7,   70, 1254, 1469, 1488, 1701, 1876, 2124, 2196, 2285, 2462,
        2499, 2509, 2541, 2614, 2617, 2872, 3152, 3365, 3841, 4013, 4014,
        4166, 4260, 4403, 4511, 4516, 4606, 4654, 4748, 4822, 5010, 5137,
        5235, 5386, 5700, 5904, 6150, 6172, 6279, 6750, 6875, 7257, 7457,
        7567, 7698, 7724, 7729, 8041, 8590, 8683, 8850, 8923, 9215, 9255,
        9323, 9370, 9411, 9540, 9565]),)
```

```
for i in outliers:
  ds['NumOfProducts'][i]=3 #replacing with previous value
```

```
sns.boxenplot(ds['NumOfProducts'])
```

Output



7. Check for Categorical columns and perform encoding.

```
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()

ds["Surname"]=le.fit_transform(ds["Surname"])
ds['Geography']=le.fit_transform(ds['Geography'])
ds['Gender']=le.fit_transform(ds['Gender'])

ds.head()
```

Output

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	15634602	1115	619	0	0	42	2	0.00	1	1	1	101348.88	1
1	2	15647311	1177	608	2	0	41	1	83807.86	1	0	1	112542.58	0
2	3	15619304	2040	502	0	0	42	8	159660.80	3	1	0	113931.57	1
3	4	15701354	289	699	0	0	39	1	0.00	2	0	0	93826.63	0
4	5	15737888	1822	850	2	0	43	2	125510.82	1	1	1	79084.10	0

8. Split the data into dependent and independent variables.

```
x = ds.iloc[:, 3:13]
y = ds.iloc[:, 13]
```

9. Scale the independent variables

```
x=x.drop(['Geography','Gender'],axis=1)
x
```

	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary
0	619	42	2	0.00	1	1	1	101348.88
1	608	41	1	83807.86	1	0	1	112542.58
2	502	42	8	159660.80	3	1	0	113931.57
3	699	39	1	0.00	2	0	0	93826.63
4	850	43	2	125510.82	1	1	1	79084.10
...	...	...	...	...	...	...	...	...
9995	771	39	5	0.00	2	1	0	96270.64
9996	516	35	10	57369.61	1	1	1	101699.77
9997	709	36	7	0.00	1	0	1	42085.58
9998	772	42	3	75075.31	2	1	0	92888.52
9999	792	28	4	130142.79	1	1	0	38190.78

10000 rows × 8 columns

```
y
```

```
0       1
1       0
2       1
3       0
4       0
       ..
9995    0
9996    0
9997    1
9998    1
9999    0
Name: Exited, Length: 10000, dtype: int64
```

10. Split the data into training and testing

```
from sklearn.model_selection import train_test_split

xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.3,random_state=0
)
xtrain.shape,xtest.shape
```

```
((7000, 8), (3000, 8))
```

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from sklearn.preprocessing import StandardScaler

sc=StandardScaler()
xtrain=sc.fit_transform(xtrain)
xtest=sc.fit_transform(xtest)

classifier=Sequential()
classifier.add(Dense(8,activation='relu'))
classifier.add(Dense(16,activation='relu'))
classifier.add(Dense(24,activation='relu'))
classifier.add(Dense(8,activation='relu'))
classifier.add(Dense(1,activation='linear'))
:
classifier.compile(optimizer = 'adam', loss = 'mse', metrics = ['accuracy'])

classifier.fit(xtrain,ytrain,batch_size=10,epochs=100)
```

Output

```
Epoch 1/100
700/700 [==============================] - 2s 2ms/step - loss: 0.1511 - acc
uracy: 0.8004
Epoch 2/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1280 - acc
uracy: 0.8329
Epoch 3/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1164 - acc
uracy: 0.8480
Epoch 4/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1127 - acc
uracy: 0.8536
Epoch 5/100
```

```
700/700 [==============================] - 1s 2ms/step - loss: 0.1111 - acc
uracy: 0.8537
Epoch 6/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1100 - acc
uracy: 0.8550
Epoch 7/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1091 - acc
uracy: 0.8559
Epoch 8/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1089 - acc
uracy: 0.8550
Epoch 9/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1088 - acc
uracy: 0.8560
Epoch 10/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1086 - acc
uracy: 0.8583
Epoch 11/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1078 - acc
uracy: 0.8574
Epoch 12/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1073 - acc
uracy: 0.8587
Epoch 13/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1068 - acc
uracy: 0.8596
Epoch 14/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1067 - acc
uracy: 0.8569
Epoch 15/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1067 - acc
uracy: 0.8584
Epoch 16/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1070 - acc
uracy: 0.8584
Epoch 17/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1062 - acc
uracy: 0.8574
Epoch 18/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1062 - acc
uracy: 0.8597
Epoch 19/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1056 - acc
uracy: 0.8597
Epoch 20/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1055 - acc
uracy: 0.8594
Epoch 21/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1052 - acc
uracy: 0.8589
Epoch 22/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1056 - acc
uracy: 0.8579
Epoch 23/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1052 - acc
uracy: 0.8594
Epoch 24/100
```

```
700/700 [==============================] - 1s 2ms/step - loss: 0.1049 - acc
uracy: 0.8599
Epoch 25/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1049 - acc
uracy: 0.8609
Epoch 26/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1049 - acc
uracy: 0.8604
Epoch 27/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1045 - acc
uracy: 0.8586
Epoch 28/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1041 - acc
uracy: 0.8619
Epoch 29/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1045 - acc
uracy: 0.8607
Epoch 30/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1039 - acc
uracy: 0.8609
Epoch 31/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1038 - acc
uracy: 0.8616
Epoch 32/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1038 - acc
uracy: 0.8646
Epoch 33/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1040 - acc
uracy: 0.8614
Epoch 34/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1035 - acc
uracy: 0.8617
Epoch 35/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1041 - acc
uracy: 0.8604
Epoch 36/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1034 - acc
uracy: 0.8627
Epoch 37/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1035 - acc
uracy: 0.8614
Epoch 38/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1030 - acc
uracy: 0.8631
Epoch 39/100
700/700 [==============================] - 2s 2ms/step - loss: 0.1035 - acc
uracy: 0.8623
Epoch 40/100
700/700 [==============================] - 2s 2ms/step - loss: 0.1031 - acc
uracy: 0.8634
Epoch 41/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1027 - acc
uracy: 0.8627
Epoch 42/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1027 - acc
uracy: 0.8641
Epoch 43/100
```

```
700/700 [==============================] - 1s 2ms/step - loss: 0.1030 - acc
uracy: 0.8623
Epoch 44/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1030 - acc
uracy: 0.8626
Epoch 45/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1020 - acc
uracy: 0.8634
Epoch 46/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1026 - acc
uracy: 0.8636
Epoch 47/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1027 - acc
uracy: 0.8651
Epoch 48/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1022 - acc
uracy: 0.8641
Epoch 49/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1022 - acc
uracy: 0.8634
Epoch 50/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1016 - acc
uracy: 0.8667
Epoch 51/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1019 - acc
uracy: 0.8649
Epoch 52/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1020 - acc
uracy: 0.8657
Epoch 53/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1018 - acc
uracy: 0.8653
Epoch 54/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1015 - acc
uracy: 0.8667
Epoch 55/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1017 - acc
uracy: 0.8661
Epoch 56/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1016 - acc
uracy: 0.8641
Epoch 57/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1012 - acc
uracy: 0.8664
Epoch 58/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1009 - acc
uracy: 0.8654
Epoch 59/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1008 - acc
uracy: 0.8649
Epoch 60/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1009 - acc
uracy: 0.8654
Epoch 61/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1007 - acc
uracy: 0.8651
Epoch 62/100
```

```
700/700 [==============================] - 1s 2ms/step - loss: 0.1006 - acc
uracy: 0.8676
Epoch 63/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1010 - acc
uracy: 0.8660
Epoch 64/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1003 - acc
uracy: 0.8694
Epoch 65/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1009 - acc
uracy: 0.8657
Epoch 66/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1004 - acc
uracy: 0.8677
Epoch 67/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1003 - acc
uracy: 0.8663
Epoch 68/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1007 - acc
uracy: 0.8667
Epoch 69/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1004 - acc
uracy: 0.8661
Epoch 70/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1001 - acc
uracy: 0.8673
Epoch 71/100
700/700 [==============================] - 1s 2ms/step - loss: 0.1001 - acc
uracy: 0.8669
Epoch 72/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0997 - acc
uracy: 0.8671
Epoch 73/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0995 - acc
uracy: 0.8700
Epoch 74/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0999 - acc
uracy: 0.8671
Epoch 75/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0998 - acc
uracy: 0.8684
Epoch 76/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0995 - acc
uracy: 0.8674
Epoch 77/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0995 - acc
uracy: 0.8673
Epoch 78/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0997 - acc
uracy: 0.8674
Epoch 79/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0995 - acc
uracy: 0.8679
Epoch 80/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0992 - acc
uracy: 0.8686
Epoch 81/100
```

```
700/700 [==============================] - 1s 2ms/step - loss: 0.0988 - acc
uracy: 0.8681
Epoch 82/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0989 - acc
uracy: 0.8701
Epoch 83/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0989 - acc
uracy: 0.8699
Epoch 84/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0991 - acc
uracy: 0.8691
Epoch 85/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0989 - acc
uracy: 0.8699
Epoch 86/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0982 - acc
uracy: 0.8711
Epoch 87/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0987 - acc
uracy: 0.8699
Epoch 88/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0985 - acc
uracy: 0.8694
Epoch 89/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0985 - acc
uracy: 0.8697
Epoch 90/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0982 - acc
uracy: 0.8706
Epoch 91/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0989 - acc
uracy: 0.8694
Epoch 92/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0984 - acc
uracy: 0.8683
Epoch 93/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0982 - acc
uracy: 0.8683
Epoch 94/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0980 - acc
uracy: 0.8686
Epoch 95/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0979 - acc
uracy: 0.8697
Epoch 96/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0977 - acc
uracy: 0.8696
Epoch 97/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0979 - acc
uracy: 0.8696
Epoch 98/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0978 - acc
uracy: 0.8710
Epoch 99/100
700/700 [==============================] - 1s 2ms/step - loss: 0.0977 - acc
uracy: 0.8697
Epoch 100/100
```

```
700/700 [==============================] - 1s 2ms/step - loss: 0.0980 - acc
uracy: 0.8694
```

```
ypred=classifier.predict(xtest)
```

```
from sklearn.metrics import r2_score
```

```
r2_score(ytest,ypred)*100
```

Output

```
29.498513365970247
```