

MAHENDRA ENGINEERING COLLEGE FOR WOMEN

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CLASS:IV YEAR-CSE

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#libraries

import pandas as pd

import numpy as np

import matplotlib.pyplot as plt

%matplotlib inline

#load dataset

df = pd.read_csv(r"/content/Churn_Modelling.csv")

df.head(10)

RowNumber CustomerId Surname CreditScore Geography Gender Age

| | | | | | | | |
|---|----|----------|----------|-----|---------|--------|----|
| 0 | 1 | 15634602 | Hargrave | 619 | France | Female | 42 |
| 1 | 2 | 15647311 | Hill | 608 | Spain | Female | 41 |
| 2 | 3 | 15619304 | Onio | 502 | France | Female | 42 |
| 3 | 4 | 15701354 | Boni | 699 | France | Female | 39 |
| 4 | 5 | 15737888 | Mitchell | 850 | Spain | Female | 43 |
| 5 | 6 | 15574012 | Chu | 645 | Spain | Male | 44 |
| 6 | 7 | 15592531 | Bartlett | 822 | France | Male | 50 |
| 7 | 8 | 15656148 | Obinna | 376 | Germany | Female | 29 |
| 8 | 9 | 15792365 | He | 501 | France | Male | 44 |
| 9 | 10 | 15592389 | H? | 684 | France | Male | 27 |

Tenure Balance NumOfProducts HasCrCard IsActiveMember \

| | | | | | |
|---|---|-----------|---|---|---|
| 0 | 2 | 0.00 | 1 | 1 | 1 |
| 1 | 1 | 83807.86 | 1 | 0 | 1 |
| 2 | 8 | 159660.80 | 3 | 1 | 0 |
| 3 | 1 | 0.00 | 2 | 0 | 0 |
| 4 | 2 | 125510.82 | 1 | 1 | 1 |
| 5 | 8 | 113755.78 | 2 | 1 | 0 |
| 6 | 7 | 0.00 | 2 | 1 | 1 |
| 7 | 4 | 115046.74 | 4 | 1 | 0 |
| 8 | 4 | 142051.07 | 2 | 0 | 1 |
| 9 | 2 | 134603.88 | 1 | 1 | 1 |

EstimatedSalary Exited

| | | |
|---|-----------|---|
| 0 | 101348.88 | 1 |
| 1 | 112542.58 | 0 |
| 2 | 113931.57 | 1 |

```
3      93826.63    0
4      79084.10    0
5      149756.71    1
6      10062.80    0
7      119346.88    1
8       74940.50    0
9       71725.73    0
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
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
```

```
#Visualizations
```

```
#Univariate Analysis
```

```
import seaborn as sns
```

```
sns.kdeplot(df['CreditScore'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fc4a0cd2790>
```

```
#Bi - Variate Analysis
```

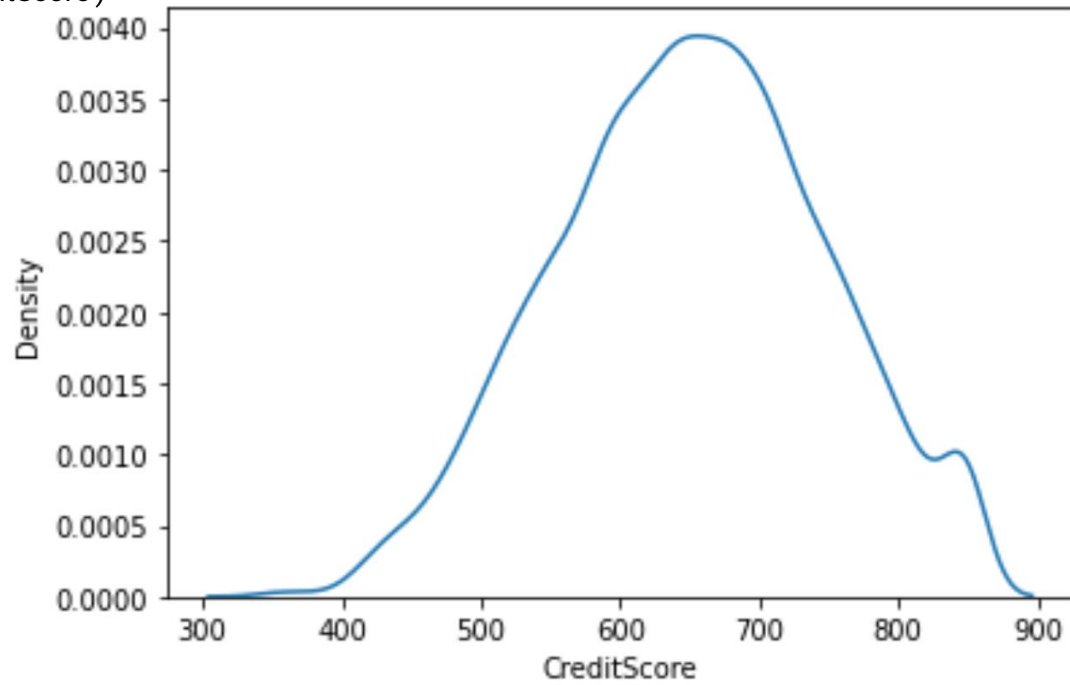
```
plt.bar(df.CustomerId, df.CreditScore)
```

```
plt.title('CreditScore')
```

```
plt.xlabel('CustomerId')
```

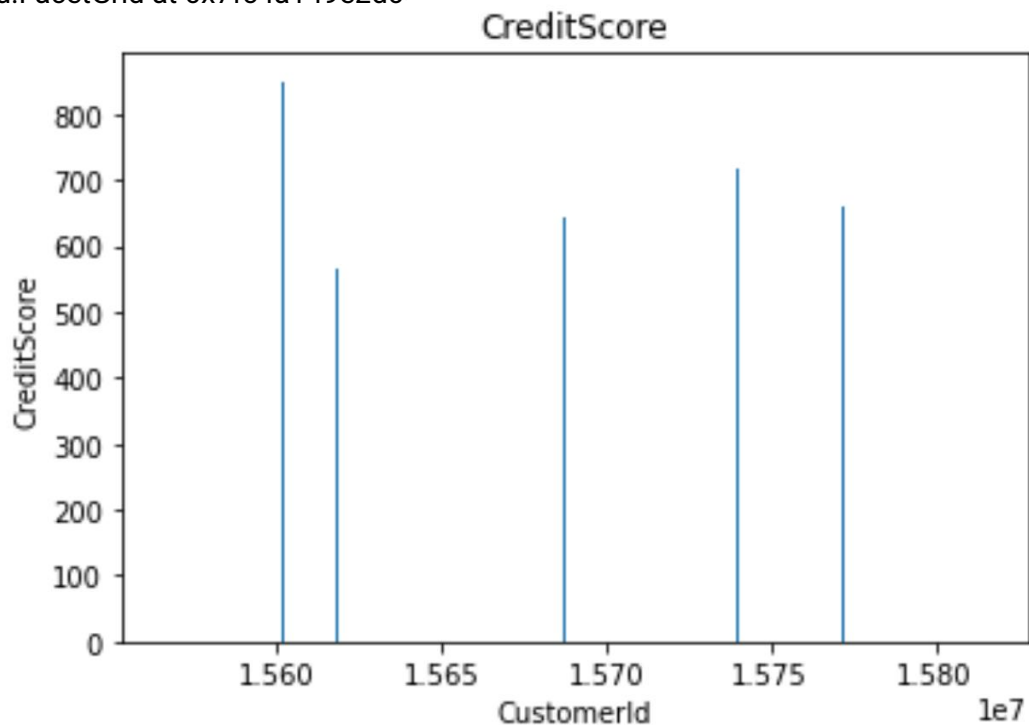
```
plt.ylabel('CreditScore')
```

```
Text(0, 0.5, 'CreditScore')
```



```
sns.lmplot(x='Tenure', y='Balance', data=df, hue='Exited', size=8)
/usr/local/lib/python3.7/dist-packages/seaborn/regression.py:581:
UserWarning: The `size` parameter has been renamed to `height`; please
update your code.
```

```
warnings.warn(msg, UserWarning)
<seaborn.axisgrid.FacetGrid at 0x7fc4a149e2d0>
```

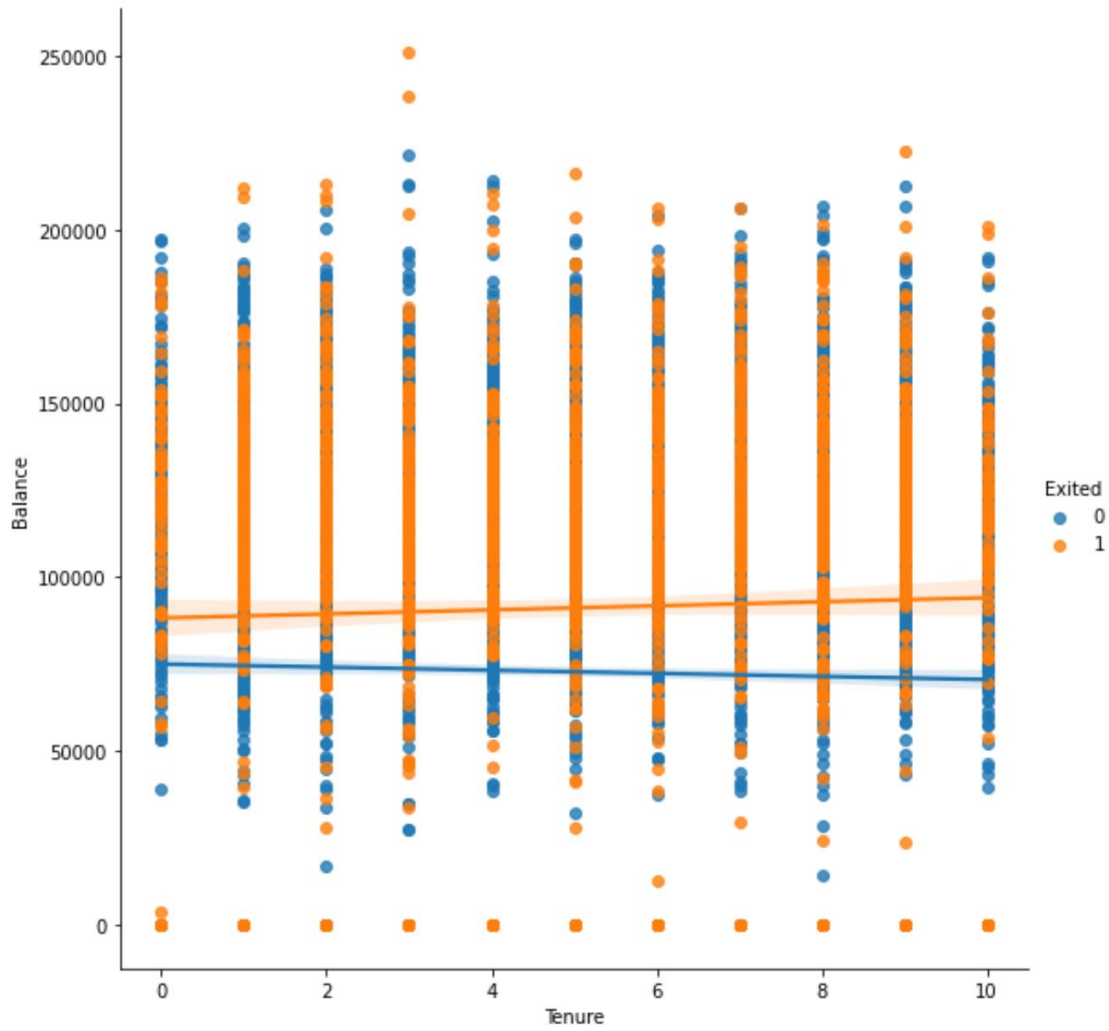


```
#Multi - Variate Analysis
```

```
ax =
```

```
df[["CreditScore","Age","Tenure","Balance"]].plot(figsize=(80,40))
```

```
ax.legend(loc='center left', bbox_to_anchor=(1, 0.5));
```



```
df.isnull().sum()
RowNumber      0
CustomerId     0
Surname        0
CreditScore    0
Geography      0
Gender         0
Age           0
Tenure        0
Balance       0
NumOfProducts 0
HasCrCard     0
IsActiveMember 0
EstimatedSalary 0
Exited        0
dtype: int64
plt.figure(figsize=(15,13))
sns.heatmap(df.corr(),annot=True,cmap='BuPu')
plt.show()
```

```
df.drop(['RowNumber', 'CustomerId', 'Surname'],axis=1,inplace=True)
```

```
df.head()
```

```
CreditScore Geography Gender Age Tenure Balance  
NumOfProducts \
```

```
0 619 France Female 42 2 0.00
```

```
1 608 Spain Female 41 1 83807.86
```

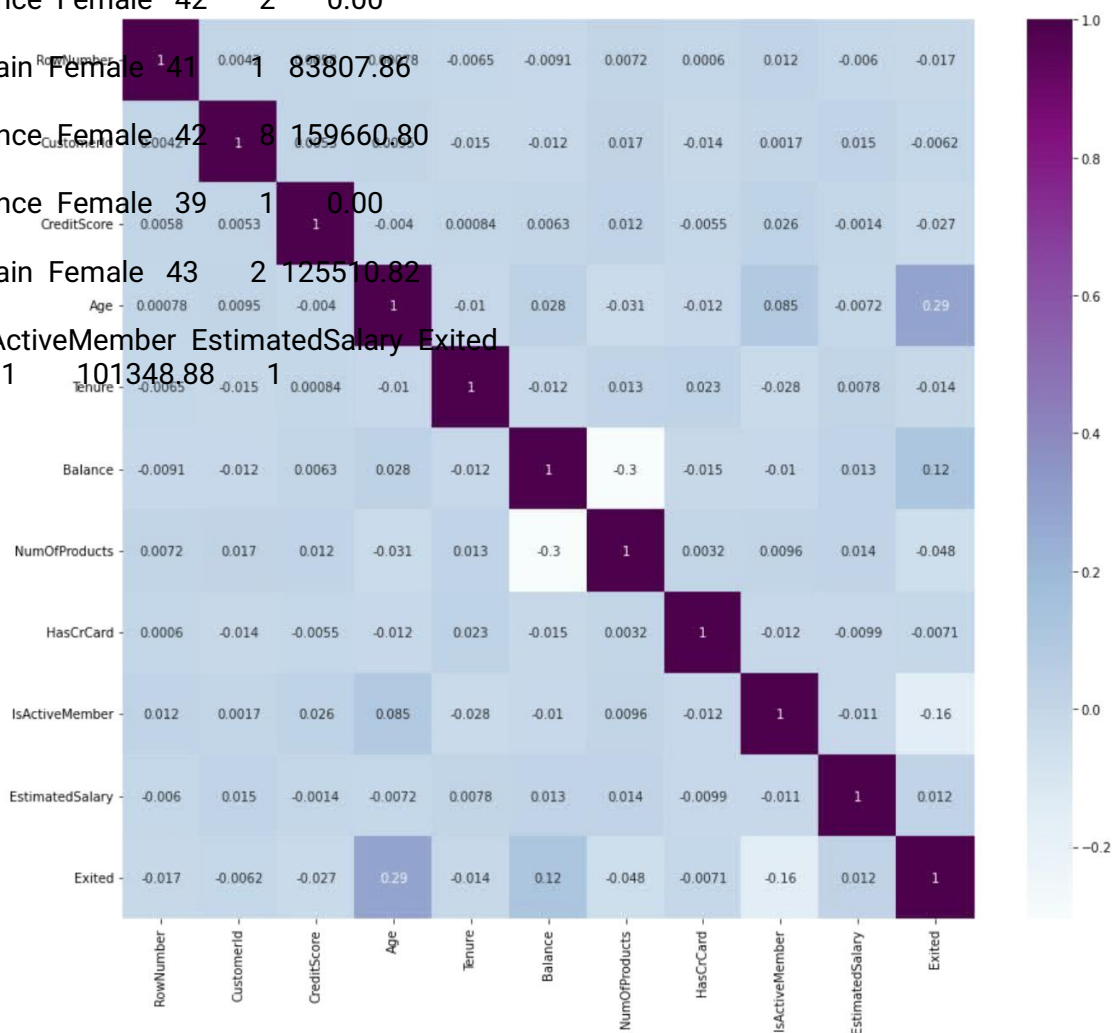
```
2 502 France Female 42 8 159660.80
```

```
3 699 France Female 39 1 0.00
```

```
4 850 Spain Female 43 2 125510.82
```

```
HasCrCard IsActiveMember EstimatedSalary Exited
```

```
0 1 1 101348.88 1
```



```

1      0      1      112542.58      0
2      1      0      113931.57      1
3      0      0      93826.63      0
4      1      1      79084.10      0
df.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 11 columns):
#   Column          Non-Null Count  Dtype
---  ---
0   CreditScore      10000 non-null  int64
1   Geography        10000 non-null  object
2   Gender           10000 non-null  object
3   Age              10000 non-null  int64
4   Tenure           10000 non-null  int64
5   Balance          10000 non-null  float64
6   NumOfProducts    10000 non-null  int64
7   HasCrCard        10000 non-null  int64
8   IsActiveMember   10000 non-null  int64
9   EstimatedSalary  10000 non-null  float64
10  Exited           10000 non-null  int64
dtypes: float64(2), int64(7), object(2)
memory usage: 859.5+ KB
df["Geography"].unique()
array(['France', 'Spain', 'Germany'], dtype=object)

df["Gender"].unique()
array(['Female', 'Male'], dtype=object)

geo=pd.get_dummies(df["Geography"],drop_first=False)

geo.head()
France  Germany  Spain
0      1      0      0
1      0      0      1
2      1      0      0
3      1      0      0
4      0      0      1

gen=pd.get_dummies(df["Gender"],drop_first=False)
df=pd.concat([df, geo, gen], axis=1)

df
   CreditScore Geography  Gender  Age  Tenure  Balance
NumOfProducts \

```


| | | | | | | |
|--|-----|---------|--------|-----------|-----|-----------|
| 0 | 619 | France | Female | 42 | 2 | 0.00 |
| 1 | | | | | | |
| 1 | 608 | Spain | Female | 41 | 1 | 83807.86 |
| 1 | | | | | | |
| 2 | 502 | France | Female | 42 | 8 | 159660.80 |
| 3 | | | | | | |
| 3 | 699 | France | Female | 39 | 1 | 0.00 |
| 2 | | | | | | |
| 4 | 850 | Spain | Female | 43 | 2 | 125510.82 |
| 1 | | | | | | |
| ... | ... | ... | ... | ... | ... | ... |
| ... | | | | | | |
| 9995 | 771 | France | Male | 39 | 5 | 0.00 |
| 2 | | | | | | |
| 9996 | 516 | France | Male | 35 | 10 | 57369.61 |
| 1 | | | | | | |
| 9997 | 709 | France | Female | 36 | 7 | 0.00 |
| 1 | | | | | | |
| 9998 | 772 | Germany | Male | 42 | 3 | 75075.31 |
| 2 | | | | | | |
| 9999 | 792 | France | Female | 28 | 4 | 130142.79 |
| 1 | | | | | | |
| HasCrCard IsActiveMember EstimatedSalary Exited France | | | | | | |
| Germany \ | | | | | | |
| 0 | 1 | | 1 | 101348.88 | 1 | 1 |
| 0 | | | | | | |
| 1 | 0 | | 1 | 112542.58 | 0 | 0 |
| 0 | | | | | | |
| 2 | 1 | | 0 | 113931.57 | 1 | 1 |
| 0 | | | | | | |
| 3 | 0 | | 0 | 93826.63 | 0 | 1 |
| 0 | | | | | | |
| 4 | 1 | | 1 | 79084.10 | 0 | 0 |
| 0 | | | | | | |
| ... | ... | | ... | ... | ... | ... |
| ... | | | | | | |
| 9995 | 1 | | 0 | 96270.64 | 0 | 1 |
| 0 | | | | | | |
| 9996 | 1 | | 1 | 101699.77 | 0 | 1 |
| 0 | | | | | | |
| 9997 | 0 | | 1 | 42085.58 | 1 | 1 |
| 0 | | | | | | |
| 9998 | 1 | | 0 | 92888.52 | 1 | 0 |
| 1 | | | | | | |
| 9999 | 1 | | 0 | 38190.78 | 0 | 1 |
| 0 | | | | | | |
| Spain Female Male | | | | | | |
| 0 | 0 | 1 | 0 | | | |

```
1 1 1 0
2 0 1 0
3 0 1 0
4 1 1 0
```

```
... ..
9995 0 0 1
9996 0 0 1
9997 0 1 0
9998 0 0 1
9999 0 1 0
```

[10000 rows x 16 columns]

```
df.drop(["Geography","Gender"], axis=1, inplace=True)
```

```
df.head()
```

```
CreditScore Age Tenure Balance NumOfProducts HasCrCard \
0 619 42 2 0.00 1 1
1 608 41 1 83807.86 1 0
2 502 42 8 159660.80 3 1
3 699 39 1 0.00 2 0
4 850 43 2 125510.82 1 1
```

```
IsActiveMember EstimatedSalary Exited France Germany Spain
Female \
```

```
0 1 101348.88 1 1 0 0
1
1 1 112542.58 0 0 0 1
1
2 0 113931.57 1 1 0 0
1
3 0 93826.63 0 1 0 0
1
4 1 79084.10 0 0 0 1
1
```

```
Male
```

```
0 0
1 0
2 0
3 0
4 0
```

```
x=df.drop('Exited',axis=1)
```

```
x
```

```
CreditScore Age Tenure Balance NumOfProducts HasCrCard \
0 619 42 2 0.00 1 1
1 608 41 1 83807.86 1 0
```

```
2      502 42      8 159660.80      3      1
3      699 39      1      0.00      2      0
4      850 43      2 125510.82      1      1
...
9995      771 39      5      0.00      2      1
9996      516 35     10 57369.61      1      1
9997      709 36      7      0.00      1      0
9998      772 42      3 75075.31      2      1
9999      792 28      4 130142.79      1      1
```

```
IsActiveMember EstimatedSalary France Germany Spain Female
Male
```

```
0      1      101348.88      1      0      0      1
0
1      1      112542.58      0      0      1      1
0
2      0      113931.57      1      0      0      1
0
3      0      93826.63      1      0      0      1
0
4      1      79084.10      0      0      1      1
0
...
...
9995      0      96270.64      1      0      0      0
1
9996      1      101699.77      1      0      0      0
1
9997      1      42085.58      1      0      0      1
0
9998      0      92888.52      0      1      0      0
1
9999      0      38190.78      1      0      0      1
0
```

```
[10000 rows x 13 columns]
```

```
y=df['Exited']
```

```
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
df.shape
(10000, 14)
x.shape
(10000, 13)
y.shape
(10000,)
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)
x_train.shape
(8000, 13)
x_test.shape
(2000, 13)
y_test.shape
(2000,)
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
x_train = sc.fit_transform(x_train)

x_train
array([[ 0.16958176, -0.46460796,  0.00666099, ...,  1.74309049,
         1.09168714, -1.09168714],
       [-2.30455945,  0.30102557, -1.37744033, ..., -0.57369368,
        -0.91601335,  0.91601335],
       [-1.19119591, -0.94312892, -1.031415 , ..., -0.57369368,
         1.09168714, -1.09168714],
       ...,
       [ 0.9015152 , -0.36890377,  0.00666099, ..., -0.57369368,
        -0.91601335,  0.91601335],
       [-0.62420521, -0.08179119,  1.39076231, ...,  1.74309049,
         1.09168714, -1.09168714],
       [-0.28401079,  0.87525072, -1.37744033, ..., -0.57369368,
         1.09168714, -1.09168714]])
x_test = sc.transform(x_test)
```

```
x_test
array([[[-0.55204276, -0.36890377, 1.04473698, ..., -0.57369368,
        1.09168714, -1.09168714],
       [-1.31490297, 0.10961719, -1.031415 , ..., -0.57369368,
        1.09168714, -1.09168714],
       [ 0.57162971, 0.30102557, 1.04473698, ..., 1.74309049,
        1.09168714, -1.09168714],
       ...,
       [-0.74791227, -0.27319958, -1.37744033, ..., 1.74309049,
        -0.91601335, 0.91601335],
       [-0.00566991, -0.46460796, -0.33936434, ..., -0.57369368,
        -0.91601335, 0.91601335],
       [-0.79945688, -0.84742473, 1.04473698, ..., -0.57369368,
        -0.91601335, 0.91601335]])
```