Assignment -2

Assignment Date	17 September 2022
Team ID	PNT2022TMID38845
Project Name	AI Based Discourse for Banking Industry
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Student Roll Number	421219104001
Maximum Marks	2 Marks

IMPORT LIBRARIES

```
import numpy as np import
pandas as pd
import matplotlib.pyplot as pltimport seaborn
as sns
```

LOADING THE DATASET

```
df = pd.read_csv('Churn_Modelling.csv', encoding='latin-1')df
```

	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	
...	...	...	...	...	...	...	...	
9995	9996	15606229	Obijiaku	771	France	Male	39	
9996	9997	15569892	Johnstone	516	France	Male	35	
9997	9998	15584532	Liu	709	France	Female	36	
9998	9999	15682355	Sabbatini	772	Germany	Male	42	
9999	10000	15628319	Walker	792	France	Female	28	

	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	
...	...	...	...	...	...	
9995	5	0.00	2	1	0	
9996	10	57369.61	1	1	1	

9997	7	0.00	1	0	1
9998	3	75075.31	2	1	0
9999	4	130142.79	1	1	0

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

[10000 rows x 14 columns]

VISUALIZATIONS

```
#visualization of categorical features
fig, ax = plt.subplots(3, 2, figsize = (15, 12))plt.title("Visualization")
sns.countplot('Geography', hue = 'Exited', data = df, ax = ax[0][0],palette='spring')
sns.countplot('Gender', hue = 'Exited', data = df, ax = ax[0][1],palette='spring')
sns.countplot('Tenure', hue = 'Exited', data = df, ax = ax[1][0],palette='spring')
sns.countplot('NumOfProducts', hue = 'Exited', data = df, ax = ax[1][1],palette='spring')
sns.countplot('HasCrCard', hue = 'Exited', data = df, ax = ax[2][0],palette='spring')
sns.countplot('IsActiveMember', hue = 'Exited', data = df, ax = ax[2][1],palette='spring')

ax[0][0].set_title('Count Plot of Geography',color='red',fontsize=15)ax[0][1].set_title('Count Plot of Gender',color='red',fontsize=15) ax[1][0].set_title('Count Plot of Tenure',color='red',fontsize=15)
ax[1][1].set_title('Count Plot of NumOfProducts',color='red',fontsize=15)
ax[2][0].set_title('Count Plot of HasCrCard',color='red',fontsize=15)ax[2][1].set_title('Count Plot of IsActiveMember',color='red',fontsize=15)

plt.tight_layout()plt.show()
```

/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in anerror or misinterpretation.

FutureWarning
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in anerror or misinterpretation.
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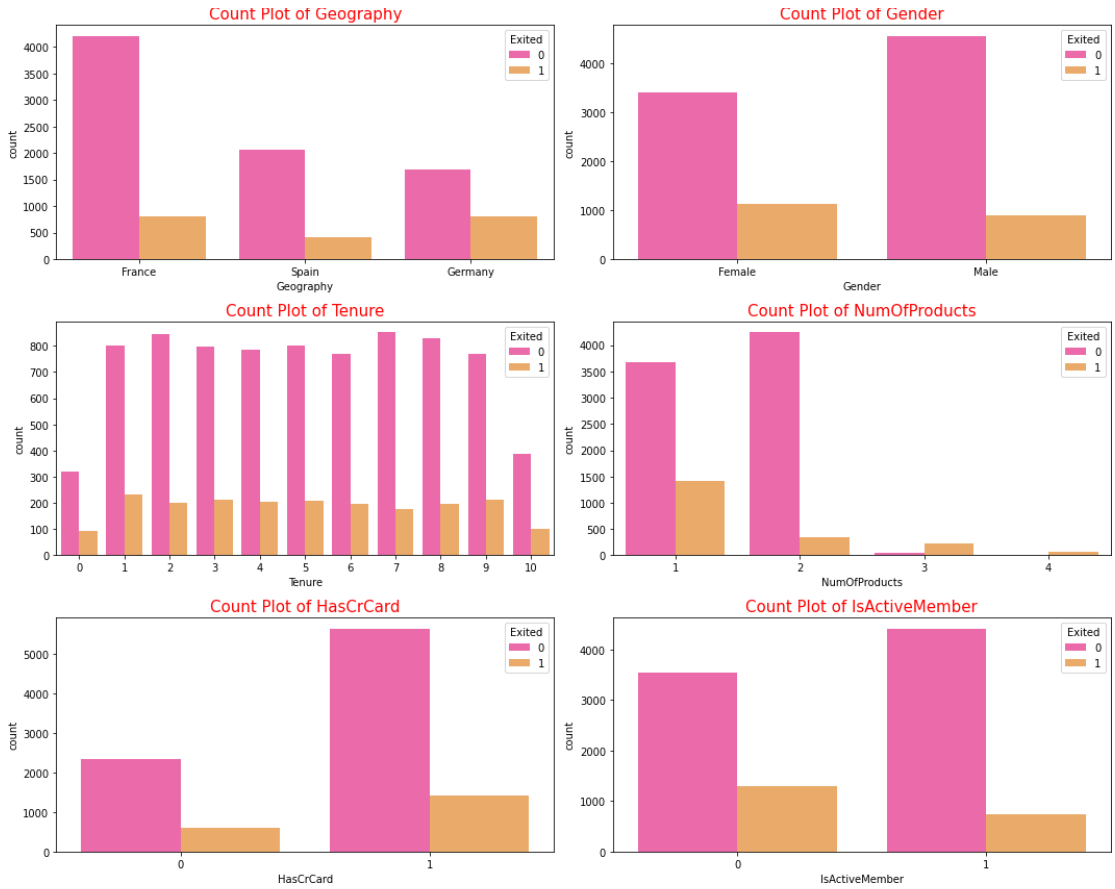
FutureWarning



DESCRIPTIVE STATISTICS

df.dtypes

RowNumber int64
CustomerId int64
Surname object
CreditScore int64
Geography object
Gender object
Age int64
Tenure int64
Balance float64
NumOfProducts int64
HasCrCard int64
IsActiveMember int64EstimatedSalary
float64Exited int64
dtype: object

df_num = df[['RowNumber','Tenure','CustomerId','CreditScore','Age','NumOfProducts','HasCrCard','IsActiveMember','Exited']]

```
df_cat = df[['Surname','Geography','Gender']]df_num.head()
```

```
   RowNumber  Tenure  CustomerId  CreditScore  Age  NumOfProducts  HasCrCard \
0          1       2    15634602          619   42              1          1
1          2       1    15647311          608   41              1          0
2          3       8    15619304          502   42              3          1
3          4       1    15701354          699   39              2          0
4          5       2    15737888          850   43              1          1

   IsActiveMember  Exited
0               1       1
1               1       0
2               0       1
3               0       0
4               1       0
```

```
df_cat.head()
```

```
   Surname Geography  Gender
0  Hargrave    France  Female
1      Hill     Spain  Female
2      Onio    France  Female
3      Boni    France  Female
4  Mitchell     Spain  Female
```

```
df_num.describe()
```

```
         RowNumber       Tenure    CustomerId   CreditScore  \
Age  \
count  10000.00000  10000.000000  1.000000e+04  10000.000000
10000.000000
mean    5000.50000      5.012800  1.569094e+07    650.528800
38.921800
std     2886.89568      2.892174  7.193619e+04     96.653299
10.487806
min        1.00000      0.000000  1.556570e+07    350.000000
18.000000
25%     2500.75000      3.000000  1.562853e+07    584.000000
32.000000
50%     5000.50000      5.000000  1.569074e+07    652.000000
37.000000
75%     7500.25000      7.000000  1.575323e+07    718.000000
44.000000
max    10000.00000     10.000000  1.581569e+07    850.000000
```

92.000000

	NumOfProducts	HasCrCard	IsActiveMember	Exited
count	10000.000000	10000.00000	10000.000000	10000.000000
mean	1.530200	0.70550	0.515100	0.203700
std	0.581654	0.45584	0.499797	0.402769
min	1.000000	0.00000	0.000000	0.000000
25%	1.000000	0.00000	0.000000	0.000000
50%	1.000000	1.00000	1.000000	0.000000
75%	2.000000	1.00000	1.000000	0.000000
max	4.000000	1.00000	1.000000	1.000000

df_cat.describe(exclude = ['int64','float64'])Surname Geography Gender

count	10000	10000	10000
unique	2932	3	2
top	Smith	France	Male
freq	32	5014	5457

HANDLE THE MISSING VALUES

print("Column Missing values")print("-----------------------")
df.isnull().sum()

Column	Missing values
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

print(f"Our target variable is Exited. We can observe that it has onlytwo possible variables: {df['Exited'].unique().tolist()}")

Our target variable is Exited. We can observe that it has only twopossible variables: [1, 0]

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

```
new_names = {
        'CreditScore': 'credit_score','Geography':
        'country', 'Gender': 'gender',
        'Age': 'age',
        'Tenure': 'tenure', 'Balance':
        'balance',
        'NumOfProducts': 'number_products', 'HasCrCard':
        'owns_credit_card', 'IsActiveMember': 'is_active_member',
        'EstimatedSalary': 'estimated_salary','Exited': 'exited'
}

df.rename(columns=new_names, inplace=True)df.head()
```

	credit_score	country	gender	age	tenure	balance	number_products	\
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	

	owns_credit_card	is_active_member	estimated_salary	exited0	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	

REPLACE OUTLIERS

```
def detect_outlier(df):
  outlier = [] threshold   =
  3 mean = np.mean(df)std =
  np.std(df) for i in df:
          z_score = (i - mean)/std
  if np.abs(z_score)>threshold:
        outlier.append(i)
  return outlier
  CreditScore_list = df['CreditScore'].tolist()Balance_list =
  df['Balance'].tolist()
```

```
EstimatedSalary_list = df_cat['EstimatedSalary'].tolist()CreditScore_outlier =
detect_outlier(CreditScore_list) CreditScore_outlier
Output-[359, 350, 350, 358, 351, 350, 350, 350]
Balance_outlier = detect_outlier(Balance_list)Balance_outlier
EstimatedSalary_outlier = detect_outlier(EstimatedSalary_list)
EstimatedSalary_outlier

print("Shape of Data before removing outliers: {}".format(df.shape))Shape of Data before removing
```

outliers: (10000, 11)

ENCODING

```
# Encoding Categorical variables into numerical variables# One Hot Encoding

x = pd.get_dummies(x)x.head()
x.shape
```

(10000, 13)

SPLIT THE DATA INTO DEPENDENT AND INDEPENDENT VARIALBLES

```
# splitting the dataset into x(independent variables) and y(dependentvariables)

x = df.iloc[:,0:10]
y = df.iloc[:,10]

print(x.shape)
print(y.shape)

print(x.columns)
#print(y)
```

```
(10000, 10)
(10000,)
Index(['credit_score', 'country', 'gender', 'age', 'tenure','balance',
       'number_products', 'owns_credit_card', 'is_active_member','estimated_salary'],
      dtype='object')
```

SCALE THE INDEPENDENT VARIABLES

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

```
x_train = pd.DataFrame(x_train)
x_train.head()
```

	credit_score	country	gender	age	tenure	balance	number_products
2967	579	Germany	Female	39	5	117833.30	3
700	750	France	Female	32	5	0.00	2
3481	729	Spain	Female	34	9	53299.96	2
1621	689	Spain	Male	38	5	75075.14	1
800	605	France	Male	52	7	0.00	2

	owns_credit_card	is_active_member	estimated_salary
2967	0	0	5831.00
700	1	0	95611.47
3481	1	1	42855.97
1621	1	1	8651.92
800	1	1	173952.50

SPLIT THE DATA INTO TRAINING AND TESTING

```
# splitting the data into training and testing set

from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size =0.25, random_state = 0)

print(x_train.shape)
print(y_train.shape)
print(x_test.shape)
print(y_test.shape)
```

```
(7500, 10)
(7500,)
(2500, 10)
(2500,)
```