Assignment -2

Assignment Date	17 September 2022
Team ID	PNT2022TMID38845
Project Name	AI Based Discourse for Banking Industry
Student Name	Senbagam J
Student Roll Number	421219104015
Maximum Marks	2 Marks

IMPORT LIBRARIES

```
import numpy as np import pandas
as pd
import matplotlib.pyplot as plt import 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

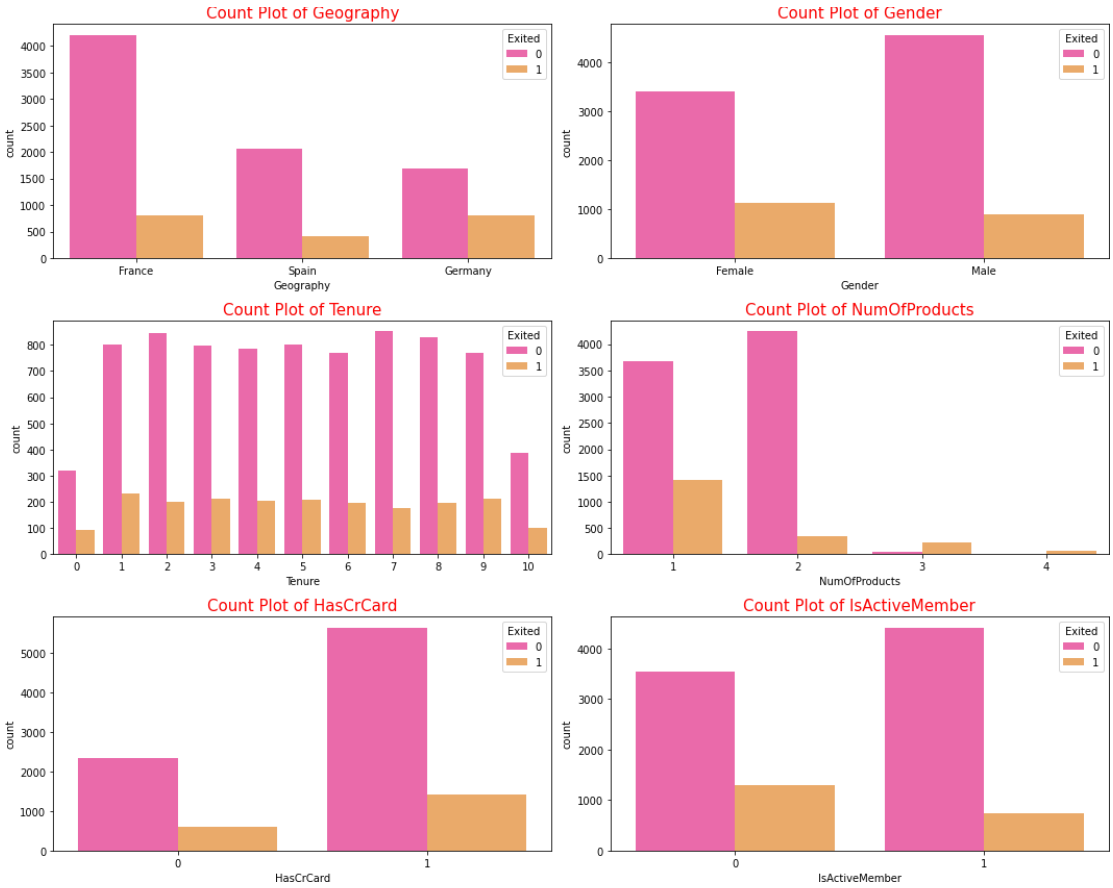
```
#visualization of categorical features
fig, ax = plt.subplots(3, 2, figsize = (15, 12)) plt.title("Visualization")
sns.countplot('Geography', hue = 'Exited', data = df, ax = ax[0] [0],palette='spring')
sns.countplot('Gender', hue = 'Exited', data = df, ax = ax[0] [1],palette='spring')
sns.countplot('Tenure', 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 an error 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 an error 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 an error 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 an error 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 an error 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 an error or misinterpretation.
  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 int64 EstimatedSalary float64 Exited 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
```

HANDLE`freq` THE MISSING`32` VALUES`5014 5457`

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 only two possible variables:
{df['Exited'].unique().tolist()}")
```

Our target variable is Exited. We can observe that it has only two possible 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	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		

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(dependent variables)

```
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 StandardScaler sc = 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,)
```