IMPORTING THE LIBRARIES

```
import pandas as pd  # Import Pandas for data manipulation
import matplotlib.pyplot as plt  # Import Matplotlib for plotting
import numpy as np  # Import NumPy for numerical computations
import seaborn as sea  # Import Seaborn for data visualization
from sklearn.preprocessing import LabelEncoder  # Import LabelEncoder
for encoding categorical variables
from sklearn.model_selection import train_test_split  # Import
train_test_split for splitting data into training and testing sets
from sklearn.linear_model import LogisticRegression  # Import
LogisticRegression for building a logistic regression model
from sklearn.metrics import accuracy_score  # Import accuracy_score
for evaluating model performance
import warnings  # Import warnings module
warnings.filterwarnings("ignore")  # Ignore any warnings
```

GATHERING THE DATA

```
# Reading the CSV file into a DataFrame named df
df=pd.read_csv("PS_20174392719_1491204439457_log.csv")

# Displaying the first few rows of the DataFrame df
df.head()
```

```
   step      type    amount     nameOrig  oldbalanceOrg
newbalanceOrig  \
0     1   PAYMENT   9839.64  C1231006815       170136.0
160296.36
1     1   PAYMENT   1864.28  C1666544295        21249.0
19384.72
2     1  TRANSFER    181.00  C1305486145          181.0
0.00
3     1  CASH_OUT    181.00   C840083671          181.0
0.00
4     1   PAYMENT  11668.14  C2048537720        41554.0
29885.86

      nameDest  oldbalanceDest  newbalanceDest  isFraud
isFlaggedFraud
0  M1979787155             0.0             0.0        0
0
1  M2044282225             0.0             0.0        0
0
2   C553264065             0.0             0.0        1
0
```

```
3    C38997010         21182.0              0.0        1
0
4  M1230701703             0.0              0.0        0
0
```

ANALYSIS ON DATA

```
# Obtaining the dimensions of the DataFrame df (number of rows, number
of columns)
df.shape
```

```
(6362620, 11)
```

```
# Displaying concise summary information about the DataFrame df
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6362620 entries, 0 to 6362619
Data columns (total 11 columns):
 #   Column          Dtype
---  ------          -----
 0   step            int64
 1   type            object
 2   amount          float64
 3   nameOrig        object
 4   oldbalanceOrg   float64
 5   newbalanceOrig  float64
 6   nameDest        object
 7   oldbalanceDest  float64
 8   newbalanceDest  float64
 9   isFraud         int64
 10  isFlaggedFraud  int64
dtypes: float64(5), int64(3), object(3)
memory usage: 534.0+ MB
```

```
# Counting the occurrences of each unique value in the 'isFraud'
column
# 0 represents non-fraudulent transactions, while 1 represents
fraudulent transactions
df["isFraud"].value_counts()
```

```
isFraud
0    6354407
1       8213
Name: count, dtype: int64
```

```
# Filtering the DataFrame to separate non-fraudulent transactions
non_fraud = df[df["isFraud"] == 0]
```

```
# Filtering the DataFrame to separate fraudulent transactions
fraud = df[df["isFraud"] == 1]

# Sampling non-fraudulent transactions to create a subset with the
same number of entries as fraudulent transactions
is_fraud_1 = non_fraud.sample(n=8213)

# Counting the occurrences of each unique value in the 'isFraud'
column in the subset
is_fraud_1["isFraud"].value_counts()
```

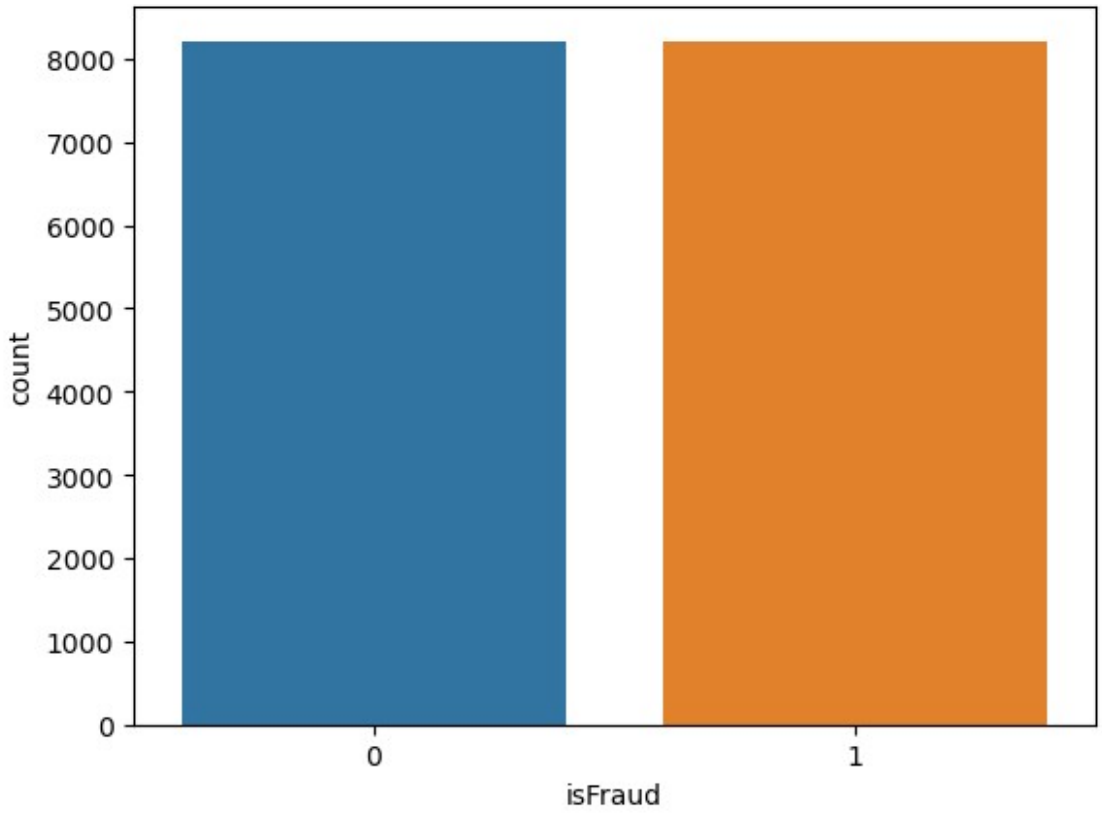
```
isFraud
0    8213
Name: count, dtype: int64
```

```
# Concatenating the subsets of non-fraudulent transactions
(is_fraud_1) and fraudulent transactions (fraud) along axis 0 (rows)
df_new = pd.concat([is_fraud_1, fraud], axis=0)

# Counting the occurrences of each unique value in the 'isFraud'
column in the concatenated DataFrame
df_new["isFraud"].value_counts()
```

```
isFraud
0    8213
1    8213
Name: count, dtype: int64
```

```
# Creating a count plot using Seaborn to visualize the distribution of
the 'isFraud' column in the DataFrame df_new
sea.countplot(x="isFraud", data=df_new)
```

```
<Axes: xlabel='isFraud', ylabel='count'>
```




```
# Obtaining the dimensions of the DataFrame df_new (number of rows,
number of columns)
df_new.shape
```

```
(16426, 11)
```

```
df_new
```

```
         step      type      amount     nameOrig  oldbalanceOrg  \
5622836   395   PAYMENT    31194.41   C749525941           0.00
5834302   402   CASH_IN    32317.84  C1162443235     1104539.18
4407058   322  CASH_OUT   322886.03  C1764906350        7226.00
3992938   298   CASH_IN   174191.76  C2062745761     2428376.15
376901     17  CASH_OUT   204443.55  C1713153259           0.00
...       ...       ...         ...          ...            ...
6362615   743  CASH_OUT   339682.13   C786484425      339682.13
6362616   743  TRANSFER  6311409.28  C1529008245     6311409.28
6362617   743  CASH_OUT  6311409.28  C1162922333     6311409.28
6362618   743  TRANSFER   850002.52  C1685995037      850002.52
6362619   743  CASH_OUT   850002.52  C1280323807      850002.52

         newbalanceOrig     nameDest  oldbalanceDest  newbalanceDest
isFraud  \
5622836            0.00   M520808676            0.00            0.00
0
```

```
5834302      1136857.01   C848102384      1159185.62      1126867.79
0
4407058            0.00   C567452972            0.00       322886.03
0
3992938      2602567.91   C753008293       792441.17       618249.41
0
376901             0.00  C1258007166       387534.91       591978.46
0
...                 ...          ...             ...             ...
...
6362615            0.00   C776919290            0.00       339682.13
1
6362616            0.00  C1881841831            0.00            0.00
1
6362617            0.00  C1365125890        68488.84      6379898.11
1
6362618            0.00  C2080388513            0.00            0.00
1
6362619            0.00   C873221189      6510099.11      7360101.63
1

         isFlaggedFraud
5622836               0
5834302               0
4407058               0
3992938               0
376901                0
...                 ...
6362615               0
6362616               0
6362617               0
6362618               0
6362619               0

[16426 rows x 11 columns]
```

```
# Resetting the index of the DataFrame df_new inplace
df_new.reset_index(inplace=True)

# Displaying the DataFrame df_new after resetting the index
df_new
```

```
         index  step      type      amount     nameOrig  oldbalanceOrg
\
0      5622836   395   PAYMENT    31194.41   C749525941            0.00

1      5834302   402   CASH_IN    32317.84  C1162443235      1104539.18

2      4407058   322  CASH_OUT   322886.03  C1764906350         7226.00
```

```
3      3992938   298   CASH_IN   174191.76  C2062745761     2428376.15

4       376901    17  CASH_OUT   204443.55  C1713153259           0.00

...        ...   ...       ...         ...          ...           ...

16421  6362615   743  CASH_OUT   339682.13   C786484425      339682.13

16422  6362616   743  TRANSFER  6311409.28  C1529008245     6311409.28

16423  6362617   743  CASH_OUT  6311409.28  C1162922333     6311409.28

16424  6362618   743  TRANSFER   850002.52  C1685995037      850002.52

16425  6362619   743  CASH_OUT   850002.52  C1280323807      850002.52


       newbalanceOrig     nameDest  oldbalanceDest  newbalanceDest
isFraud  \
0                0.00   M520808676            0.00            0.00
0
1          1136857.01   C848102384      1159185.62      1126867.79
0
2                0.00   C567452972            0.00       322886.03
0
3          2602567.91   C753008293       792441.17       618249.41
0
4                0.00  C1258007166       387534.91       591978.46
0
...               ...          ...             ...             ...
...
16421            0.00   C776919290            0.00       339682.13
1
16422            0.00  C1881841831            0.00            0.00
1
16423            0.00  C1365125890        68488.84      6379898.11
1
16424            0.00  C2080388513            0.00            0.00
1
16425            0.00   C873221189      6510099.11      7360101.63
1

       isFlaggedFraud
0                   0
1                   0
2                   0
3                   0
4                   0
...               ...
16421               0
```

```
16422                0
16423                0
16424                0
16425                0

[16426 rows x 12 columns]
```

```
# Dropping the 'index' column from the DataFrame df_new along axis 1 (columns)
df_new.drop("index", axis=1, inplace=True)

# Dropping the 'nameOrig' column from the DataFrame df_new along axis 1 (columns)
df_new.drop("nameOrig", axis=1, inplace=True)

# Dropping the 'nameDest' column from the DataFrame df_new along axis 1 (columns)
df_new.drop("nameDest", axis=1, inplace=True)

# Counting the occurrences of each unique value in the 'type' column of the DataFrame df_new
df_new["type"].value_counts()
```

```
type
CASH_OUT    6974
TRANSFER    4799
PAYMENT     2835
CASH_IN     1777
DEBIT         41
Name: count, dtype: int64
```

```
# Counting the occurrences of each unique value in the 'step' column of the DataFrame df_new
df_new["step"].value_counts()
```

```
step
212    91
19     86
18     81
43     80
306    79
       ..
29      4
708     4
28      4
662     2
112     2
Name: count, Length: 743, dtype: int64
```

```
df_new.head()
```

```
   step      type     amount  oldbalanceOrg  newbalanceOrig
oldbalanceDest  \
0   395   PAYMENT   31194.41           0.00            0.00
0.00
1   402   CASH_IN   32317.84     1104539.18      1136857.01
1159185.62
2   322  CASH_OUT  322886.03        7226.00            0.00
0.00
3   298   CASH_IN  174191.76     2428376.15      2602567.91
792441.17
4    17  CASH_OUT  204443.55           0.00            0.00
387534.91

   newbalanceDest  isFraud  isFlaggedFraud
0            0.00        0               0
1      1126867.79        0               0
2       322886.03        0               0
3       618249.41        0               0
4       591978.46        0               0
```

```
# Displaying concise summary information about the DataFrame df_new
df_new.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 16426 entries, 0 to 16425
Data columns (total 9 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   step            16426 non-null  int64
 1   type            16426 non-null  object
 2   amount          16426 non-null  float64
 3   oldbalanceOrg   16426 non-null  float64
 4   newbalanceOrig  16426 non-null  float64
 5   oldbalanceDest  16426 non-null  float64
 6   newbalanceDest  16426 non-null  float64
 7   isFraud         16426 non-null  int64
 8   isFlaggedFraud  16426 non-null  int64
dtypes: float64(5), int64(3), object(1)
memory usage: 1.1+ MB
```

```
# Generating descriptive statistics for numerical columns in the
DataFrame df_new
df_new.describe()
```

```
                step        amount  oldbalanceOrg  newbalanceOrig  \
count  16426.000000  1.642600e+04    1.642600e+04    1.642600e+04
mean     304.789419  8.195891e+05    1.227894e+06    5.104432e+05
std      193.564031  1.846487e+06    3.241269e+06    2.483640e+06
min        1.000000  0.000000e+00    0.000000e+00    0.000000e+00
25%      161.000000  3.707424e+04    1.022400e+04    0.000000e+00
```

```
50%      282.000000  1.711097e+05   1.184629e+05    0.000000e+00
75%      408.000000  5.402709e+05   7.734583e+05    0.000000e+00
max      743.000000  1.362836e+07   5.958504e+07    4.958504e+07
```

```
       oldbalanceDest  newbalanceDest       isFraud  isFlaggedFraud
count    1.642600e+04    1.642600e+04  16426.000000    16426.000000
mean     8.111774e+05    1.236932e+06      0.500000        0.000974
std      3.376082e+06    3.724865e+06      0.500015        0.031196
min      0.000000e+00    0.000000e+00      0.000000        0.000000
25%      0.000000e+00    0.000000e+00      0.000000        0.000000
50%      0.000000e+00    1.136763e+05      0.500000        0.000000
75%      5.011579e+05    1.097598e+06      1.000000        0.000000
max      2.362305e+08    2.367265e+08      1.000000        1.000000
```

```
# Calculating the sum of missing values for each column in the
DataFrame df_new
df_new.isna().sum()
```

```
step              0
type              0
amount            0
oldbalanceOrg     0
newbalanceOrig    0
oldbalanceDest    0
newbalanceDest    0
isFraud           0
isFlaggedFraud    0
dtype: int64
```

```
# Initialize LabelEncoder object
lb = LabelEncoder()

# Using the initialized LabelEncoder to transform the "type" column
into numerical labels
type_label = lb.fit_transform(df_new["type"])

# Displaying the transformed labels
type_label
```

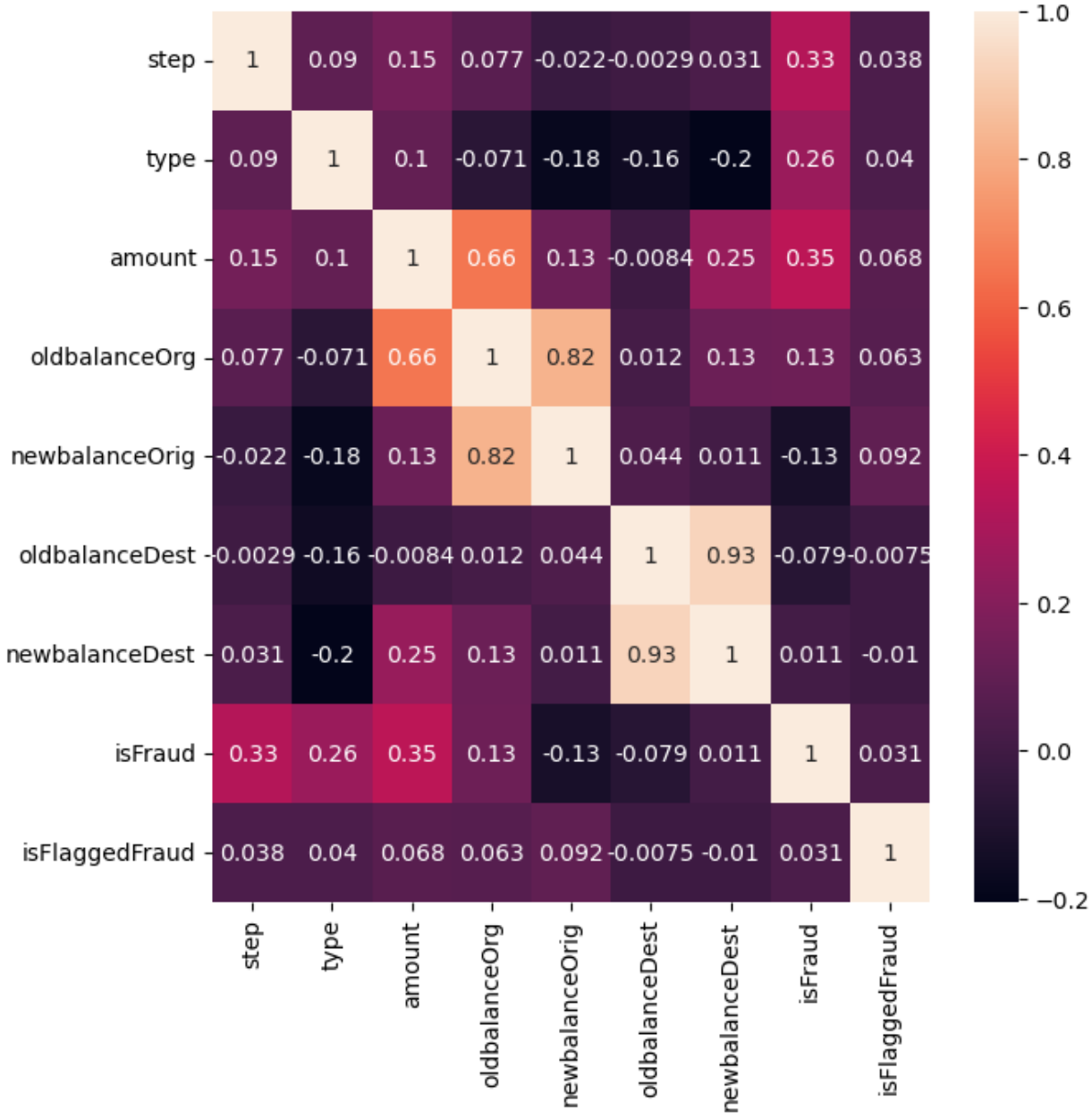
```
array([3, 0, 1, ..., 1, 4, 1])
```

```
# Assigning the transformed numerical labels to the "type" column of
the DataFrame df_new
df_new["type"] = type_label

# Displaying the updated DataFrame df_new with the "type" column
transformed to numerical labels
df_new
```

```
       step  type      amount  oldbalanceOrg  newbalanceOrig
oldbalanceDest  \
```

```
0       395     3    31194.41           0.00            0.00
0.00
1       402     0    32317.84     1104539.18      1136857.01
1159185.62
2       322     1   322886.03        7226.00            0.00
0.00
3       298     0   174191.76     2428376.15      2602567.91
792441.17
4        17     1   204443.55           0.00            0.00
387534.91
...     ...   ...         ...            ...             ...
...
16421   743     1   339682.13      339682.13            0.00
0.00
16422   743     4  6311409.28     6311409.28            0.00
0.00
16423   743     1  6311409.28     6311409.28            0.00
68488.84
16424   743     4   850002.52      850002.52            0.00
0.00
16425   743     1   850002.52      850002.52            0.00
6510099.11

       newbalanceDest  isFraud  isFlaggedFraud
0                0.00        0               0
1          1126867.79        0               0
2           322886.03        0               0
3           618249.41        0               0
4           591978.46        0               0
...               ...      ...             ...
16421       339682.13        1               0
16422            0.00        1               0
16423      6379898.11        1               0
16424            0.00        1               0
16425      7360101.63        1               0

[16426 rows x 9 columns]

# Computing the pairwise correlation of columns in the DataFrame
df_new
df_corr = df_new.corr()

# Creating a figure and axis for the heatmap plot with specified
figsize
fig, ax = plt.subplots(figsize=(7, 7))

# Generating a heatmap of the correlation matrix with Seaborn
# annot=True displays the correlation values on the heatmap
sea.heatmap(df_corr, ax=ax, annot=True)
```

```
# Displaying the heatmap
plt.show()
```




```
# Counting the occurrences of each unique value in the 'type' column
of the DataFrame df_new
df_new["type"].value_counts()
```

```
type
1    6974
4    4799
3    2835
```

```
0    1777
2      41
Name: count, dtype: int64

# Assigning features (independent variables) to the variable x
x = df_new.iloc[:, :-2]

# Assigning the target variable (dependent variable) to the variable y
y = df_new["isFraud"]

# Displaying the features (independent variables) x
x
```

```
       step  type      amount  oldbalanceOrg  newbalanceOrig
oldbalanceDest  \
0       395     3    31194.41           0.00            0.00
0.00
1       402     0    32317.84     1104539.18      1136857.01
1159185.62
2       322     1   322886.03        7226.00            0.00
0.00
3       298     0   174191.76     2428376.15      2602567.91
792441.17
4        17     1   204443.55           0.00            0.00
387534.91
...     ...   ...         ...            ...             ...
...
16421   743     1   339682.13      339682.13            0.00
0.00
16422   743     4  6311409.28     6311409.28            0.00
0.00
16423   743     1  6311409.28     6311409.28            0.00
68488.84
16424   743     4   850002.52      850002.52            0.00
0.00
16425   743     1   850002.52      850002.52            0.00
6510099.11
```

```
       newbalanceDest
0                0.00
1          1126867.79
2           322886.03
3           618249.41
4           591978.46
...               ...
16421       339682.13
16422            0.00
16423      6379898.11
16424            0.00
16425      7360101.63
```

```
[16426 rows x 7 columns]
```

```
# Splitting the data into training and testing sets
# x_train: features for training
# x_test: features for testing
# y_train: target variable for training
# y_test: target variable for testing
# stratify=y ensures that the proportion of classes in the target
variable is similar in both training and testing sets
# test_size=0.2 specifies that 20% of the data will be used for
testing
# random_state=3 sets the random seed for reproducibility
x_train, x_test, y_train, y_test = train_test_split(x, y, stratify=y,
test_size=0.2, random_state=3)
```

CHOOSING THE MODEL

```
# Initializing a Logistic Regression model
lr = LogisticRegression()

# Fitting the Logistic Regression model to the training data
lr.fit(x_train, y_train)
```

```
LogisticRegression()
```

```
# Predicting the target variable using the trained model on the
training data
x_train_pred = lr.predict(x_train)

# Calculating the accuracy of the predictions on the training data
x_train_accuracy = accuracy_score(x_train_pred, y_train)

# Printing the accuracy score
print("Training Accuracy:", x_train_accuracy)
```

```
Training Accuracy: 0.9035007610350076
```

```
# Predicting the target variable using the trained model on the
testing data
x_test_pred = lr.predict(x_test)

# Calculating the accuracy of the predictions on the testing data
x_test_accuracy = accuracy_score(x_test_pred, y_test)

# Printing the accuracy score
print("Testing Accuracy:", x_test_accuracy)
```

```
Testing Accuracy: 0.8995739500912964
```

PREDICTION WITH EXAMPLE INPUT DATA

```
# Example input data including all relevant features
input_data = (1, "CASH_OUT", 181, 181, 0, 21182, 0)

# Mapping of transaction types to numerical values
transaction_type_mapping = {
    'CASH_IN': 0,
    'CASH_OUT': 1,
    'DEBIT': 2,
    'PAYMENT': 3,
    'TRANSFER': 4
}

# Map transaction type to numerical value
input_data_list = list(input_data)
input_data_list[1] = transaction_type_mapping[input_data_list[1]]

# Convert to numpy array
temp = np.array(input_data_list).reshape(1, -1)

# Predict using the logistic regression model
prediction = lr.predict(temp)

# Print the prediction result
if prediction[0] == 1:
    print("FRAUD")
else:
    print("NOT FRAUD")
```

```
FRAUD
```