In [1]:
```
import pandas as pd
import numpy as np
```

In [2]:
```
data = pd.read_csv("Credit_crad_data.csv")
print(data.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
```

In [3]:
```
##Check for any NULls in Data
```

In [4]:
```
print(data.isnull().sum())
```

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

Data set doesn't have any NULLs

In [5]:
```
#Check transaction Types
```

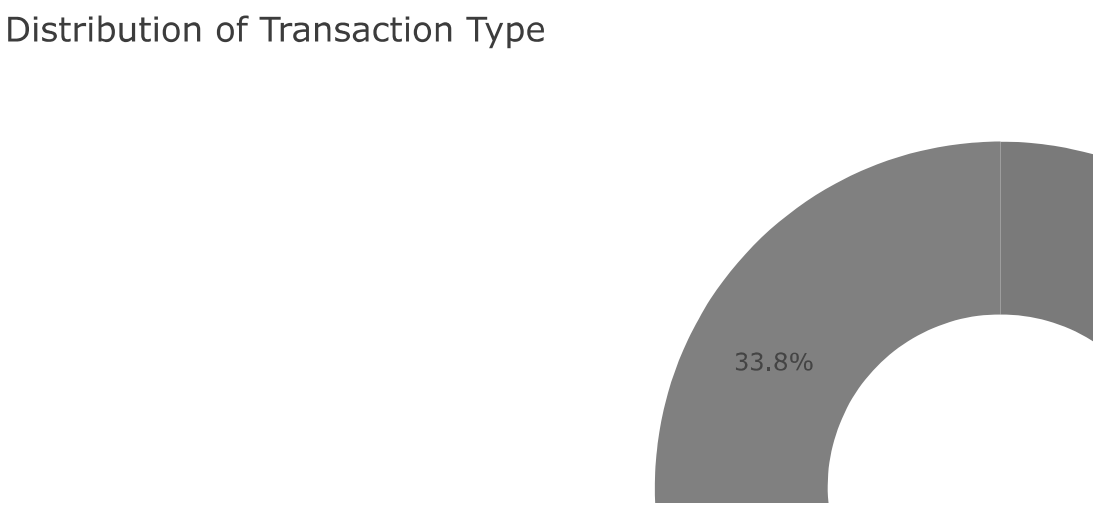
In [6]:
```
print(data.type.value_counts())
```

```
type
CASH_OUT    2237500
PAYMENT     2151495
CASH_IN     1399284
TRANSFER     532909
DEBIT         41432
Name: count, dtype: int64
```

In [7]:
```
#check Distribution of Transaction types.
```

In [8]:
```
type = data["type"].value_counts()
transactions = type.index
quantity = type.values
```

```
import plotly.express as px
figure = px.pie(data,
             values=quantity,
             names=transactions,hole = 0.5,
             title="Distribution of Transaction Type")
figure.show()
```



In [9]:
```
# Drop type & object columns to Check correlation
data_num = data.drop(columns=["type"])
data_num = data_num.select_dtypes(exclude=['object'])
```

In [10]:
```
#Describe after dropping columns
print(data_num.dtypes)
```

```
step              int64
amount          float64
oldbalanceOrg   float64
newbalanceOrig  float64
oldbalanceDest  float64
newbalanceDest  float64
isFraud           int64
isFlaggedFraud    int64
dtype: object
```

In [11]:
```
#Checking correlation
correlation = data_num.corr()
```

```
print(correlation["isFraud"].sort_values(ascending=False))
```

```
isFraud           1.000000
amount            0.076688
isFlaggedFraud    0.044109
step              0.031578
oldbalanceOrg     0.010154
newbalanceDest    0.000535
oldbalanceDest   -0.005885
newbalanceOrig   -0.008148
Name: isFraud, dtype: float64
```

In summary IsFruad has Week possitive correraltion with Amount,isFlaggedFraud and Step , Very week to negligeble positive correlation with rest of the features.

Convert categorical features into numerical

In [12]:
```
data["type"] = data["type"].map({"CASH_OUT": 1, "PAYMENT": 2,
                                 "CASH_IN": 3, "TRANSFER": 4,
                                 "DEBIT": 5})
print(data.head())
```

```
   step  type    amount     nameOrig  oldbalanceOrg  newbalanceOrig  \
0     1     2   9839.64  C1231006815       170136.0       160296.36
1     1     2   1864.28  C1666544295        21249.0        19384.72
2     1     4    181.00  C1305486145          181.0            0.00
3     1     1    181.00   C840083671          181.0            0.00
4     1     2  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
```

In [13]:
```
data["isFraud"] = data["isFraud"].map({0: "No Fraud", 1: "Fraud"})
print(data.head())
```

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

      nameDest  oldbalanceDest  newbalanceDest   isFraud  isFlaggedFraud
0  M1979787155             0.0             0.0  No Fraud               0
1  M2044282225             0.0             0.0  No Fraud               0
2   C553264065             0.0             0.0     Fraud               0
3    C38997010         21182.0             0.0     Fraud               0
4  M1230701703             0.0             0.0  No Fraud               0
```

Fraud Detection Model

In [14]:
```
#Split the data into Training and test
```

In [15]:
```
from sklearn.model_selection import train_test_split
x = np.array(data[["type", "amount", "oldbalanceOrg", "newbalanceOrig"]])
y = np.array(data[["isFraud"]])
```

In [16]:
```
# ML Model Training - Decision tree classifier
```

In [17]:
```
from sklearn.tree import DecisionTreeClassifier
xtrain, xtest, ytrain, ytest = train_test_split(x, y, test_size=0.20, random_state=42)
model = DecisionTreeClassifier()
model.fit(xtrain, ytrain)
print(model.score(xtest, ytest))
```

```
0.999704524236871
```

In [18]:
```
# Model cross validation , Hyperparameter tuning
```

In [19]:
```
from sklearn.model_selection import cross_val_score, GridSearchCV

# Cross-validation model evaluation
cv_scores = cross_val_score(model, x, y, cv=5)  # Perform 5-fold cross-validation
print("Cross-validation scores:", cv_scores)
print("Mean cross-validation score:", cv_scores.mean())

# Hyperparameter tuning
param_grid = {'max_depth': [None, 10, 20, 30], 'min_samples_split': [2, 5, 10]}
grid_search = GridSearchCV(model, param_grid, cv=5)
grid_search.fit(x, y)

print("Best hyperparameters:", grid_search.best_params_)
print("Best cross-validation score:", grid_search.best_score_)
```

```
Cross-validation scores: [0.99964559 0.99970217 0.99969981 0.99973989 0.99969588]
Mean cross-validation score: 0.9996966658389154
Best hyperparameters: {'max_depth': 30, 'min_samples_split': 2}
Best cross-validation score: 0.9996960371670791
```

In [22]:
```
import numpy as np

distinct_values = np.unique(ytest)
print("Distinct values in ytest:", distinct_values)
```

```
Distinct values in ytest: ['Fraud' 'No Fraud']
```

In [25]:
```
from sklearn.metrics import precision_score, recall_score, f1_score

# Assuming y_pred is the predicted labels and y_true is the true labels
y_pred = model.predict(xtest)
distinct_values = np.unique(y_pred)
print("Distinct values in ytest:", distinct_values)
```

```
Distinct values in ytest: ['Fraud' 'No Fraud']
```

In [39]:
```
from sklearn.metrics import precision_score, recall_score, f1_score

# Calculate precision, recall, and F1 score with pos_label='Fraud'
precision = precision_score(ytest, y_pred, pos_label='Fraud')
recall = recall_score(ytest, y_pred, pos_label='Fraud')
f1 = f1_score(ytest, y_pred, pos_label='Fraud')
```

```
print("Precision:", precision)
print("Recall:", recall)
print("F1 Score:", f1)
```

```
Precision: 0.8868159203980099
Recall: 0.8802469135802469
F1 Score: 0.8835192069392813
```

In [ ]: