Install Required Libraries

```
pip install pandas numpy scikit-learn imbalanced-learn matplotlib seaborn
```

```
Requirement already satisfied: pandas in /usr/local/lib/python3.11/dist-packages (2.2.2)
Requirement already satisfied: numpy in /usr/local/lib/python3.11/dist-packages (1.26.4)
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.11/dist-packages (1.6.1)
Requirement already satisfied: imbalanced-learn in /usr/local/lib/python3.11/dist-packages (0.13.0)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.11/dist-packages (3.10.0)
Requirement already satisfied: seaborn in /usr/local/lib/python3.11/dist-packages (0.13.2)
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.11/dist-packages (from pandas) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas) (2025.1)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/dist-packages (from pandas) (2025.1)
Requirement already satisfied: scipy>=1.6.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (1.13.1)
Requirement already satisfied: joblib>=1.2.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (1.4.2)
Requirement already satisfied: threadpoolctl>=3.1.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (3.5.0)
Requirement already satisfied: sklearn-compat<1,>=0.1 in /usr/local/lib/python3.11/dist-packages (from imbalanced-learn) (0.1.3)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (1.3.1)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (4.56.0)
Requirement already satisfied: kiwisolver>=1.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (1.4.8)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (24.2)
Requirement already satisfied: pillow>=8 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (11.1.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (3.2.1)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.8.2->pandas) (1.17.0)
```

Import Libraries

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import precision_score, recall_score, f1_score, confusion_matrix, classification_report
from imblearn.over_sampling import SMOTE
import matplotlib.pyplot as plt
import seaborn as sns
```

Load and Explore the Dataset

```
df = pd.read_csv('/content/archive (3).zip')

print(df.head())

print(df.isnull().sum())
```

```
   Time        V1        V2        V3        V4        V5        V6        V7  \
0   0.0 -1.359807 -0.072781  2.536347  1.378155 -0.338321  0.462388  0.239599
1   0.0  1.191857  0.266151  0.166480  0.448154  0.060018 -0.082361 -0.078803
2   1.0 -1.358354 -1.340163  1.773209  0.379780 -0.503198  1.800499  0.791461
3   1.0 -0.966272 -0.185226  1.792993 -0.863291 -0.010309  1.247203  0.237609
4   2.0 -1.158233  0.877737  1.548718  0.403034 -0.407193  0.095921  0.592941

         V8        V9  ...       V21       V22       V23       V24       V25  \
0  0.098698  0.363787  ... -0.018307  0.277838 -0.110474  0.066928  0.128539
1  0.085102 -0.255425  ... -0.225775 -0.638672  0.101288 -0.339846  0.167170
2  0.247676 -1.514654  ...  0.247998  0.771679  0.909412 -0.689281 -0.327642
3  0.377436 -1.387024  ... -0.108300  0.005274 -0.190321 -1.175575  0.647376
4 -0.270533  0.817739  ... -0.009431  0.798278 -0.137458  0.141267 -0.206010

        V26       V27       V28  Amount  Class
0 -0.189115  0.133558 -0.021053  149.62      0
1  0.125895 -0.008983  0.014724    2.69      0
2 -0.139097 -0.055353 -0.059752  378.66      0
3 -0.221929  0.062723  0.061458  123.50      0
4  0.502292  0.219422  0.215153   69.99      0

[5 rows x 31 columns]
Time      0
V1        0
V2        0
V3        0
V4        0
V5        0
V6        0
V7        0
V8        0
V9        0
```

```
V10       0
V11       0
V12       0
V13       0
V14       0
V15       0
V16       0
V17       0
V18       0
V19       0
V20       0
V21       0
V22       0
V23       0
V24       0
V25       0
V26       0
V27       0
V28       0
Amount    0
Class     0
dtype: int64
```

Preprocessing the Data

```
X = df.drop('Class', axis=1)
y = df['Class']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

Handling Class Imbalance using SMOTE

```
smote = SMOTE(random_state=42)
X_train_smote, y_train_smote = smote.fit_resample(X_train, y_train)
print("Class distribution after SMOTE:", pd.Series(y_train_smote).value_counts())
```

```
Class distribution after SMOTE: Class
0    227451
1    227451
Name: count, dtype: int64
```

Train a Classification Model a)logistic regression

```
logreg = LogisticRegression(random_state=42)
logreg.fit(X_train_smote, y_train_smote)
y_pred_logreg = logreg.predict(X_test)
print("Logistic Regression - Classification Report:")
print(classification_report(y_test, y_pred_logreg))
```

```
Logistic Regression - Classification Report:
              precision    recall  f1-score   support

           0       1.00      0.97      0.99     56864
           1       0.06      0.92      0.11        98

    accuracy                           0.97     56962
   macro avg       0.53      0.95      0.55     56962
weighted avg       1.00      0.97      0.99     56962
```

b)Random Forest Classifier

```
rf_model = RandomForestClassifier(random_state=42)
rf_model.fit(X_train_smote, y_train_smote)
y_pred_rf = rf_model.predict(X_test)
print("Random Forest - Classification Report:")
print(classification_report(y_test, y_pred_rf))
```

```
Random Forest - Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00     56864
           1       0.91      0.84      0.87        98
```

```
           accuracy                           1.00     56962
          macro avg       0.96      0.92      0.94     56962
       weighted avg       1.00      1.00      1.00     56962
```

Evaluate the Model's Performance

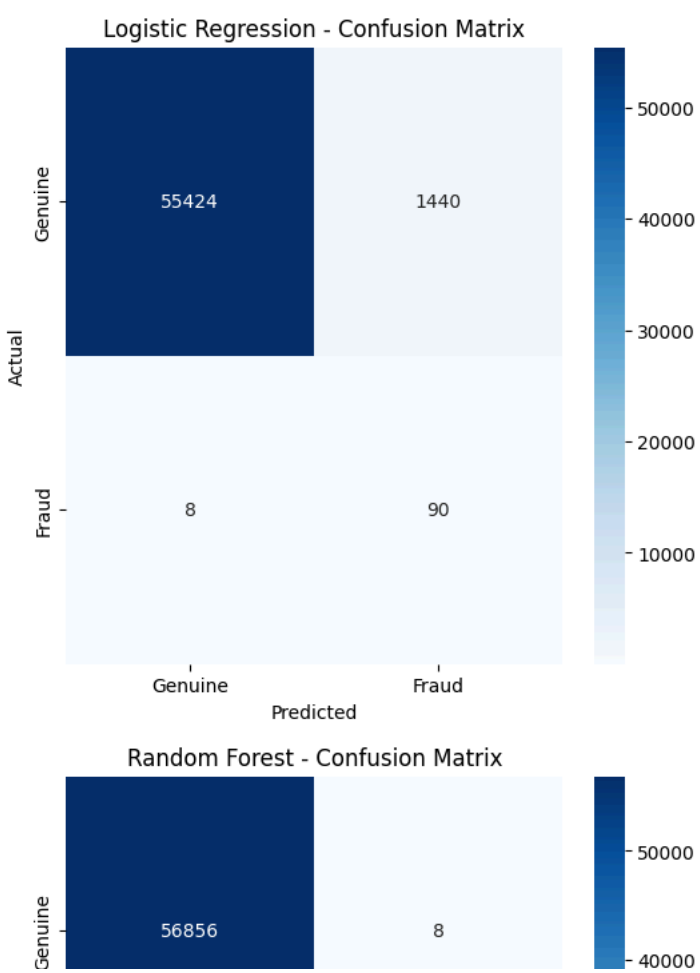
```
precision_logreg = precision_score(y_test, y_pred_logreg)
recall_logreg = recall_score(y_test, y_pred_logreg)
f1_logreg = f1_score(y_test, y_pred_logreg)
print(f'Logistic Regression - Precision: {precision_logreg:.4f}, Recall: {recall_logreg:.4f}, F1-score: {f1_logreg:.4f}')
precision_rf = precision_score(y_test, y_pred_rf)
recall_rf = recall_score(y_test, y_pred_rf)
f1_rf = f1_score(y_test, y_pred_rf)

print(f'Random Forest - Precision: {precision_rf:.4f}, Recall: {recall_rf:.4f}, F1-score: {f1_rf:.4f}')
```

```
Logistic Regression - Precision: 0.0588, Recall: 0.9184, F1-score: 0.1106
Random Forest - Precision: 0.9111, Recall: 0.8367, F1-score: 0.8723
```

Confusion Matrix:

```
conf_matrix_logreg = confusion_matrix(y_test, y_pred_logreg)
plt.figure(figsize=(6, 6))
sns.heatmap(conf_matrix_logreg, annot=True, fmt='d', cmap='Blues', xticklabels=['Genuine', 'Fraud'], yticklabels=['Genuine', 'Fraud'])
plt.title('Logistic Regression - Confusion Matrix')
plt.ylabel('Actual')
plt.xlabel('Predicted')
plt.show()
conf_matrix_rf = confusion_matrix(y_test, y_pred_rf)
plt.figure(figsize=(6, 6))
sns.heatmap(conf_matrix_rf, annot=True, fmt='d', cmap='Blues', xticklabels=['Genuine', 'Fraud'], yticklabels=['Genuine', 'Fraud'])
plt.title('Random Forest - Confusion Matrix')
plt.ylabel('Actual')
plt.xlabel('Predicted')
plt.show()
```


Logistic Regression - Confusion Matrix
Actual
Genuine
Fraud
55424
1440
8
90
Genuine
Fraud
Predicted
50000
40000
30000
20000
10000

Random Forest - Confusion Matrix
Genuine
56856
8
50000
40000