```
# import the necessary packages
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from matplotlib import gridspec
```

```
# Load the dataset from the csv file using pandas
# best way is to mount the drive on colab and
# copy the path for the csv file
data = pd.read_csv("/content/creditcard.csv")
```

```
# Grab a peek at the data
data.head()
```

	Time	V1	V2	V3	V4	V5	V6	V7	V8	V9	...	V21	V22	V23	
0	0.0	-1.359807	-0.072781	2.536347	1.378155	-0.338321	0.462388	0.239599	0.098698	0.363787	...	-0.018307	0.277838	-0.110474	0.
1	0.0	1.191857	0.266151	0.166480	0.448154	0.060018	-0.082361	-0.078803	0.085102	-0.255425	...	-0.225775	-0.638672	0.101288	-0.
2	1.0	-1.358354	-1.340163	1.773209	0.379780	-0.503198	1.800499	0.791461	0.247676	-1.514654	...	0.247998	0.771679	0.909412	-0.
3	1.0	-0.966272	-0.185226	1.792993	-0.863291	-0.010309	1.247203	0.237609	0.377436	-1.387024	...	-0.108300	0.005274	-0.190321	-1.
4	2.0	-1.158233	0.877737	1.548718	0.403034	-0.407193	0.095921	0.592941	-0.270533	0.817739	...	-0.009431	0.798278	-0.137458	0.

5 rows × 31 columns

```
data.isnull().sum()
```

```
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       1
V19       1
V20       1
V21       1
V22       1
V23       1
V24       1
V25       1
V26       1
V27       1
V28       1
Amount    1
Class     1
dtype: int64
```

```
#data.dropna(axis=0,how='any',inplace=True)
```

```
data.isnull().sum()
```

```
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       1
V19       1
V20       1
V21       1
V22       1
V23       1
V24       1
V25       1
V26       1
V27       1
V28       1
Amount    1
Class     1
dtype: int64
```

```
# Print the shape of the data
# data = data.sample(frac = 0.1, random_state = 48)
print(data.shape)
print(data.describe())
```

```
(170463, 31)
                Time             V1             V2             V3  \
count  170463.000000  170463.000000  170463.000000  170463.000000   
mean    60945.692185      -0.171418       0.041438       0.496009   
std     27706.565970       1.850499       1.611466       1.382129   
min         0.000000     -56.407510     -72.715728     -33.680984   
25%     41172.500000      -0.987177      -0.538322      -0.061200   
50%     60665.000000      -0.185295       0.110233       0.625232   
75%     78493.000000       1.183845       0.804500       1.298406   
max    120194.000000       2.439207      22.057729       9.382558   

                  V4             V5             V6             V7  \
count  170463.000000  170463.000000  170463.000000  170463.000000   
mean        0.118163      -0.177346       0.058682      -0.081195   
std         1.371813       1.338482       1.295161       1.208874   
min        -5.519697     -42.147898     -26.160506     -43.557242   
25%        -0.742708      -0.829775      -0.690531      -0.586555   
50%         0.124920      -0.227397      -0.202146      -0.032314   
75%         0.938294       0.372807       0.449766       0.462061   
max        16.875344      34.801666      22.529298      36.677268   

                  V8             V9  ...            V21            V22  \
count  170463.000000  170463.000000  ...  170462.000000  170462.000000   
mean        0.032564       0.019095  ...      -0.028654      -0.084279   
std         1.228228       1.152669  ...       0.743809       0.667001   
min       -73.216718     -13.434066  ...     -34.830382     -10.933144   
25%        -0.162257      -0.660021  ...      -0.230739      -0.546821   
50%         0.056915      -0.079157  ...      -0.054634      -0.067189   
75%         0.351272       0.641997  ...       0.127892       0.362294   
max        20.007208      15.594995  ...      27.202839      10.503090   

                 V23            V24            V25            V26  \
count  170462.000000  170462.000000  170462.000000  170462.000000   
mean       -0.022592       0.009210       0.092750       0.012698   
std         0.584789       0.598609       0.465168       0.490741   
min       -44.807735      -2.836627     -10.295397      -2.604551   
25%        -0.170281      -0.332191      -0.195154      -0.330339   
50%        -0.036388       0.059690       0.136222      -0.059032   
75%         0.098484       0.415848       0.399693       0.273055   
max        19.002942       4.022866       7.519589       3.517346   

                 V27            V28         Amount          Class  
count  170462.000000  170462.000000  170462.000000  170462.000000  
mean        0.002063       0.002476      87.323837       0.002112  
std         0.392259       0.307549     246.031624       0.045907  
min       -22.565679     -11.710896       0.000000       0.000000  
25%        -0.065088      -0.026686       5.470000       0.000000  
```

```
     50%         0.008744       0.021198      21.860000       0.000000
     75%         0.089745       0.078337      76.677500       0.000000
     max        12.152401      33.847808   19656.530000       1.000000

     [8 rows x 31 columns]
```

```
# Determine number of fraud cases in dataset
fraud = data[data['Class'] == 1]
valid = data[data['Class'] == 0]
outlierFraction = len(fraud)/float(len(valid))
print(outlierFraction)
print('Fraud Cases: {}'.format(len(data[data['Class'] == 1])))
print('Valid Transactions: {}'.format(len(data[data['Class'] == 0])))
```

```
     0.002116377232484039
     Fraud Cases: 360
     Valid Transactions: 170102
```

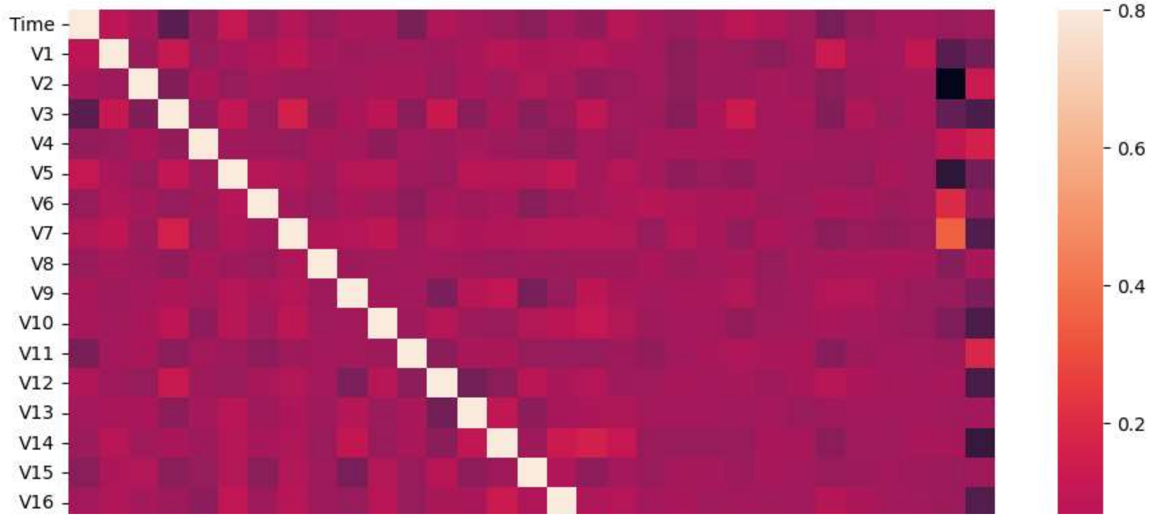
```
print("Amount details of the fraudulent transaction")
fraud.Amount.describe()
```

```
     Amount details of the fraudulent transaction
     count     360.000000
     mean      111.576722
     std       227.309252
     min         0.000000
     25%         1.000000
     50%        11.385000
     75%       104.007500
     max      1809.680000
     Name: Amount, dtype: float64
```

```
print("details of valid transaction")
valid.Amount.describe()
```

```
     details of valid transaction
     count    170102.000000
     mean         87.272509
     std         246.067820
     min           0.000000
     25%           5.490000
     50%          21.890000
     75%          76.500000
     max       19656.530000
     Name: Amount, dtype: float64
```

```
# Correlation matrix
corrmat = data.corr()
fig = plt.figure(figsize = (12, 9))
sns.heatmap(corrmat, vmax = .8, square = True)
plt.show()
```



```
# dividing the X and the Y from the dataset
X = data.drop(['Class'], axis = 1)
Y = data["Class"].fillna(1)
print(X.shape)
print(Y.shape)
# getting just the values for the sake of processing
# (its a numpy array with no columns)
xData = X.values
yData = Y.values
```

```
(170463, 30)
(170463,)
```

```
# Using Scikit-learn to split data into training and testing sets
from sklearn.model_selection import train_test_split
# Split the data into training and testing sets
xTrain, xTest, yTrain, yTest = train_test_split(
        xData, yData, test_size = 0.2, random_state = 42)
```

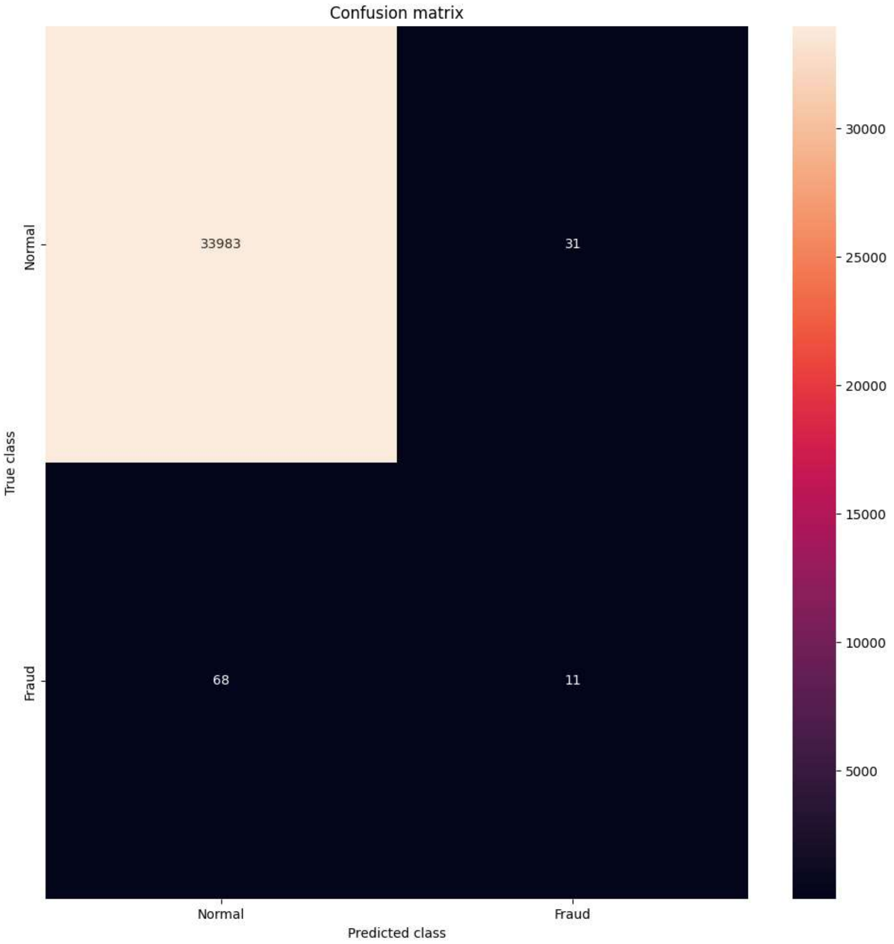
```
# Building the Random Forest Classifier (RANDOM FOREST)
from sklearn.ensemble import RandomForestClassifier
# random forest model creation
rfc = RandomForestClassifier()
rfc.fit(xTrain, yTrain)
# predictions
yPred = rfc.predict(xTest)

"""
keynote: at first I havent removed the null values so i got below erro,
ValueError: Input X contains NaN.
RandomForestClassifier does not accept missing values encoded as NaN natively.
 For supervised learning, you might want to consider sklearn.ensemble.HistGradientBoostingClassifier
 and Regressor which accept missing values encoded as NaNs natively.
 Alternatively, it is possible to preprocess the data, for instance by using an imputer
  transformer in a pipeline or drop samples with missing values. See https://scikit-learn.org/stable/modules/impute.html
  You can find a list of all estimators that handle NaN values at the following
  page: https://scikit-learn.org/stable/modules/impute.html#estimators-that-handle-nan-values
"""
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-64-88c74b1a8e3b> in <cell line: 5>()
      3 # random forest model creation
      4 rfc = RandomForestClassifier()
----> 5 rfc.fit(xTrain, yTrain)
      6 # predictions
      7 yPred = rfc.predict(xTest)

                                  4 frames
/usr/local/lib/python3.10/dist-packages/sklearn/utils/validation.py in _assert_all_finite(X, allow_nan, msg_dtype, estimator_name, input_
    159                 "#estimators-that-handle-nan-values"
    160             )
--> 161         raise ValueError(msg_err)
    162
```

```
# Building the Random Forest Classifier (RANDOM FOREST)
from sklearn.ensemble import HistGradientBoostingClassifier
# random forest model creation

rfc = HistGradientBoostingClassifier()

rfc.fit(xTrain, yTrain)
# predictions
yPred = rfc.predict(xTest)


# Evaluating the classifier
# printing every score of the classifier
# scoring in anything
from sklearn.metrics import classification_report, accuracy_score
from sklearn.metrics import precision_score, recall_score
from sklearn.metrics import f1_score, matthews_corrcoef
from sklearn.metrics import confusion_matrix

n_outliers = len(fraud)
n_errors = (yPred != yTest).sum()
print("The model used is Random Forest classifier")

acc = accuracy_score(yTest, yPred)
print("The accuracy is {}".format(acc))

prec = precision_score(yTest, yPred)
print("The precision is {}".format(prec))

rec = recall_score(yTest, yPred)
print("The recall is {}".format(rec))

f1 = f1_score(yTest, yPred)
print("The F1-Score is {}".format(f1))

MCC = matthews_corrcoef(yTest, yPred)
print("The Matthews correlation coefficient is{}".format(MCC))
```

```
The model used is Random Forest classifier
The accuracy is 0.99709617781010764
The precision is 0.2619047619047619
The recall is 0.13924050632911392
The F1-Score is 0.1818181818181818
The Matthews correlation coefficient is0.18961226373447604
```

```
# printing the confusion matrix
LABELS = ['Normal', 'Fraud']
conf_matrix = confusion_matrix(yTest, yPred)
plt.figure(figsize =(12, 12))
sns.heatmap(conf_matrix, xticklabels = LABELS,
      yticklabels = LABELS, annot = True, fmt ="d");
plt.title("Confusion matrix")
plt.ylabel('True class')
plt.xlabel('Predicted class')
plt.show()
```


Confusion matrix
True class
Normal
Fraud
33983
31
68
11
Normal
Fraud
Predicted class
30000
25000
20000
15000
10000
5000