import pandas as pd # data processing import numpy as np # working with arrays import matplotlib.pyplot as plt # visualization from termcolor import colored as cl # text customization import itertools # advanced tools

```
pip install termcolor
```

```
Collecting termcolor
  Downloading termcolor-1.1.0.tar.gz (3.9 kB)
Building wheels for collected packages: termcolor
  Building wheel for termcolor (setup.py): started
  Building wheel for termcolor (setup.py): finished with status 'done'
  Created wheel for termcolor: filename=termcolor-1.1.0-py3-none-
any.whl size=4835
sha256=3c605ee7cc816aba43c34b98a2d1d91e79ba4585f0eb9ea4a725dcf590fa83c
a
  Stored in directory: c:\users\hp\appdata\local\pip\cache\wheels\
a0\16\9c\5473df82468f958445479c59e784896fa24f4a5fc024b0f501
Successfully built termcolor
Installing collected packages: termcolor
Successfully installed termcolor-1.1.0
Note: you may need to restart the kernel to use updated packages.
```

```
import pandas as pd # data processing
import numpy as np # working with arrays
import matplotlib.pyplot as plt # visualization
from termcolor import colored as cl # text customization
import itertools # advanced tools
```

```
pip install xgboost
```

```
Collecting xgboost
  Downloading xgboost-1.4.2-py3-none-win_amd64.whl (97.8 MB)
Requirement already satisfied: numpy in c:\users\hp\anaconda3\lib\
site-packages (from xgboost) (1.19.2)
Requirement already satisfied: scipy in c:\users\hp\anaconda3\lib\
site-packages (from xgboost) (1.5.2)
Installing collected packages: xgboost
Successfully installed xgboost-1.4.2
Note: you may need to restart the kernel to use updated packages.
```

```
from sklearn.preprocessing import StandardScaler # data normalization
from sklearn.model_selection import train_test_split # data split
from sklearn.tree import DecisionTreeClassifier # Decision tree
algorithm
from sklearn.neighbors import KNeighborsClassifier # KNN algorithm
from sklearn.linear_model import LogisticRegression # Logistic
regression algorithm
from sklearn.svm import SVC # SVM algorithm
from sklearn.ensemble import RandomForestClassifier # Random forest
tree algorithm
from xgboost import XGBClassifier # XGBoost algorithm
```

```
from sklearn.metrics import confusion_matrix # evaluation metric
from sklearn.metrics import accuracy_score # evaluation metric
from sklearn.metrics import f1_score # evaluation metric

df = pd.read_csv('creditcard.csv')
df.drop('Time', axis = 1, inplace = True)

print(df.head())
```

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

         V8        V9       V10  ...       V21       V22       V23
V24  \
0  0.098698  0.363787  0.090794  ... -0.018307  0.277838 -0.110474
0.066928
1  0.085102 -0.255425 -0.166974  ... -0.225775 -0.638672  0.101288 -
0.339846
2  0.247676 -1.514654  0.207643  ...  0.247998  0.771679  0.909412 -
0.689281
3  0.377436 -1.387024 -0.054952  ... -0.108300  0.005274 -0.190321 -
1.175575
4 -0.270533  0.817739  0.753074  ... -0.009431  0.798278 -0.137458
0.141267

        V25       V26       V27       V28  Amount  Class
0  0.128539 -0.189115  0.133558 -0.021053  149.62      0
1  0.167170  0.125895 -0.008983  0.014724    2.69      0
2 -0.327642 -0.139097 -0.055353 -0.059752  378.66      0
3  0.647376 -0.221929  0.062723  0.061458  123.50      0
4 -0.206010  0.502292  0.219422  0.215153   69.99      0

[5 rows x 30 columns]
```

```
cases = len(df)
nonfraud_count = len(df[df.Class == 0])
fraud_count = len(df[df.Class == 1])
fraud_percentage = round(fraud_count/nonfraud_count*100, 2)

print(cl('CASE COUNT', attrs = ['bold']))
print(cl('----------------------------------------------', attrs =
```

```
['bold']))
print(cl('Total number of cases are {}'.format(cases), attrs =
['bold']))
print(cl('Number of Non-fraud cases are {}'.format(nonfraud_count),
attrs = ['bold']))
print(cl('Number of Non-fraud cases are {}'.format(fraud_count), attrs
= ['bold']))
print(cl('Percentage of fraud cases is {}'.format(fraud_percentage),
attrs = ['bold']))
print(cl('-----------------------------------------', attrs =
['bold']))
```

```
CASE COUNT
-----------------------------------------
Total number of cases are 284807
Number of Non-fraud cases are 284315
Number of Non-fraud cases are 492
Percentage of fraud cases is 0.17
-----------------------------------------
```

```
nonfraud_cases = df[df.Class == 0]
fraud_cases = df[df.Class == 1]

print(cl('CASE AMOUNT STATISTICS', attrs = ['bold']))
print(cl('-----------------------------------------', attrs =
['bold']))
print(cl('NON-FRAUD CASE AMOUNT STATS', attrs = ['bold']))
print(nonfraud_cases.Amount.describe())
print(cl('-----------------------------------------', attrs =
['bold']))
print(cl('FRAUD CASE AMOUNT STATS', attrs = ['bold']))
print(fraud_cases.Amount.describe())
print(cl('-----------------------------------------', attrs =
['bold']))
```

```
CASE AMOUNT STATISTICS
-----------------------------------------
NON-FRAUD CASE AMOUNT STATS
count    284315.000000
mean         88.291022
std         250.105092
min           0.000000
25%           5.650000
50%          22.000000
75%          77.050000
max       25691.160000
Name: Amount, dtype: float64
-----------------------------------------
FRAUD CASE AMOUNT STATS
count     492.000000
mean      122.211321
```

```
std       256.683288
min         0.000000
25%         1.000000
50%         9.250000
75%       105.890000
max      2125.870000
Name: Amount, dtype: float64
------------------------------------------

X = df.drop('Class', axis = 1).values
y = df['Class'].values

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size =
0.2, random_state = 0)

print(cl('X_train samples : ', attrs = ['bold']), X_train[:1])
print(cl('X_test samples : ', attrs = ['bold']), X_test[0:1])
print(cl('y_train samples : ', attrs = ['bold']), y_train[0:10])
print(cl('y_test samples : ', attrs = ['bold']), y_test[0:10])

X_train samples :  [[-1.11504743e+00  1.03558276e+00  8.00712441e-01 -
1.06039825e+00
   3.26211690e-02  8.53422160e-01 -6.14243480e-01 -3.23116112e+00
   1.53994798e+00 -8.16908791e-01 -1.30559201e+00  1.08177199e-01
  -8.59609580e-01 -7.19342108e-02  9.06655628e-01 -1.72092961e+00
   7.97853221e-01 -6.75939779e-03  1.95677806e+00 -6.44895565e-01
   3.02038533e+00 -5.39617976e-01  3.31564886e-02 -7.74945766e-01
   1.05867812e-01 -4.30853482e-01  2.29736936e-01 -7.05913036e-02
   1.29500000e+01]]
X_test samples :  [[-3.23333572e-01  1.05745525e+00 -4.83411518e-02 -
6.07204308e-01
   1.25982115e+00 -9.17607168e-02  1.15910150e+00 -1.24334606e-01
  -1.74639536e-01 -1.64440065e+00 -1.11886302e+00  2.02647310e-01
   1.14596495e+00 -1.80235956e+00 -2.47177932e-01 -6.09453515e-02
   8.46605738e-01  3.79454387e-01  8.47262245e-01  1.86409421e-01
  -2.07098267e-01 -4.33890272e-01 -2.61613283e-01 -4.66506063e-02
   2.11512300e-01  8.29721214e-03  1.08494430e-01  1.61139167e-01
   4.00000000e+01]]
y_train samples :  [0 0 0 0 0 0 0 0 0 0]
y_test samples :  [0 0 0 0 0 0 0 0 0 0]

from sklearn.preprocessing import StandardScaler

tree_model = DecisionTreeClassifier(max_depth = 4, criterion =
'entropy')
tree_model.fit(X_train, y_train)
tree_yhat = tree_model.predict(X_test)

# 2. K-Nearest Neighbors

n = 5
```

```
knn = KNeighborsClassifier(n_neighbors = n)
knn.fit(X_train, y_train)
knn_yhat = knn.predict(X_test)

# 3. Logistic Regression

lr = LogisticRegression()
lr.fit(X_train, y_train)
lr_yhat = lr.predict(X_test)

# 4. SVM

svm = SVC()
svm.fit(X_train, y_train)
svm_yhat = svm.predict(X_test)

# 5. Random Forest Tree

rf = RandomForestClassifier(max_depth = 4)
rf.fit(X_train, y_train)
rf_yhat = rf.predict(X_test)

# 6. XGBoost

xgb = XGBClassifier(max_depth = 4)
xgb.fit(X_train, y_train)
xgb_yhat = xgb.predict(X_test)

print(cl('ACCURACY SCORE', attrs = ['bold']))
print(cl('------------------------------------------------------------
------------', attrs = ['bold']))
print(cl('Accuracy score of the Decision Tree model is
{}'.format(accuracy_score(y_test, tree_yhat)), attrs = ['bold']))
print(cl('------------------------------------------------------------
------------', attrs = ['bold']))
print(cl('Accuracy score of the KNN model is
{}'.format(accuracy_score(y_test, knn_yhat)), attrs = ['bold'], color
= 'green'))
print(cl('------------------------------------------------------------
------------', attrs = ['bold']))
print(cl('Accuracy score of the Logistic Regression model is
{}'.format(accuracy_score(y_test, lr_yhat)), attrs = ['bold'], color =
'red'))
print(cl('------------------------------------------------------------
------------', attrs = ['bold']))
print(cl('Accuracy score of the SVM model is
{}'.format(accuracy_score(y_test, svm_yhat)), attrs = ['bold']))
print(cl('------------------------------------------------------------
```

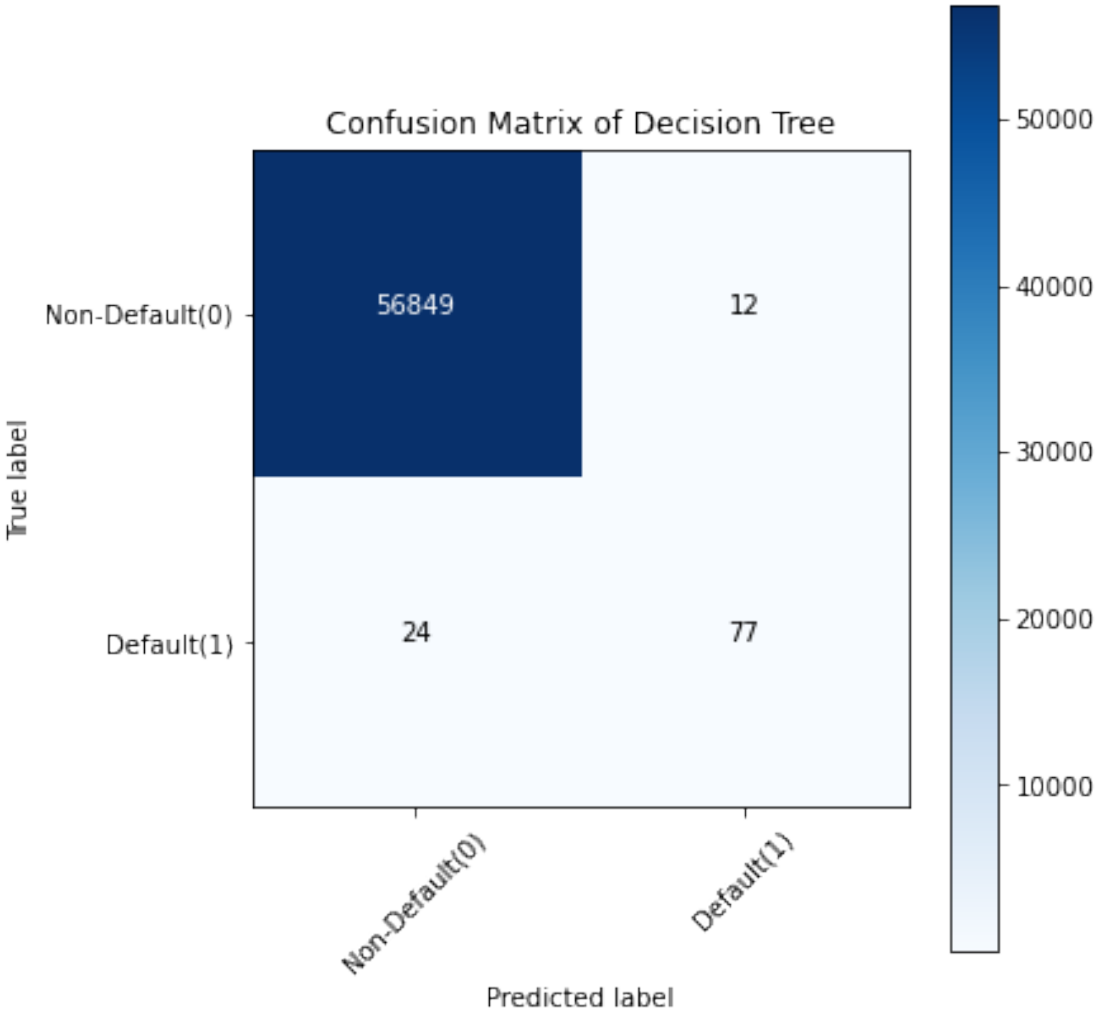
```
------------', attrs = ['bold']))
print(cl('Accuracy score of the Random Forest Tree model is
{}'.format(accuracy_score(y_test, rf_yhat)), attrs = ['bold']))
print(cl('-------------------------------------------------------------
------------', attrs = ['bold']))
print(cl('Accuracy score of the XGBoost model is
{}'.format(accuracy_score(y_test, xgb_yhat)), attrs = ['bold']))
print(cl('-------------------------------------------------------------
------------', attrs = ['bold']))
```

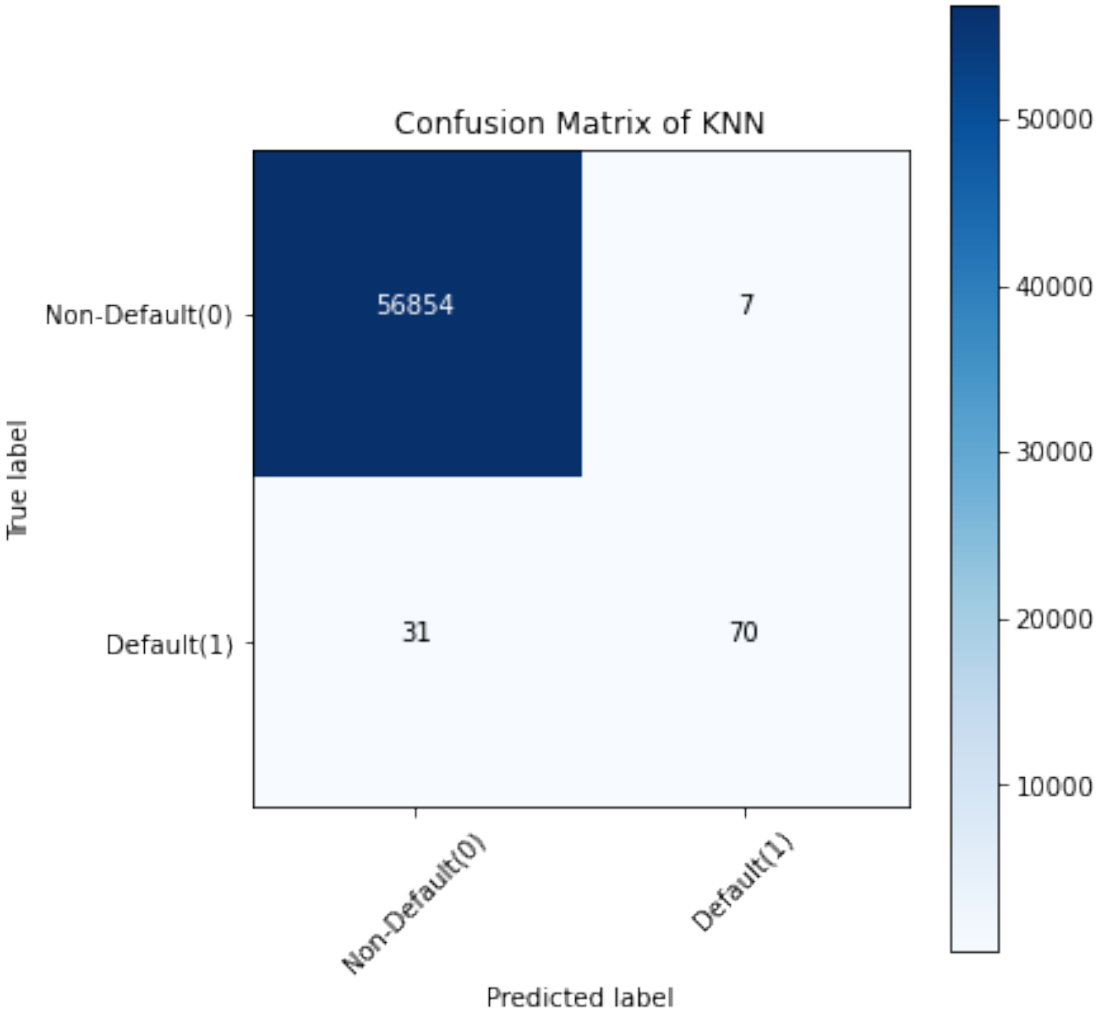
```
ACCURACY SCORE
------------------------------------------------------------------------
--
Accuracy score of the Decision Tree model is 0.9993679997191109
------------------------------------------------------------------------
--
Accuracy score of the KNN model is 0.9993328885923949
------------------------------------------------------------------------
--
Accuracy score of the Logistic Regression model is 0.9991573329588147
------------------------------------------------------------------------
--
Accuracy score of the SVM model is 0.998735999438222
------------------------------------------------------------------------
--
Accuracy score of the Random Forest Tree model is 0.9993153330290369
------------------------------------------------------------------------
--
Accuracy score of the XGBoost model is 0.9994908886626171
------------------------------------------------------------------------
--
```

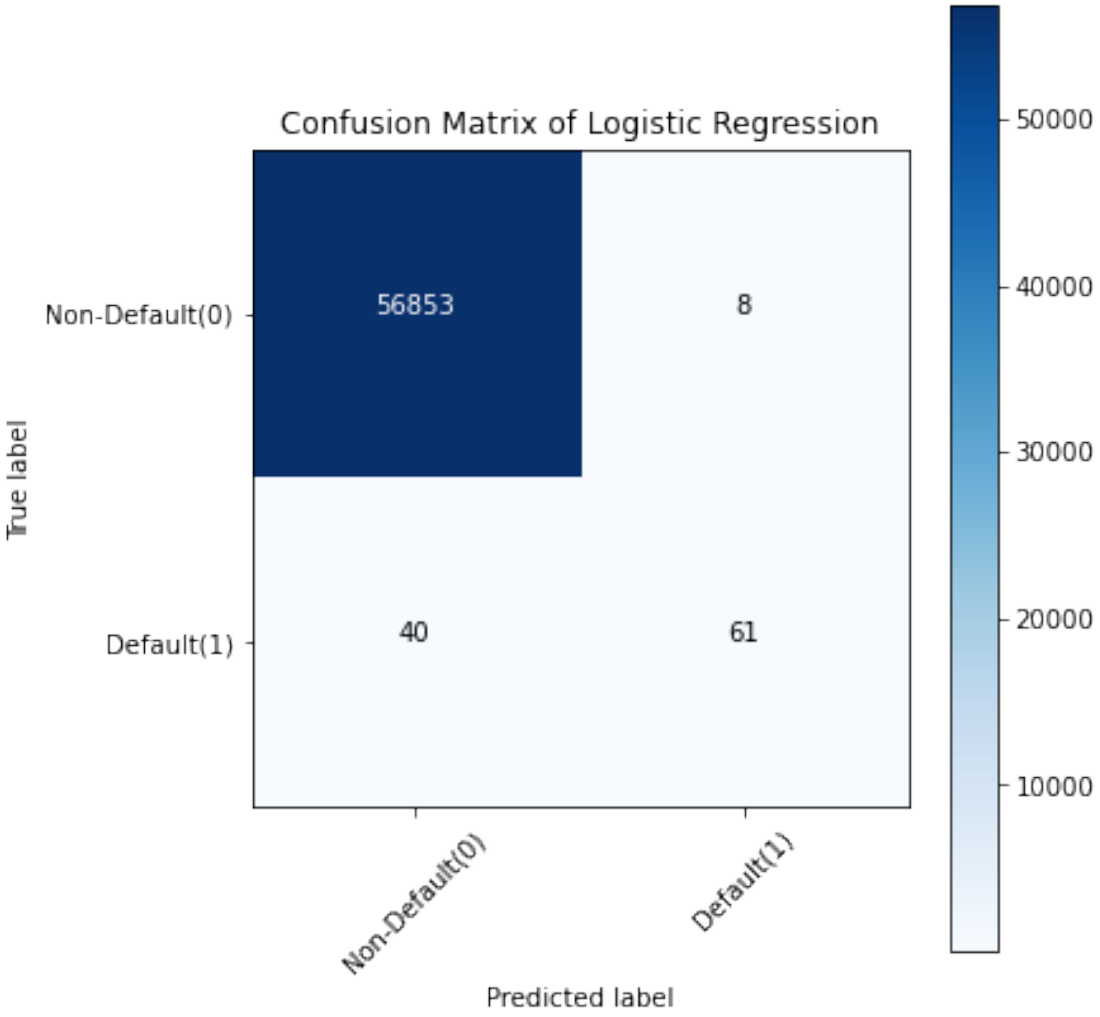
```
def plot_confusion_matrix(cm, classes, title, normalize = False, cmap
= plt.cm.Blues):
    title = 'Confusion Matrix of {}'.format(title)
    if normalize:
        cm = cm.astype(float) / cm.sum(axis=1)[:, np.newaxis]

    plt.imshow(cm, interpolation = 'nearest', cmap = cmap)
    plt.title(title)
    plt.colorbar()
    tick_marks = np.arange(len(classes))
    plt.xticks(tick_marks, classes, rotation = 45)
    plt.yticks(tick_marks, classes)

    fmt = '.2f' if normalize else 'd'
    thresh = cm.max() / 2.
    for i, j in itertools.product(range(cm.shape[0]),
range(cm.shape[1])):
        plt.text(j, i, format(cm[i, j], fmt),
```

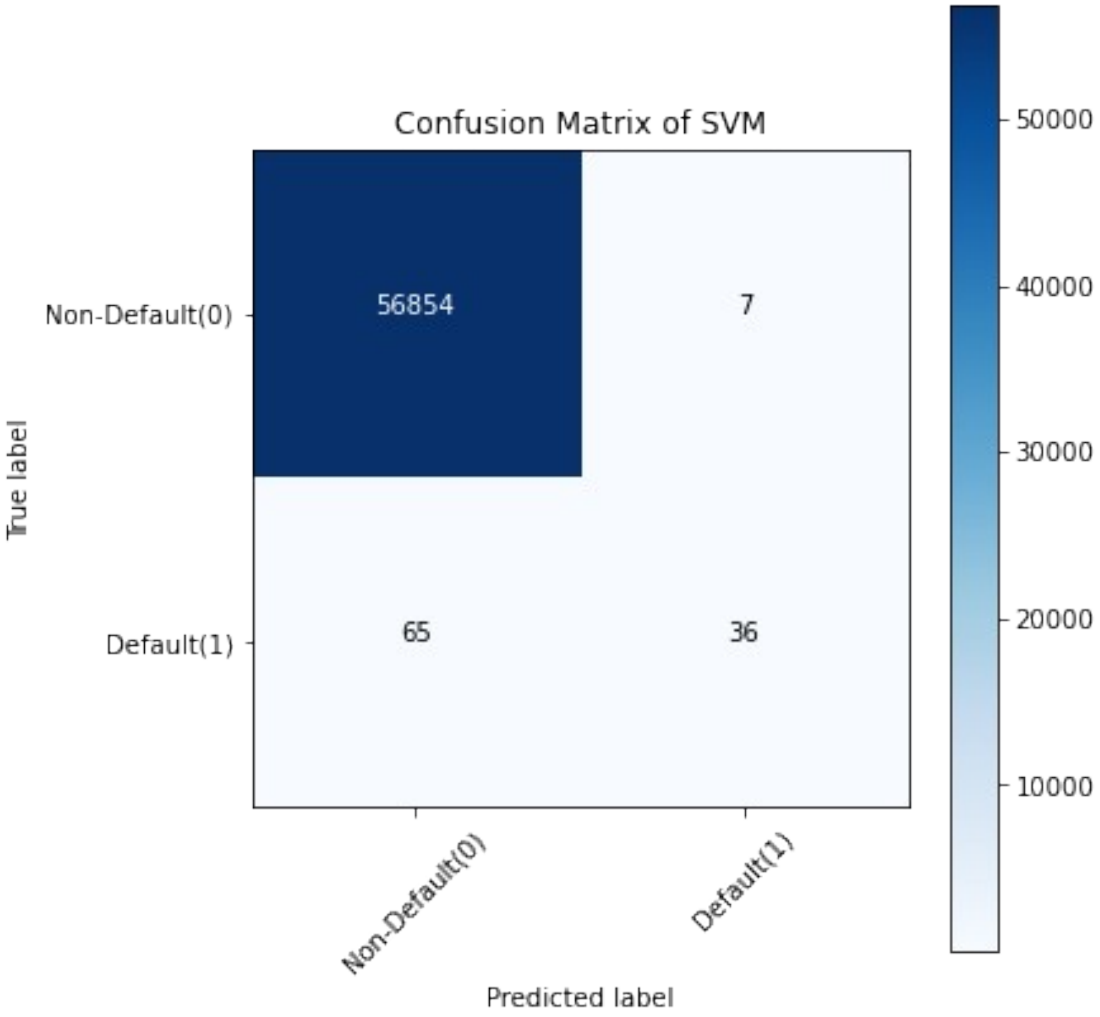
```
                horizontalalignment = 'center',
                color = 'white' if cm[i, j] > thresh else 'black')

    plt.tight_layout()
    plt.ylabel('True label')
    plt.xlabel('Predicted label')

# Compute confusion matrix for the models

tree_matrix = confusion_matrix(y_test, tree_yhat, labels = [0, 1]) #
Decision Tree
knn_matrix = confusion_matrix(y_test, knn_yhat, labels = [0, 1]) # K-
Nearest Neighbors
lr_matrix = confusion_matrix(y_test, lr_yhat, labels = [0, 1]) #
Logistic Regression
svm_matrix = confusion_matrix(y_test, svm_yhat, labels = [0, 1]) #
Support Vector Machine
rf_matrix = confusion_matrix(y_test, rf_yhat, labels = [0, 1]) #
Random Forest Tree
xgb_matrix = confusion_matrix(y_test, xgb_yhat, labels = [0, 1]) #
XGBoost

# Plot the confusion matrix

plt.rcParams['figure.figsize'] = (6, 6)

# 1. Decision tree

tree_cm_plot = plot_confusion_matrix(tree_matrix,
                                     classes = ['Non-
Default(0)','Default(1)'],
                                     normalize = False, title = 'Decision
Tree')
plt.savefig('tree_cm_plot.png')
plt.show()

# 2. K-Nearest Neighbors

knn_cm_plot = plot_confusion_matrix(knn_matrix,
                                     classes = ['Non-
Default(0)','Default(1)'],
                                     normalize = False, title = 'KNN')
plt.savefig('knn_cm_plot.png')
plt.show()

# 3. Logistic regression

lr_cm_plot = plot_confusion_matrix(lr_matrix,
                                     classes = ['Non-
```

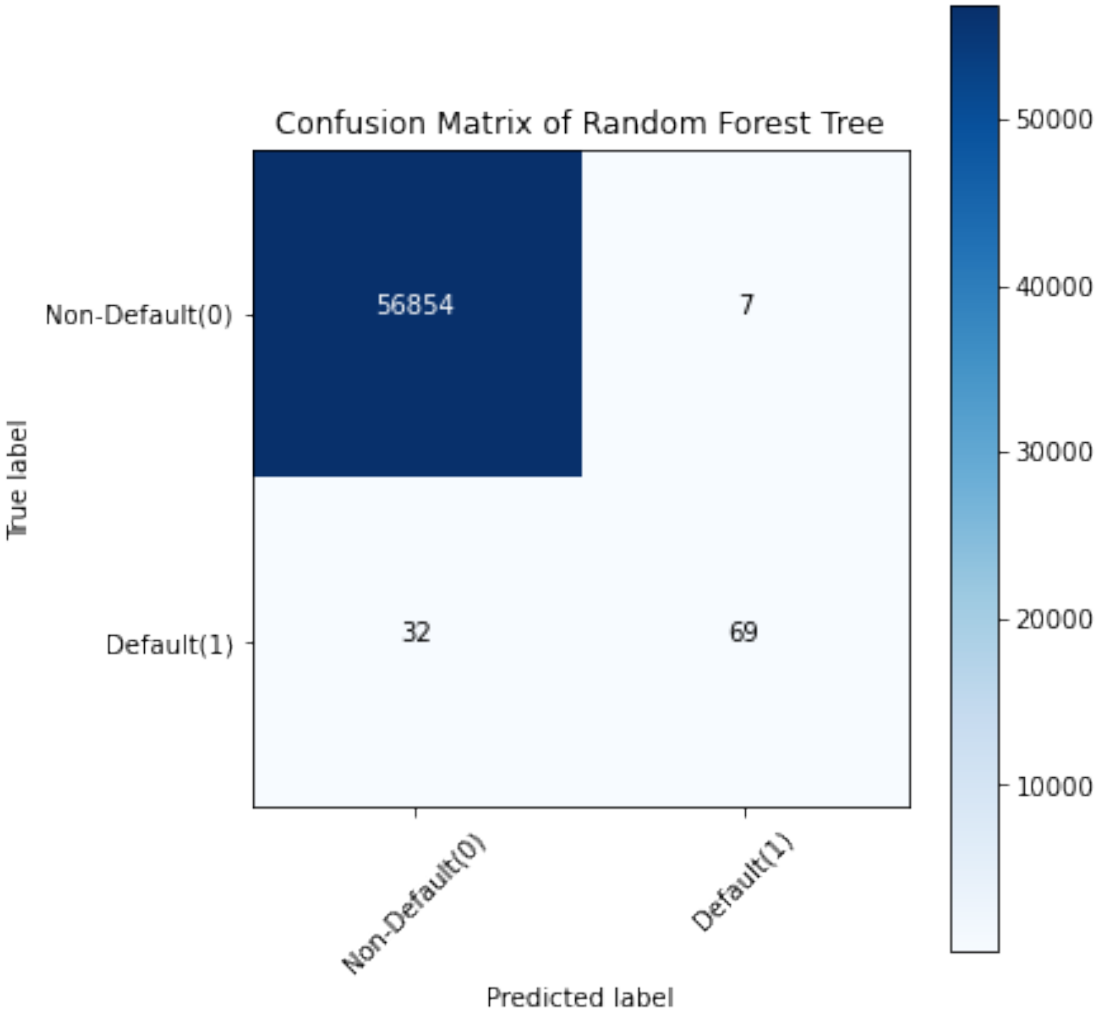
```
Default(0)','Default(1)'],
                                  normalize = False, title = 'Logistic
Regression')
plt.savefig('lr_cm_plot.png')
plt.show()

# 4. Support Vector Machine

svm_cm_plot = plot_confusion_matrix(svm_matrix,
                                  classes = ['Non-
Default(0)','Default(1)'],
                                  normalize = False, title = 'SVM')
plt.savefig('svm_cm_plot.png')
plt.show()

# 5. Random forest tree

rf_cm_plot = plot_confusion_matrix(rf_matrix,
                                  classes = ['Non-
Default(0)','Default(1)'],
                                  normalize = False, title = 'Random
Forest Tree')
plt.savefig('rf_cm_plot.png')
plt.show()

# 6. XGBoost

xgb_cm_plot = plot_confusion_matrix(xgb_matrix,
                                  classes = ['Non-
Default(0)','Default(1)'],
                                  normalize = False, title = 'XGBoost')
plt.savefig('xgb_cm_plot.png')
plt.show()
```

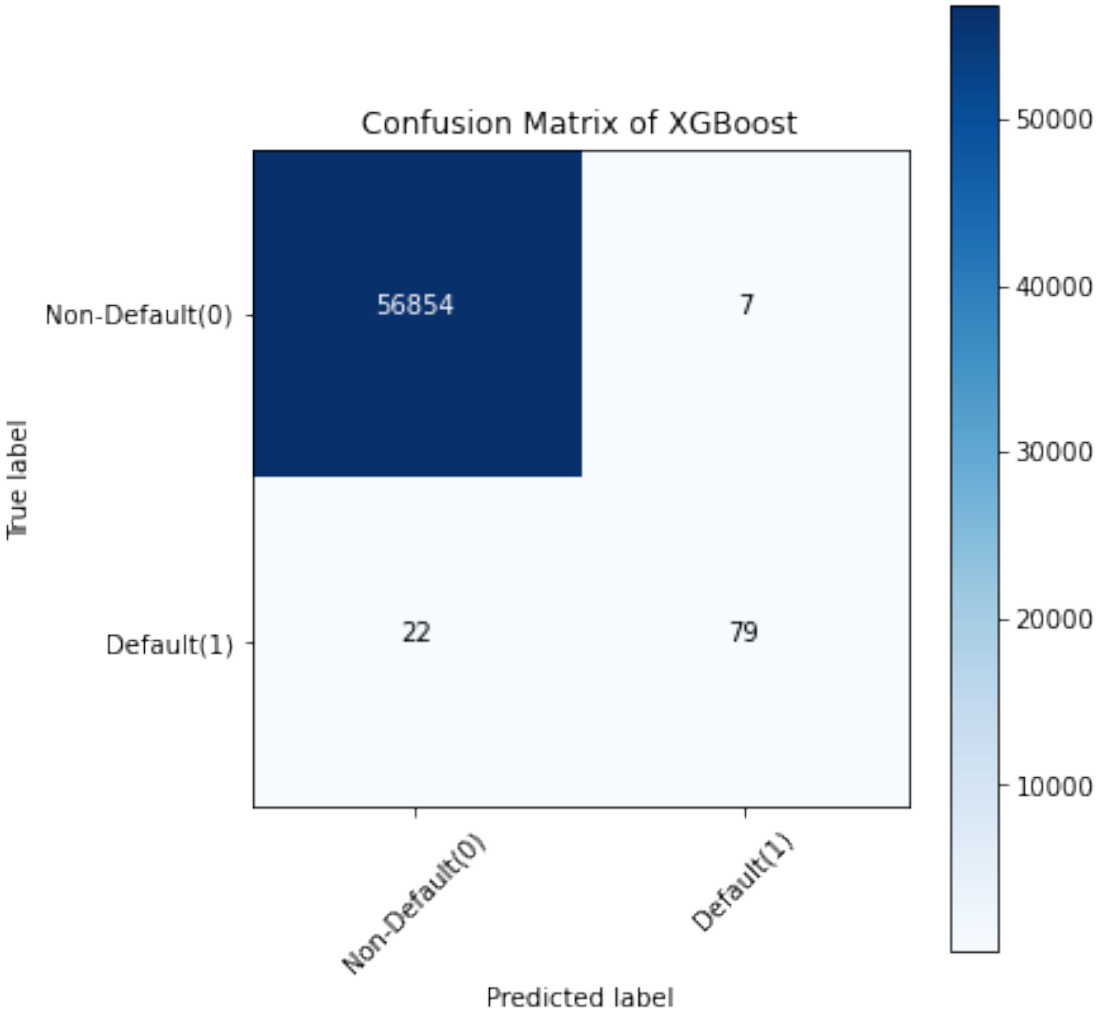

Confusion Matrix of Decision Tree
Non-Default(0)
Default(1)
True label
56849
12
24
77
Non-Default(0)
Default(1)
Predicted label
50000
40000
30000
20000
10000


Confusion Matrix of KNN
Non-Default(0)
Default(1)
True label
56854
7
31
70
Non-Default(0)
Default(1)
Predicted label
50000
40000
30000
20000
10000


Confusion Matrix of Logistic Regression
Non-Default(0)
Default(1)
True label
56853
8
40
61
Non-Default(0)
Default(1)
Predicted label
50000
40000
30000
20000
10000


Confusion Matrix of SVM
Non-Default(0)
Default(1)
True label
56854
7
65
36
Non-Default(0)
Default(1)
Predicted label
50000
40000
30000
20000
10000


Confusion Matrix of Random Forest Tree
Non-Default(0)
Default(1)
True label
56854
7
32
69
Non-Default(0)
Default(1)
Predicted label
50000
40000
30000
20000
10000


Confusion Matrix of XGBoost
Non-Default(0)
Default(1)
True label
56854
7
22
79
Non-Default(0)
Default(1)
Predicted label
50000
40000
30000
20000
10000