In [1]:

```
import pandas as pd
from collections import Counter
import itertools
# Load the csv file
dataframe = pd.read_csv("C:/Users/test/Downloads/fraud_data.csv")
dataframe.head()
```

Out[1]:

	V1	V2	V3	V4	V5	V6	V7	V8	
0	1.176563	0.323798	0.536927	1.047002	-0.368652	-0.728586	0.084678	-0.069246	-0.2(
1	0.681109	-3.934776	-3.801827	-1.147468	-0.735540	-0.501097	1.038865	-0.626979	-2.27
2	1.140729	0.453484	0.247010	2.383132	0.343287	0.432804	0.093380	0.173310	-0.8(
3	-1.107073	-3.298902	-0.184092	-1.795744	2.137564	-1.684992	-2.015606	-0.007181	-0.1(
4	-0.314818	0.866839	-0.124577	-0.627638	2.651762	3.428128	0.194637	0.670674	-0.4(

5 rows × 30 columns

In [2]:

```
dataframe.isnull().values.any()
```

Out[2]:

```
False
```

In [3]:

```
dataframe["Amount"].describe()
```

Out[3]:

```
count    21693.000000
mean        86.776247
std        235.644479
min          0.000000
25%          5.370000
50%         21.950000
75%         76.480000
max       7712.430000
Name: Amount, dtype: float64
```

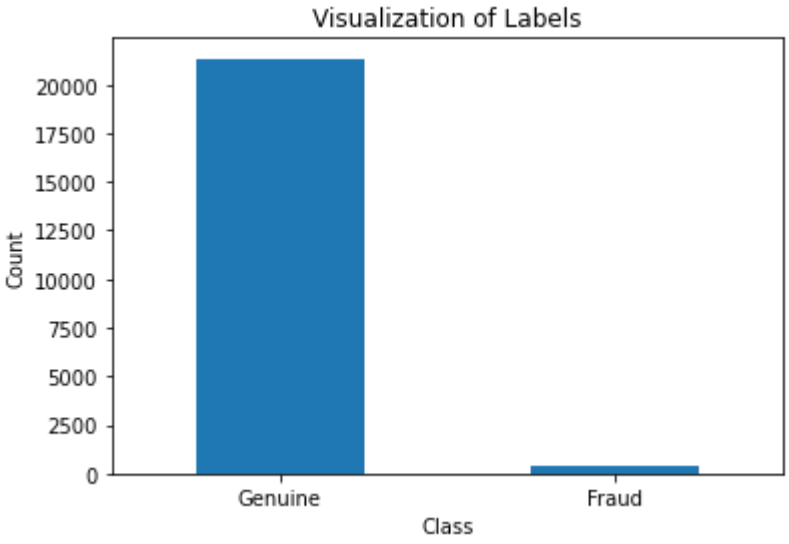
In [4]:

```
non_fraud = len(dataframe[dataframe.Class == 0])
fraud = len(dataframe[dataframe.Class == 1])
fraud_percent = (fraud / (fraud + non_fraud)) * 100
print("Number of Genuine transactions: ", non_fraud)
print("Number of Fraud transactions: ", fraud)
print("Percentage of Fraud transactions: {:.4f}".format(fraud_percent))
```

```
Number of Genuine transactions:  21337
Number of Fraud transactions:  356
Percentage of Fraud transactions: 1.6411
```

In [5]:

```
import matplotlib.pyplot as plt
labels = ["Genuine", "Fraud"]
count_classes = dataframe.value_counts(dataframe['Class'], sort= True)
count_classes.plot(kind = "bar", rot = 0)
plt.title("Visualization of Labels")
plt.ylabel("Count")
plt.xticks(range(2), labels)
plt.show()
```



In [6]:

```
import numpy as np
from sklearn.preprocessing import StandardScaler

scaler = StandardScaler()
dataframe["NormalizedAmount"] = scaler.fit_transform(dataframe["Amount"].values.reshape(
dataframe.drop(["Amount"], inplace= True, axis= 1)

Y = dataframe["Class"]
X = dataframe.drop(["Class"], axis= 1)
```

In [7]:

```
from sklearn.model_selection import train_test_split

(train_X, test_X, train_Y, test_Y) = train_test_split(X, Y, test_size= 0.3, random_state

print("Shape of train_X: ", train_X.shape)
print("Shape of test_X: ", test_X.shape)
```

```
Shape of train_X:  (15185, 29)
Shape of test_X:  (6508, 29)
```

In [8]:

```
#Dropping Time as it's non business required data
estimators=[ 'V1', 'V2', 'V3', 'V4', 'V5', 'V6', 'V7', 'V8', 'V9', 'V10',
       'V11', 'V12', 'V13', 'V14', 'V15', 'V16', 'V17', 'V18', 'V19', 'V20',
       'V21', 'V22', 'V23', 'V24', 'V25', 'V26', 'V27', 'V28']

X = dataframe[estimators]
Y = dataframe['Class']
```

In [9]:

```
col=X.columns[:-1]
col
```

Out[9]:

```
Index(['V1', 'V2', 'V3', 'V4', 'V5', 'V6', 'V7', 'V8', 'V9', 'V10', 'V11',
       'V12', 'V13', 'V14', 'V15', 'V16', 'V17', 'V18', 'V19', 'V20', 'V2
1',
       'V22', 'V23', 'V24', 'V25', 'V26', 'V27'],
      dtype='object')
```

In [10]:

```
import statsmodels.api as sm
```

In [11]:

```
X1 = sm.add_constant(X)
reg_logit = sm.Logit(Y,X1)
results_logit = reg_logit.fit()
```

```
Optimization terminated successfully.
         Current function value: 0.017693
         Iterations 11
```

In [12]:

```
results_logit.summary()
```

Out[12]:

Logit Regression Results

Dep. Variable:	Class	**No. Observations:**	21693
Model:	Logit	**Df Residuals:**	21664
Method:	MLE	**Df Model:**	28
Date:	Mon, 10 Apr 2023	**Pseudo R-squ.:**	0.7887
Time:	09:33:51	**Log-Likelihood:**	-383.81
converged:	True	**LL-Null:**	-1816.2
Covariance Type:	nonrobust	**LLR p-value:**	0.000

	coef	std err	z	P>|z|	[0.025	0.975]
const	-6.8729	0.216	-31.813	0.000	-7.296	-6.449
V1	0.0849	0.060	1.421	0.155	-0.032	0.202
V2	-0.0368	0.067	-0.547	0.584	-0.169	0.095
V3	-0.0059	0.071	-0.083	0.934	-0.145	0.133
V4	0.7388	0.097	7.624	0.000	0.549	0.929
V5	0.0447	0.094	0.475	0.635	-0.140	0.229
V6	-0.2189	0.134	-1.639	0.101	-0.481	0.043
V7	-0.0430	0.086	-0.501	0.617	-0.211	0.125
V8	-0.3116	0.054	-5.791	0.000	-0.417	-0.206
V9	-0.2162	0.148	-1.464	0.143	-0.506	0.073
V10	-0.4411	0.145	-3.040	0.002	-0.725	-0.157
V11	0.3104	0.108	2.861	0.004	0.098	0.523
V12	-0.4134	0.116	-3.569	0.000	-0.640	-0.186
V13	-0.2703	0.117	-2.313	0.021	-0.499	-0.041
V14	-0.6817	0.094	-7.275	0.000	-0.865	-0.498
V15	-0.1947	0.129	-1.515	0.130	-0.447	0.057
V16	-0.3024	0.169	-1.785	0.074	-0.634	0.030
V17	0.0450	0.100	0.449	0.654	-0.151	0.241
V18	-0.1209	0.177	-0.684	0.494	-0.467	0.226
V19	-0.0796	0.140	-0.567	0.570	-0.355	0.195
V20	-0.1446	0.138	-1.044	0.296	-0.416	0.127
V21	0.3163	0.094	3.369	0.001	0.132	0.500
V22	0.4881	0.188	2.598	0.009	0.120	0.856
V23	-0.1311	0.109	-1.202	0.229	-0.345	0.083
V24	0.1085	0.242	0.448	0.654	-0.366	0.583
V25	0.0161	0.216	0.075	0.941	-0.407	0.439
V26	-0.4271	0.298	-1.433	0.152	-1.011	0.157
V27	-0.2557	0.264	-0.968	0.333	-0.774	0.262

V28	0.0216	0.252	0.086	0.932	-0.472	0.515

In [13]:

```
from sklearn.linear_model import LogisticRegression
logreg=LogisticRegression()
logreg.fit(train_X,train_Y)
```

Out[13]:

```
LogisticRegression()
```

In [14]:

```
pred = logreg.predict(test_X)
```

In [15]:

```
from sklearn.metrics import accuracy_score, precision_score, confusion_matrix, recall_sc
```

In [16]:

```
cm1 = confusion_matrix(test_Y, pred)
cm1
```

Out[16]:

```
array([[6406,    3],
       [  16,   83]], dtype=int64)
```

In [17]:

```
def metrics(actuals, predictions):
    print("Accuracy: {:.5f}".format(accuracy_score(actuals, predictions)))
    print("Precision: {:.5f}".format(precision_score(actuals, predictions)))
    print("Recall: {:.5f}".format(recall_score(actuals, predictions)))
    print("F1-score: {:.5f}".format(f1_score(actuals, predictions)))
```

In [18]:

```
print("Evaluation of Logistic Regression")
print()
metrics(test_Y, pred.round())
```

```
Evaluation of Logistic Regression

Accuracy: 0.99708
Precision: 0.96512
Recall: 0.83838
F1-score: 0.89730
```

In [19]:

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
#Decision Tree
decision_tree = DecisionTreeClassifier()
# Random Forest
random_forest = RandomForestClassifier(n_estimators= 100)
```

In [20]:

```
decision_tree.fit(train_X, train_Y)
predictions_dt = decision_tree.predict(test_X)
decision_tree_score = decision_tree.score(test_X, test_Y) * 100

random_forest.fit(train_X, train_Y)
predictions_rf = random_forest.predict(test_X)
random_forest_score = random_forest.score(test_X, test_Y) * 100

print("Random Forest Score: ", random_forest_score)
print("Decision Tree Score: ", decision_tree_score)
```

```
Random Forest Score:  99.7541487400123
Decision Tree Score:  99.0780577750461
```

In [21]:

```
from sklearn.metrics import accuracy_score, precision_score, confusion_matrix, recall_sc


def metrics(actuals, predictions):
    print("Accuracy: {:.5f}".format(accuracy_score(actuals, predictions)))
    print("Precision: {:.5f}".format(precision_score(actuals, predictions)))
    print("Recall: {:.5f}".format(recall_score(actuals, predictions)))
    print("F1-score: {:.5f}".format(f1_score(actuals, predictions)))
```

In [22]:

```
confusion_matrix_dt = confusion_matrix(test_Y, predictions_dt.round())
print("Confusion Matrix - Decision Tree")
print(confusion_matrix_dt)
```

```
Confusion Matrix - Decision Tree
[[6370   39]
 [  21   78]]
```

In [23]:

```
print("Evaluation of Decision Tree Model")
print()
metrics(test_Y, predictions_dt.round())
```

```
Evaluation of Decision Tree Model

Accuracy: 0.99078
Precision: 0.66667
Recall: 0.78788
F1-score: 0.72222
```

In [24]:

```
confusion_matrix_rf = confusion_matrix(test_Y, predictions_rf.round())
print("Confusion Matrix - Random Forest")
print(confusion_matrix_rf)
```

```
Confusion Matrix - Random Forest
[[6407    2]
 [  14   85]]
```

In [25]:

```
print("Evaluation of Random Forest Model")
print()
metrics(test_Y, predictions_rf.round())
```

```
Evaluation of Random Forest Model

Accuracy: 0.99754
Precision: 0.97701
Recall: 0.85859
F1-score: 0.91398
```

In [26]:

```
from sklearn import svm


import matplotlib.pyplot as plt
%matplotlib inline
from sklearn.svm import SVC
from sklearn.svm import SVR

classifier =svm.SVC(kernel='linear')
classifier.fit(train_X, train_Y)
```

Out[26]:

```
SVC(kernel='linear')
```

In [27]:

```
prediction_SVM_all = classifier.predict(test_X)
```

In [28]:

```
cm = confusion_matrix(test_Y, prediction_SVM_all)
cm
```

Out[28]:

```
array([[6407,    2],
       [  17,   82]], dtype=int64)
```

In [29]:

```
def metrics(actuals, predictions):
    print("Accuracy: {:.5f}".format(accuracy_score(actuals, predictions)))
    print("Precision: {:.5f}".format(precision_score(actuals, predictions)))
    print("Recall: {:.5f}".format(recall_score(actuals, predictions)))
    print("F1-score: {:.5f}".format(f1_score(actuals, predictions)))
```

In [30]:

```
print("Evaluation of Support Vector Machine")
print()
metrics(test_Y, prediction_SVM_all.round())
```

```
Evaluation of Support Vector Machine

Accuracy: 0.99708
Precision: 0.97619
Recall: 0.82828
F1-score: 0.89617
```

In [31]:

```
X_array=X.values
Y_array=Y.values
```

In [32]:

```
from sklearn.cluster import KMeans
kmeans=KMeans(n_clusters=2,random_state=0,algorithm="elkan",max_iter=10000,n_jobs=-1)
kmeans.fit(train_X,train_Y)
```

```
C:\Users\test\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:792:
FutureWarning: 'n_jobs' was deprecated in version 0.23 and will be removed
in 1.0 (renaming of 0.25).
  warnings.warn("'n_jobs' was deprecated in version 0.23 and will be"
```

Out[32]:

```
KMeans(algorithm='elkan', max_iter=10000, n_clusters=2, n_jobs=-1,
       random_state=0)
```

In [33]:

```
kmeans_predicted_train_labels=kmeans.predict(test_X)
```

In [34]:

```
#confusion matrix
# tn fp
# fn tp
print("tn --> true negatives")
print("fp --> false positives")
print("fn --> false negatives")
print("tp --> true positives")
```

```
tn --> true negatives
fp --> false positives
fn --> false negatives
tp --> true positives
```

In [35]:

```
cm4= confusion_matrix(test_Y,kmeans_predicted_train_labels)
cm4
```

Out[35]:

```
array([[6409,    0],
       [  54,   45]], dtype=int64)
```

In [36]:

```
def metrics(actuals, predictions):
    print("Accuracy: {:.5f}".format(accuracy_score(actuals, predictions)))
    print("Precision: {:.5f}".format(precision_score(actuals, predictions)))
    print("Recall: {:.5f}".format(recall_score(actuals, predictions)))
    print("F1-score: {:.5f}".format(f1_score(actuals, predictions)))
```

In [37]:

```
print("Evaluation of Kmeans Clustering")
print()
metrics(test_Y, kmeans_predicted_train_labels.round())
```

```
Evaluation of Kmeans Clustering

Accuracy: 0.99170
Precision: 1.00000
Recall: 0.45455
F1-score: 0.62500
```

In [38]:

```
from sklearn.metrics import classification_report
from sklearn.metrics import roc_auc_score as roc
```

In [39]:

```
from sklearn.preprocessing import StandardScaler
from sklearn.naive_bayes import GaussianNB
```

In [40]:

```
classifier = GaussianNB()
scaler = StandardScaler()
train_X = scaler.fit_transform(train_X)
test_X = scaler.fit_transform(test_X)
```

In [41]:

```
classifier.fit(train_X, train_Y)
```

Out[41]:

```
GaussianNB()
```

In [42]:

```
#predict the model on the train values and check results
predTrain = classifier.predict(train_X)
print(classification_report(train_Y, predTrain))
print('ROC AUC Score: ',roc(train_Y, predTrain))
```

```
              precision    recall  f1-score   support

           0       1.00      0.98      0.99     14928
           1       0.38      0.83      0.52       257

    accuracy                           0.97     15185
   macro avg       0.69      0.90      0.75     15185
weighted avg       0.99      0.97      0.98     15185

ROC AUC Score:  0.9025734680812909
```

In [43]:

```
#predict test values and check results
predTest = classifier.predict(test_X)
print(classification_report(test_Y, predTest))
print('ROC AUC Score: ',roc(test_Y, predTest))
```

```
              precision    recall  f1-score   support

           0       1.00      0.98      0.99      6409
           1       0.38      0.87      0.53        99

    accuracy                           0.98      6508
   macro avg       0.69      0.92      0.76      6508
weighted avg       0.99      0.98      0.98      6508

ROC AUC Score:  0.9234212936038494
```

In [45]:

```
from sklearn.neighbors import KNeighborsClassifier
(train_X, test_X, train_Y, test_Y) = train_test_split(X, Y, test_size= 0.3, random_state
```

In [47]:

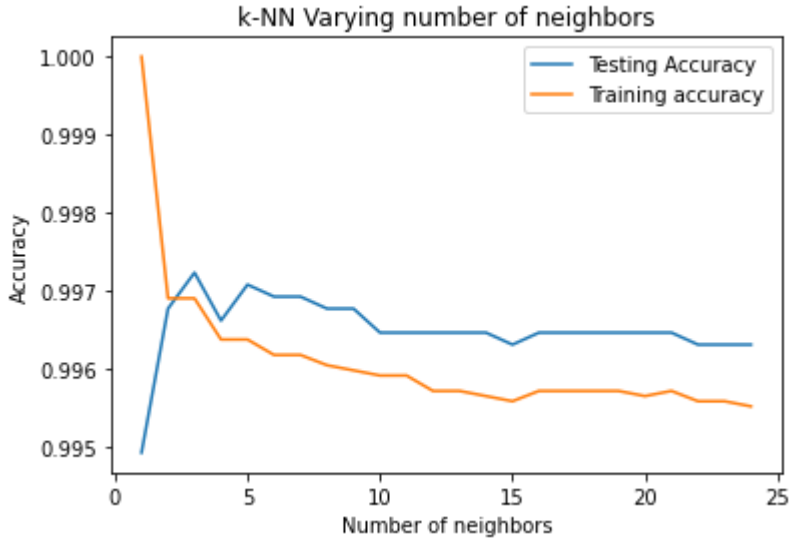
```
from sklearn.preprocessing import normalize
train_X = normalize(train_X)
test_X=normalize(test_X)
```

In [49]:

```
neighbours = np.arange(1,25)
train_accuracy =np.empty(len(neighbours))
test_accuracy = np.empty(len(neighbours))

for i,k in enumerate(neighbours):
    #Setup a knn classifier with k neighbors
    knn=KNeighborsClassifier(n_neighbors=k,algorithm="kd_tree",n_jobs=-1)

    #Fit the model
    knn.fit(train_X,train_Y.ravel())

    #Compute accuracy on the training set
    train_accuracy[i] = knn.score(train_X, train_Y.ravel())

    #Compute accuracy on the test set
    test_accuracy[i] = knn.score(test_X, test_Y.ravel())
```

In [50]:

```
plt.title('k-NN Varying number of neighbors')
plt.plot(neighbours, test_accuracy, label='Testing Accuracy')
plt.plot(neighbours, train_accuracy, label='Training accuracy')
plt.legend()
plt.xlabel('Number of neighbors')
plt.ylabel('Accuracy')
plt.show()
```



In [51]:

```
idx = np.where(test_accuracy == max(test_accuracy))
x = neighbours[idx]
```

In [52]:

```
knn=KNeighborsClassifier(n_neighbors=x[0],algorithm="kd_tree",n_jobs=-1)
knn.fit(train_X,train_Y.ravel())
```

Out[52]:

```
KNeighborsClassifier(algorithm='kd_tree', n_jobs=-1, n_neighbors=3)
```

In [55]:

```
knn_predicted_test_labels=knn.predict(test_X)
```

In [56]:

```
knn_accuracy_score  = accuracy_score(test_Y,knn_predicted_test_labels)
knn_precison_score  = precision_score(test_Y,knn_predicted_test_labels)
knn_recall_score    = recall_score(test_Y,knn_predicted_test_labels)
knn_f1_score        = f1_score(test_Y,knn_predicted_test_labels)
```

In [57]:

```
print("")
print("K-Nearest Neighbours")
print("Scores")
print("Accuracy -->",knn_accuracy_score)
print("Precison -->",knn_precison_score)
print("Recall -->",knn_recall_score)
print("F1 -->",knn_f1_score)
print(classification_report(test_Y,knn_predicted_test_labels))
```

```
K-Nearest Neighbours
Scores
Accuracy --> 0.9972341733251383
Precison --> 0.9550561797752809
Recall --> 0.8585858585858586
F1 --> 0.9042553191489363
              precision    recall  f1-score   support

           0       1.00      1.00      1.00      6409
           1       0.96      0.86      0.90        99

    accuracy                           1.00      6508
   macro avg       0.98      0.93      0.95      6508
weighted avg       1.00      1.00      1.00      6508
```

In [62]:

```
from sklearn.ensemble import AdaBoostClassifier
from sklearn.ensemble import GradientBoostingClassifier
```

In [66]:

```
# Applying Ada Boost Classifier
ada_boost = AdaBoostClassifier(n_estimators = 100, random_state = 123)
```

In [67]:

```
ada_boost.fit(train_X,train_Y)
```

Out[67]:

```
AdaBoostClassifier(n_estimators=100, random_state=123)
```

In [68]:

```
y_predictions_ab = ada_boost.predict(test_X)
```

In [70]:

```
# Printing Evaluation Metrics for Ada Boost
metrics_ab = [['Accuracy',(accuracy_score(test_Y, y_predictions_ab))],
                          ['Precision',precision_score(test_Y, y_predictions_ab)],
                          ['Recall', recall_score(test_Y, y_predictions_ab)],
                          ['F1_score',f1_score(test_Y, y_predictions_ab)]]
metrics_df_ab = pd.DataFrame(metrics_ab, columns = ['Metrics', 'Results'])
metrics_df_ab
```

Out[70]:

	Metrics	Results
0	Accuracy	0.995698
1	Precision	0.890110
2	Recall	0.818182
3	F1_score	0.852632

In [71]:

```
gradient_boosting = GradientBoostingClassifier(n_estimators = 100, random_state = 123)
gradient_boosting.fit(train_X,train_Y)
```

Out[71]:

```
GradientBoostingClassifier(random_state=123)
```

In [72]:

```
y_prediction_gb = gradient_boosting.predict(test_X)
```

In [74]:

```
metrics_gb = [['Accuracy',(accuracy_score(test_Y, y_prediction_gb))],
                          ['Precision',precision_score(test_Y, y_prediction_gb)],
                          ['Recall', recall_score(test_Y, y_prediction_gb)],
                          ['F1_score',f1_score(test_Y, y_prediction_gb)]]
metrics_df_gb = pd.DataFrame(metrics_gb, columns = ['Metrics', 'Results'])
metrics_df_gb
```

Out[74]:

	Metrics	Results
0	Accuracy	0.995083
1	Precision	0.876404
2	Recall	0.787879
3	F1_score	0.829787

In [77]:

```
from sklearn.metrics import roc_auc_score
print('Ada Boost ROC AUC Score: ', (roc_auc_score(test_Y, y_predictions_ab) * 100).round
print('Gradient Boost ROC AUC Score: ', (roc_auc_score(test_Y, y_prediction_gb) * 100).r
```

```
Ada Boost ROC AUC Score:  90.83
Gradient Boost ROC AUC Score:  89.31
```

In [ ]:

```

```