assignment8

April 26, 2024

[ ]:

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
```

```
/home/oneautumleaf/.local/lib/python3.10/site-
packages/matplotlib/projections/__init__.py:63: UserWarning: Unable to import
Axes3D. This may be due to multiple versions of Matplotlib being installed (e.g.
as a system package and as a pip package). As a result, the 3D projection is not
available.
  warnings.warn("Unable to import Axes3D. This may be due to multiple versions
of "
```

[ ]:

```
df = pd.read_csv('./datasets/creditcardfraud_normalised.csv')
df.shape
```

[ ]:

```
(284807, 30)
```

[ ]:

```
df = df[:10000]
```

[ ]:

```
df.head()
```

[ ]:

```
         V1        V2        V3        V4        V5        V6        V7  \
0  0.935192  0.766490  0.881365  0.313023  0.763439  0.267669  0.266815
1  0.978542  0.770067  0.840298  0.271796  0.766120  0.262192  0.264875
2  0.935217  0.753118  0.868141  0.268766  0.762329  0.281122  0.270177
3  0.941878  0.765304  0.868484  0.213661  0.765647  0.275559  0.266803
4  0.938617  0.776520  0.864251  0.269796  0.762975  0.263984  0.268968

         V8        V9       V10  …       V21       V22       V23       V24  \
0  0.786444  0.475312  0.510600  …  0.561184  0.522992  0.663793  0.391253
1  0.786298  0.453981  0.505267  …  0.557840  0.480237  0.666938  0.336440
2  0.788042  0.410603  0.513018  …  0.565477  0.546030  0.678939  0.289354
3  0.789434  0.414999  0.507585  …  0.559734  0.510277  0.662607  0.223826
4  0.782484  0.490950  0.524303  …  0.561327  0.547271  0.663392  0.401270

        V25       V26       V27       V28    Amount  class
0  0.585122  0.394557  0.418976  0.312697  0.005824      0
```

```
1  0.587290  0.446013  0.416345  0.313423  0.000105      0
2  0.559515  0.402727  0.415489  0.311911  0.014739      0
3  0.614245  0.389197  0.417669  0.314371  0.004807      0
4  0.566343  0.507497  0.420561  0.317490  0.002724      0

[5 rows x 30 columns]
```

[ ]:

```
df.describe()
```

[ ]:

```
                 V1            V2            V3            V4            V5  \
count  10000.000000  10000.000000  10000.000000  10000.000000  10000.000000
mean       0.954185      0.770233      0.853118      0.263640      0.765404
std        0.025851      0.013803      0.020086      0.063889      0.007963
min        0.488205      0.402097      0.568886      0.045465      0.549673
25%        0.941079      0.765060      0.844567      0.224693      0.761385
50%        0.951960      0.770303      0.853778      0.261676      0.764688
75%        0.977845      0.776774      0.865190      0.301830      0.768215
max        0.991600      0.858383      0.908491      0.715747      0.995272

                 V6            V7            V8            V9           V10  \
count  10000.000000  10000.000000  10000.000000  10000.000000  10000.000000
mean       0.264358      0.264919      0.784691      0.490415      0.504108
std        0.013144      0.006564      0.013506      0.039795      0.022625
min        0.026782      0.103621      0.531883      0.244729      0.235755
25%        0.256686      0.262052      0.783340      0.465221      0.494479
50%        0.261486      0.265017      0.785524      0.490521      0.501672
75%        0.268101      0.268258      0.788331      0.514670      0.512328
max        0.478107      0.474334      0.839667      0.820797      0.762376

       …           V21           V22           V23           V24  \
count  …  10000.000000  10000.000000  10000.000000  10000.000000
mean   …      0.560641      0.502909      0.664940      0.385109
std    …      0.014731      0.029440      0.007244      0.080099
min    …      0.376604      0.112240      0.440527      0.043693
25%    …      0.557158      0.484391      0.662848      0.338061
50%    …      0.559492      0.503651      0.664753      0.393011
75%    …      0.562007      0.521576      0.666646      0.437600
max    …      0.925623      0.721563      0.871507      0.813460

                V25           V26           V27           V28        Amount  \
count  10000.000000  10000.000000  10000.000000  10000.000000  10000.000000
mean       0.582798      0.443113      0.416613      0.313183      0.002453
std        0.024034      0.091931      0.007584      0.005403      0.007181
min        0.433233      0.206798      0.269290      0.241910      0.000000
25%        0.569030      0.371874      0.414952      0.312804      0.000195
50%        0.584699      0.432450      0.416427      0.313446      0.000621
75%        0.598061      0.503266      0.418741      0.314690      0.001984
```

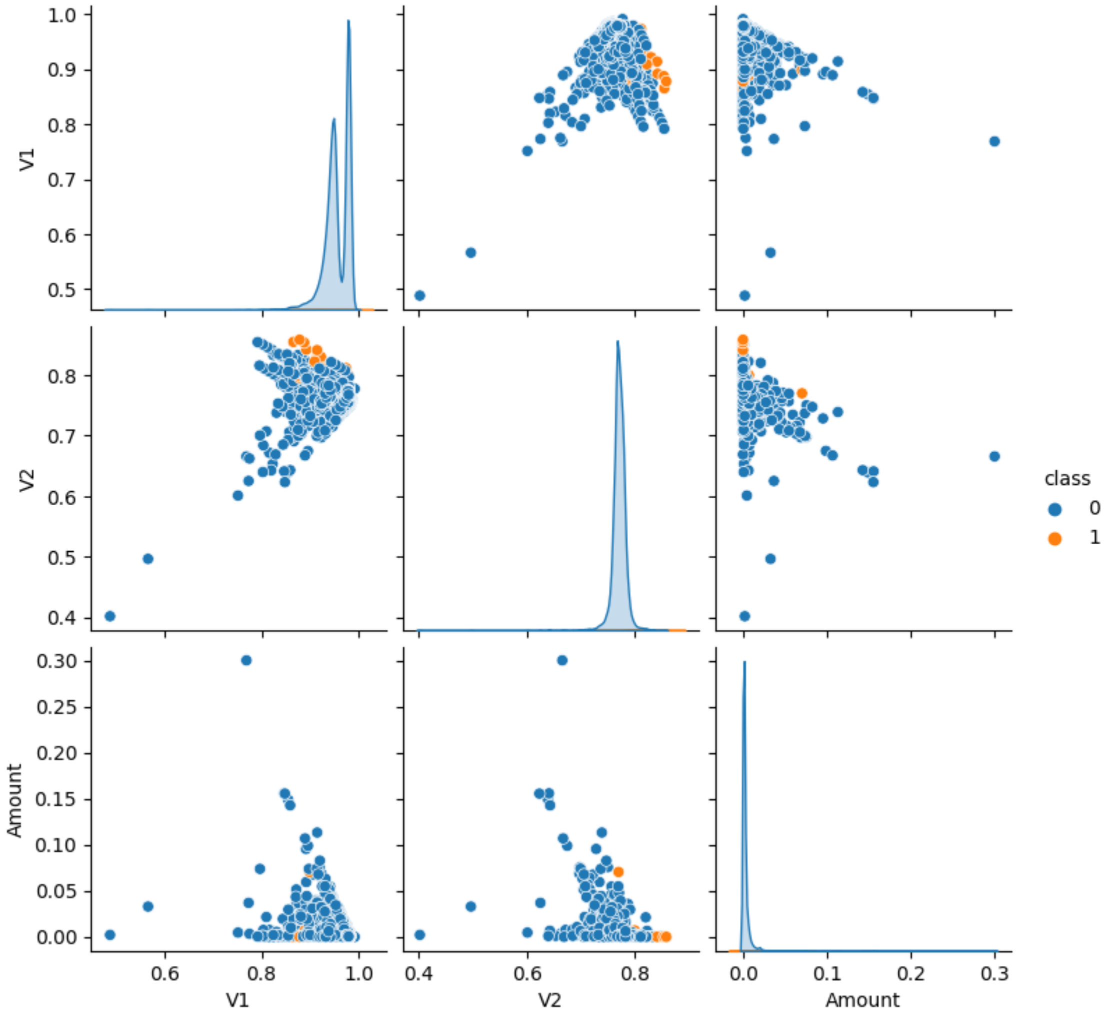
```
max       0.888044      1.000000      0.568868      0.411764      0.300198

             class
count  10000.00000
mean       0.00380
std        0.06153
min        0.00000
25%        0.00000
50%        0.00000
75%        0.00000
max        1.00000

[8 rows x 30 columns]
```

```
[ ]: sns.pairplot(df[['V1', 'V2', 'Amount', 'class']], hue='class')
```

```
[ ]: <seaborn.axisgrid.PairGrid at 0x7f322189d090>
```



Split the data into input and output

[ ]:
```python
X = df.drop('class', axis=1)
y = df['class']
```

Split into train and test

[ ]:
```python
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y)
```

3. Apply Outlier Detection Algorithms

[ ]:
```python
from pyod.models.knn import KNN
from pyod.models.lof import LOF
from pyod.models.abod import ABOD
from pyod.models.cblof import CBLOF
from pyod.models.iforest import IForest
```

[ ]:
```python
classifiers = {
    'K Nearest Neighbors (KNN)': KNN(),
    'Average KNN': KNN(method='mean'),
    'Angle-based Outlier Detector (ABOD)': ABOD(),
    'Cluster-based Local Outlier Factor (CBLOF)': CBLOF(),
    'Isolation Forest': IForest(),
}
```

[ ]:
```python
for clf_name, clf in classifiers.items():
    clf.fit(X_train)
```

```
/home/oneautumleaf/.local/lib/python3.10/site-
packages/numpy/core/fromnumeric.py:3787: RuntimeWarning: Degrees of freedom <= 0
for slice
  return _methods._var(a, axis=axis, dtype=dtype, out=out, ddof=ddof,
/home/oneautumleaf/.local/lib/python3.10/site-
packages/numpy/core/_methods.py:163: RuntimeWarning: invalid value encountered
in divide
  arrmean = um.true_divide(arrmean, div, out=arrmean,
/home/oneautumleaf/.local/lib/python3.10/site-
packages/numpy/core/_methods.py:198: RuntimeWarning: invalid value encountered
in scalar divide
  ret = ret.dtype.type(ret / rcount)
/home/oneautumleaf/.local/lib/python3.10/site-
packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of
`n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init`
explicitly to suppress the warning
  warnings.warn(
```

[ ]:

```
outlier_scores = np.zeros((len(X_test), len(classifiers)))
```

[ ]:

```
for i, clf in enumerate(classifiers.values()):
    outlier_scores[:, i] = clf.predict(X_test)
```

```
/home/oneautumleaf/.local/lib/python3.10/site-
packages/numpy/core/fromnumeric.py:3787: RuntimeWarning: Degrees of freedom <= 0
for slice
  return _methods._var(a, axis=axis, dtype=dtype, out=out, ddof=ddof,
/home/oneautumleaf/.local/lib/python3.10/site-
packages/numpy/core/_methods.py:163: RuntimeWarning: invalid value encountered
in divide
  arrmean = um.true_divide(arrmean, div, out=arrmean,
/home/oneautumleaf/.local/lib/python3.10/site-
packages/numpy/core/_methods.py:198: RuntimeWarning: invalid value encountered
in scalar divide
  ret = ret.dtype.type(ret / rcount)
/home/oneautumleaf/.local/lib/python3.10/site-packages/sklearn/base.py:402:
UserWarning: X has feature names, but IsolationForest was fitted without feature
names
  warnings.warn(
```

[ ]:

```
ensemble_scores = np.mean(outlier_scores, axis=1)
```

[ ]:

```
y_pred = np.where(ensemble_scores > 0, 1, 0)
```

[ ]:

```
from sklearn.metrics import classification_report, confusion_matrix,␣
 ↪accuracy_score
```

[ ]:

```
print(
    f"Classification Report: \n{classification_report(y_true=y_test,␣
 ↪y_pred=y_pred)}")
```

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

           0       1.00      1.00      1.00      2490
           1       0.00      0.00      0.00        10

    accuracy                           0.99      2500
   macro avg       0.50      0.50      0.50      2500
weighted avg       0.99      0.99      0.99      2500
```

[ ]:

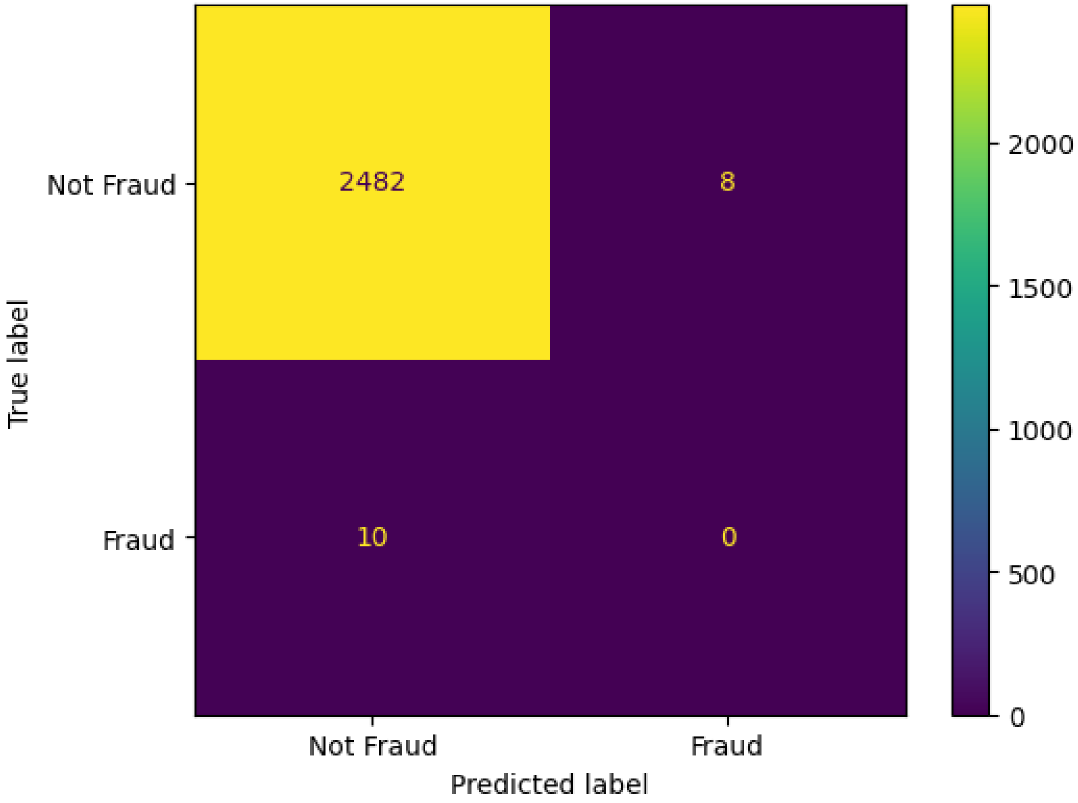
```
cm = confusion_matrix(y_true=y_test, y_pred=y_pred)
print(f"Confustion Matrix:\n {cm}")
```

```
Confustion Matrix:
```

```
[[2482    8]
 [  10    0]]
```

```
[ ]: from sklearn.metrics import ConfusionMatrixDisplay
     ConfusionMatrixDisplay(cm, display_labels=['Not Fraud', 'Fraud']).plot()
```

```
[ ]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
     0x7f32048a2800>
```



```
[ ]: print(f"Accuracy Score: {accuracy_score(y_test, y_pred)}")
```

```
Accuracy Score: 0.9928
```