# Linear Algebra (Credit card fraud detection)

Please download the data from https://www.kaggle.com/dalpozz/creditcardfraud/data (https://www.kaggle.com/dalpozz/creditcardfraud/data)

Info about data: it is a CSV file, contains 31 features, the last feature is used to classify the transaction whether it is a fraud or not

Task 1: please do proper analysis of the whole data, plot all relevant plots, note down all observations.

Task 2: Let's define a matric

similarity(i,j) = dot product (vi, vj) / length(vi) * length(vj) Take out any sample from the data set which contains no less than 100 transactions, for every transaction in the sample find out top 10 transactions in the dataset which have the highest similarity(i,j).

In [1]:
```python
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np

url = "creditcard.csv"

creditcard = pd.read_csv(url)

creditcard
```

Out[1]:

| V5 | V6 | V7 | V8 | V9 | ... | V21 | V22 | V23 | V24 | V25 | V26 | V27 | V28 | Amou |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -0.338321 | 0.462388 | 0.239599 | 0.098698 | 0.363787 | ... | -0.018307 | 0.277838 | -0.110474 | 0.066928 | 0.128539 | -0.189115 | 0.133558 | -0.021053 | 149. |
| 0.060018 | -0.082361 | -0.078803 | 0.085102 | -0.255425 | ... | -0.225775 | -0.638672 | 0.101288 | -0.339846 | 0.167170 | 0.125895 | -0.008983 | 0.014724 | 2. |
| -0.503198 | 1.800499 | 0.791461 | 0.247676 | -1.514654 | ... | 0.247998 | 0.771679 | 0.909412 | -0.689281 | -0.327642 | -0.139097 | -0.055353 | -0.059752 | 378. |
| -0.010309 | 1.247203 | 0.237609 | 0.377436 | -1.387024 | ... | -0.108300 | 0.005274 | -0.190321 | -1.175575 | 0.647376 | -0.221929 | 0.062723 | 0.061458 | 123. |
| -0.407193 | 0.095921 | 0.592941 | -0.270533 | 0.817739 | ... | -0.009431 | 0.798278 | -0.137458 | 0.141267 | -0.206010 | 0.502292 | 0.219422 | 0.215153 | 69. |
| 0.420987 | -0.029728 | 0.476201 | 0.260314 | -0.568671 | ... | -0.208254 | -0.559825 | -0.026398 | -0.371427 | -0.232794 | 0.105915 | 0.253844 | 0.081080 | 3. |
| 0.191881 | 0.272708 | -0.005159 | 0.081213 | 0.464960 | ... | -0.167716 | -0.270710 | -0.154104 | -0.780055 | 0.750137 | -0.257237 | 0.034507 | 0.005168 | 4. |
| 0.948934 | 0.428118 | 1.120631 | -3.807864 | 0.615375 | ... | 1.943465 | -1.015455 | 0.057504 | -0.649709 | -0.415267 | -0.051634 | -1.206921 | -1.085339 | 40. |
| 2.669599 | 3.721818 | 0.370145 | 0.851084 | -0.392048 | ... | -0.073425 | -0.268092 | -0.204233 | 1.011592 | 0.373205 | -0.384157 | 0.011747 | 0.142404 | 93. |
| 0.499361 | -0.246761 | 0.651583 | 0.069539 | -0.736727 | ... | -0.246914 | -0.633753 | -0.120794 | -0.385050 | -0.069733 | 0.094199 | 0.246219 | 0.083076 | 3. |
| -1.971383 | -0.629152 | -1.423236 | 0.048456 | -1.720408 | ... | -0.009302 | 0.313894 | 0.027740 | 0.500512 | 0.251367 | -0.129478 | 0.042850 | 0.016253 | 7. |
| 2.924584 | 3.317027 | 0.470455 | 0.538247 | -0.558895 | ... | 0.049924 | 0.238422 | 0.009130 | 0.996710 | -0.767315 | -0.492208 | 0.042472 | -0.054337 | 9. |
| -1.485419 | -0.753230 | -0.689405 | -0.227487 | -2.094011 | ... | -0.231809 | -0.483285 | 0.084668 | 0.392831 | 0.161135 | -0.354990 | 0.026416 | 0.042422 | 121. |
| -0.178398 | 0.337544 | -0.096717 | 0.115982 | -0.221083 | ... | -0.036876 | 0.074412 | -0.071407 | 0.104744 | 0.548265 | 0.104094 | 0.021491 | 0.021293 | 27. |
| -0.136588 | 0.807596 | -0.422911 | -1.907107 | 0.755713 | ... | 1.151663 | 0.222182 | 1.020586 | 0.028317 | -0.232746 | -0.235557 | -0.164778 | -0.030154 | 58. |
| -1.158394 | -0.077850 | -0.608581 | 0.003603 | -0.436167 | ... | 0.499625 | 1.353650 | -0.256573 | -0.065084 | -0.039124 | -0.087086 | -0.180998 | 0.129394 | 15. |
| -0.735997 | 0.288069 | -0.586057 | 0.189380 | 0.782333 | ... | -0.024612 | 0.196002 | 0.013802 | 0.103758 | 0.364298 | -0.382261 | 0.092809 | 0.037051 | 12. |
| 0.915679 | -0.127867 | 0.707642 | 0.087962 | -0.665271 | ... | -0.194796 | -0.672638 | -0.156858 | -0.888386 | -0.342413 | -0.049027 | 0.079692 | 0.131024 | 0. |

| V5 | V6 | V7 | V8 | V9 | ... | V21 | V22 | V23 | V24 | V25 | V26 | V27 | V28 | Amou |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.049106 | -1.763406 | -1.559738 | 0.160842 | 1.233090 | ... | -0.503600 | 0.984460 | 2.458589 | 0.042119 | -0.481631 | -0.621272 | 0.392053 | 0.949594 | 46. |
| -1.555434 | -0.720961 | -1.080664 | -0.053127 | -1.978682 | ... | -0.177650 | -0.175074 | 0.040002 | 0.295814 | 0.332931 | -0.220385 | 0.022298 | 0.007602 | 5. |
| -1.191209 | 1.309109 | -0.878586 | 0.445290 | -0.446196 | ... | -0.295583 | -0.571955 | -0.050881 | -0.304215 | 0.072001 | -0.422234 | 0.086553 | 0.063499 | 231. |
| 1.129566 | 1.696038 | 0.107712 | 0.521502 | -1.191311 | ... | 0.143997 | 0.402492 | -0.048508 | -1.371866 | 0.390814 | 0.199964 | 0.016371 | -0.014605 | 34. |
| 0.428804 | 0.089474 | 0.241147 | 0.138082 | -0.989162 | ... | 0.018702 | -0.061972 | -0.103855 | -0.370415 | 0.603200 | 0.108556 | -0.040521 | -0.011418 | 2. |
| -1.314394 | -0.150116 | -0.946365 | -1.617935 | 1.544071 | ... | 1.650180 | 0.200454 | -0.185353 | 0.423073 | 0.820591 | -0.227632 | 0.336634 | 0.250475 | 22. |
| 2.941968 | 2.955053 | -0.063063 | 0.855546 | 0.049967 | ... | -0.579526 | -0.799229 | 0.870300 | 0.983421 | 0.321201 | 0.149650 | 0.707519 | 0.014600 | 0. |
| 0.295198 | -0.959537 | 0.543985 | -0.104627 | 0.475664 | ... | -0.403639 | -0.227404 | 0.742435 | 0.398535 | 0.249212 | 0.274404 | 0.359969 | 0.243232 | 26. |
| -0.172577 | -0.916054 | 0.369025 | -0.327260 | -0.246651 | ... | 0.067003 | 0.227812 | -0.150487 | 0.435045 | 0.724825 | -0.337082 | 0.016368 | 0.030041 | 41. |
| -0.836758 | -0.831083 | -0.264905 | -0.220982 | -1.071425 | ... | -0.284376 | -0.323357 | -0.037710 | 0.347151 | 0.559639 | -0.280158 | 0.042335 | 0.028822 | 16. |
| 0.007443 | -0.200331 | 0.740228 | -0.029247 | -0.593392 | ... | 0.077237 | 0.457331 | -0.038500 | 0.642522 | -0.183891 | -0.277464 | 0.182687 | 0.152665 | 33. |
| -0.786002 | 0.578435 | -0.767084 | 0.401046 | 0.699500 | ... | 0.013676 | 0.213734 | 0.014462 | 0.002951 | 0.294638 | -0.395070 | 0.081461 | 0.024220 | 12. |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| -0.045791 | -1.345452 | 0.227476 | -0.378355 | 0.665911 | ... | 0.235758 | 0.829758 | -0.002063 | 0.001344 | 0.262183 | -0.105327 | -0.022363 | -0.060283 | 1. |
| 0.901528 | -0.760802 | 0.758545 | 0.414698 | -0.730854 | ... | 0.003530 | -0.431876 | 0.141759 | 0.587119 | -0.200998 | 0.267337 | -0.152951 | -0.065285 | 80. |
| 2.327804 | 3.664740 | -0.533297 | 0.842937 | 1.128798 | ... | 0.086043 | 0.543613 | -0.032129 | 0.768379 | 0.477688 | -0.031833 | 0.014151 | -0.066542 | 25. |
| -0.884199 | 0.793083 | -0.527298 | 0.866429 | 0.853819 | ... | -0.094708 | 0.236818 | -0.204280 | 1.158185 | 0.627801 | -0.399981 | 0.510818 | 0.233265 | 30. |
| 1.451777 | 0.093598 | 0.191353 | 0.092211 | -0.062621 | ... | -0.191027 | -0.631658 | -0.147249 | 0.212931 | 0.354257 | -0.241068 | -0.161717 | -0.149188 | 13. |
| 0.639105 | 0.186479 | -0.045911 | 0.936448 | -2.419986 | ... | -0.263889 | -0.857904 | 0.235172 | -0.681794 | -0.668894 | 0.044657 | -0.066751 | -0.072447 | 12. |
| 2.199572 | 3.123732 | -0.270714 | 1.657495 | 0.465804 | ... | 0.271170 | 1.145750 | 0.084783 | 0.721269 | -0.529906 | -0.240117 | 0.129126 | -0.080620 | 11. |
| 2.833960 | 3.240843 | 0.181576 | 1.282746 | -0.893890 | ... | 0.183856 | 0.202670 | -0.373023 | 0.651122 | 1.073823 | 0.844590 | -0.286676 | -0.187719 | 40. |
| 2.932315 | 3.401529 | 0.337434 | 0.925377 | -0.165663 | ... | -0.266113 | -0.716336 | 0.108519 | 0.688519 | -0.460220 | 0.161939 | 0.265368 | 0.090245 | 1. |
| 1.982785 | 3.732950 | -1.217430 | -0.536644 | 0.272867 | ... | 2.016666 | -1.588269 | 0.588482 | 0.632444 | -0.201064 | 0.199251 | 0.438657 | 0.172923 | 8. |
| 2.424360 | -2.956733 | 0.283610 | -0.332656 | -0.247488 | ... | 0.353722 | 0.488487 | 0.293632 | 0.107812 | -0.935586 | 1.138216 | 0.025271 | 0.255347 | 9. |
| -0.715798 | -0.751373 | -0.458972 | -0.140140 | 0.959971 | ... | -0.208260 | -0.430347 | 0.416765 | 0.064819 | -0.608337 | 0.268436 | -0.028069 | -0.041367 | 3. |
| 0.578957 | -0.605641 | 1.253430 | -1.042610 | -0.417116 | ... | 0.851800 | 0.305268 | -0.148093 | -0.038712 | 0.010209 | -0.362666 | 0.503092 | 0.229921 | 60. |

| V5 | V6 | V7 | V8 | V9 | ... | V21 | V22 | V23 | V24 | V25 | V26 | V27 | V28 | Amou |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.912430 | -0.316187 | 0.396137 | 0.532364 | -0.224606 | ... | -0.280302 | -0.849919 | 0.300245 | 0.000607 | -0.376379 | 0.128660 | -0.015205 | -0.021486 | 9. |
| 0.356561 | -1.046238 | 0.757051 | 0.230473 | -0.506856 | ... | -0.108846 | -0.480820 | -0.074513 | -0.003988 | -0.113149 | 0.280378 | -0.077310 | 0.023079 | 20. |
| 0.709499 | -0.482638 | 0.548393 | 0.343003 | -0.226323 | ... | 0.414621 | 1.307511 | -0.059545 | 0.242669 | -0.665424 | -0.269869 | -0.170579 | -0.030692 | 3. |
| 1.718797 | 3.911336 | -1.259306 | 1.056209 | 1.315006 | ... | 0.188758 | 0.694418 | 0.163002 | 0.726365 | -0.058282 | -0.191813 | 0.061858 | -0.043716 | 4. |
| 1.531993 | -1.788600 | 0.314741 | 0.004704 | 0.013857 | ... | -0.157831 | -0.883365 | 0.088485 | -0.076790 | -0.095833 | 0.132720 | -0.028468 | 0.126494 | 0. |
| -4.586669 | -1.394465 | -3.632516 | 5.498583 | 4.893089 | ... | -0.944759 | -1.565026 | 0.890675 | -1.253276 | 1.786717 | 0.320763 | 2.090712 | 1.232864 | 9. |
| -0.035300 | -0.613638 | 0.190241 | -0.249058 | 0.666458 | ... | 0.144008 | 0.634646 | -0.042114 | -0.053206 | 0.316403 | -0.461441 | 0.018265 | -0.041068 | 60. |
| 0.244531 | -1.343668 | 0.929369 | -0.206210 | 0.106234 | ... | -0.228876 | -0.514376 | 0.279598 | 0.371441 | -0.559238 | 0.113144 | 0.131507 | 0.081265 | 5. |
| -0.152971 | -1.014307 | 0.427126 | 0.121340 | -0.285670 | ... | 0.099936 | 0.337120 | 0.251791 | 0.057688 | -1.508368 | 0.144023 | 0.181205 | 0.215243 | 24. |
| 1.196063 | 5.519980 | -1.518185 | 2.080825 | 1.159498 | ... | 0.103302 | 0.654850 | -0.348929 | 0.745323 | 0.704545 | -0.127579 | 0.454379 | 0.130308 | 79. |
| -0.008713 | -0.726571 | 0.017050 | -0.118228 | 0.435402 | ... | -0.268048 | -0.717211 | 0.297930 | -0.359769 | -0.315610 | 0.201114 | -0.080826 | -0.075071 | 2. |
| 1.130314 | -0.235973 | 0.812722 | 0.115093 | -0.204064 | ... | -0.314205 | -0.808520 | 0.050343 | 0.102800 | -0.435870 | 0.124079 | 0.217940 | 0.068803 | 2. |
| -5.364473 | -2.606837 | -4.918215 | 7.305334 | 1.914428 | ... | 0.213454 | 0.111864 | 1.014480 | -0.509348 | 1.436807 | 0.250034 | 0.943651 | 0.823731 | 0. |
| 0.868229 | 1.058415 | 0.024330 | 0.294869 | 0.584800 | ... | 0.214205 | 0.924384 | 0.012463 | -1.016226 | -0.606624 | -0.395255 | 0.068472 | -0.053527 | 24. |
| 2.630515 | 3.031260 | -0.296827 | 0.708417 | 0.432454 | ... | 0.232045 | 0.578229 | -0.037501 | 0.640134 | 0.265745 | -0.087371 | 0.004455 | -0.026561 | 67. |
| -0.377961 | 0.623708 | -0.686180 | 0.679145 | 0.392087 | ... | 0.265245 | 0.800049 | -0.163298 | 0.123205 | -0.569159 | 0.546668 | 0.108821 | 0.104533 | 10. |
| -0.012546 | -0.649617 | 1.577006 | -0.414650 | 0.486180 | ... | 0.261057 | 0.643078 | 0.376777 | 0.008797 | -0.473649 | -0.818267 | -0.002415 | 0.013649 | 217. |

**Information about data set**

The datasets contains transactions made by credit cards in September 2013 by european cardholders. This dataset presents transactions that occurred in two days, where we have 492 frauds out of 284,807 transactions. The dataset is highly unbalanced, the positive class (frauds) account for 0.172% of all transactions.

It contains only numerical input variables which are the result of a PCA transformation. Unfortunately, due to confidentiality issues, we cannot provide the original features and more background information about the data. Features V1, V2, ... V28 are the principal components obtained with PCA, the only features which have not been transformed with PCA are 'Time' and 'Amount'. Feature 'Time' contains the seconds elapsed between each

transaction and the first transaction in the dataset. The feature 'Amount' is the transaction Amount, this feature can be used for example-dependant cost-senstive learning. **Feature 'Class' is the response variable and it takes value 1 in case of fraud and 0 otherwise.**

Given the class imbalance ratio, we recommend measuring the accuracy using the Area Under the Precision-Recall Curve (AUPRC). Confusion matrix accuracy is not meaningful for unbalanced classification.

The dataset has been collected and analysed during a research collaboration of Worldline and the Machine Learning Group ([http://mlg.ulb.ac.be (http://mlg.ulb.ac.be)](http://mlg.ulb.ac.be)) of ULB (Université Libre de Bruxelles) on big data mining and fraud detection.

In [2]:
```python
print(creditcard.shape)
```

```
(284807, 31)
```

In [3]:
```python
print(creditcard.columns)
```

```
Index(['Time', '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', 'Amount',
       'Class'],
      dtype='object')
```

In [4]:
```python
creditcard["Class"].value_counts()
```

Out[4]:
```
0    284315
1       492
Name: Class, dtype: int64
```

# 2-D Scatter Plot

In [5]:
```python
sns.set_style("whitegrid")
sns.FacetGrid(creditcard, hue="Class", size = 6).map(plt.scatter, "Time", "Amount").add_legend()
plt.show()
```
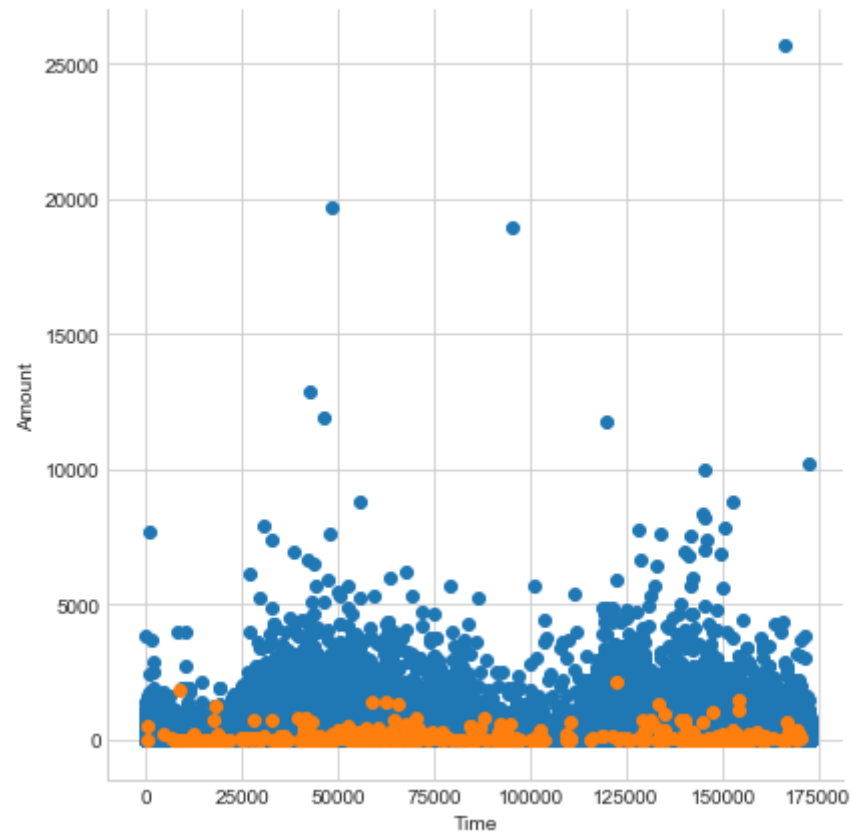
In [6]:
```python
sns.set_style("whitegrid")
sns.FacetGrid(creditcard, hue="Class", size = 6).map(plt.scatter, "Amount", "Time").add_legend()
plt.show()
```
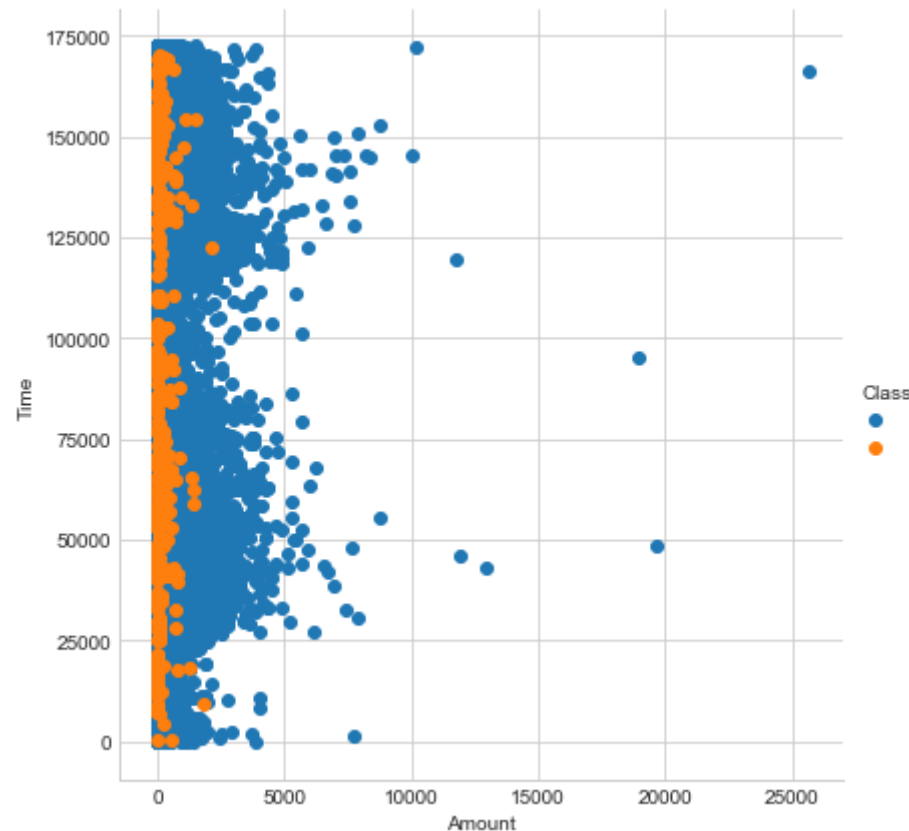


Observations:

1. From the above two plots it is clearly visible that there are frauds only on the transactions which have transaction amount approximately less than 2500. Transactions which have transaction amount approximately above 2500 have no fraud.
2. As per with the time, the frauds in the transactions are evenly distributed throughout time.

## 3D Scatter plot

In [7]:
```python
FilteredData = creditcard[['Time','Amount', 'Class']]
```

In [8]: `FilteredData`

Out[8]:

| | Time | Amount | Class |
|---|---|---|---|
| 0 | 0.0 | 149.62 | 0 |
| 1 | 0.0 | 2.69 | 0 |
| 2 | 1.0 | 378.66 | 0 |
| 3 | 1.0 | 123.50 | 0 |
| 4 | 2.0 | 69.99 | 0 |
| 5 | 2.0 | 3.67 | 0 |
| 6 | 4.0 | 4.99 | 0 |
| 7 | 7.0 | 40.80 | 0 |
| 8 | 7.0 | 93.20 | 0 |
| 9 | 9.0 | 3.68 | 0 |
| 10 | 10.0 | 7.80 | 0 |
| 11 | 10.0 | 9.99 | 0 |
| 12 | 10.0 | 121.50 | 0 |
| 13 | 11.0 | 27.50 | 0 |
| 14 | 12.0 | 58.80 | 0 |
| 15 | 12.0 | 15.99 | 0 |
| 16 | 12.0 | 12.99 | 0 |
| 17 | 13.0 | 0.89 | 0 |
| 18 | 14.0 | 46.80 | 0 |
| 19 | 15.0 | 5.00 | 0 |
| 20 | 16.0 | 231.71 | 0 |
| 21 | 17.0 | 34.09 | 0 |
| 22 | 18.0 | 2.28 | 0 |
| 23 | 18.0 | 22.75 | 0 |

| | Time | Amount | Class |
|---|---|---|---|
| 24 | 22.0 | 0.89 | 0 |
| 25 | 22.0 | 26.43 | 0 |
| 26 | 23.0 | 41.88 | 0 |
| 27 | 23.0 | 16.00 | 0 |
| 28 | 23.0 | 33.00 | 0 |
| 29 | 23.0 | 12.99 | 0 |
| ... | ... | ... | ... |
| 284777 | 172764.0 | 1.00 | 0 |
| 284778 | 172764.0 | 80.00 | 0 |
| 284779 | 172766.0 | 25.00 | 0 |
| 284780 | 172766.0 | 30.00 | 0 |
| 284781 | 172766.0 | 13.00 | 0 |
| 284782 | 172767.0 | 12.82 | 0 |
| 284783 | 172768.0 | 11.46 | 0 |
| 284784 | 172768.0 | 40.00 | 0 |
| 284785 | 172768.0 | 1.79 | 0 |
| 284786 | 172768.0 | 8.95 | 0 |
| 284787 | 172769.0 | 9.99 | 0 |
| 284788 | 172770.0 | 3.99 | 0 |
| 284789 | 172770.0 | 60.50 | 0 |
| 284790 | 172771.0 | 9.81 | 0 |
| 284791 | 172774.0 | 20.32 | 0 |
| 284792 | 172774.0 | 3.99 | 0 |
| 284793 | 172775.0 | 4.99 | 0 |
| 284794 | 172777.0 | 0.89 | 0 |
| 284795 | 172778.0 | 9.87 | 0 |

| | Time | Amount | Class |
|---|---|---|---|
| **284796** | 172780.0 | 60.00 | 0 |
| **284797** | 172782.0 | 5.49 | 0 |
| **284798** | 172782.0 | 24.05 | 0 |
| **284799** | 172783.0 | 79.99 | 0 |
| **284800** | 172784.0 | 2.68 | 0 |
| **284801** | 172785.0 | 2.69 | 0 |
| **284802** | 172786.0 | 0.77 | 0 |
| **284803** | 172787.0 | 24.79 | 0 |
| **284804** | 172788.0 | 67.88 | 0 |
| **284805** | 172788.0 | 10.00 | 0 |
| **284806** | 172792.0 | 217.00 | 0 |

284807 rows × 3 columns

In [9]:
```python
print(FilteredData.shape)
```

(284807, 3)

In [10]:
```python
FilteredData["Class"].value_counts()
```

Out[10]:
```
0    284315
1       492
Name: Class, dtype: int64
```

In [11]:
```python
plt.close();
sns.set_style("whitegrid");
sns.pairplot(FilteredData, hue="Class", size=5);
plt.show()
```
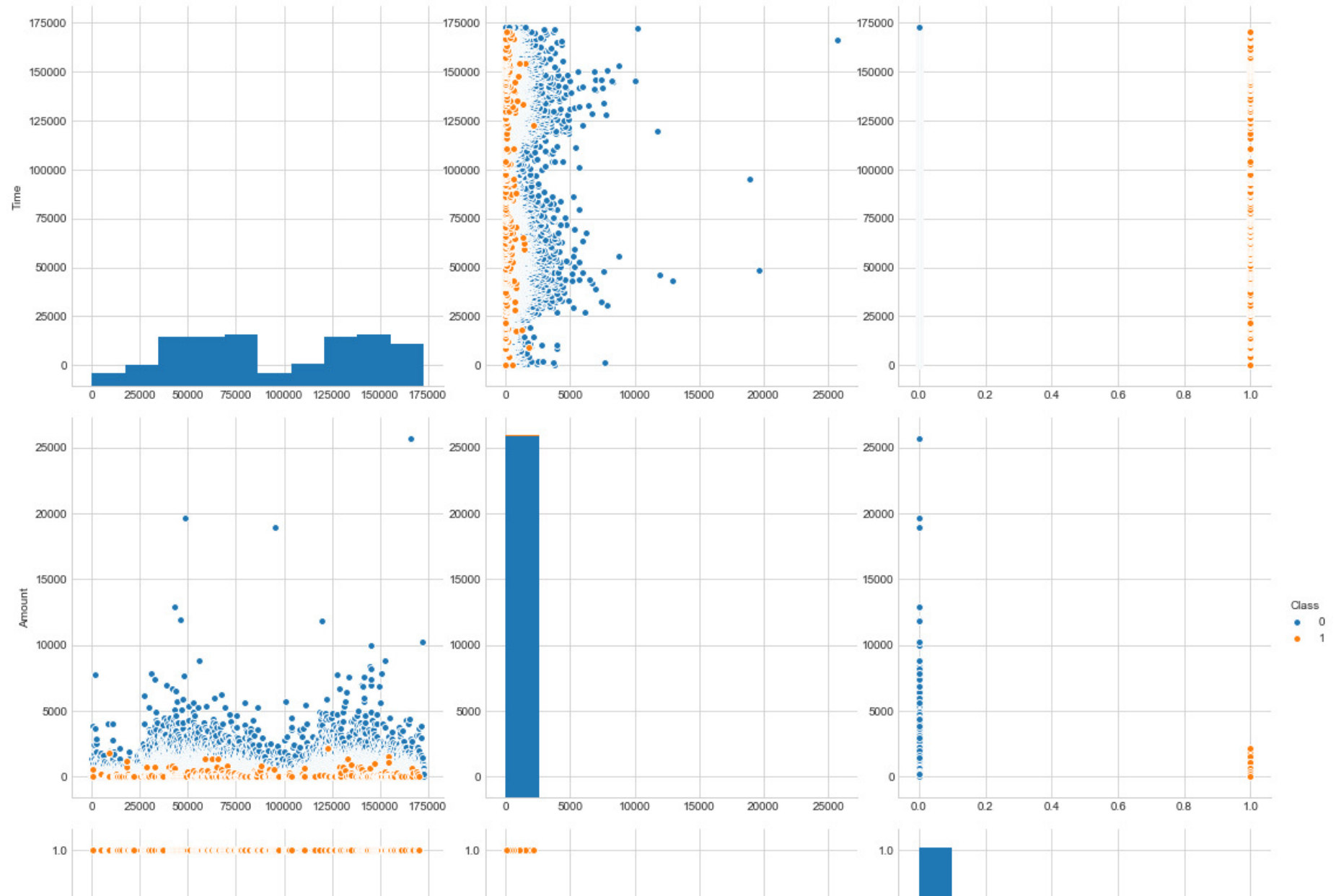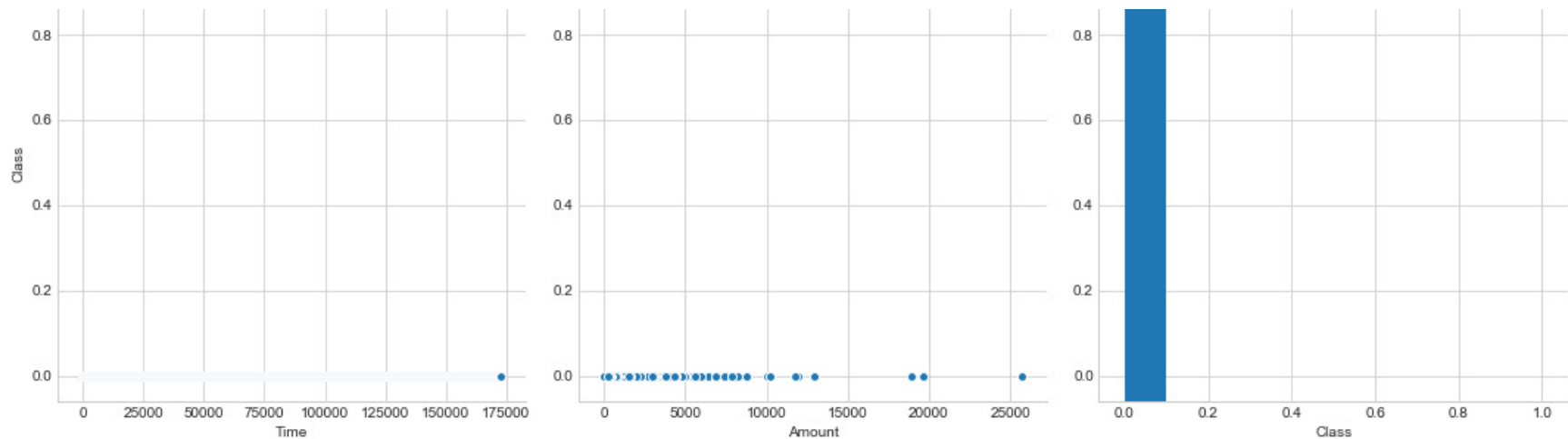
In [12]:
```python
countLess = 0
countMore= 0
for i in range(284806):
    if(FilteredData.iloc[i]["Amount"] < 2500):
        countLess = countLess + 1
    else:
        countMore = countMore + 1
print(countLess)
print(countMore)
```

284357
449

In [13]:
```python
percentage = (countLess/284807)*100
percentage
```

Out[13]: 99.84199826549207

Observations:

Now it has been calculated that there are 284357 transactions which has a transaction amount less than 2500. Means 99.84% of transactions have transaction amount less than 2500

```
In [14]: class0 = 0
         class1 = 0
         for i in range(284806):
             if(FilteredData.iloc[i]["Amount"] < 2500):
                 if(FilteredData.iloc[i]["Class"] == 0):
                     class0 = class0 + 1
                 else:
                     class1 = class1 + 1

         print(class0)
         print(class1)
```

```
283865
492
```

```
In [15]: FilteredData["Class"].value_counts()
```

```
Out[15]: 0    284315
         1       492
         Name: Class, dtype: int64
```

Observations:

Now the total number of fraud transactions in whole data are 492. It has been calculated that total number of fraud transactions in data where transaction amount is less than 2500 is also 492. Therefore, all 100% fraud transactions have transaction amount less than 2500 and there is no fraud transaction where transaction amount is more than 2500.

# Histogram, PDF and CDF

In [16]:
```python
creditCard_genuine = FilteredData.loc[FilteredData["Class"] == 0]
creditCard_fraud = FilteredData.loc[FilteredData["Class"] == 1]

plt.plot(creditCard_genuine["Time"], np.zeros_like(creditCard_genuine["Time"]), "o")
plt.plot(creditCard_fraud["Time"], np.zeros_like(creditCard_fraud["Time"]), "o")

plt.show()

#X-axis: Time
```
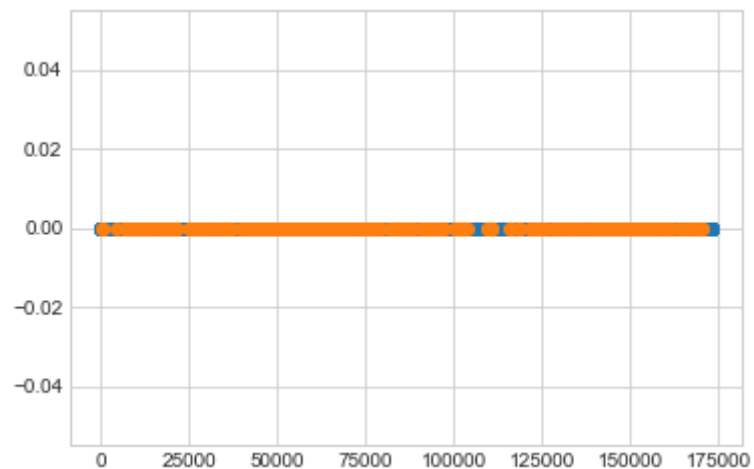
Observations:

Fraud and genuine transactions are spread evenly thought time and there is no clear distinction.

In [17]:
```python
plt.plot(creditCard_genuine["Amount"], np.zeros_like(creditCard_genuine["Amount"]), "o")
plt.plot(creditCard_fraud["Amount"], np.zeros_like(creditCard_fraud["Amount"]), "o")

plt.show()
#X-axis: Amount
```
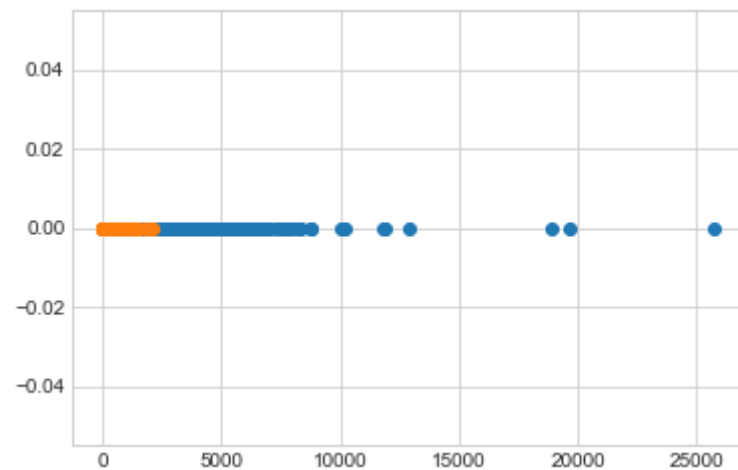


Observations:

It can clearly be observed from this 1D scatter plot that the fraud transactions are there only on the transaction amount less than 2500.

In [18]:
```python
sns.FacetGrid(FilteredData, hue="Class", size=10).map(sns.distplot, "Time").add_legend()
plt.show()
```

CreditCardFraudDetection
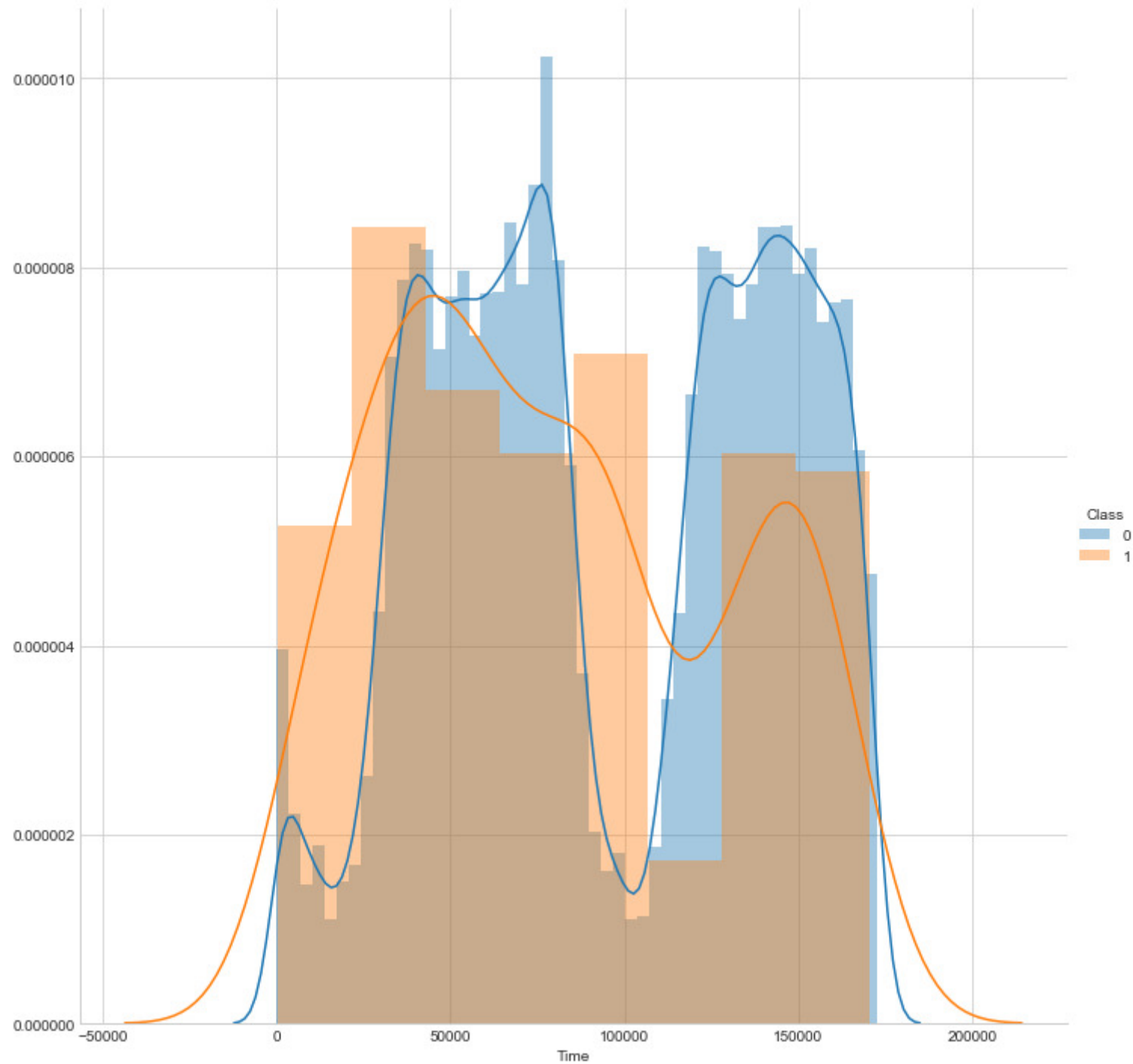
Observations:

There is a heavy overlap of genuine and fraud transactions throughout the time and there is no clear distinction.

In [19]:
```python
sns.FacetGrid(FilteredData, hue="Class", size=10).map(sns.distplot, "Amount").add_legend()
plt.show()
```
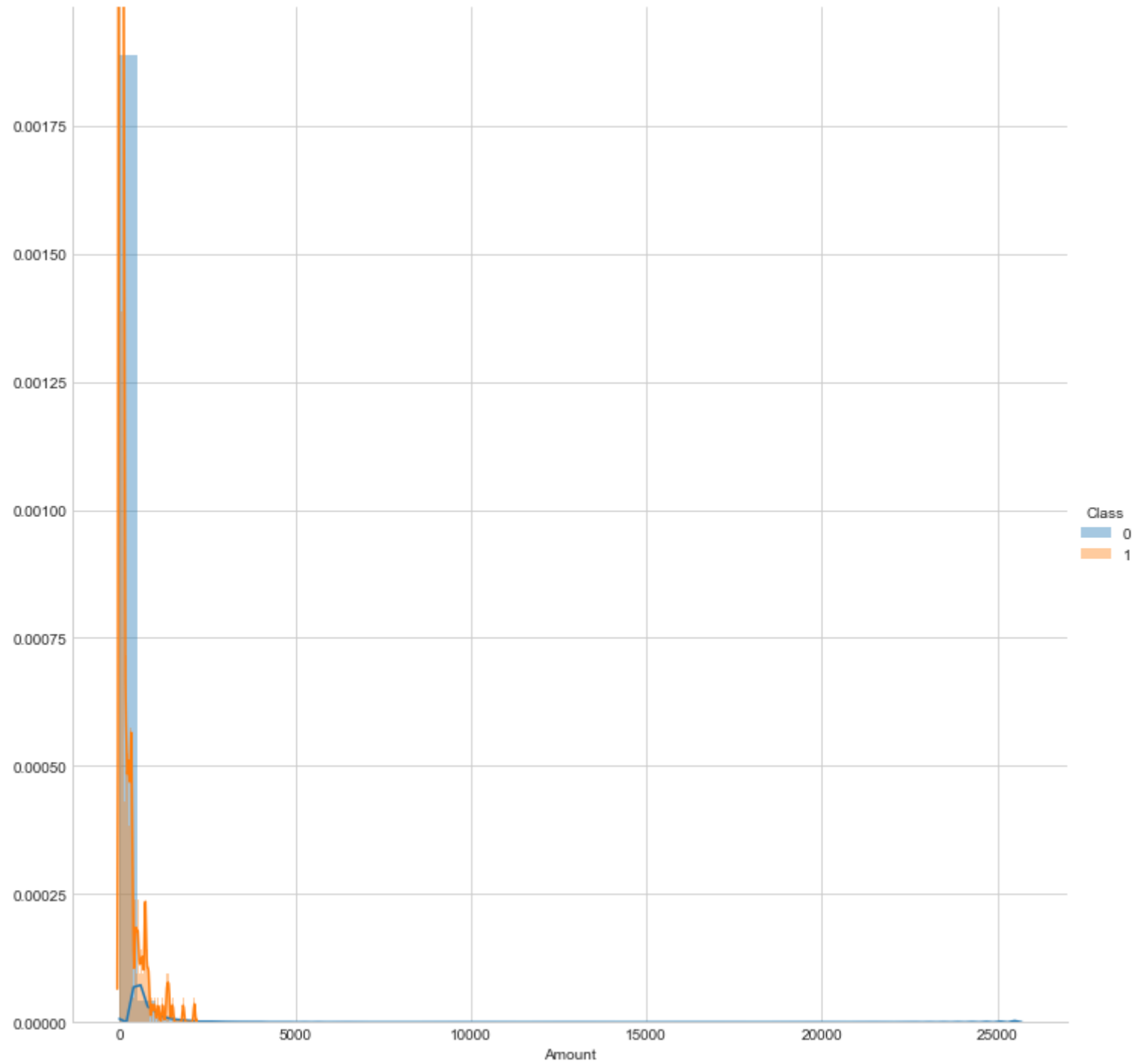
Observations:

Most of the transaction have amount less than 2500 approximately and all of the fraud transactions have transaction amount less than 2500. There is no fraud transaction of transaction amount greater than 2500.

**Hence, this is the best histogram we have**

In [13]:
```python
counts, bin_edges = np.histogram(FilteredData['Amount'], bins=10, density = True)
pdf = counts/(sum(counts))

print("pdf = ",pdf)
print("\n")
print("Counts =",counts)
print("\n")
print("Bin edges = ",bin_edges)

cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf)
plt.plot(bin_edges[1:], cdf)


plt.show();
```

```
pdf =  [9.98553406e-01 1.26401388e-03 1.26401388e-04 3.51114966e-05
 7.02229931e-06 3.51114966e-06 0.00000000e+00 7.02229931e-06
 0.00000000e+00 3.51114966e-06]


Counts = [3.88675874e-04 4.92003427e-07 4.92003427e-08 1.36667619e-08
 2.73335237e-09 1.36667619e-09 0.00000000e+00 2.73335237e-09
 0.00000000e+00 1.36667619e-09]


Bin edges =  [    0.     2569.116  5138.232  7707.348 10276.464 12845.58  15414.696
 17983.812 20552.928 23122.044 25691.16 ]
```
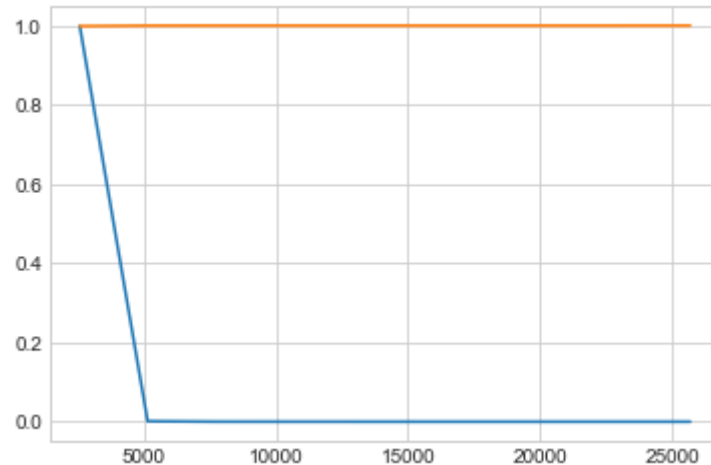
Observations:

Probability of the points having transaction amount approximately less than 2500 is 1, it means almost all of the transactions have transaction amount less than 2500 and cdf curve verifies this fact.

# Mean, Variance and Std-dev

```
In [21]:  print("Means:")
          print("Mean of transaction amount of genuine transactions: ",np.mean(creditCard_genuine["Amount"]))
          print("Mean of transaction amount of fraud transactions: ",np.mean(creditCard_fraud["Amount"]))
```

```
Means:
Mean of transaction amount of genuine transactions:  88.29102242225574
Mean of transaction amount of fraud transactions:  122.21132113821133
```

```
In [22]:  print("Standard Deviation:")
          print("Std-Deviation of transaction amount of genuine transactions: ", np.std(creditCard_genuine["Amount"]))
          print("Std-Deviation of transaction amount of fraud transactions: ", np.std(creditCard_fraud["Amount"]))
```

```
Standard Deviation:
Std-Deviation of transaction amount of genuine transactions:  250.1046523874637
Std-Deviation of transaction amount of fraud transactions:  256.42229861324483
```

In [23]:
```python
print("Median:")
print("Median of transaction amount of genuine transactions: ", np.median(creditCard_genuine["Amount"]))
print("Median of transaction amount of fraud transactions: ", np.median(creditCard_fraud["Amount"]))
```

```
Median:
Median of transaction amount of genuine transactions:  22.0
Median of transaction amount of fraud transactions:  9.25
```

In [24]:
```python
print("\nQuantiles:")
print(np.percentile(creditCard_genuine["Amount"],np.arange(0, 100, 25)))
print(np.percentile(creditCard_fraud["Amount"],np.arange(0, 100, 25)))
```

```
Quantiles:
[ 0.    5.65 22.   77.05]
[ 0.    1.    9.25 105.89]
```

# Box plot and Whiskers

In [25]:
```python
sns.boxplot(x = "Class", y = "Time", data = creditcard)
plt.show()
```
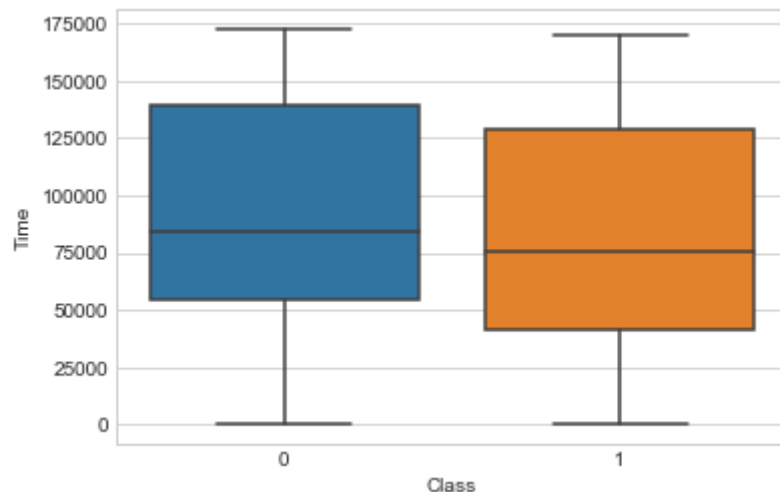
Observations:

By looking at the above box plot we can say that both fraud & genuine transactions occur throughout time and there is no distinction between them.

In [26]:
```python
sns.boxplot(x = "Class", y = "Amount", data = creditcard)
plt.ylim(0, 5000)
plt.show()
```
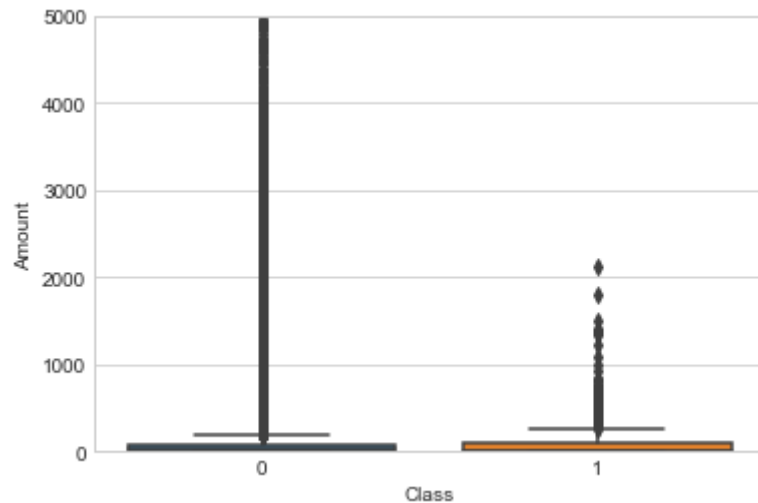


Observations:

From above box plot we can easily infer that there are no fraud transactions occur above the transaction amount of 3000. All of the fraud transactions have transaction amount less than 3000. However, there are many transactions which have a transaction amount greater than 3000 and all of them are genuine.

# Similarity

In [14]:
```python
from scipy import spatial
```

In [15]:
```python
sampleData = creditcard.head(20000)    #Sample the data from original data so as to save the computation time.
```

In [16]:
```python
samples = creditcard.loc[30401:30500]    #Taking sample of size 100 from index 30401 to 30500.
```

In [36]:
```javascript
%%javascript
IPython.OutputArea.prototype._should_scroll = function(lines) {
    return false;
}
```

In [37]:
```python
frame = []
```

In [42]:
```python
for i in range(30401, 30501):
    t1 = samples.loc[i]
    c = samples.loc[i]["Class"]
    for j in range(20000):
        t2 = sampleData.loc[j]
        classLabel = creditcard.loc[j]["Class"]
        similarity = 1 - spatial.distance.cosine(t1, t2)
        frame.append([classLabel, similarity, j])

    df = pd.DataFrame(frame, columns=['Class', 'Similarity', 'Transaction ID'])
    df_sorted = df.sort_values("Similarity", ascending=False)
    print("Top 10 transactions having highest similarity with transaction ID = "+str(i)+" and class = "+str(c)+":")
    print(df_sorted.iloc[:10])
    print("\n")
    frame = []
```

```
Top 10 transactions having highest similarity with transaction ID = 30401 and class = 0.0:
       Class  Similarity  Transaction ID
21501    0.0         1.0            16709
23546    0.0         1.0            18754
20632    0.0         1.0            15840
21046    0.0         1.0            16254
23378    0.0         1.0            18586
21420    0.0         1.0            16628
23230    0.0         1.0            18438
22838    0.0         1.0            18046
20738    0.0         1.0            15946
19596    0.0         1.0            14804


Top 10 transactions having highest similarity with transaction ID = 30402 and class = 0.0:
       Class  Similarity  Transaction ID
19040    0.0         1.0            19040
16720    0.0         1.0            16720
18994    0.0         1.0            18994
19142    0.0         1.0            19142
15480    0.0         1.0            15480
17628    0.0         1.0            17628
17591    0.0         1.0            17591
17876    0.0         1.0            17876
17702    0.0         1.0            17702
```

```
18873     0.0          1.0            18873


Top 10 transactions having highest similarity with transaction ID = 30403 and class = 0.0:
        Class  Similarity  Transaction ID
19891     0.0          1.0            19891
16169     0.0          1.0            16169
14732     0.0          1.0            14732
18378     0.0          1.0            18378
18484     0.0          1.0            18484
18640     0.0          1.0            18640
18884     0.0          1.0            18884
18195     0.0          1.0            18195
17543     0.0          1.0            17543
18584     0.0          1.0            18584


Top 10 transactions having highest similarity with transaction ID = 30404 and class = 0.0:
        Class  Similarity  Transaction ID
16348     0.0          1.0            16348
18390     0.0          1.0            18390
16264     0.0          1.0            16264
17166     0.0          1.0            17166
15248     0.0          1.0            15248
15263     0.0          1.0            15263
14506     0.0          1.0            14506
15636     0.0          1.0            15636
19278     0.0          1.0            19278
17522     0.0          1.0            17522


Top 10 transactions having highest similarity with transaction ID = 30405 and class = 0.0:
        Class  Similarity  Transaction ID
17296     0.0          1.0            17296
15162     0.0          1.0            15162
14209     0.0          1.0            14209
17175     0.0          1.0            17175
18301     0.0          1.0            18301
19185     0.0          1.0            19185
19831     0.0          1.0            19831
18762     0.0          1.0            18762
18839     0.0          1.0            18839
```

```
17704      0.0          1.0              17704
```

Top 10 transactions having highest similarity with transaction ID = 30406 and class = 0.0:

```
        Class  Similarity  Transaction ID
14972    0.0      1.0           14972
15826    0.0      1.0           15826
19655    0.0      1.0           19655
15083    0.0      1.0           15083
18291    0.0      1.0           18291
15654    0.0      1.0           15654
19774    0.0      1.0           19774
16421    0.0      1.0           16421
17621    0.0      1.0           17621
17450    0.0      1.0           17450
```

Top 10 transactions having highest similarity with transaction ID = 30407 and class = 0.0:

```
        Class  Similarity  Transaction ID
18057    0.0      1.0           18057
14583    0.0      1.0           14583
19963    0.0      1.0           19963
15085    0.0      1.0           15085
14828    0.0      1.0           14828
17876    0.0      1.0           17876
14850    0.0      1.0           14850
17005    0.0      1.0           17005
15480    0.0      1.0           15480
14626    0.0      1.0           14626
```

Top 10 transactions having highest similarity with transaction ID = 30408 and class = 0.0:

```
        Class  Similarity  Transaction ID
18560    0.0      1.0           18560
16101    0.0      1.0           16101
16717    0.0      1.0           16717
15231    0.0      1.0           15231
18521    0.0      1.0           18521
19469    0.0      1.0           19469
19478    0.0      1.0           19478
19072    0.0      1.0           19072
19067    0.0      1.0           19067
```

```
18656      0.0           1.0              18656


Top 10 transactions having highest similarity with transaction ID = 30409 and class = 0.0:
        Class   Similarity   Transaction ID
17901     0.0           1.0              17901
19047     0.0           1.0              19047
16103     0.0           1.0              16103
18032     0.0           1.0              18032
15272     0.0           1.0              15272
14894     0.0           1.0              14894
16302     0.0           1.0              16302
19628     0.0           1.0              19628
15800     0.0           1.0              15800
18129     0.0           1.0              18129


Top 10 transactions having highest similarity with transaction ID = 30410 and class = 0.0:
        Class   Similarity   Transaction ID
19070     0.0           1.0              19070
19956     0.0           1.0              19956
14199     0.0           1.0              14199
16376     0.0           1.0              16376
12473     0.0           1.0              12473
10719     0.0           1.0              10719
13483     0.0           1.0              13483
13757     0.0           1.0              13757
10639     0.0           1.0              10639
15691     0.0           1.0              15691


Top 10 transactions having highest similarity with transaction ID = 30411 and class = 0.0:
        Class   Similarity   Transaction ID
16771     0.0           1.0              16771
18398     0.0           1.0              18398
17159     0.0           1.0              17159
17956     0.0           1.0              17956
17170     0.0           1.0              17170
16628     0.0           1.0              16628
17881     0.0           1.0              17881
15946     0.0           1.0              15946
16286     0.0           1.0              16286
```

```
15982     0.0          1.0              15982


Top 10 transactions having highest similarity with transaction ID = 30412 and class = 0.0:
        Class  Similarity  Transaction ID
14907     0.0          1.0              14907
15054     0.0          1.0              15054
18925     0.0          1.0              18925
14647     0.0          1.0              14647
14942     0.0          1.0              14942
14350     0.0          1.0              14350
17816     0.0          1.0              17816
18260     0.0          1.0              18260
15244     0.0          1.0              15244
16040     0.0          1.0              16040


Top 10 transactions having highest similarity with transaction ID = 30413 and class = 0.0:
        Class  Similarity  Transaction ID
16568     0.0          1.0              16568
15575     0.0          1.0              15575
17005     0.0          1.0              17005
15528     0.0          1.0              15528
19264     0.0          1.0              19264
19459     0.0          1.0              19459
18287     0.0          1.0              18287
17890     0.0          1.0              17890
18056     0.0          1.0              18056
17811     0.0          1.0              17811


Top 10 transactions having highest similarity with transaction ID = 30414 and class = 0.0:
        Class  Similarity  Transaction ID
16816     0.0          1.0              16816
18611     0.0          1.0              18611
18555     0.0          1.0              18555
18886     0.0          1.0              18886
18839     0.0          1.0              18839
17060     0.0          1.0              17060
19960     0.0          1.0              19960
19296     0.0          1.0              19296
15659     0.0          1.0              15659
```

```
16612      0.0          1.0              16612


Top 10 transactions having highest similarity with transaction ID = 30415 and class = 0.0:
         Class  Similarity  Transaction ID
14885      0.0          1.0              14885
18634      0.0          1.0              18634
15059      0.0          1.0              15059
16975      0.0          1.0              16975
18346      0.0          1.0              18346
16124      0.0          1.0              16124
19340      0.0          1.0              19340
16846      0.0          1.0              16846
17389      0.0          1.0              17389
18123      0.0          1.0              18123


Top 10 transactions having highest similarity with transaction ID = 30416 and class = 0.0:
         Class  Similarity  Transaction ID
19246      0.0          1.0              19246
15639      0.0          1.0              15639
16875      0.0          1.0              16875
15322      0.0          1.0              15322
18272      0.0          1.0              18272
18696      0.0          1.0              18696
18018      0.0          1.0              18018
16193      0.0          1.0              16193
15625      0.0          1.0              15625
17719      0.0          1.0              17719


Top 10 transactions having highest similarity with transaction ID = 30417 and class = 0.0:
         Class  Similarity  Transaction ID
18282      0.0          1.0              18282
16276      0.0          1.0              16276
19010      0.0          1.0              19010
19241      0.0          1.0              19241
14453      0.0          1.0              14453
16129      0.0          1.0              16129
17456      0.0          1.0              17456
19496      0.0          1.0              19496
```

```
16235     0.0          1.0            16235
16518     0.0          1.0            16518


Top 10 transactions having highest similarity with transaction ID = 30418 and class = 0.0:
          Class  Similarity  Transaction ID
18914     0.0          1.0            18914
19552     0.0          1.0            19552
16206     0.0          1.0            16206
14957     0.0          1.0            14957
16093     0.0          1.0            16093
16156     0.0          1.0            16156
18677     0.0          1.0            18677
18012     0.0          1.0            18012
15521     0.0          1.0            15521
18116     0.0          1.0            18116


Top 10 transactions having highest similarity with transaction ID = 30419 and class = 0.0:
          Class  Similarity  Transaction ID
19673     0.0          1.0            19673
16465     0.0          1.0            16465
14932     0.0          1.0            14932
19029     0.0          1.0            19029
17234     0.0          1.0            17234
19542     0.0          1.0            19542
19243     0.0          1.0            19243
15124     0.0          1.0            15124
15753     0.0          1.0            15753
17815     0.0          1.0            17815


Top 10 transactions having highest similarity with transaction ID = 30420 and class = 0.0:
          Class  Similarity  Transaction ID
15960     0.0          1.0            15960
16035     0.0          1.0            16035
19858     0.0          1.0            19858
15867     0.0          1.0            15867
18138     0.0          1.0            18138
17860     0.0          1.0            17860
19948     0.0          1.0            19948
17556     0.0          1.0            17556
```

```
17245      0.0          1.0              17245
15461      0.0          1.0              15461
```

Top 10 transactions having highest similarity with transaction ID = 30421 and class = 0.0:

```
       Class  Similarity   Transaction ID
16485      0.0          1.0              16485
19321      0.0          1.0              19321
19122      0.0          1.0              19122
18484      0.0          1.0              18484
18584      0.0          1.0              18584
17241      0.0          1.0              17241
17667      0.0          1.0              17667
18195      0.0          1.0              18195
17372      0.0          1.0              17372
17978      0.0          1.0              17978
```

Top 10 transactions having highest similarity with transaction ID = 30422 and class = 0.0:

```
       Class  Similarity   Transaction ID
16737      0.0          1.0              16737
18460      0.0          1.0              18460
19415      0.0          1.0              19415
16823      0.0          1.0              16823
19078      0.0          1.0              19078
17519      0.0          1.0              17519
16184      0.0          1.0              16184
18356      0.0          1.0              18356
19818      0.0          1.0              19818
19130      0.0          1.0              19130
```

Top 10 transactions having highest similarity with transaction ID = 30423 and class = 0.0:

```
       Class  Similarity   Transaction ID
15508      0.0          1.0              15508
16085      0.0          1.0              16085
16738      0.0          1.0              16738
17126      0.0          1.0              17126
15314      0.0          1.0              15314
19678      0.0          1.0              19678
18812      0.0          1.0              18812
15672      0.0          1.0              15672
```

```
14395     0.0          1.0          14395
15167     0.0          1.0          15167


Top 10 transactions having highest similarity with transaction ID = 30424 and class = 0.0:
          Class  Similarity   Transaction ID
17131     0.0          1.0          17131
15684     0.0          1.0          15684
15716     0.0          1.0          15716
16917     0.0          1.0          16917
16283     0.0          1.0          16283
14191     0.0          1.0          14191
19746     0.0          1.0          19746
16761     0.0          1.0          16761
19853     0.0          1.0          19853
18956     0.0          1.0          18956


Top 10 transactions having highest similarity with transaction ID = 30425 and class = 0.0:
          Class  Similarity   Transaction ID
19886     0.0          1.0          19886
14410     0.0          1.0          14410
14599     0.0          1.0          14599
18441     0.0          1.0          18441
14577     0.0          1.0          14577
14499     0.0          1.0          14499
14470     0.0          1.0          14470
18583     0.0          1.0          18583
18037     0.0          1.0          18037
14594     0.0          1.0          14594


Top 10 transactions having highest similarity with transaction ID = 30426 and class = 0.0:
          Class  Similarity   Transaction ID
16646     0.0          1.0          16646
17902     0.0          1.0          17902
16874     0.0          1.0          16874
14452     0.0          1.0          14452
15918     0.0          1.0          15918
19352     0.0          1.0          19352
19113     0.0          1.0          19113
18940     0.0          1.0          18940
```

```
14885      0.0           1.0              14885
17775      0.0           1.0              17775


Top 10 transactions having highest similarity with transaction ID = 30427 and class = 0.0:
           Class   Similarity   Transaction ID
18724      0.0           1.0              18724
19322      0.0           1.0              19322
14993      0.0           1.0              14993
19612      0.0           1.0              19612
18193      0.0           1.0              18193
18186      0.0           1.0              18186
14911      0.0           1.0              14911
15911      0.0           1.0              15911
18518      0.0           1.0              18518
19247      0.0           1.0              19247


Top 10 transactions having highest similarity with transaction ID = 30428 and class = 0.0:
           Class   Similarity   Transaction ID
19195      0.0           1.0              19195
19046      0.0           1.0              19046
14478      0.0           1.0              14478
15750      0.0           1.0              15750
18065      0.0           1.0              18065
19756      0.0           1.0              19756
18203      0.0           1.0              18203
19166      0.0           1.0              19166
16667      0.0           1.0              16667
16416      0.0           1.0              16416


Top 10 transactions having highest similarity with transaction ID = 30429 and class = 0.0:
           Class   Similarity   Transaction ID
15684      0.0           1.0              15684
19853      0.0           1.0              19853
17131      0.0           1.0              17131
16164      0.0           1.0              16164
18776      0.0           1.0              18776
19162      0.0           1.0              19162
16917      0.0           1.0              16917
19823      0.0           1.0              19823
```

```
15716      0.0          1.0              15716
16761      0.0          1.0              16761


Top 10 transactions having highest similarity with transaction ID = 30430 and class = 0.0:
          Class  Similarity   Transaction ID
16278      0.0          1.0              16278
18854      0.0          1.0              18854
15324      0.0          1.0              15324
15423      0.0          1.0              15423
17773      0.0          1.0              17773
16386      0.0          1.0              16386
17269      0.0          1.0              17269
19621      0.0          1.0              19621
18572      0.0          1.0              18572
17353      0.0          1.0              17353


Top 10 transactions having highest similarity with transaction ID = 30431 and class = 0.0:
          Class  Similarity   Transaction ID
19791      0.0          1.0              19791
19671      0.0          1.0              19671
18130      0.0          1.0              18130
15494      0.0          1.0              15494
19592      0.0          1.0              19592
18478      0.0          1.0              18478
15518      0.0          1.0              15518
17633      0.0          1.0              17633
16288      0.0          1.0              16288
17655      0.0          1.0              17655


Top 10 transactions having highest similarity with transaction ID = 30432 and class = 0.0:
          Class  Similarity   Transaction ID
19617      0.0          1.0              19617
19616      0.0          1.0              19616
16314      0.0          1.0              16314
19270      0.0          1.0              19270
14706      0.0          1.0              14706
16334      0.0          1.0              16334
18889      0.0          1.0              18889
18163      0.0          1.0              18163
```

```
14526    0.0         1.0         14526
15789    0.0         1.0         15789
```

Top 10 transactions having highest similarity with transaction ID = 30433 and class = 0.0:
```
         Class  Similarity  Transaction ID
19807    0.0         1.0         19807
16918    0.0         1.0         16918
16914    0.0         1.0         16914
16462    0.0         1.0         16462
16115    0.0         1.0         16115
15791    0.0         1.0         15791
16998    0.0         1.0         16998
18753    0.0         1.0         18753
17769    0.0         1.0         17769
18618    0.0         1.0         18618
```

Top 10 transactions having highest similarity with transaction ID = 30434 and class = 0.0:
```
         Class  Similarity  Transaction ID
18452    0.0         1.0         18452
17930    0.0         1.0         17930
19659    0.0         1.0         19659
16395    0.0         1.0         16395
18709    0.0         1.0         18709
15126    0.0         1.0         15126
16883    0.0         1.0         16883
15483    0.0         1.0         15483
18412    0.0         1.0         18412
16859    0.0         1.0         16859
```

Top 10 transactions having highest similarity with transaction ID = 30435 and class = 0.0:
```
         Class  Similarity  Transaction ID
18142    0.0         1.0         18142
16772    0.0         1.0         16772
18888    0.0         1.0         18888
15345    0.0         1.0         15345
14814    0.0         1.0         14814
14619    0.0         1.0         14619
15560    0.0         1.0         15560
```

```
15088    0.0        1.0       15088
17450    0.0        1.0       17450
19315    0.0        1.0       19315


Top 10 transactions having highest similarity with transaction ID = 30436 and class = 0.0:
         Class  Similarity  Transaction ID
16767    0.0        1.0       16767
15667    0.0        1.0       15667
19119    0.0        1.0       19119
15282    0.0        1.0       15282
19406    0.0        1.0       19406
16323    0.0        1.0       16323
15425    0.0        1.0       15425
16783    0.0        1.0       16783
17071    0.0        1.0       17071
16308    0.0        1.0       16308


Top 10 transactions having highest similarity with transaction ID = 30437 and class = 0.0:
         Class  Similarity  Transaction ID
19593    0.0        1.0       19593
18532    0.0        1.0       18532
15312    0.0        1.0       15312
17553    0.0        1.0       17553
14973    0.0        1.0       14973
16905    0.0        1.0       16905
14771    0.0        1.0       14771
19742    0.0        1.0       19742
16784    0.0        1.0       16784
18584    0.0        1.0       18584


Top 10 transactions having highest similarity with transaction ID = 30438 and class = 0.0:
         Class  Similarity  Transaction ID
19632    0.0        1.0       19632
14192    0.0        1.0       14192
16688    0.0        1.0       16688
16885    0.0        1.0       16885
15147    0.0        1.0       15147
16236    0.0        1.0       16236
18968    0.0        1.0       18968
```

```
17258    0.0       1.0          17258
16201    0.0       1.0          16201
16795    0.0       1.0          16795


Top 10 transactions having highest similarity with transaction ID = 30439 and class = 0.0:
         Class   Similarity   Transaction ID
18064    0.0       1.0          18064
17835    0.0       1.0          17835
13292    0.0       1.0          13292
10054    0.0       1.0          10054
8783     0.0       1.0           8783
12586    0.0       1.0          12586
8968     0.0       1.0           8968
7881     0.0       1.0           7881
13175    0.0       1.0          13175
15577    0.0       1.0          15577


Top 10 transactions having highest similarity with transaction ID = 30440 and class = 0.0:
         Class   Similarity   Transaction ID
14909    0.0       1.0          14909
18815    0.0       1.0          18815
18740    0.0       1.0          18740
17783    0.0       1.0          17783
19308    0.0       1.0          19308
19242    0.0       1.0          19242
16972    0.0       1.0          16972
18704    0.0       1.0          18704
18354    0.0       1.0          18354
16312    0.0       1.0          16312


Top 10 transactions having highest similarity with transaction ID = 30441 and class = 0.0:
         Class   Similarity   Transaction ID
16264    0.0       1.0          16264
18353    0.0       1.0          18353
16601    0.0       1.0          16601
16302    0.0       1.0          16302
19625    0.0       1.0          19625
18078    0.0       1.0          18078
15646    0.0       1.0          15646
```

```
14945     0.0       1.0          14945
19948     0.0       1.0          19948
19931     0.0       1.0          19931


Top 10 transactions having highest similarity with transaction ID = 30442 and class = 1.0:
        Class  Similarity  Transaction ID
18649     0.0       1.0          18649
16851     0.0       1.0          16851
18773     1.0       1.0          18773
18388     0.0       1.0          18388
19611     0.0       1.0          19611
17286     0.0       1.0          17286
16736     0.0       1.0          16736
17227     0.0       1.0          17227
18969     0.0       1.0          18969
16983     0.0       1.0          16983


Top 10 transactions having highest similarity with transaction ID = 30443 and class = 0.0:
        Class  Similarity  Transaction ID
19946     0.0       1.0          19946
16351     0.0       1.0          16351
14758     0.0       1.0          14758
18795     0.0       1.0          18795
18853     0.0       1.0          18853
17219     0.0       1.0          17219
17882     0.0       1.0          17882
19975     0.0       1.0          19975
18406     0.0       1.0          18406
16112     0.0       1.0          16112


Top 10 transactions having highest similarity with transaction ID = 30444 and class = 0.0:
        Class  Similarity  Transaction ID
14286     0.0       1.0          14286
16117     0.0       1.0          16117
14611     0.0       1.0          14611
14548     0.0       1.0          14548
15913     0.0       1.0          15913
14502     0.0       1.0          14502
18782     0.0       1.0          18782
```

```
15580     0.0         1.0          15580
18718     0.0         1.0          18718
17685     0.0         1.0          17685
```

Top 10 transactions having highest similarity with transaction ID = 30445 and class = 0.0:

```
       Class  Similarity  Transaction ID
18022     0.0         1.0          18022
14442     0.0         1.0          14442
14979     0.0         1.0          14979
19329     0.0         1.0          19329
19251     0.0         1.0          19251
14436     0.0         1.0          14436
19227     0.0         1.0          19227
17477     0.0         1.0          17477
14823     0.0         1.0          14823
17693     0.0         1.0          17693
```

Top 10 transactions having highest similarity with transaction ID = 30446 and class = 0.0:

```
       Class  Similarity  Transaction ID
16629     0.0         1.0          16629
15660     0.0         1.0          15660
16883     0.0         1.0          16883
18963     0.0         1.0          18963
14675     0.0         1.0          14675
16375     0.0         1.0          16375
16888     0.0         1.0          16888
14741     0.0         1.0          14741
14860     0.0         1.0          14860
19837     0.0         1.0          19837
```

Top 10 transactions having highest similarity with transaction ID = 30447 and class = 0.0:

```
       Class  Similarity  Transaction ID
19944     0.0         1.0          19944
17224     0.0         1.0          17224
19621     0.0         1.0          19621
18572     0.0         1.0          18572
15453     0.0         1.0          15453
17497     0.0         1.0          17497
17346     0.0         1.0          17346
```

```
17716     0.0          1.0          17716
15343     0.0          1.0          15343
14198     0.0          1.0          14198
```

```
Top 10 transactions having highest similarity with transaction ID = 30448 and class = 0.0:
        Class  Similarity  Transaction ID
18423     0.0          1.0          18423
19727     0.0          1.0          19727
19564     0.0          1.0          19564
19824     0.0          1.0          19824
14614     0.0          1.0          14614
16070     0.0          1.0          16070
14425     0.0          1.0          14425
18397     0.0          1.0          18397
19022     0.0          1.0          19022
17104     0.0          1.0          17104
```

```
Top 10 transactions having highest similarity with transaction ID = 30449 and class = 0.0:
        Class  Similarity  Transaction ID
19548     0.0          1.0          19548
15247     0.0          1.0          15247
16746     0.0          1.0          16746
16879     0.0          1.0          16879
17181     0.0          1.0          17181
15377     0.0          1.0          15377
19196     0.0          1.0          19196
18363     0.0          1.0          18363
18478     0.0          1.0          18478
18086     0.0          1.0          18086
```

```
Top 10 transactions having highest similarity with transaction ID = 30450 and class = 0.0:
        Class  Similarity  Transaction ID
15922     0.0          1.0          15922
17232     0.0          1.0          17232
17178     0.0          1.0          17178
17344     0.0          1.0          17344
17252     0.0          1.0          17252
17791     0.0          1.0          17791
```

```
14329    0.0         1.0            14329
14459    0.0         1.0            14459
19986    0.0         1.0            19986
14283    0.0         1.0            14283


Top 10 transactions having highest similarity with transaction ID = 30451 and class = 0.0:
         Class   Similarity   Transaction ID
19267    0.0         1.0            19267
16004    0.0         1.0            16004
17842    0.0         1.0            17842
18123    0.0         1.0            18123
17430    0.0         1.0            17430
15579    0.0         1.0            15579
15180    0.0         1.0            15180
19121    0.0         1.0            19121
17954    0.0         1.0            17954
19340    0.0         1.0            19340


Top 10 transactions having highest similarity with transaction ID = 30452 and class = 0.0:
         Class   Similarity   Transaction ID
17523    0.0         1.0            17523
15065    0.0         1.0            15065
17278    0.0         1.0            17278
18033    0.0         1.0            18033
15576    0.0         1.0            15576
17455    0.0         1.0            17455
19936    0.0         1.0            19936
18777    0.0         1.0            18777
17744    0.0         1.0            17744
14874    0.0         1.0            14874


Top 10 transactions having highest similarity with transaction ID = 30453 and class = 0.0:
         Class   Similarity   Transaction ID
14754    0.0         1.0            14754
17973    0.0         1.0            17973
19034    0.0         1.0            19034
16562    0.0         1.0            16562
17382    0.0         1.0            17382
15228    0.0         1.0            15228
```

```
16157     0.0          1.0              16157
18617     0.0          1.0              18617
19481     0.0          1.0              19481
16220     0.0          1.0              16220


Top 10 transactions having highest similarity with transaction ID = 30454 and class = 0.0:
        Class  Similarity  Transaction ID
18278     0.0          1.0              18278
16653     0.0          1.0              16653
18922     0.0          1.0              18922
16447     0.0          1.0              16447
17266     0.0          1.0              17266
17661     0.0          1.0              17661
14356     0.0          1.0              14356
15778     0.0          1.0              15778
14855     0.0          1.0              14855
16275     0.0          1.0              16275


Top 10 transactions having highest similarity with transaction ID = 30455 and class = 0.0:
        Class  Similarity  Transaction ID
18605     0.0          1.0              18605
15723     0.0          1.0              15723
17845     0.0          1.0              17845
15520     0.0          1.0              15520
16488     0.0          1.0              16488
15880     0.0          1.0              15880
16753     0.0          1.0              16753
14244     0.0          1.0              14244
17148     0.0          1.0              17148
17851     0.0          1.0              17851


Top 10 transactions having highest similarity with transaction ID = 30456 and class = 0.0:
        Class  Similarity  Transaction ID
17185     0.0          1.0              17185
16862     0.0          1.0              16862
17107     0.0          1.0              17107
14524     0.0          1.0              14524
18392     0.0          1.0              18392
16890     0.0          1.0              16890
```

```
17090      0.0         1.0          17090
15978      0.0         1.0          15978
18694      0.0         1.0          18694
17003      0.0         1.0          17003


Top 10 transactions having highest similarity with transaction ID = 30457 and class = 0.0:
        Class  Similarity  Transaction ID
16264      0.0         1.0          16264
15349      0.0         1.0          15349
16869      0.0         1.0          16869
18124      0.0         1.0          18124
19625      0.0         1.0          19625
15335      0.0         1.0          15335
17015      0.0         1.0          17015
19284      0.0         1.0          19284
17860      0.0         1.0          17860
16785      0.0         1.0          16785


Top 10 transactions having highest similarity with transaction ID = 30458 and class = 0.0:
        Class  Similarity  Transaction ID
17917      0.0         1.0          17917
15173      0.0         1.0          15173
17810      0.0         1.0          17810
17833      0.0         1.0          17833
19249      0.0         1.0          19249
19451      0.0         1.0          19451
17298      0.0         1.0          17298
16160      0.0         1.0          16160
19800      0.0         1.0          19800
17860      0.0         1.0          17860


Top 10 transactions having highest similarity with transaction ID = 30459 and class = 0.0:
        Class  Similarity  Transaction ID
15591      0.0         1.0          15591
18819      0.0         1.0          18819
16889      0.0         1.0          16889
19901      0.0         1.0          19901
19082      0.0         1.0          19082
15261      0.0         1.0          15261
```

```
19547      0.0           1.0            19547
16959      0.0           1.0            16959
15388      0.0           1.0            15388
18380      0.0           1.0            18380
```

Top 10 transactions having highest similarity with transaction ID = 30460 and class = 0.0:
```
       Class  Similarity  Transaction ID
19291      0.0           1.0            19291
19463      0.0           1.0            19463
18029      0.0           1.0            18029
19008      0.0           1.0            19008
17898      0.0           1.0            17898
15933      0.0           1.0            15933
16953      0.0           1.0            16953
15794      0.0           1.0            15794
16010      0.0           1.0            16010
15402      0.0           1.0            15402
```

Top 10 transactions having highest similarity with transaction ID = 30461 and class = 0.0:
```
       Class  Similarity  Transaction ID
18156      0.0           1.0            18156
17013      0.0           1.0            17013
19676      0.0           1.0            19676
18842      0.0           1.0            18842
17400      0.0           1.0            17400
17425      0.0           1.0            17425
18593      0.0           1.0            18593
15323      0.0           1.0            15323
17564      0.0           1.0            17564
18645      0.0           1.0            18645
```

Top 10 transactions having highest similarity with transaction ID = 30462 and class = 0.0:
```
       Class  Similarity  Transaction ID
18346      0.0           1.0            18346
18634      0.0           1.0            18634
14885      0.0           1.0            14885
16124      0.0           1.0            16124
16400      0.0           1.0            16400
15830      0.0           1.0            15830
```

```
19388    0.0         1.0            19388
18793    0.0         1.0            18793
15755    0.0         1.0            15755
17902    0.0         1.0            17902
```

Top 10 transactions having highest similarity with transaction ID = 30463 and class = 0.0:

```
        Class  Similarity  Transaction ID
18282    0.0         1.0            18282
17456    0.0         1.0            17456
19241    0.0         1.0            19241
18237    0.0         1.0            18237
19299    0.0         1.0            19299
16518    0.0         1.0            16518
14453    0.0         1.0            14453
19033    0.0         1.0            19033
16276    0.0         1.0            16276
19010    0.0         1.0            19010
```

Top 10 transactions having highest similarity with transaction ID = 30464 and class = 0.0:

```
        Class  Similarity  Transaction ID
18793    0.0         1.0            18793
18838    0.0         1.0            18838
16004    0.0         1.0            16004
19927    0.0         1.0            19927
15628    0.0         1.0            15628
18346    0.0         1.0            18346
18039    0.0         1.0            18039
14889    0.0         1.0            14889
15171    0.0         1.0            15171
15823    0.0         1.0            15823
```

Top 10 transactions having highest similarity with transaction ID = 30465 and class = 0.0:

```
        Class  Similarity  Transaction ID
19761    0.0         1.0            19761
17254    0.0         1.0            17254
17341    0.0         1.0            17341
17802    0.0         1.0            17802
19045    0.0         1.0            19045
```

```
17781    0.0       1.0          17781
17489    0.0       1.0          17489
16904    0.0       1.0          16904
15541    0.0       1.0          15541
17919    0.0       1.0          17919


Top 10 transactions having highest similarity with transaction ID = 30466 and class = 0.0:
       Class  Similarity  Transaction ID
14858    0.0       1.0          14858
19062    0.0       1.0          19062
14586    0.0       1.0          14586
15844    0.0       1.0          15844
18020    0.0       1.0          18020
15495    0.0       1.0          15495
14414    0.0       1.0          14414
19247    0.0       1.0          19247
17084    0.0       1.0          17084
17196    0.0       1.0          17196


Top 10 transactions having highest similarity with transaction ID = 30467 and class = 0.0:
       Class  Similarity  Transaction ID
15640    0.0       1.0          15640
16928    0.0       1.0          16928
17447    0.0       1.0          17447
18836    0.0       1.0          18836
17491    0.0       1.0          17491
16365    0.0       1.0          16365
17435    0.0       1.0          17435
17495    0.0       1.0          17495
14979    0.0       1.0          14979
16331    0.0       1.0          16331


Top 10 transactions having highest similarity with transaction ID = 30468 and class = 0.0:
       Class  Similarity  Transaction ID
19495    0.0       1.0          19495
14810    0.0       1.0          14810
19891    0.0       1.0          19891
16901    0.0       1.0          16901
16527    0.0       1.0          16527
```

```
19976      0.0          1.0          19976
17780      0.0          1.0          17780
16729      0.0          1.0          16729
14559      0.0          1.0          14559
18378      0.0          1.0          18378


Top 10 transactions having highest similarity with transaction ID = 30469 and class = 0.0:
        Class  Similarity   Transaction ID
19142      0.0          1.0          19142
19578      0.0          1.0          19578
16720      0.0          1.0          16720
19394      0.0          1.0          19394
16262      0.0          1.0          16262
17517      0.0          1.0          17517
19040      0.0          1.0          19040
19134      0.0          1.0          19134
15480      0.0          1.0          15480
15290      0.0          1.0          15290


Top 10 transactions having highest similarity with transaction ID = 30470 and class = 0.0:
        Class  Similarity   Transaction ID
15646      0.0          1.0          15646
16132      0.0          1.0          16132
18390      0.0          1.0          18390
16264      0.0          1.0          16264
18353      0.0          1.0          18353
18144      0.0          1.0          18144
18625      0.0          1.0          18625
15326      0.0          1.0          15326
17396      0.0          1.0          17396
17181      0.0          1.0          17181


Top 10 transactions having highest similarity with transaction ID = 30471 and class = 0.0:
        Class  Similarity   Transaction ID
16945      0.0          1.0          16945
17007      0.0          1.0          17007
19996      0.0          1.0          19996
15333      0.0          1.0          15333
14855      0.0          1.0          14855
```

```
17243     0.0        1.0          17243
19431     0.0        1.0          19431
17626     0.0        1.0          17626
17661     0.0        1.0          17661
17268     0.0        1.0          17268


Top 10 transactions having highest similarity with transaction ID = 30472 and class = 0.0:
        Class  Similarity   Transaction ID
17338     0.0        1.0          17338
18214     0.0        1.0          18214
19355     0.0        1.0          19355
17694     0.0        1.0          17694
14215     0.0        1.0          14215
12785     0.0        1.0          12785
16525     0.0        1.0          16525
12087     0.0        1.0          12087
13038     0.0        1.0          13038
9524      0.0        1.0           9524


Top 10 transactions having highest similarity with transaction ID = 30473 and class = 1.0:
        Class  Similarity   Transaction ID
18649     0.0        1.0          18649
16851     0.0        1.0          16851
16415     1.0        1.0          16415
19762     0.0        1.0          19762
14270     0.0        1.0          14270
18882     0.0        1.0          18882
17193     0.0        1.0          17193
16981     0.0        1.0          16981
19234     0.0        1.0          19234
15058     0.0        1.0          15058


Top 10 transactions having highest similarity with transaction ID = 30474 and class = 0.0:
        Class  Similarity   Transaction ID
17963     0.0        1.0          17963
19509     0.0        1.0          19509
16900     0.0        1.0          16900
15895     0.0        1.0          15895
18159     0.0        1.0          18159
```

```
13273      0.0          1.0          13273
15464      0.0          1.0          15464
18549      0.0          1.0          18549
16245      0.0          1.0          16245
16414      0.0          1.0          16414


Top 10 transactions having highest similarity with transaction ID = 30475 and class = 0.0:
        Class  Similarity  Transaction ID
18936      0.0          1.0          18936
18408      0.0          1.0          18408
17013      0.0          1.0          17013
14770      0.0          1.0          14770
18645      0.0          1.0          18645
19738      0.0          1.0          19738
18842      0.0          1.0          18842
17425      0.0          1.0          17425
16367      0.0          1.0          16367
19668      0.0          1.0          19668


Top 10 transactions having highest similarity with transaction ID = 30476 and class = 0.0:
        Class  Similarity  Transaction ID
19485      0.0          1.0          19485
15592      0.0          1.0          15592
15372      0.0          1.0          15372
15866      0.0          1.0          15866
19650      0.0          1.0          19650
14530      0.0          1.0          14530
17421      0.0          1.0          17421
15337      0.0          1.0          15337
16587      0.0          1.0          16587
19863      0.0          1.0          19863


Top 10 transactions having highest similarity with transaction ID = 30477 and class = 0.0:
        Class  Similarity  Transaction ID
18179      0.0          1.0          18179
19169      0.0          1.0          19169
15972      0.0          1.0          15972
19715      0.0          1.0          19715
19747      0.0          1.0          19747
```

```
16523     0.0          1.0          16523
19347     0.0          1.0          19347
16261     0.0          1.0          16261
15056     0.0          1.0          15056
16020     0.0          1.0          16020


Top 10 transactions having highest similarity with transaction ID = 30478 and class = 0.0:
          Class  Similarity   Transaction ID
16947     0.0          1.0          16947
16604     0.0          1.0          16604
16959     0.0          1.0          16959
15362     0.0          1.0          15362
14540     0.0          1.0          14540
17906     0.0          1.0          17906
18768     0.0          1.0          18768
14532     0.0          1.0          14532
17337     0.0          1.0          17337
15261     0.0          1.0          15261


Top 10 transactions having highest similarity with transaction ID = 30479 and class = 0.0:
          Class  Similarity   Transaction ID
16245     0.0          1.0          16245
19509     0.0          1.0          19509
18549     0.0          1.0          18549
17538     0.0          1.0          17538
19454     0.0          1.0          19454
17112     0.0          1.0          17112
19728     0.0          1.0          19728
16900     0.0          1.0          16900
18159     0.0          1.0          18159
18267     0.0          1.0          18267


Top 10 transactions having highest similarity with transaction ID = 30480 and class = 0.0:
          Class  Similarity   Transaction ID
19951     0.0          1.0          19951
19023     0.0          1.0          19023
18679     0.0          1.0          18679
19199     0.0          1.0          19199
15250     0.0          1.0          15250
```

```
16996     0.0          1.0          16996
19734     0.0          1.0          19734
15034     0.0          1.0          15034
17239     0.0          1.0          17239
19465     0.0          1.0          19465
```

```
Top 10 transactions having highest similarity with transaction ID = 30481 and class = 0.0:
        Class   Similarity   Transaction ID
18704     0.0          1.0          18704
18874     0.0          1.0          18874
19889     0.0          1.0          19889
16884     0.0          1.0          16884
18877     0.0          1.0          18877
17423     0.0          1.0          17423
16162     0.0          1.0          16162
17926     0.0          1.0          17926
19859     0.0          1.0          19859
17812     0.0          1.0          17812
```

```
Top 10 transactions having highest similarity with transaction ID = 30482 and class = 0.0:
        Class   Similarity   Transaction ID
19232     0.0          1.0          19232
16614     0.0          1.0          16614
15093     0.0          1.0          15093
16322     0.0          1.0          16322
13159     0.0          1.0          13159
17892     0.0          1.0          17892
13125     0.0          1.0          13125
17068     0.0          1.0          17068
16135     0.0          1.0          16135
17957     0.0          1.0          17957
```

```
Top 10 transactions having highest similarity with transaction ID = 30483 and class = 0.0:
        Class   Similarity   Transaction ID
14705     0.0          1.0          14705
18781     0.0          1.0          18781
17032     0.0          1.0          17032
19539     0.0          1.0          19539
```

```
14730     0.0          1.0            14730
18220     0.0          1.0            18220
18139     0.0          1.0            18139
17735     0.0          1.0            17735
18381     0.0          1.0            18381
18013     0.0          1.0            18013


Top 10 transactions having highest similarity with transaction ID = 30484 and class = 0.0:
          Class   Similarity   Transaction ID
18768     0.0          1.0            18768
16947     0.0          1.0            16947
16604     0.0          1.0            16604
19205     0.0          1.0            19205
16739     0.0          1.0            16739
16206     0.0          1.0            16206
16959     0.0          1.0            16959
15032     0.0          1.0            15032
14605     0.0          1.0            14605
16093     0.0          1.0            16093


Top 10 transactions having highest similarity with transaction ID = 30485 and class = 0.0:
          Class   Similarity   Transaction ID
17586     0.0          1.0            17586
17211     0.0          1.0            17211
19532     0.0          1.0            19532
17243     0.0          1.0            17243
19724     0.0          1.0            19724
19431     0.0          1.0            19431
14703     0.0          1.0            14703
14855     0.0          1.0            14855
15861     0.0          1.0            15861
17411     0.0          1.0            17411


Top 10 transactions having highest similarity with transaction ID = 30486 and class = 0.0:
          Class   Similarity   Transaction ID
19502     0.0          1.0            19502
19820     0.0          1.0            19820
17378     0.0          1.0            17378
16250     0.0          1.0            16250
```

```
16177      0.0          1.0              16177
18245      0.0          1.0              18245
19185      0.0          1.0              19185
18301      0.0          1.0              18301
15340      0.0          1.0              15340
15662      0.0          1.0              15662


Top 10 transactions having highest similarity with transaction ID = 30487 and class = 0.0:
          Class   Similarity   Transaction ID
18682      0.0          1.0              18682
16877      0.0          1.0              16877
18371      0.0          1.0              18371
16880      0.0          1.0              16880
19911      0.0          1.0              19911
15936      0.0          1.0              15936
14750      0.0          1.0              14750
16134      0.0          1.0              16134
19778      0.0          1.0              19778
18815      0.0          1.0              18815


Top 10 transactions having highest similarity with transaction ID = 30488 and class = 0.0:
          Class   Similarity   Transaction ID
14878      0.0          1.0              14878
16801      0.0          1.0              16801
16456      0.0          1.0              16456
14238      0.0          1.0              14238
18642      0.0          1.0              18642
15420      0.0          1.0              15420
19125      0.0          1.0              19125
16561      0.0          1.0              16561
16860      0.0          1.0              16860
18170      0.0          1.0              18170


Top 10 transactions having highest similarity with transaction ID = 30489 and class = 0.0:
          Class   Similarity   Transaction ID
19204      0.0          1.0              19204
17368      0.0          1.0              17368
14489      0.0          1.0              14489
16699      0.0          1.0              16699
```

```
15805    0.0         1.0              15805
17469    0.0         1.0              17469
17431    0.0         1.0              17431
18936    0.0         1.0              18936
18348    0.0         1.0              18348
19342    0.0         1.0              19342
```

```
Top 10 transactions having highest similarity with transaction ID = 30490 and class = 0.0:
         Class   Similarity   Transaction ID
17375    0.0         1.0              17375
16619    0.0         1.0              16619
14847    0.0         1.0              14847
18517    0.0         1.0              18517
16213    0.0         1.0              16213
15221    0.0         1.0              15221
16908    0.0         1.0              16908
15114    0.0         1.0              15114
15140    0.0         1.0              15140
15150    0.0         1.0              15150
```

```
Top 10 transactions having highest similarity with transaction ID = 30491 and class = 0.0:
         Class   Similarity   Transaction ID
18254    0.0         1.0              18254
18979    0.0         1.0              18979
19887    0.0         1.0              19887
18825    0.0         1.0              18825
18502    0.0         1.0              18502
19144    0.0         1.0              19144
19802    0.0         1.0              19802
17533    0.0         1.0              17533
17174    0.0         1.0              17174
19545    0.0         1.0              19545
```

```
Top 10 transactions having highest similarity with transaction ID = 30492 and class = 0.0:
         Class   Similarity   Transaction ID
17021    0.0         1.0              17021
16032    0.0         1.0              16032
16274    0.0         1.0              16274
17032    0.0         1.0              17032
```

```
18781      0.0          1.0              18781
17325      0.0          1.0              17325
19840      0.0          1.0              19840
16450      0.0          1.0              16450
16589      0.0          1.0              16589
16480      0.0          1.0              16480


Top 10 transactions having highest similarity with transaction ID = 30493 and class = 0.0:
        Class   Similarity   Transaction ID
19028      0.0          1.0              19028
15078      0.0          1.0              15078
19883      0.0          1.0              19883
19054      0.0          1.0              19054
19166      0.0          1.0              19166
19510      0.0          1.0              19510
17124      0.0          1.0              17124
18880      0.0          1.0              18880
17980      0.0          1.0              17980
18864      0.0          1.0              18864


Top 10 transactions having highest similarity with transaction ID = 30494 and class = 0.0:
        Class   Similarity   Transaction ID
15681      0.0          1.0              15681
19870      0.0          1.0              19870
15046      0.0          1.0              15046
17325      0.0          1.0              17325
18781      0.0          1.0              18781
17032      0.0          1.0              17032
18589      0.0          1.0              18589
14705      0.0          1.0              14705
16480      0.0          1.0              16480
14201      0.0          1.0              14201


Top 10 transactions having highest similarity with transaction ID = 30495 and class = 0.0:
        Class   Similarity   Transaction ID
16857      0.0          1.0              16857
19729      0.0          1.0              19729
17119      0.0          1.0              17119
18678      0.0          1.0              18678
```

```
19009      0.0         1.0           19009
16887      0.0         1.0           16887
16784      0.0         1.0           16784
18541      0.0         1.0           18541
14973      0.0         1.0           14973
18532      0.0         1.0           18532


Top 10 transactions having highest similarity with transaction ID = 30496 and class = 1.0:
           Class   Similarity   Transaction ID
18125      0.0         1.0           18125
18150      0.0         1.0           18150
17916      0.0         1.0           17916
17592      0.0         1.0           17592
17322      0.0         1.0           17322
19145      0.0         1.0           19145
19183      0.0         1.0           19183
9643       0.0         1.0            9643
18038      0.0         1.0           18038
18081      0.0         1.0           18081


Top 10 transactions having highest similarity with transaction ID = 30497 and class = 0.0:
           Class   Similarity   Transaction ID
16671      0.0         1.0           16671
14875      0.0         1.0           14875
17632      0.0         1.0           17632
19007      0.0         1.0           19007
17244      0.0         1.0           17244
18109      0.0         1.0           18109
15270      0.0         1.0           15270
15972      0.0         1.0           15972
19747      0.0         1.0           19747
18473      0.0         1.0           18473


Top 10 transactions having highest similarity with transaction ID = 30498 and class = 0.0:
           Class   Similarity   Transaction ID
16671      0.0         1.0           16671
15229      0.0         1.0           15229
14604      0.0         1.0           14604
```

```
19665      0.0          1.0            19665
18906      0.0          1.0            18906
14908      0.0          1.0            14908
19747      0.0          1.0            19747
19998      0.0          1.0            19998
18679      0.0          1.0            18679
17244      0.0          1.0            17244


Top 10 transactions having highest similarity with transaction ID = 30499 and class = 0.0:
        Class  Similarity   Transaction ID
19925      0.0          1.0            19925
19907      0.0          1.0            19907
18175      0.0          1.0            18175
19063      0.0          1.0            19063
15737      0.0          1.0            15737
18103      0.0          1.0            18103
16002      0.0          1.0            16002
16277      0.0          1.0            16277
17583      0.0          1.0            17583
15713      0.0          1.0            15713


Top 10 transactions having highest similarity with transaction ID = 30500 and class = 0.0:
        Class  Similarity   Transaction ID
19535      0.0          1.0            19535
15901      0.0          1.0            15901
17153      0.0          1.0            17153
18648      0.0          1.0            18648
14382      0.0          1.0            14382
18638      0.0          1.0            18638
14596      0.0          1.0            14596
14179      0.0          1.0            14179
15407      0.0          1.0            15407
14222      0.0          1.0            14222
```