Assignment for Week 5 - Neural Network

Task 1:

Neural Networks

Bike Share data: https://archive.ics.uci.edu/ml/datasets/bike+sharing+dataset

Train a regression neural net to predict the amount of bike rentals each hour.
Try at least 5 different architectures, pick the best one and defend your choice

The following sites might be good references for you:

- https://www.springboard.com/blog/beginners-guide-neural-network-in-python-scikit-learn-0-18/
- https://datascience.stackexchange.com/questions/36049/how-to-adjust-the-hyperparameters-of-mlp-classifier-to-get-more-perfect-performa

In [91]:
```python
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np

# sklearn packages
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import StandardScaler
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import classification_report, confusion_matrix

# plotting
import seaborn as sns

# will show plots without doing plt.show()
%matplotlib inline
```

Task 1

In [92]:
```python
# Read dataset to pandas dataframe
bike = pd.read_csv('data_bike/hour.csv')
```

In [93]:
```python
bike.head()
```

Out[93]:

	instant	dteday	season	yr	mnth	hr	holiday	weekday	workingday	weathersit	temp	atemp	hum	windspeed	casual	registered	cnt
0	1	2011-01-01	1	0	1	0	0	6	0	1	0.24	0.2879	0.81	0.0	3	13	16
1	2	2011-01-01	1	0	1	1	0	6	0	1	0.22	0.2727	0.80	0.0	8	32	40
2	3	2011-01-01	1	0	1	2	0	6	0	1	0.22	0.2727	0.80	0.0	5	27	32
3	4	2011-01-01	1	0	1	3	0	6	0	1	0.24	0.2879	0.75	0.0	3	10	13
4	5	2011-01-01	1	0	1	4	0	6	0	1	0.24	0.2879	0.75	0.0	0	1	1

In [94]:
```python
bike.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 17379 entries, 0 to 17378
Data columns (total 17 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   instant     17379 non-null  int64  
 1   dteday      17379 non-null  object 
 2   season      17379 non-null  int64  
 3   yr          17379 non-null  int64  
 4   mnth        17379 non-null  int64  
 5   hr          17379 non-null  int64  
 6   holiday     17379 non-null  int64  
 7   weekday     17379 non-null  int64  
 8   workingday  17379 non-null  int64  
 9   weathersit  17379 non-null  int64  
 10  temp        17379 non-null  float64
 11  atemp       17379 non-null  float64
 12  hum         17379 non-null  float64
 13  windspeed   17379 non-null  float64
 14  casual      17379 non-null  int64  
 15  registered  17379 non-null  int64  
 16  cnt         17379 non-null  int64  
dtypes: float64(4), int64(12), object(1)
memory usage: 2.3+ MB
```

In [95]:
```python
bike.describe(include='all')
```

Out[95]:

	instant	dteday	season	yr	mnth	hr	holiday	weekday	workingday	weathersit
count	17379.0000	17379	17379.000000	17379.000000	17379.000000	17379.000000	17379.000000	17379.000000	17379.000000	17379.000000
unique	NaN	731	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
top	NaN	2012-01-19	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
freq	NaN	24	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
mean	8690.0000	NaN	2.501640	0.502561	6.537775	11.546752	0.028770	3.003683	0.682721	1.425283
std	5017.0295	NaN	1.106918	0.500008	3.438776	6.914405	0.167165	2.005771	0.465431	0.639357
min	1.0000	NaN	1.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	1.000000
25%	4345.5000	NaN	2.000000	0.000000	4.000000	6.000000	0.000000	1.000000	0.000000	1.000000
50%	8690.0000	NaN	3.000000	1.000000	7.000000	12.000000	0.000000	3.000000	1.000000	1.000000
75%	13034.5000	NaN	3.000000	1.000000	10.000000	18.000000	0.000000	5.000000	1.000000	2.000000
max	17379.0000	NaN	4.000000	1.000000	12.000000	23.000000	1.000000	6.000000	1.000000	4.000000

In [96]:
```python
bike.shape
```

Out[96]: (17379, 17)

Dropping instant, year, month. I am dropping them because instant is the row number, and as for year and month I will extract them from the date for more accurate data

In [97]:
```python
bike.drop('instant',axis=1, inplace=True)
bike.drop('yr',axis=1, inplace=True)
bike.drop('mnth',axis=1, inplace=True)
```

In [98]:
```python
bike.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 17379 entries, 0 to 17378
Data columns (total 14 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   dteday      17379 non-null  object 
 1   season      17379 non-null  int64  
 2   hr          17379 non-null  int64  
 3   holiday     17379 non-null  int64  
 4   weekday     17379 non-null  int64  
 5   workingday  17379 non-null  int64  
 6   weathersit  17379 non-null  int64  
 7   temp        17379 non-null  float64
 8   atemp       17379 non-null  float64
 9   hum         17379 non-null  float64
 10  windspeed   17379 non-null  float64
 11  casual      17379 non-null  int64  
 12  registered  17379 non-null  int64  
 13  cnt         17379 non-null  int64  
dtypes: float64(4), int64(9), object(1)
memory usage: 1.9+ MB
```

Because date column is not float or integer, model will not be fitted. So, here I am creating 3 columns for year, month, and day. Then dropping Date column

In [99]:
```python
# we need to convert dteday to int

new = bike["dteday"].str.split("-", n = 2, expand = True)
bike["year"]= new[0]
bike["month"]= new[1]
bike["day"]= new[2]
```

In [100…
```python
bike['year'] = bike['year'].astype(str).astype(int)
bike['month'] = bike['month'].astype(str).astype(int)
bike['day'] = bike['day'].astype(str).astype(int)
```

In [101…
```python
bike.drop('dteday',axis=1, inplace=True)
```

In [102…
```python
bike.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 17379 entries, 0 to 17378
Data columns (total 16 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   season      17379 non-null  int64  
 1   hr          17379 non-null  int64  
 2   holiday     17379 non-null  int64  
 3   weekday     17379 non-null  int64  
 4   workingday  17379 non-null  int64  
 5   weathersit  17379 non-null  int64  
 6   temp        17379 non-null  float64
 7   atemp       17379 non-null  float64
 8   hum         17379 non-null  float64
 9   windspeed   17379 non-null  float64
 10  casual      17379 non-null  int64  
 11  registered  17379 non-null  int64  
 12  cnt         17379 non-null  int64  
 13  year        17379 non-null  int32  
 14  month       17379 non-null  int32  
 15  day         17379 non-null  int32  
dtypes: float64(4), int32(3), int64(9)
memory usage: 1.9 MB
```

The target has a huge unique values

In [103…
```python
bike.cnt.unique()
```

Out[103…
```
array([ 16,  40,  32,  13,   1,   2,   3,   8,  14,  36,  56,  84,  94,
       106, 110,  93,  67,  35,  37,  34,  28,  39,  17,   9,   6,  20,
        53,  70,  75,  59,  74,  76,  65,  30,  22,  31,   5,  64, 154,
        88,  44,  51,  61,  77,  72, 157,  52,  12,   4, 179, 100,  42,
        57,  78,  97,  63,  83, 212, 182, 112,  54,  48,  11,  33, 195,
       115,  46,  79,  71,  62,  89, 190, 169, 132,  43,  19,  95, 219,
       122,  45,  86, 172, 163,  69,  23,   7, 210, 134,  73,  50,  87,
       187, 123,  15,  25,  98, 102,  55,  10,  49,  82,  92,  41,  38,
       188,  47, 178, 155,  24,  18,  27,  99, 217, 130, 136,  29, 128,
        81,  68, 139, 137, 202,  60, 162, 144, 158, 117,  90, 159, 101,
       118, 129,  26, 104,  91, 113, 105,  21,  80, 125, 133, 197, 109,
       161, 249, 143, 215, 185, 152, 126, 166, 120,  96, 103,  58, 116,
       177, 184, 153, 108, 238, 222, 225, 146, 119, 149, 107, 156, 111,
       135, 176, 168, 175, 147, 220, 127, 205, 174, 121, 230,  66, 114,
       216, 243, 199, 170, 165, 160, 140, 211, 145, 256, 223,  85, 206,
       124, 255, 285, 274, 272, 191, 232, 327, 224, 196, 171, 198, 167,
       235, 209, 141, 252, 189, 183, 193, 259, 282, 261, 268, 142, 131,
       214, 242, 148, 201, 150, 228, 204, 164, 233, 257, 151, 248, 194,
       244, 213, 181, 221, 250, 304, 241, 271, 253, 237, 299, 313, 310,
       207, 138, 280, 173, 332, 331, 267, 301, 312, 278, 203, 279, 308,
       226, 276, 336, 307, 273, 227, 239, 254, 287, 294, 263, 192, 281,
       367, 349, 292, 303, 339, 366, 386, 325, 356, 314, 343, 333, 297,
       288, 236, 240, 452, 383, 284, 291, 309, 321, 337, 388, 300, 200,
       180, 354, 361, 306, 277, 428, 362, 286, 351, 411, 421, 396, 432,
       441, 365, 481, 324, 346, 391, 397, 426, 376, 283, 289, 317, 420,
       369, 359, 270, 353, 521, 499, 382, 449, 186, 528, 328, 234, 246,
       444, 218, 412, 260, 398, 455, 530, 404, 269, 508, 439, 416, 464,
       407, 371, 387, 264, 266, 537, 518, 265, 459, 517, 544, 290, 410,
       296, 440, 533, 520, 258, 450, 344, 553, 470, 298, 347, 373, 436,
       378, 342, 340, 390, 358, 385, 374, 598, 524, 384, 425, 611, 550,
       434, 318, 442, 401, 594, 527, 364, 491, 295, 322, 456, 437, 392,
       231, 394, 453, 604, 480, 565, 489, 487, 302, 547, 513, 319, 330,
       554, 473, 323, 418, 493, 462, 506, 471, 305, 316, 409, 429, 548,
       564, 355, 531, 601, 405, 494, 478, 419, 399, 402, 341, 251, 229,
       350, 311, 406, 495, 417, 454, 486, 467, 572, 525, 379, 502, 558,
       293, 247, 451, 335, 363, 357, 438, 579, 556, 334, 477, 539, 551,
       424, 466, 326, 463, 380, 275, 315, 360, 476, 586, 423, 569, 538,
       370, 498, 638, 607, 552, 208, 468, 381, 377, 431, 536, 529, 540,
       400, 352, 557, 375, 443, 403, 447, 591, 504, 570, 588, 320, 555,
       492, 427, 461, 422, 414, 408, 457, 545, 496, 368, 245, 596, 563,
       562, 372, 514, 472, 511, 488, 595, 578, 348, 587, 497, 433, 475,
       430, 262, 485, 546, 541, 483, 338, 543, 413, 435, 523, 532, 585,
       584, 559, 582, 571, 516, 465, 329, 600, 609, 651, 519, 567, 621,
       484, 469, 576, 608, 446, 628, 389, 505, 460, 590, 599, 566, 482,
       568, 415, 589, 345, 593, 393, 500, 479, 620, 625, 614, 395, 445,
       512, 490, 515, 526, 509, 448, 560, 610, 522, 549, 501, 612, 597,
       644, 712, 676, 734, 662, 782, 749, 623, 713, 746, 686, 690, 679,
       685, 648, 503, 721, 801, 750, 535, 729, 779, 649, 810, 957, 830,
       657, 664, 684, 458, 581, 658, 641, 654, 703, 681, 606, 605, 561,
       573, 618, 757, 800, 744, 759, 822, 698, 655, 643, 626, 615, 617,
       632, 646, 692, 704, 624, 656, 738, 671, 678, 660, 635, 616, 673,
       781, 775, 677, 748, 776, 700, 580, 819, 668, 640, 639, 691, 732,
       709, 592, 702, 653, 603, 683, 743, 666, 813, 627, 706, 575, 769,
       680, 717, 710, 622, 705, 630, 770, 659, 602, 733, 650, 873, 846,
       474, 634, 852, 868, 745, 812, 669, 642, 730, 672, 645, 637, 577,
       785, 719, 798, 752, 583, 839, 796, 507, 693, 827, 694, 647, 665,
       834, 850, 790, 724, 869, 793, 723, 534, 831, 613, 857, 867, 823,
       542, 811, 795, 833, 791, 900, 824, 687, 843, 804, 697, 747, 722,
       689, 849, 872, 631, 674, 814, 633, 825, 629, 835, 667, 755, 794,
       661, 772, 771, 777, 715, 847, 741, 877, 788, 913, 891, 688, 699,
       751, 760, 820, 837, 652, 739, 865, 767, 858, 737, 862, 818, 854,
       682, 851, 848, 897, 832, 893, 815, 878, 740, 783, 707, 941, 736,
       845, 864, 808, 870, 754, 844, 853, 856, 725, 863, 792, 696, 701,
       871, 968, 970, 925, 977, 758, 884, 766, 894, 842, 774, 797, 886,
       892, 976, 805, 898, 967, 838, 953, 905, 899, 663, 727, 784, 809,
       917, 901, 887, 761, 806, 948, 670, 619, 943, 817, 888, 890, 714,
       711, 731, 675, 728, 922, 786, 938, 826, 963, 708, 636], dtype=int64)
```

In [104…
```python
#gather up names of all the columns
cols = bike.columns

#set the prediction column and the feature columns for KNN
prediction_col = 'cnt'
feature_cols = [c for c in cols if c != prediction_col]

x = bike[feature_cols]
y = bike[prediction_col]

#split the dataset into the train and test data
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, random_state=41)
```

Scaling the feature on train data.

In [105…
```python
scaler = StandardScaler()
scaler.fit(x_train)

x_train = scaler.transform(x_train)
x_test = scaler.transform(x_test)
```

Fitting the model with 10,10,10 hidden layers parameters.

In [106…
```python
mlp = MLPClassifier(hidden_layer_sizes=(10, 10, 10), max_iter=1000)
mlp.fit(x_train, y_train.values.ravel())
```

Out[106… MLPClassifier(hidden_layer_sizes=(10, 10, 10), max_iter=1000)

In [107…
```python
predictions = mlp.predict(x_test)
```

In [108…
```python
print(predictions)
```

```
[  1  24 218 ...  21 210 179]
```

26% accuracy, the model performed badly. I think it's because we need to put the target to categories because the model is a classifier. For example, putting every 100 bike into one value so we minimize the target levels. Also, number of nodes for hidden layers plays a role in the model pereformence

In [109…
```python
print(confusion_matrix(y_test,predictions))
print(classification_report(y_test,predictions))
```

```
[[33  0  0 ...  0  0  0]
 [ 1 37  0 ...  0  0  0]
 [ 0  1 42 ...  0  0  0]
 ...
 [ 0  0  0 ...  0  0  0]
 [ 0  0  0 ...  0  0  0]
 [ 0  0  0 ...  0  0  0]]
```

	precision	recall	f1-score	support
1	0.94	1.00	0.97	33
2	0.97	0.97	0.97	38
3	1.00	0.98	0.99	43
4	0.96	0.98	0.97	50
5	1.00	0.96	0.98	52
6	0.48	1.00	0.65	39
7	1.00	0.02	0.05	43
8	0.59	1.00	0.75	41
9	0.00	0.00	0.00	29
10	0.92	0.38	0.53	32
11	0.45	0.59	0.51	29
12	0.32	0.95	0.48	22
13	0.67	0.08	0.14	26
14	0.29	0.47	0.36	19
15	0.00	0.00	0.00	18
16	0.00	0.00	0.00	19
17	0.36	0.96	0.53	25
18	0.17	0.05	0.07	21
19	0.00	0.00	0.00	16
20	0.00	0.00	0.00	8
21	0.38	0.93	0.54	14
22	0.33	0.08	0.12	13
23	0.00	0.00	0.00	15
24	0.17	0.92	0.29	13
25	0.00	0.00	0.00	13
26	0.00	0.00	0.00	23
27	0.00	0.00	0.00	16
28	0.50	0.20	0.29	15
29	0.17	0.50	0.26	8
30	0.00	0.00	0.00	15
31	0.19	1.00	0.33	7
32	0.00	0.00	0.00	13
33	0.28	0.71	0.40	14
34	0.25	0.14	0.18	7
35	0.00	0.00	0.00	11
36	0.33	0.18	0.24	11
37	0.00	0.00	0.00	9
38	0.00	0.00	0.00	6
39	0.14	0.83	0.24	12
40	0.00	0.00	0.00	15
41	0.00	0.00	0.00	9
42	0.00	0.00	0.00	15
43	0.00	0.00	0.00	7
44	0.42	0.38	0.40	13
45	0.00	0.00	0.00	7
46	0.23	0.60	0.33	10
47	0.00	0.00	0.00	17
48	0.33	0.17	0.22	6
49	0.00	0.00	0.00	6
50	0.00	0.00	0.00	14
51	0.00	0.00	0.00	11
52	0.11	1.00	0.20	10
53	0.00	0.00	0.00	6
54	0.00	0.00	0.00	12
55	0.09	0.08	0.09	12
56	0.00	0.00	0.00	9
57	0.00	0.00	0.00	9
58	0.00	0.00	0.00	7
59	0.38	0.56	0.45	9
60	0.00	0.00	0.00	10
61	0.00	0.00	0.00	8
62	0.00	0.00	0.00	7
63	0.00	0.00	0.00	7
64	0.17	0.82	0.28	11
65	0.00	0.00	0.00	7
66	0.00	0.00	0.00	10
67	0.00	0.00	0.00	6
68	0.00	0.00	0.00	9
69	0.00	0.00	0.00	9
70	0.06	0.09	0.07	11
71	0.00	0.00	0.00	9
72	0.09	0.75	0.16	8
73	0.00	0.00	0.00	4
74	0.00	0.00	0.00	11
75	0.00	0.00	0.00	10
76	0.00	0.00	0.00	6
77	0.00	0.00	0.00	8
78	0.36	0.87	0.51	15
79	0.00	0.00	0.00	11
80	0.00	0.00	0.00	7
81	0.00	0.00	0.00	4
82	0.00	0.00	0.00	8
83	0.00	0.00	0.00	5
84	0.00	0.00	0.00	12
85	0.18	0.67	0.29	6
86	0.00	0.00	0.00	18
87	0.00	0.00	0.00	10
88	0.00	0.00	0.00	7
89	0.13	1.00	0.23	8
90	0.00	0.00	0.00	9
91	0.00	0.00	0.00	4
92	0.00	0.00	0.00	8
93	0.14	0.18	0.16	11
94	0.00	0.00	0.00	7
95	0.00	0.00	0.00	11
96	0.13	0.80	0.22	5
97	0.13	0.50	0.21	6
98	0.00	0.00	0.00	10
99	0.00	0.00	0.00	10
100	0.00	0.00	0.00	7
101	0.31	0.45	0.37	11
102	0.00	0.00	0.00	7
103	0.17	0.33	0.22	6
104	0.17	0.20	0.18	5
105	0.00	0.00	0.00	10
106	0.37	0.79	0.50	14
107	0.00	0.00	0.00	5
108	0.00	0.00	0.00	10
109	0.00	0.00	0.00	6
110	0.23	1.00	0.38	7
111	0.00	0.00	0.00	13
112	0.00	0.00	0.00	5
113	0.28	0.62	0.38	8
114	0.00	0.00	0.00	7
115	0.43	1.00	0.60	6
116	0.67	0.33	0.44	6
117	0.00	0.00	0.00	5
118	0.00	0.00	0.00	11
119	0.00	0.00	0.00	10
120	0.23	1.00	0.37	7
121	0.00	0.00	0.00	7
122	0.00	0.00	0.00	8
123	0.00	0.00	0.00	9
124	0.30	0.82	0.44	17
125	0.25	0.29	0.27	7
126	0.50	0.12	0.20	8
127	0.75	0.38	0.50	8
128	0.00	0.00	0.00	3
129	0.47	1.00	0.64	9
130	0.00	0.00	0.00	4
131	0.00	0.00	0.00	4
132	0.62	1.00	0.76	8
133	0.29	0.25	0.27	8
134	0.17	0.17	0.17	6
135	0.00	0.00	0.00	4
136	0.67	0.33	0.44	6
137	0.48	1.00	0.65	11
138	0.00	0.00	0.00	9
139	1.00	0.80	0.89	5
140	1.00	0.14	0.25	7
141	0.25	1.00	0.40	7
142	0.00	0.00	0.00	5
143	0.00	0.00	0.00	9
144	0.89	1.00	0.94	8
145	0.00	0.00	0.00	4
146	0.25	0.20	0.22	5
147	0.44	1.00	0.62	12
148	0.00	0.00	0.00	7
149	1.00	0.14	0.25	7
150	1.00	0.50	0.67	6
151	1.00	0.30	0.46	10
152	0.00	0.00	0.00	9
153	0.00	0.00	0.00	12
154	0.13	1.00	0.23	7
155	0.00	0.00	0.00	6
156	0.00	0.00	0.00	11
157	0.00	0.00	0.00	7
158	0.50	0.60	0.55	5
159	0.50	0.43	0.46	7
160	0.71	0.62	0.67	8
161	0.25	0.17	0.20	6
162	0.40	0.67	0.50	3
163	0.00	0.00	0.00	7
164	0.14	0.25	0.18	4
165	0.00	0.00	0.00	6
166	0.36	0.67	0.47	6
167	1.00	0.09	0.17	11
168	0.34	0.85	0.49	13
169	0.00	0.00	0.00	8
170	0.00	0.00	0.00	12
171	0.00	0.00	0.00	10
172	0.21	1.00	0.35	9
173	0.00	0.00	0.00	7
174	0.00	0.00	0.00	8
175	0.80	0.50	0.62	8
176	0.80	0.44	0.57	9
177	0.33	0.22	0.27	9
178	0.00	0.00	0.00	11
179	0.24	0.92	0.39	13
180	0.00	0.00	0.00	5
181	0.00	0.00	0.00	9
182	0.00	0.00	0.00	10
183	0.00	0.00	0.00	4
184	0.00	0.00	0.00	6
185	0.22	1.00	0.35	11
186	0.00	0.00	0.00	5
187	0.00	0.00	0.00	5
188	0.00	0.00	0.00	11
189	0.00	0.00	0.00	7
190	0.11	0.50	0.18	10
191	0.00	0.00	0.00	5
192	0.00	0.00	0.00	7
193	0.00	0.00	0.00	8
194	0.00	0.00	0.00	4
195	0.00	0.00	0.00	5
196	0.33	0.17	0.22	6
197	0.00	0.00	0.00	6
198	0.00	0.00	0.00	7
199	0.00	0.00	0.00	6
200	0.00	0.00	0.00	2
201	0.25	0.29	0.27	14
202	0.00	0.00	0.00	7
203	0.00	0.00	0.00	8
204	0.15	1.00	0.26	8
205	0.00	0.00	0.00	5
206	0.00	0.00	0.00	9
207	0.00	0.00	0.00	5
208	0.50	0.20	0.29	5
209	0.00	0.00	0.00	7
210	0.17	0.17	0.17	6
211	0.27	0.80	0.40	5
212	1.00	0.50	0.67	2
213	1.00	0.23	0.38	13
214	0.20	1.00	0.33	2
215	0.00	0.00	0.00	6
216	0.00	0.00	0.00	3
217	0.00	0.00	0.00	7
218	0.25	0.88	0.39	8
219	0.00	0.00	0.00	10
220	0.10	0.67	0.17	6
221	0.00	0.00	0.00	7
222	0.00	0.00	0.00	7
223	0.00	0.00	0.00	6
224	0.00	0.00	0.00	11
225	0.00	0.00	0.00	9
226	0.00	0.00	0.00	7
227	0.00	0.00	0.00	4
228	0.00	0.00	0.00	8
229	0.17	1.00	0.29	9
230	0.00	0.00	0.00	5
231	0.00	0.00	0.00	2
232	0.00	0.00	0.00	6
233	0.00	0.00	0.00	5
234	0.00	0.00	0.00	3
235	0.00	0.00	0.00	8
236	0.00	0.00	0.00	4
237	0.00	0.00	0.00	9
238	0.00	0.00	0.00	9
239	0.06	0.75	0.11	4
240	0.00	0.00	0.00	4
241	0.00	0.00	0.00	6
242	0.00	0.00	0.00	5
243	0.00	0.00	0.00	6
244	0.00	0.00	0.00	4
245	0.00	0.00	0.00	5
246	0.00	0.00	0.00	5
247	0.00	0.00	0.00	4
248	0.00	0.00	0.00	6
249	0.17	1.00	0.29	5
250	0.00	0.00	0.00	3
251	1.00	0.25	0.40	4
252	0.00	0.00	0.00	2
253	0.08	0.33	0.13	3
254	0.33	0.20	0.25	5
255	0.00	0.00	0.00	2
256	0.57	1.00	0.73	4
257	0.00	0.00	0.00	7
258	0.50	0.30	0.37	10
259	0.32	0.88	0.47	8
260	0.00	0.00	0.00	3
261	0.43	0.38	0.40	8
262	0.00	0.00	0.00	4
263	1.00	0.12	0.22	8
264	0.00	0.00	0.00	7
265	0.00	0.00	0.00	3
266	0.00	0.00	0.00	1
267	0.00	0.00	0.00	6
268	0.19	0.90	0.31	10
269	0.00	0.00	0.00	3
270	0.00	0.00	0.00	8
271	0.00	0.00	0.00	5
272	0.09	0.10	0.10	10
273	0.00	0.00	0.00	5
274	0.11	0.17	0.13	6
275	0.00	0.00	0.00	5
276	0.00	0.00	0.00	10
277	0.00	0.00	0.00	3
278	0.00	0.00	0.00	8
279	0.00	0.00	0.00	2
280	0.12	1.00	0.22	6
281	0.00	0.00	0.00	6
282	0.00	0.00	0.00	6
283	0.00	0.00	0.00	6
284	0.00	0.00	0.00	4
285	0.00	0.00	0.00	5
286	0.00	0.00	0.00	10
287	0.17	1.00	0.29	5
288	0.00	0.00	0.00	7
289	0.00	0.00	0.00	3
290	0.00	0.00	0.00	3
291	0.22	1.00	0.36	2
292	0.00	0.00	0.00	4
293	0.00	0.00	0.00	3
294	0.25	0.71	0.37	7
295	0.00	0.00	0.00	4
296	0.00	0.00	0.00	4
297	0.00	0.00	0.00	4
298	0.00	0.00	0.00	1
299	0.00	0.00	0.00	7
300	0.00	0.00	0.00	13
301	0.00	0.00	0.00	1
302	0.14	1.00	0.24	3
303	0.00	0.00	0.00	2
304	0.00	0.00	0.00	7
305	0.00	0.00	0.00	5
306	0.00	0.00	0.00	8
307	0.00	0.00	0.00	2
308	0.10	0.75	0.18	8
309	0.00	0.00	0.00	5
310	1.00	0.33	0.50	3
311	0.00	0.00	0.00	2
312	0.00	0.00	0.00	6
313	0.00	0.00	0.00	4
314	0.00	0.00	0.00	4
315	0.00	0.00	0.00	4
316	0.10	0.33	0.15	3
317	0.00	0.00	0.00	4
318	0.00	0.00	0.00	3
319	0.00	0.00	0.00	3
320	0.00	0.00	0.00	4
321	0.00	0.00	0.00	2
322	0.00	0.00	0.00	6
323	0.00	0.00	0.00	2
324	0.00	0.00	0.00	2
325	0.00	0.00	0.00	4
326	0.00	0.00	0.00	2
327	0.00	0.00	0.00	5
328	0.15	1.00	0.26	6
329	0.00	0.00	0.00	2
330	0.00	0.00	0.00	4
331	0.00	0.00	0.00	4
332	0.00	0.00	0.00	2
333	0.00	0.00	0.00	3
334	0.00	0.00	0.00	5
335	0.14	0.50	0.22	2
336	0.00	0.00	0.00	2
337	0.00	0.00	0.00	3
338	0.00	0.00	0.00	4
339	0.00	0.00	0.00	2
340	0.12	1.00	0.22	1
341	0.17	0.25	0.20	4
342	0.00	0.00	0.00	3
343	0.00	0.00	0.00	6
344	0.17	0.50	0.25	2
345	0.00	0.00	0.00	3
346	0.18	1.00	0.31	2
347	0.00	0.00	0.00	3
348	0.00	0.00	0.00	2
350	0.00	0.00	0.00	5
351	0.07	0.67	0.13	3
352	0.00	0.00	0.00	3
353	0.00	0.00	0.00	2
354	0.00	0.00	0.00	5
355	0.00	0.00	0.00	3
356	0.00	0.00	0.00	1
358	0.00	0.00	0.00	5
359	0.00	0.00	0.00	4
360	0.07	0.33	0.12	3
361	0.00	0.00	0.00	5
362	0.00	0.00	0.00	2
363	0.00	0.00	0.00	8
364	0.00	0.00	0.00	3
365	0.00	0.00	0.00	1
366	0.00	0.00	0.00	3
367	1.00	0.20	0.33	5
370	0.00	0.00	0.00	2
371	0.00	0.00	0.00	1
372	0.40	0.50	0.44	4
373	0.00	0.00	0.00	4
374	0.08	0.33	0.12	3
375	0.00	0.00	0.00	5
376	0.00	0.00	0.00	2
377	0.00	0.00	0.00	1
378	0.00	0.00	0.00	2
379	0.00	0.00	0.00	3
380	0.00	0.00	0.00	2
381	0.00	0.00	0.00	3
382	0.00	0.00	0.00	5
384	0.00	0.00	0.00	3
385	0.00	0.00	0.00	4
386	0.00	0.00	0.00	4
387	0.04	0.50	0.08	2
388	0.00	0.00	0.00	3
389	0.00	0.00	0.00	1
390	0.12	0.67	0.21	3
391	0.00	0.00	0.00	1
392	0.00	0.00	0.00	3
393	0.00	0.00	0.00	1
394	0.00	0.00	0.00	1
395	0.00	0.00	0.00	4
396	0.00	0.00	0.00	5
398	0.20	1.00	0.33	3
399	0.00	0.00	0.00	3
400	0.00	0.00	0.00	1
401	0.00	0.00	0.00	2
402	0.00	0.00	0.00	3
403	0.00	0.00	0.00	2
404	0.00	0.00	0.00	2
405	0.14	0.33	0.20	3
406	0.00	0.00	0.00	3
407	0.20	0.50	0.29	2
408	0.00	0.00	0.00	3
409	0.00	0.00	0.00	3
410	0.33	0.67	0.44	3
411	0.00	0.00	0.00	2
412	0.00	0.00	0.00	2
413	0.00	0.00	0.00	4
414	0.00	0.00	0.00	2
415	0.00	0.00	0.00	1
416	0.20	0.50	0.29	2
417	0.00	0.00	0.00	1
419	0.00	0.00	0.00	2
420	0.00	0.00	0.00	2
421	0.25	0.67	0.36	3
423	0.00	0.00	0.00	0
424	0.00	0.00	0.00	1
425	0.00	0.00	0.00	2
426	0.00	0.00	0.00	1
427	0.00	0.00	0.00	1
428	0.00	0.00	0.00	2
430	0.00	0.00	0.00	2
431	0.00	0.00	0.00	1
432	0.00	0.00	0.00	4
433	0.00	0.00	0.00	1
435	0.00	0.00	0.00	0
436	0.07	0.50	0.12	2
437	0.00	0.00	0.00	1
440	0.00	0.00	0.00	1
441	0.00	0.00	0.00	3
442	0.00	0.00	0.00	3
443	0.00	0.00	0.00	4
444	0.00	0.00	0.00	3
446	0.00	0.00	0.00	4
447	0.00	0.00	0.00	1
448	0.00	0.00	0.00	1
449	0.00	0.00	0.00	2
450	0.00	0.00	0.00	1
451	0.00	0.00	0.00	1
452	0.33	0.25	0.29	4
453	0.00	0.00	0.00	1
454	0.00	0.00	0.00	1
455	0.00	0.00	0.00	4
456	0.00	0.00	0.00	2
457	0.00	0.00	0.00	3
458	0.00	0.00	0.00	2
459	0.00	0.00	0.00	1
460	0.00	0.00	0.00	4
461	0.00	0.00	0.00	2
462	0.00	0.00	0.00	1
463	0.02	1.00	0.04	1
464	0.00	0.00	0.00	2
465	0.00	0.00	0.00	3
466	0.00	0.00	0.00	1
467	0.00	0.00	0.00	1
468	0.00	0.00	0.00	1
469	0.00	0.00	0.00	3
470	0.00	0.00	0.00	3
474	0.00	0.00	0.00	1
476	0.00	0.00	0.00	1
477	0.00	0.00	0.00	1
478	0.00	0.00	0.00	3
479	0.00	0.00	0.00	3
480	0.00	0.00	0.00	1
481	0.00	0.00	0.00	1
482	0.00	0.00	0.00	2
483	0.00	0.00	0.00	2
484	0.00	0.00	0.00	2
485	0.00	0.00	0.00	1
486	0.00	0.00	0.00	3
487	0.00	0.00	0.00	1
488	0.00	0.00	0.00	3
489	0.00	0.00	0.00	1
490	0.00	0.00	0.00	2
491	0.00	0.00	0.00	2
492	0.00	0.00	0.00	5
493	0.00	0.00	0.00	2
494	0.00	0.00	0.00	4
495	0.00	0.00	0.00	4
496	0.00	0.00	0.00	0
497	0.00	0.00	0.00	2
498	0.00	0.00	0.00	2
499	0.00	0.00	0.00	3
501	0.00	0.00	0.00	2
502	0.00	0.00	0.00	1
503	0.00	0.00	0.00	2
504	0.00	0.00	0.00	1
505	0.00	0.00	0.00	3
506	0.00	0.00	0.00	1
507	0.00	0.00	0.00	2
508	0.00	0.00	0.00	3
509	0.05	1.00	0.09	1
511	0.00	0.00	0.00	1
512	0.00	0.00	0.00	1
513	0.00	0.00	0.00	3
514	0.00	0.00	0.00	1
515	0.00	0.00	0.00	1
516	0.17	0.50	0.25	2
517	0.00	0.00	0.00	4
518	0.00	0.00	0.00	3
519	0.00	0.00	0.00	1
521	0.08	0.33	0.12	3
522	0.00	0.00	0.00	1
525	0.00	0.00	0.00	1
527	0.00	0.00	0.00	2
530	0.00	0.00	0.00	3
531	0.00	0.00	0.00	3
532	0.00	0.00	0.00	0
534	0.00	0.00	0.00	1
536	0.00	0.00	0.00	2
537	0.00	0.00	0.00	1
539	0.50	0.33	0.40	3
541	0.00	0.00	0.00	2
542	0.00	0.00	0.00	1
543	0.00	0.00	0.00	1
544	0.00	0.00	0.00	2
546	0.00	0.00	0.00	1
547	0.00	0.00	0.00	0
548	0.00	0.00	0.00	1
550	0.00	0.00	0.00	2
551	0.00	0.00	0.00	1
552	0.00	0.00	0.00	1
553	0.00	0.00	0.00	1
554	0.00	0.00	0.00	1
555	0.00	0.00	0.00	3
556	0.00	0.00	0.00	2
557	0.00	0.00	0.00	2
558	0.00	0.00	0.00	1
559	0.00	0.00	0.00	1
560	0.00	0.00	0.00	2
561	0.00	0.00	0.00	1
562	0.00	0.00	0.00	1
563	0.00	0.00	0.00	1
564	0.00	0.00	0.00	2
565	0.00	0.00	0.00	1
566	0.00	0.00	0.00	1
567	0.00	0.00	0.00	4
568	0.00	0.00	0.00	3
569	0.00	0.00	0.00	2
570	0.00	0.00	0.00	1
571	0.00	0.00	0.00	1
572	0.00	0.00	0.00	0
573	0.00	0.00	0.00	1
576	0.00	0.00	0.00	1
577	0.00	0.00	0.00	1
578	0.00	0.00	0.00	1
579	0.00	0.00	0.00	2
580	0.00	0.00	0.00	1
581	0.00	0.00	0.00	1
582	0.00	0.00	0.00	1
584	0.00	0.00	0.00	1
585	0.00	0.00	0.00	2
586	0.08	1.00	0.15	1
588	0.00	0.00	0.00	1
590	0.00	0.00	0.00	3
591	0.00	0.00	0.00	1
592	0.00	0.00	0.00	1
593	0.00	0.00	0.00	2
594	0.00	0.00	0.00	1
596	0.00	0.00	0.00	2
597	0.00	0.00	0.00	1
598	0.00	0.00	0.00	1
602	0.00	0.00	0.00	1
604	0.00	0.00	0.00	1
607	0.00	0.00	0.00	1
609	0.00	0.00	0.00	1
610	0.00	0.00	0.00	1
611	0.00	0.00	0.00	1
612	0.00	0.00	0.00	1
613	0.00	0.00	0.00	1
614	0.00	0.00	0.00	2
618	0.00	0.00	0.00	2
620	0.00	0.00	0.00	2
622	0.00	0.00	0.00	2
623	0.00	0.00	0.00	2
624	0.00	0.00	0.00	0
625	0.00	0.00	0.00	2
626	0.00	0.00	0.00	1
627	0.00	0.00	0.00	1
628	0.00	0.00	0.00	1
631	0.00	0.00	0.00	2
633	0.00	0.00	0.00	1
634	0.00	0.00	0.00	2
636	0.00	0.00	0.00	1
637	0.00	0.00	0.00	0
638	0.00	0.00	0.00	1
640	0.00	0.00	0.00	0
641	0.00	0.00	0.00	2
643	0.00	0.00	0.00	2
644	0.00	0.00	0.00	2
645	0.00	0.00	0.00	1
646	0.00	0.00	0.00	1
647	0.00	0.00	0.00	1
648	0.00	0.00	0.00	1
651	0.00	0.00	0.00	1
654	0.00	0.00	0.00	2
660	0.00	0.00	0.00	1
662	0.00	0.00	0.00	2
664	0.00	0.00	0.00	0
667	0.00	0.00	0.00	1
668	0.00	0.00	0.00	1
670	0.00	0.00	0.00	1
672	0.00	0.00	0.00	1
675	0.00	0.00	0.00	1
676	0.00	0.00	0.00	2
678	0.00	0.00	0.00	3
679	0.00	0.00	0.00	1
682	0.00	0.00	0.00	1
684	0.00	0.00	0.00	2
688	0.00	0.00	0.00	1
691	0.00	0.00	0.00	1
693	0.00	0.00	0.00	2
696	0.00	0.00	0.00	1
698	0.00	0.00	0.00	1
699	0.00	0.00	0.00	1
700	0.00	0.00	0.00	2
704	0.00	0.00	0.00	2
706	0.00	0.00	0.00	1
707	0.00	0.00	0.00	2
709	0.00	0.00	0.00	1
710	0.00	0.00	0.00	2
711	0.00	0.00	0.00	1
713	0.00	0.00	0.00	1
715	0.00	0.00	0.00	1
722	0.00	0.00	0.00	0
723	0.00	0.00	0.00	1
729	0.17	0.50	0.25	2
730	0.00	0.00	0.00	1
731	0.00	0.00	0.00	0
733	0.00	0.00	0.00	1
738	0.00	0.00	0.00	1
741	0.00	0.00	0.00	1
743	0.00	0.00	0.00	1
744	0.00	0.00	0.00	0
745	0.00	0.00	0.00	1
746	0.00	0.00	0.00	1
749	0.00	0.00	0.00	1
752	0.00	0.00	0.00	1
757	0.00	0.00	0.00	1
758	0.00	0.00	0.00	1
760	0.00	0.00	0.00	1
761	0.00	0.00	0.00	1
766	0.00	0.00	0.00	2
774	0.00	0.00	0.00	1
788	0.00	0.00	0.00	1
791	0.00	0.00	0.00	1
795	0.00	0.00	0.00	2
797	0.00	0.00	0.00	1
798	0.00	0.00	0.00	1
801	0.00	0.00	0.00	1
804	0.00	0.00	0.00	1
805	0.00	0.00	0.00	1
808	0.00	0.00	0.00	1
809	0.00	0.00	0.00	1
812	0.00	0.00	0.00	2
813	0.00	0.00	0.00	1
814	0.00	0.00	0.00	1
817	0.00	0.00	0.00	0
820	0.00	0.00	0.00	1
823	0.00	0.00	0.00	1
827	0.00	0.00	0.00	0
830	0.00	0.00	0.00	1
831	0.00	0.00	0.00	1
838	0.00	0.00	0.00	0
839	0.00	0.00	0.00	1
844	0.00	0.00	0.00	1
849	0.00	0.00	0.00	1
852	0.00	0.00	0.00	1
856	0.00	0.00	0.00	0
858	0.00	0.00	0.00	1
863	0.00	0.00	0.00	1
872	0.00	0.00	0.00	2
886	0.00	0.00	0.00	1
891	0.00	0.00	0.00	1
900	0.00	0.00	0.00	0
938	0.00	0.00	0.00	1
948	0.00	0.00	0.00	1
967	0.00	0.00	0.00	1
977	0.00	0.00	0.00	1
accuracy			0.26	3476
macro avg	0.08	0.13	0.08	3476
weighted avg	0.20	0.26	0.19	3476

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Recall and F-score are ill-defined and being set to 0.0 in labels with no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Recall and F-score are ill-defined and being set to 0.0 in labels with no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Recall and F-score are ill-defined and being set to 0.0 in labels with no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

Fitting the modell with 22, 22, 22.

In [114…

```
## model 2

mlp = MLPClassifier(hidden_layer_sizes=(22, 22, 22), max_iter=1000)
mlp.fit(x_train, y_train.values.ravel())
```

Out[114…

```
MLPClassifier(hidden_layer_sizes=(22, 22, 22), max_iter=1000)
```

In [115…

```
predictions = mlp.predict(x_test)
print(predictions)
```

```
[  3  26 221 ...  18 209 181]
```

The accuracy went up. However, 34% is not good. Again, I believe that because of continuous target. Also, the model took about 20 minutes to train the data.

In [116…

```
print(confusion_matrix(y_test,predictions))
print(classification_report(y_test,predictions))
```

```
[[33  0  0 ...  0  0  0]
 [ 0 35  3 ...  0  0  0]
 [ 0  0 40 ...  0  0  0]
 ...
 [ 0  0  0 ...  0  0  0]
 [ 0  0  0 ...  0  0  0]
 [ 0  0  0 ...  0  1  0]]
```

	precision	recall	f1-score	support
1	1.00	1.00	1.00	33
2	1.00	0.92	0.96	38
3	0.93	0.93	0.93	43
4	0.91	1.00	0.95	50
5	1.00	0.94	0.97	52
6	0.97	1.00	0.99	39
7	1.00	1.00	1.00	43
8	0.98	0.98	0.98	41
9	0.97	0.97	0.97	29
10	0.94	0.91	0.92	32
11	0.86	0.86	0.86	29
12	0.74	0.91	0.82	22
13	0.50	0.08	0.13	26
14	0.39	0.95	0.55	19
15	0.67	0.44	0.53	18
16	0.88	0.79	0.83	19
17	1.00	0.68	0.81	25
18	0.62	0.95	0.75	21
19	1.00	0.06	0.12	16
20	0.32	1.00	0.48	8
21	1.00	0.29	0.44	14
22	0.50	0.54	0.52	13
23	0.50	0.80	0.62	15
24	0.00	0.00	0.00	13
25	0.00	0.00	0.00	13
26	0.44	0.83	0.58	23
27	0.24	0.69	0.35	16
28	0.00	0.00	0.00	15
29	0.00	0.00	0.00	8
30	0.38	0.40	0.39	15
31	0.00	0.00	0.00	7
32	0.00	0.00	0.00	13
33	0.00	0.00	0.00	14
34	0.14	0.86	0.24	7
35	0.00	0.00	0.00	11
36	0.29	0.18	0.22	11
37	0.42	0.56	0.48	9
38	0.00	0.00	0.00	6
39	0.00	0.00	0.00	12
40	0.00	0.00	0.00	15
41	0.13	1.00	0.22	9
42	0.00	0.00	0.00	15
43	0.00	0.00	0.00	7
44	0.00	0.00	0.00	13
45	0.00	0.00	0.00	7
46	0.00	0.00	0.00	10
47	0.00	0.00	0.00	17
48	0.05	1.00	0.10	6
49	0.00	0.00	0.00	6
50	0.00	0.00	0.00	14
51	0.00	0.00	0.00	11
52	0.00	0.00	0.00	10
53	0.00	0.00	0.00	6
54	0.00	0.00	0.00	12
55	0.07	0.08	0.07	12
56	0.00	0.00	0.00	9
57	0.11	0.22	0.14	9
58	0.18	0.29	0.22	7
59	0.00	0.00	0.00	9
60	0.00	0.00	0.00	10
61	0.00	0.00	0.00	8
62	0.07	0.14	0.09	7
63	0.00	0.00	0.00	7
64	0.28	0.73	0.40	11
65	0.29	0.29	0.29	7
66	0.00	0.00	0.00	10
67	0.00	0.00	0.00	6
68	0.00	0.00	0.00	9
69	0.14	0.89	0.25	9
70	0.00	0.00	0.00	11
71	0.00	0.00	0.00	9
72	0.00	0.00	0.00	8
73	0.00	0.00	0.00	4
74	0.00	0.00	0.00	11
75	0.00	0.00	0.00	10
76	0.00	0.00	0.00	6
77	0.00	0.00	0.00	8
78	0.27	0.80	0.40	15
79	0.00	0.00	0.00	11
80	0.00	0.00	0.00	7
81	0.00	0.00	0.00	4
82	0.00	0.00	0.00	8
83	0.00	0.00	0.00	5
84	0.00	0.00	0.00	12
85	0.14	0.50	0.22	6
86	1.00	0.06	0.11	18
87	0.13	0.70	0.22	10
88	0.17	0.43	0.24	7
89	0.00	0.00	0.00	8
90	0.00	0.00	0.00	9
91	0.00	0.00	0.00	4
92	0.00	0.00	0.00	8
93	0.00	0.00	0.00	11
94	0.00	0.00	0.00	7
95	0.46	0.55	0.50	11
96	0.12	0.60	0.21	5
97	0.00	0.00	0.00	6
98	0.33	0.10	0.15	10
99	0.00	0.00	0.00	10
100	0.00	0.00	0.00	7
101	0.13	0.45	0.20	11
102	0.00	0.00	0.00	7
103	0.06	0.33	0.11	6
104	0.00	0.00	0.00	5
105	0.00	0.00	0.00	10
106	0.00	0.00	0.00	14
107	0.00	0.00	0.00	5
108	0.09	0.10	0.10	10
109	0.00	0.00	0.00	6
110	0.00	0.00	0.00	7
111	0.24	0.85	0.37	13
112	0.00	0.00	0.00	5
113	0.00	0.00	0.00	8
114	0.00	0.00	0.00	7
115	0.00	0.00	0.00	6
116	0.00	0.00	0.00	6
117	0.14	0.60	0.22	5
118	0.26	0.45	0.33	11
119	0.00	0.00	0.00	10
120	0.00	0.00	0.00	7
121	0.00	0.00	0.00	7
122	0.00	0.00	0.00	8
123	0.20	0.89	0.33	9
124	0.38	0.18	0.24	17
125	0.00	0.00	0.00	7
126	0.00	0.00	0.00	8
127	0.00	0.00	0.00	8
128	0.00	0.00	0.00	3
129	0.35	0.89	0.50	9
130	0.00	0.00	0.00	4
131	0.50	0.25	0.33	4
132	0.25	0.50	0.33	8
133	0.00	0.00	0.00	8
134	0.00	0.00	0.00	6
135	0.00	0.00	0.00	4
136	0.12	1.00	0.21	6
137	0.00	0.00	0.00	11
138	0.00	0.00	0.00	9
139	0.00	0.00	0.00	5
140	0.17	0.14	0.15	7
141	0.00	0.00	0.00	7
142	0.00	0.00	0.00	5
143	0.50	0.22	0.31	9
144	0.00	0.00	0.00	8
145	0.00	0.00	0.00	4
146	0.00	0.00	0.00	5
147	0.36	0.42	0.38	12
148	0.24	0.86	0.38	7
149	0.00	0.00	0.00	7
150	0.00	0.00	0.00	6
151	0.40	0.60	0.48	10
152	0.00	0.00	0.00	9
153	0.53	0.67	0.59	12
154	0.38	0.86	0.52	7
155	0.36	0.67	0.47	6
156	0.00	0.00	0.00	11
157	0.46	0.86	0.60	7
158	0.50	0.20	0.29	5
159	0.00	0.00	0.00	7
160	0.42	1.00	0.59	8
161	0.00	0.00	0.00	6
162	0.17	0.33	0.22	3
163	0.00	0.00	0.00	7
164	0.50	0.75	0.60	4
165	0.86	1.00	0.92	6
166	1.00	0.17	0.29	6
167	0.50	0.91	0.65	11
168	0.24	0.38	0.29	13
169	0.00	0.00	0.00	8
170	0.29	0.33	0.31	12
171	0.00	0.00	0.00	10
172	0.00	0.00	0.00	9
173	0.41	1.00	0.58	7
174	0.50	0.25	0.33	8
175	0.33	0.75	0.46	8
176	0.00	0.00	0.00	9
177	0.40	0.22	0.29	9
178	0.53	0.82	0.64	11
179	0.00	0.00	0.00	13
180	0.67	0.40	0.50	5
181	0.29	1.00	0.45	9
182	0.00	0.00	0.00	10
183	0.00	0.00	0.00	4
184	0.83	0.83	0.83	6
185	0.00	0.00	0.00	11
186	0.25	1.00	0.40	5
187	0.00	0.00	0.00	5
188	0.00	0.00	0.00	11
189	0.26	1.00	0.41	7
190	0.22	0.20	0.21	10
191	0.00	0.00	0.00	5
192	0.71	0.71	0.71	7
193	1.00	0.62	0.77	8
194	0.00	0.00	0.00	4
195	1.00	0.20	0.33	5
196	0.18	1.00	0.31	6
197	0.00	0.00	0.00	6
198	0.00	0.00	0.00	7
199	0.00	0.00	0.00	6
200	0.00	0.00	0.00	2
201	0.00	0.00	0.00	14
202	0.23	1.00	0.37	7
203	0.00	0.00	0.00	8
204	0.58	0.88	0.70	8
205	0.00	0.00	0.00	5
206	0.62	0.89	0.73	9
207	0.50	0.60	0.55	5
208	0.00	0.00	0.00	5
209	1.00	1.00	1.00	7
210	0.50	1.00	0.67	6
211	0.00	0.00	0.00	5
212	0.08	0.50	0.14	2
213	0.00	0.00	0.00	13
214	0.22	1.00	0.36	2
215	0.00	0.00	0.00	6
216	0.40	0.67	0.50	3
217	0.00	0.00	0.00	7
218	0.36	1.00	0.53	8
219	0.00	0.00	0.00	10
220	0.40	0.33	0.36	6
221	0.32	1.00	0.48	7
222	0.00	0.00	0.00	7
223	1.00	0.17	0.29	6
224	0.00	0.00	0.00	11
225	0.35	0.89	0.50	9
226	0.75	0.43	0.55	7
227	0.33	1.00	0.50	4
228	1.00	0.12	0.22	8
229	1.00	0.89	0.94	9
230	1.00	0.40	0.57	5
231	0.00	0.00	0.00	2
232	0.38	0.83	0.53	6
233	0.75	0.60	0.67	5
234	0.00	0.00	0.00	3
235	0.00	0.00	0.00	8
236	0.05	0.25	0.09	4
237	0.00	0.00	0.00	9
238	0.57	0.44	0.50	9
239	0.00	0.00	0.00	4
240	0.44	1.00	0.62	4
241	0.00	0.00	0.00	6
242	0.57	0.80	0.67	5
243	0.00	0.00	0.00	6
244	0.30	0.75	0.43	4
245	0.00	0.00	0.00	5
246	0.28	1.00	0.43	5
247	0.00	0.00	0.00	4
248	0.38	0.50	0.43	6
249	0.00	0.00	0.00	5
250	0.00	0.00	0.00	3
251	0.40	1.00	0.57	4
252	0.00	0.00	0.00	2
253	0.00	0.00	0.00	3
254	0.00	0.00	0.00	5
255	0.25	1.00	0.40	2
256	0.67	0.50	0.57	4
257	0.46	0.86	0.60	7
258	0.00	0.00	0.00	10
259	0.00	0.00	0.00	8
260	0.19	1.00	0.32	3
261	0.60	0.38	0.46	8
262	0.00	0.00	0.00	4
263	0.33	0.62	0.43	8
264	0.00	0.00	0.00	7
265	0.22	0.67	0.33	3
266	0.00	0.00	0.00	1
267	1.00	0.17	0.29	6
268	0.00	0.00	0.00	10
269	0.00	0.00	0.00	3
270	0.40	1.00	0.57	8
271	1.00	0.20	0.33	5
272	0.53	1.00	0.69	10
273	0.00	0.00	0.00	5
274	1.00	0.83	0.91	6
275	0.50	0.20	0.29	5
276	0.53	1.00	0.69	10
277	0.00	0.00	0.00	3
278	0.80	0.50	0.62	8
279	0.00	0.00	0.00	2
280	0.33	0.17	0.22	6
281	0.15	0.33	0.21	6
282	0.00	0.00	0.00	6
283	0.29	0.67	0.40	6
284	0.00	0.00	0.00	4
285	0.00	0.00	0.00	5
286	0.00	0.00	0.00	10
287	0.00	0.00	0.00	5
288	0.25	0.57	0.35	7
289	0.00	0.00	0.00	3
290	1.00	0.33	0.50	3
291	0.67	1.00	0.80	2
292	0.67	1.00	0.80	4
293	0.00	0.00	0.00	3
294	0.60	0.43	0.50	7
295	0.00	0.00	0.00	4
296	0.11	0.25	0.15	4
297	0.12	0.50	0.20	4
298	0.00	0.00	0.00	1
299	0.00	0.00	0.00	7
300	0.00	0.00	0.00	13
301	0.00	0.00	0.00	1
302	0.11	0.67	0.19	3
303	0.00	0.00	0.00	2
304	1.00	0.14	0.25	7
305	0.25	0.20	0.22	5
306	0.00	0.00	0.00	8
307	0.11	1.00	0.19	2
308	0.00	0.00	0.00	8
309	0.50	0.20	0.29	5
310	0.50	0.33	0.40	3
311	0.40	1.00	0.57	2
312	0.00	0.00	0.00	6
313	0.14	0.25	0.18	4
314	0.33	0.50	0.40	4
315	0.00	0.00	0.00	4
316	0.00	0.00	0.00	3
317	0.67	0.50	0.57	4
318	0.27	1.00	0.43	3
319	0.00	0.00	0.00	3
320	0.33	0.25	0.29	4
321	0.12	0.50	0.20	2
322	1.00	0.17	0.29	6
323	0.33	1.00	0.50	2
324	0.00	0.00	0.00	2
325	0.67	0.50	0.57	4
326	0.00	0.00	0.00	2
327	0.00	0.00	0.00	5
328	0.27	1.00	0.43	6
329	0.00	0.00	0.00	2
330	0.00	0.00	0.00	4
331	0.00	0.00	0.00	4
332	0.00	0.00	0.00	2
333	0.00	0.00	0.00	3
334	0.38	0.60	0.46	5
335	0.00	0.00	0.00	2
336	0.00	0.00	0.00	2
337	0.50	0.33	0.40	3
338	0.38	0.75	0.50	4
339	0.00	0.00	0.00	2
340	0.00	0.00	0.00	1
341	0.00	0.00	0.00	4
342	0.50	0.67	0.57	3
343	0.43	0.50	0.46	6
344	0.00	0.00	0.00	2
345	0.00	0.00	0.00	3
346	0.33	0.50	0.40	2
347	0.00	0.00	0.00	3
348	0.00	0.00	0.00	2
349	0.00	0.00	0.00	0
350	0.00	0.00	0.00	5
351	0.00	0.00	0.00	3
352	0.00	0.00	0.00	3
353	0.00	0.00	0.00	2
354	0.00	0.00	0.00	5
355	0.14	0.67	0.24	3
356	0.00	0.00	0.00	1
357	0.00	0.00	0.00	0
358	1.00	0.40	0.57	5
359	0.00	0.00	0.00	4
360	0.00	0.00	0.00	3
361	0.10	0.40	0.15	5
362	0.00	0.00	0.00	2
363	0.00	0.00	0.00	8
364	0.00	0.00	0.00	3
365	0.00	0.00	0.00	1
366	0.00	0.00	0.00	3
367	0.00	0.00	0.00	5
369	0.00	0.00	0.00	0
370	0.00	0.00	0.00	2
371	0.00	0.00	0.00	1
372	0.00	0.00	0.00	4
373	0.00	0.00	0.00	4
374	0.18	1.00	0.30	3
375	0.00	0.00	0.00	5
376	0.00	0.00	0.00	2
377	0.00	0.00	0.00	1
378	0.20	1.00	0.33	2
379	0.00	0.00	0.00	3
380	0.00	0.00	0.00	2
381	0.00	0.00	0.00	3
382	0.57	0.80	0.67	5
384	0.50	0.33	0.40	3
385	0.67	0.50	0.57	4
386	0.43	0.75	0.55	4
387	0.00	0.00	0.00	2
388	0.00	0.00	0.00	3
389	0.33	1.00	0.50	1
390	0.00	0.00	0.00	3
391	0.00	0.00	0.00	1
392	0.00	0.00	0.00	3
393	0.00	0.00	0.00	1
394	0.00	0.00	0.00	1
395	0.00	0.00	0.00	4
396	0.00	0.00	0.00	5
397	0.00	0.00	0.00	0
398	0.33	1.00	0.50	3
399	0.00	0.00	0.00	3
400	0.00	0.00	0.00	1
401	0.67	1.00	0.80	2
402	0.00	0.00	0.00	3
403	0.33	0.50	0.40	2
404	0.00	0.00	0.00	2
405	0.00	0.00	0.00	3
406	0.23	1.00	0.38	3
407	0.00	0.00	0.00	2
408	0.00	0.00	0.00	3
409	0.00	0.00	0.00	3
410	0.00	0.00	0.00	3
411	0.00	0.00	0.00	2
412	0.00	0.00	0.00	2
413	0.00	0.00	0.00	4
414	0.00	0.00	0.00	2
415	0.00	0.00	0.00	1
416	0.07	1.00	0.13	2
417	0.00	0.00	0.00	1
419	0.00	0.00	0.00	2
420	0.00	0.00	0.00	2
421	0.00	0.00	0.00	3
424	0.00	0.00	0.00	1
425	0.00	0.00	0.00	2
426	0.00	0.00	0.00	1
427	0.00	0.00	0.00	1
428	0.00	0.00	0.00	2
430	0.00	0.00	0.00	2
431	0.00	0.00	0.00	1
432	0.00	0.00	0.00	4
433	0.00	0.00	0.00	1
435	0.00	0.00	0.00	0
436	0.00	0.00	0.00	2
437	0.00	0.00	0.00	1
440	0.00	0.00	0.00	1
441	0.00	0.00	0.00	3
442	0.00	0.00	0.00	3
443	0.00	0.00	0.00	4
444	0.00	0.00	0.00	3
446	0.00	0.00	0.00	4
447	0.00	0.00	0.00	1
448	0.00	0.00	0.00	1
449	0.00	0.00	0.00	2
450	0.00	0.00	0.00	1
451	0.00	0.00	0.00	1
452	0.10	0.75	0.18	4
453	0.00	0.00	0.00	1
454	0.00	0.00	0.00	1
455	0.00	0.00	0.00	4
456	0.00	0.00	0.00	2
457	0.00	0.00	0.00	3
458	0.00	0.00	0.00	2
459	0.00	0.00	0.00	1
460	0.00	0.00	0.00	4
461	0.00	0.00	0.00	2
462	0.00	0.00	0.00	1
463	0.00	0.00	0.00	1
464	0.11	0.50	0.18	2
465	0.00	0.00	0.00	3
466	0.00	0.00	0.00	1
467	0.00	0.00	0.00	1
468	0.00	0.00	0.00	1
469	0.00	0.00	0.00	3
470	0.00	0.00	0.00	3
474	0.00	0.00	0.00	1
476	0.00	0.00	0.00	1
477	0.00	0.00	0.00	1
478	0.00	0.00	0.00	3
479	0.00	0.00	0.00	3
480	0.00	0.00	0.00	1
481	0.00	0.00	0.00	1
482	0.00	0.00	0.00	2
483	0.00	0.00	0.00	2
484	0.00	0.00	0.00	2
485	0.00	0.00	0.00	1
486	0.00	0.00	0.00	3
487	0.00	0.00	0.00	1
488	0.00	0.00	0.00	3
489	0.00	0.00	0.00	1
490	0.10	0.50	0.17	2
491	0.00	0.00	0.00	2
492	0.12	0.60	0.19	5
493	0.00	0.00	0.00	2
494	0.00	0.00	0.00	4
495	0.00	0.00	0.00	4
497	0.00	0.00	0.00	2
498	0.00	0.00	0.00	2
499	0.00	0.00	0.00	3
501	0.00	0.00	0.00	2
502	0.00	0.00	0.00	1
503	0.00	0.00	0.00	2
504	0.00	0.00	0.00	1
505	0.00	0.00	0.00	3
506	0.00	0.00	0.00	1
507	0.00	0.00	0.00	2
508	0.00	0.00	0.00	3
509	0.00	0.00	0.00	1
511	0.11	1.00	0.20	1
512	0.00	0.00	0.00	1
513	0.00	0.00	0.00	3
514	0.00	0.00	0.00	1
515	0.00	0.00	0.00	1
516	0.00	0.00	0.00	2
517	0.50	0.25	0.33	4
518	0.00	0.00	0.00	3
519	0.00	0.00	0.00	1
521	0.00	0.00	0.00	3
522	0.20	1.00	0.33	1
524	0.00	0.00	0.00	0
525	0.00	0.00	0.00	1
526	0.00	0.00	0.00	0
527	0.00	0.00	0.00	2
528	0.00	0.00	0.00	0
530	0.00	0.00	0.00	3
531	0.00	0.00	0.00	3
534	0.00	0.00	0.00	1
535	0.00	0.00	0.00	0
536	0.00	0.00	0.00	2
537	0.00	0.00	0.00	1
539	0.00	0.00	0.00	3
541	0.33	0.50	0.40	2
542	0.00	0.00	0.00	1
543	0.00	0.00	0.00	1
544	0.00	0.00	0.00	2
546	0.00	0.00	0.00	1
547	0.00	0.00	0.00	0
548	0.00	0.00	0.00	1
549	0.00	0.00	0.00	0
550	0.00	0.00	0.00	2
551	0.00	0.00	0.00	1
552	0.00	0.00	0.00	1
553	0.11	1.00	0.20	1
554	0.00	0.00	0.00	1
555	0.00	0.00	0.00	3
556	0.20	0.50	0.29	2
557	0.00	0.00	0.00	2
558	0.00	0.00	0.00	1
559	0.00	0.00	0.00	1
560	0.12	0.50	0.20	2
561	0.00	0.00	0.00	1
562	0.00	0.00	0.00	1
563	0.00	0.00	0.00	1
564	0.00	0.00	0.00	2
565	0.00	0.00	0.00	1
566	0.00	0.00	0.00	1
567	0.00	0.00	0.00	4
568	0.00	0.00	0.00	3
569	0.25	0.50	0.33	2
570	0.12	1.00	0.22	1
571	0.00	0.00	0.00	1
572	0.00	0.00	0.00	0
573	0.00	0.00	0.00	1
575	0.00	0.00	0.00	0
576	0.00	0.00	0.00	1
577	0.00	0.00	0.00	1
578	0.00	0.00	0.00	1
579	0.00	0.00	0.00	2
580	0.00	0.00	0.00	1
581	0.00	0.00	0.00	1
582	0.00	0.00	0.00	1
584	0.00	0.00	0.00	1
585	0.06	0.50	0.11	2
586	0.00	0.00	0.00	1
588	0.00	0.00	0.00	1
590	0.00	0.00	0.00	3
591	0.11	1.00	0.20	1
592	0.00	0.00	0.00	1
593	0.00	0.00	0.00	2
594	0.00	0.00	0.00	1
596	0.00	0.00	0.00	2
597	0.00	0.00	0.00	1
598	0.00	0.00	0.00	1
602	0.00	0.00	0.00	1
604	0.00	0.00	0.00	1
607	0.00	0.00	0.00	1
609	0.00	0.00	0.00	1
610	0.00	0.00	0.00	1
611	0.00	0.00	0.00	1
612	0.00	0.00	0.00	1
613	0.00	0.00	0.00	1
614	0.00	0.00	0.00	2
615	0.00	0.00	0.00	0
618	0.00	0.00	0.00	2
620	0.00	0.00	0.00	2
622	0.00	0.00	0.00	2
623	0.00	0.00	0.00	2
625	0.00	0.00	0.00	2
626	0.33	1.00	0.50	1
627	0.00	0.00	0.00	1
628	0.00	0.00	0.00	1
631	0.00	0.00	0.00	2
632	0.00	0.00	0.00	0
633	0.00	0.00	0.00	1
634	0.00	0.00	0.00	2
636	0.00	0.00	0.00	1
638	0.00	0.00	0.00	1
640	0.00	0.00	0.00	0
641	0.00	0.00	0.00	2
643	0.00	0.00	0.00	2
644	0.14	0.50	0.22	2
645	0.00	0.00	0.00	1
646	0.00	0.00	0.00	1
647	0.00	0.00	0.00	1
648	0.00	0.00	0.00	1
651	0.00	0.00	0.00	1
654	0.00	0.00	0.00	2
660	0.00	0.00	0.00	1
662	0.00	0.00	0.00	2
664	0.00	0.00	0.00	0
665	0.00	0.00	0.00	0
667	0.00	0.00	0.00	1
668	0.00	0.00	0.00	1
670	0.00	0.00	0.00	1
672	0.00	0.00	0.00	1
675	0.00	0.00	0.00	1
676	0.00	0.00	0.00	2
678	0.20	0.33	0.25	3
679	0.00	0.00	0.00	1
681	0.00	0.00	0.00	0
682	0.00	0.00	0.00	1
684	0.00	0.00	0.00	2
685	0.00	0.00	0.00	0
686	0.00	0.00	0.00	0
688	0.00	0.00	0.00	1
691	0.07	1.00	0.13	1
693	0.00	0.00	0.00	2
696	0.00	0.00	0.00	1
698	0.00	0.00	0.00	1
699	0.00	0.00	0.00	1
700	0.00	0.00	0.00	2
704	0.50	0.50	0.50	2
705	0.00	0.00	0.00	0
706	0.00	0.00	0.00	1
707	0.00	0.00	0.00	2
709	0.00	0.00	0.00	1
710	0.00	0.00	0.00	2
711	0.00	0.00	0.00	1
713	0.00	0.00	0.00	1
715	0.00	0.00	0.00	1
719	0.00	0.00	0.00	0
721	0.00	0.00	0.00	0
722	0.00	0.00	0.00	0
723	0.00	0.00	0.00	1
729	0.00	0.00	0.00	2
730	0.00	0.00	0.00	1
733	0.00	0.00	0.00	1
738	0.00	0.00	0.00	1
741	0.00	0.00	0.00	1
743	0.20	1.00	0.33	1
745	0.00	0.00	0.00	1
746	0.00	0.00	0.00	1
749	0.00	0.00	0.00	1
752	0.00	0.00	0.00	1
757	0.00	0.00	0.00	1
758	0.00	0.00	0.00	1
759	0.00	0.00	0.00	0
760	0.00	0.00	0.00	1
761	0.00	0.00	0.00	1
766	0.00	0.00	0.00	2
770	0.00	0.00	0.00	0
774	0.00	0.00	0.00	1
776	0.00	0.00	0.00	0
786	0.00	0.00	0.00	0
788	0.00	0.00	0.00	1
791	0.00	0.00	0.00	1
795	0.00	0.00	0.00	2
797	0.00	0.00	0.00	1
798	0.00	0.00	0.00	1
801	0.20	1.00	0.33	1
804	0.00	0.00	0.00	1
805	0.00	0.00	0.00	1
808	0.00	0.00	0.00	1
809	0.00	0.00	0.00	1
812	0.00	0.00	0.00	2
813	0.00	0.00	0.00	1
814	0.00	0.00	0.00	1
820	0.00	0.00	0.00	1
823	0.00	0.00	0.00	1
830	0.00	0.00	0.00	1
831	0.00	0.00	0.00	1
839	0.00	0.00	0.00	1
844	0.00	0.00	0.00	1
846	0.00	0.00	0.00	0
849	0.00	0.00	0.00	1
852	0.00	0.00	0.00	1
857	0.00	0.00	0.00	0
858	0.00	0.00	0.00	1
863	0.00	0.00	0.00	1
868	0.00	0.00	0.00	0
872	0.00	0.00	0.00	2
886	0.00	0.00	0.00	1
891	0.00	0.00	0.00	1
922	0.00	0.00	0.00	0
938	0.00	0.00	0.00	1
941	0.00	0.00	0.00	0
948	0.00	0.00	0.00	1
967	0.00	0.00	0.00	1
976	0.00	0.00	0.00	0
977	0.00	0.00	0.00	1
accuracy			0.34	3476
macro avg	0.13	0.19	0.13	3476
weighted avg	0.29	0.34	0.28	3476

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Recall and F-score are ill-defined and being set to 0.0 in labels with no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Recall and F-score are ill-defined and being set to 0.0 in labels with no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Recall and F-score are ill-defined and being set to 0.0 in labels with no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

Fitting the model with 26,26,26 parameters for hidden layer.

In [117…

```
## model 3

mlp = MLPClassifier(hidden_layer_sizes=(26, 26, 26), max_iter=1000)
mlp.fit(x_train, y_train.values.ravel())
```

Out[117… MLPClassifier(hidden_layer_sizes=(26, 26, 26), max_iter=1000)

In [118…

```
predictions = mlp.predict(x_test)
print(predictions)
```

```
[  2  25 221 ...  20 209 179]
```

In [119…

```
print(confusion_matrix(y_test,predictions))
print(classification_report(y_test,predictions))
```

```
[[30  3  0 ...  0  0  0]
 [ 0 37  1 ...  0  0  0]
 [ 0  0 33 ...  0  0  0]
 ...
 [ 0  0  0 ...  0  0  0]
 [ 0  0  0 ...  1  0  0]
 [ 0  0  0 ...  0  0  0]]
              precision    recall  f1-score   support

           1       1.00      0.91      0.95        33
           2       0.93      0.97      0.95        38
           3       0.97      0.77      0.86        43
           4       0.81      0.94      0.87        50
           5       0.92      0.63      0.75        52
           6       0.64      0.90      0.74        39
           7       0.73      0.26      0.38        43
           8       0.46      0.98      0.62        41
           9       0.50      0.03      0.06        29
          10       0.54      0.97      0.70        32
          11       0.33      0.07      0.11        29
          12       0.50      0.95      0.66        22
          13       0.00      0.00      0.00        26
          14       0.47      0.95      0.63        19
          15       0.90      0.50      0.64        18
          16       0.57      0.42      0.48        19
          17       0.44      0.92      0.60        25
          18       0.00      0.00      0.00        21
          19       0.50      0.06      0.11        16
          20       0.20      1.00      0.33         8
          21       1.00      0.07      0.13        14
          22       0.71      0.38      0.50        13
          23       0.45      0.33      0.38        15
          24       0.10      0.08      0.09        13
          25       0.38      0.46      0.41        13
          26       0.42      0.87      0.56        23
          27       0.00      0.00      0.00        16
          28       0.60      0.20      0.30        15
          29       0.12      0.25      0.16         8
          30       0.00      0.00      0.00        15
          31       0.16      0.86      0.27         7
          32       0.00      0.00      0.00        13
          33       0.67      0.14      0.24        14
          34       0.00      0.00      0.00         7
          35       0.25      1.00      0.40        11
          36       0.00      0.00      0.00        11
          37       0.00      0.00      0.00         9
          38       0.20      0.17      0.18         6
          39       0.17      0.08      0.11        12
          40       0.39      0.87      0.54        15
          41       0.00      0.00      0.00         9
          42       0.00      0.00      0.00        15
          43       0.09      0.29      0.14         7
          44       0.00      0.00      0.00        13
          45       0.50      0.14      0.22         7
          46       0.21      0.70      0.33        10
          47       0.25      0.29      0.27        17
          48       0.00      0.00      0.00         6
          49       0.00      0.00      0.00         6
          50       0.67      0.14      0.24        14
          51       0.00      0.00      0.00        11
          52       0.16      0.50      0.24        10
          53       0.00      0.00      0.00         6
          54       0.33      0.58      0.42        12
          55       0.00      0.00      0.00        12
          56       0.00      0.00      0.00         9
          57       0.29      0.56      0.38         9
          58       0.29      0.29      0.29         7
          59       1.00      0.11      0.20         9
          60       0.00      0.00      0.00        10
          61       0.00      0.00      0.00         8
          62       0.12      1.00      0.22         7
          63       0.00      0.00      0.00         7
          64       0.00      0.00      0.00        11
          65       0.00      0.00      0.00         7
          66       0.20      0.20      0.20        10
          67       0.00      0.00      0.00         6
          68       0.40      0.22      0.29         9
          69       0.00      0.00      0.00         9
          70       0.15      0.64      0.24        11
          71       0.00      0.00      0.00         9
          72       0.00      0.00      0.00         8
          73       0.00      0.00      0.00         4
          74       0.00      0.00      0.00        11
          75       0.43      0.30      0.35        10
          76       0.33      0.17      0.22         6
          77       0.12      0.38      0.19         8
          78       0.00      0.00      0.00        15
          79       0.00      0.00      0.00        11
          80       0.11      0.14      0.12         7
          81       0.12      0.75      0.21         4
          82       0.00      0.00      0.00         8
          83       0.12      0.40      0.19         5
          84       0.00      0.00      0.00        12
          85       0.33      0.33      0.33         6
          86       0.65      0.72      0.68        18
          87       1.00      0.30      0.46        10
          88       0.15      0.29      0.20         7
          89       0.00      0.00      0.00         8
          90       0.33      0.89      0.48         9
          91       0.00      0.00      0.00         4
          92       0.80      0.50      0.62         8
          93       0.73      0.73      0.73        11
          94       0.78      1.00      0.88         7
          95       0.82      0.82      0.82        11
          96       0.23      0.60      0.33         5
          97       0.00      0.00      0.00         6
          98       0.56      0.50      0.53        10
          99       0.43      0.60      0.50        10
         100       0.20      0.14      0.17         7
         101       0.80      0.36      0.50        11
         102       0.30      0.86      0.44         7
         103       0.00      0.00      0.00         6
         104       0.33      0.40      0.36         5
         105       0.00      0.00      0.00        10
         106       0.80      0.29      0.42        14
         107       0.00      0.00      0.00         5
         108       0.25      0.20      0.22        10
         109       0.15      1.00      0.26         6
         110       0.00      0.00      0.00         7
         111       0.36      0.31      0.33        13
         112       0.00      0.00      0.00         5
         113       0.00      0.00      0.00         8
         114       0.00      0.00      0.00         7
         115       0.20      0.33      0.25         6
         116       0.56      0.83      0.67         6
         117       0.67      0.80      0.73         5
         118       0.00      0.00      0.00        11
         119       0.21      0.40      0.28        10
         120       0.00      0.00      0.00         7
         121       0.10      0.29      0.15         7
         122       0.14      0.62      0.22         8
         123       0.00      0.00      0.00         9
         124       0.50      0.06      0.11        17
         125       0.00      0.00      0.00         7
         126       0.33      0.12      0.18         8
         127       0.00      0.00      0.00         8
         128       0.00      0.00      0.00         3
         129       0.00      0.00      0.00         9
         130       0.10      0.50      0.17         4
         131       0.33      0.25      0.29         4
         132       0.00      0.00      0.00         8
         133       0.40      0.75      0.52         8
         134       0.00      0.00      0.00         6
         135       0.31      1.00      0.47         4
         136       0.50      0.50      0.50         6
         137       0.70      0.64      0.67        11
         138       0.71      0.56      0.63         9
         139       1.00      0.20      0.33         5
         140       0.14      0.29      0.19         7
         141       0.00      0.00      0.00         7
         142       0.25      0.40      0.31         5
         143       0.00      0.00      0.00         9
         144       0.18      0.25      0.21         8
         145       0.00      0.00      0.00         4
         146       0.00      0.00      0.00         5
         147       0.00      0.00      0.00        12
         148       0.25      0.14      0.18         7
         149       0.12      0.86      0.22         7
         150       0.00      0.00      0.00         6
         151       0.00      0.00      0.00        10
         152       0.00      0.00      0.00         9
         153       0.00      0.00      0.00        12
         154       0.17      0.86      0.28         7
         155       0.42      0.83      0.56         6
         156       0.25      0.09      0.13        11
         157       0.00      0.00      0.00         7
         158       0.10      0.40      0.16         5
         159       0.00      0.00      0.00         7
         160       0.00      0.00      0.00         8
         161       0.00      0.00      0.00         6
         162       0.25      0.67      0.36         3
         163       0.57      0.57      0.57         7
         164       0.00      0.00      0.00         4
         165       0.38      1.00      0.55         6
         166       0.00      0.00      0.00         6
         167       0.45      0.45      0.45        11
         168       0.00      0.00      0.00        13
         169       0.00      0.00      0.00         8
         170       0.22      0.75      0.34        12
         171       0.11      0.10      0.11        10
         172       0.00      0.00      0.00         9
         173       0.00      0.00      0.00         7
         174       0.44      1.00      0.62         8
         175       0.00      0.00      0.00         8
         176       0.50      0.33      0.40         9
         177       0.32      0.67      0.43         9
         178       0.00      0.00      0.00        11
         179       0.32      0.62      0.42        13
         180       0.00      0.00      0.00         5
         181       0.27      0.44      0.33         9
         182       0.00      0.00      0.00        10
         183       0.40      0.50      0.44         4
         184       0.18      0.67      0.29         6
         185       0.00      0.00      0.00        11
         186       0.00      0.00      0.00         5
         187       0.29      1.00      0.45         5
         188       0.50      0.18      0.27        11
         189       0.00      0.00      0.00         7
         190       0.00      0.00      0.00        10
         191       0.00      0.00      0.00         5
         192       0.22      1.00      0.36         7
         193       0.00      0.00      0.00         8
         194       0.00      0.00      0.00         4
         195       0.00      0.00      0.00         5
         196       0.46      1.00      0.63         6
         197       0.00      0.00      0.00         6
         198       0.00      0.00      0.00         7
         199       0.24      0.83      0.37         6
         200       0.00      0.00      0.00         2
         201       0.58      0.79      0.67        14
         202       0.00      0.00      0.00         7
         203       0.67      0.50      0.57         8
         204       0.00      0.00      0.00         8
         205       0.00      0.00      0.00         5
         206       0.35      0.89      0.50         9
         207       0.50      0.40      0.44         5
         208       0.00      0.00      0.00         5
         209       0.33      0.86      0.48         7
         210       0.00      0.00      0.00         6
         211       0.25      0.40      0.31         5
         212       0.00      0.00      0.00         2
         213       0.67      0.31      0.42        13
         214       0.00      0.00      0.00         2
         215       0.33      0.17      0.22         6
         216       0.33      0.67      0.44         3
         217       0.75      0.43      0.55         7
         218       0.57      0.50      0.53         8
         219       0.57      0.80      0.67        10
         220       0.00      0.00      0.00         6
         221       0.23      0.43      0.30         7
         222       0.22      0.86      0.35         7
         223       0.00      0.00      0.00         6
         224       0.00      0.00      0.00        11
         225       0.00      0.00      0.00         9
         226       0.00      0.00      0.00         7
         227       0.14      0.25      0.18         4
         228       0.00      0.00      0.00         8
         229       0.53      0.89      0.67         9
         230       0.20      0.20      0.20         5
         231       0.00      0.00      0.00         2
         232       0.00      0.00      0.00         6
         233       0.38      1.00      0.56         5
         234       0.00      0.00      0.00         3
         235       0.00      0.00      0.00         8
         236       0.00      0.00      0.00         4
         237       0.00      0.00      0.00         9
         238       1.00      0.22      0.36         9
         239       0.30      0.75      0.43         4
         240       0.00      0.00      0.00         4
         241       0.62      0.83      0.71         6
         242       0.00      0.00      0.00         5
         243       0.00      0.00      0.00         6
         244       0.00      0.00      0.00         4
         245       0.21      1.00      0.34         5
         246       0.00      0.00      0.00         5
         247       0.00      0.00      0.00         4
         248       0.00      0.00      0.00         6
         249       0.00      0.00      0.00         5
         250       0.00      0.00      0.00         3
         251       0.29      0.50      0.36         4
         252       0.00      0.00      0.00         2
         253       0.00      0.00      0.00         3
         254       0.18      0.60      0.27         5
         255       0.00      0.00      0.00         2
         256       0.00      0.00      0.00         4
         257       0.00      0.00      0.00         7
         258       0.50      0.10      0.17        10
         259       0.24      0.62      0.34         8
         260       0.50      0.33      0.40         3
         261       0.00      0.00      0.00         8
         262       0.00      0.00      0.00         4
         263       0.56      0.62      0.59         8
         264       0.62      0.71      0.67         7
         265       0.00      0.00      0.00         3
         266       0.25      1.00      0.40         1
         267       0.00      0.00      0.00         6
         268       0.38      0.80      0.52        10
         269       0.12      0.33      0.18         3
         270       0.00      0.00      0.00         8
         271       0.50      0.20      0.29         5
         272       0.00      0.00      0.00        10
         273       0.12      0.20      0.15         5
         274       0.21      0.83      0.33         6
         275       0.33      0.20      0.25         5
         276       0.00      0.00      0.00        10
         277       0.30      1.00      0.46         3
         278       0.00      0.00      0.00         8
         279       0.00      0.00      0.00         2
         280       0.00      0.00      0.00         6
         281       0.32      1.00      0.48         6
         282       0.00      0.00      0.00         6
         283       0.00      0.00      0.00         6
         284       0.00      0.00      0.00         4
         285       0.18      1.00      0.30         5
         286       0.00      0.00      0.00        10
         287       0.00      0.00      0.00         5
         288       0.14      0.57      0.23         7
         289       0.00      0.00      0.00         3
         290       0.20      0.33      0.25         3
         291       0.00      0.00      0.00         2
         292       0.00      0.00      0.00         4
         293       0.00      0.00      0.00         3
         294       0.00      0.00      0.00         7
         295       0.00      0.00      0.00         4
         296       0.09      0.25      0.13         4
         297       0.00      0.00      0.00         4
         298       0.00      0.00      0.00         1
         299       0.23      0.71      0.34         7
         300       0.00      0.00      0.00        13
         301       0.00      0.00      0.00         1
         302       0.00      0.00      0.00         3
         303       0.00      0.00      0.00         2
         304       0.25      0.86      0.39         7
         305       0.00      0.00      0.00         5
         306       0.00      0.00      0.00         8
         307       0.20      0.50      0.29         2
         308       0.00      0.00      0.00         8
         309       0.33      0.40      0.36         5
         310       0.33      0.33      0.33         3
         311       0.00      0.00      0.00         2
         312       0.38      0.83      0.53         6
         313       0.00      0.00      0.00         4
         314       0.00      0.00      0.00         4
         315       0.00      0.00      0.00         4
         316       0.00      0.00      0.00         3
         317       0.38      0.75      0.50         4
         318       0.50      0.33      0.40         3
         319       0.00      0.00      0.00         3
         320       0.20      0.25      0.22         4
         321       0.00      0.00      0.00         2
         322       0.00      0.00      0.00         6
         323       0.06      0.50      0.10         2
         324       0.00      0.00      0.00         2
         325       0.00      0.00      0.00         4
         326       0.00      0.00      0.00         2
         327       0.00      0.00      0.00         5
         328       0.28      0.83      0.42         6
         329       0.00      0.00      0.00         2
         330       0.00      0.00      0.00         4
         331       0.00      0.00      0.00         4
         332       0.20      0.50      0.29         2
         333       0.00      0.00      0.00         3
         334       0.33      0.20      0.25         5
         335       0.09      0.50      0.15         2
         336       0.00      0.00      0.00         2
         337       0.00      0.00      0.00         3
         338       0.00      0.00      0.00         4
         339       0.00      0.00      0.00         2
         340       0.00      0.00      0.00         1
         341       0.00      0.00      0.00         4
         342       0.33      0.33      0.33         3
         343       1.00      0.17      0.29         6
         344       0.12      0.50      0.20         2
         345       0.40      0.67      0.50         3
         346       0.00      0.00      0.00         2
         347       0.00      0.00      0.00         3
         348       0.00      0.00      0.00         2
         350       0.00      0.00      0.00         5
         351       0.33      0.67      0.44         3
         352       0.00      0.00      0.00         3
         353       0.00      0.00      0.00         2
         354       0.00      0.00      0.00         5
         355       0.00      0.00      0.00         3
         356       0.00      0.00      0.00         1
         358       0.00      0.00      0.00         5
         359       0.13      1.00      0.24         4
         360       0.00      0.00      0.00         3
         361       0.00      0.00      0.00         5
         362       0.00      0.00      0.00         2
         363       0.00      0.00      0.00         8
         364       0.00      0.00      0.00         3
         365       0.00      0.00      0.00         1
         366       0.00      0.00      0.00         3
         367       0.00      0.00      0.00         5
         369       0.00      0.00      0.00         0
         370       0.00      0.00      0.00         2
         371       0.00      0.00      0.00         1
         372       1.00      0.25      0.40         4
         373       0.00      0.00      0.00         4
         374       0.00      0.00      0.00         3
         375       0.00      0.00      0.00         5
         376       0.00      0.00      0.00         2
         377       0.00      0.00      0.00         1
         378       0.22      1.00      0.36         2
         379       0.00      0.00      0.00         3
         380       0.00      0.00      0.00         2
         381       0.00      0.00      0.00         3
         382       0.17      1.00      0.29         5
         384       0.00      0.00      0.00         3
         385       0.00      0.00      0.00         4
         386       0.00      0.00      0.00         4
         387       0.00      0.00      0.00         2
         388       0.00      0.00      0.00         3
         389       0.00      0.00      0.00         1
         390       0.00      0.00      0.00         3
         391       0.00      0.00      0.00         1
         392       0.00      0.00      0.00         3
         393       0.00      0.00      0.00         1
         394       0.00      0.00      0.00         1
         395       0.00      0.00      0.00         4
         396       0.00      0.00      0.00         5
         398       0.19      1.00      0.32         3
         399       0.00      0.00      0.00         3
         400       0.00      0.00      0.00         1
         401       0.00      0.00      0.00         2
         402       0.00      0.00      0.00         3
         403       0.00      0.00      0.00         2
         404       0.12      1.00      0.21         2
         405       0.00      0.00      0.00         3
         406       0.00      0.00      0.00         3
         407       0.00      0.00      0.00         2
         408       0.00      0.00      0.00         3
         409       1.00      0.33      0.50         3
         410       0.00      0.00      0.00         3
         411       0.00      0.00      0.00         2
         412       0.00      0.00      0.00         2
         413       0.00      0.00      0.00         4
         414       0.00      0.00      0.00         2
         415       0.12      1.00      0.22         1
         416       0.00      0.00      0.00         2
         417       0.00      0.00      0.00         1
         419       0.00      0.00      0.00         2
         420       0.25      1.00      0.40         2
         421       0.00      0.00      0.00         3
         423       0.00      0.00      0.00         0
         424       0.00      0.00      0.00         1
         425       0.00      0.00      0.00         2
         426       0.00      0.00      0.00         1
         427       0.00      0.00      0.00         1
         428       0.12      1.00      0.21         2
         430       0.00      0.00      0.00         2
         431       0.00      0.00      0.00         1
         432       0.00      0.00      0.00         4
         433       0.00      0.00      0.00         1
         435       0.00      0.00      0.00         0
         436       0.00      0.00      0.00         2
         437       0.00      0.00      0.00         1
         438       0.00      0.00      0.00         0
         440       0.00      0.00      0.00         1
         441       0.00      0.00      0.00         3
         442       0.00      0.00      0.00         3
         443       0.00      0.00      0.00         4
         444       0.00      0.00      0.00         3
         445       0.00      0.00      0.00         0
         446       0.00      0.00      0.00         4
         447       0.00      0.00      0.00         1
         448       0.00      0.00      0.00         1
         449       0.11      1.00      0.19         2
         450       0.00      0.00      0.00         1
         451       0.00      0.00      0.00         1
         452       0.00      0.00      0.00         4
         453       0.00      0.00      0.00         1
         454       0.00      0.00      0.00         1
         455       0.00      0.00      0.00         4
         456       0.00      0.00      0.00         2
         457       0.00      0.00      0.00         3
         458       0.00      0.00      0.00         2
         459       0.00      0.00      0.00         1
         460       0.00      0.00      0.00         4
         461       0.00      0.00      0.00         2
         462       0.25      1.00      0.40         1
         463       0.00      0.00      0.00         1
         464       0.33      0.50      0.40         2
         465       0.00      0.00      0.00         3
         466       0.00      0.00      0.00         1
         467       0.00      0.00      0.00         1
         468       0.06      1.00      0.11         1
         469       0.00      0.00      0.00         3
         470       0.00      0.00      0.00         3
         471       0.00      0.00      0.00         0
         472       0.00      0.00      0.00         0
         474       0.00      0.00      0.00         1
         476       0.00      0.00      0.00         1
         477       0.00      0.00      0.00         1
         478       0.00      0.00      0.00         3
         479       0.00      0.00      0.00         3
         480       0.00      0.00      0.00         1
         481       0.00      0.00      0.00         1
         482       0.00      0.00      0.00         2
         483       0.00      0.00      0.00         2
         484       0.00      0.00      0.00         2
         485       0.00      0.00      0.00         1
         486       0.00      0.00      0.00         3
         487       0.00      0.00      0.00         1
         488       0.00      0.00      0.00         3
         489       0.00      0.00      0.00         1
         490       0.00      0.00      0.00         2
         491       0.00      0.00      0.00         2
         492       0.00      0.00      0.00         5
         493       0.00      0.00      0.00         2
         494       0.00      0.00      0.00         4
         495       0.00      0.00      0.00         4
         497       0.00      0.00      0.00         2
         498       0.00      0.00      0.00         2
         499       0.50      0.33      0.40         3
         500       0.00      0.00      0.00         0
         501       0.00      0.00      0.00         2
         502       0.00      0.00      0.00         1
         503       0.00      0.00      0.00         2
         504       0.00      0.00      0.00         1
         505       0.00      0.00      0.00         3
         506       0.00      0.00      0.00         1
         507       0.00      0.00      0.00         2
         508       1.00      0.33      0.50         3
         509       0.00      0.00      0.00         1
         511       0.00      0.00      0.00         1
         512       0.00      0.00      0.00         1
         513       0.00      0.00      0.00         3
         514       0.00      0.00      0.00         1
         515       0.00      0.00      0.00         1
         516       0.00      0.00      0.00         2
         517       0.00      0.00      0.00         4
         518       0.00      0.00      0.00         3
         519       0.00      0.00      0.00         1
         521       0.00      0.00      0.00         3
         522       0.20      1.00      0.33         1
         524       0.00      0.00      0.00         0
         525       0.00      0.00      0.00         1
         526       0.00      0.00      0.00         0
         527       0.00      0.00      0.00         2
         530       0.00      0.00      0.00         3
         531       0.29      0.67      0.40         3
         532       0.00      0.00      0.00         0
         534       0.00      0.00      0.00         1
         535       0.00      0.00      0.00         0
         536       0.00      0.00      0.00         2
         537       0.00      0.00      0.00         1
         538       0.00      0.00      0.00         0
         539       1.00      0.33      0.50         3
         541       0.00      0.00      0.00         2
         542       0.00      0.00      0.00         1
         543       0.00      0.00      0.00         1
         544       0.00      0.00      0.00         2
         546       0.00      0.00      0.00         1
         547       0.00      0.00      0.00         0
         548       0.00      0.00      0.00         1
         550       0.00      0.00      0.00         2
         551       0.00      0.00      0.00         1
         552       0.00      0.00      0.00         1
         553       0.00      0.00      0.00         1
         554       0.00      0.00      0.00         1
         555       0.00      0.00      0.00         3
         556       0.00      0.00      0.00         2
         557       0.00      0.00      0.00         2
         558       0.04      1.00      0.08         1
         559       0.00      0.00      0.00         1
         560       0.00      0.00      0.00         2
         561       0.00      0.00      0.00         1
         562       0.00      0.00      0.00         1
         563       0.00      0.00      0.00         1
         564       0.00      0.00      0.00         2
         565       0.00      0.00      0.00         1
         566       0.00      0.00      0.00         1
         567       0.00      0.00      0.00         4
         568       0.00      0.00      0.00         3
         569       0.00      0.00      0.00         2
         570       0.00      0.00      0.00         1
         571       0.00      0.00      0.00         1
         573       0.00      0.00      0.00         1
         576       0.00      0.00      0.00         1
         577       0.00      0.00      0.00         1
         578       0.00      0.00      0.00         1
         579       0.33      1.00      0.50         2
         580       0.00      0.00      0.00         1
         581       0.00      0.00      0.00         1
         582       0.00      0.00      0.00         1
         584       0.00      0.00      0.00         1
         585       0.00      0.00      0.00         2
         586       0.06      1.00      0.11         1
         588       0.00      0.00      0.00         1
         590       0.00      0.00      0.00         3
         591       0.00      0.00      0.00         1
         592       0.00      0.00      0.00         1
         593       0.00      0.00      0.00         2
         594       0.00      0.00      0.00         1
         596       0.00      0.00      0.00         2
         597       0.00      0.00      0.00         1
         598       0.00      0.00      0.00         1
         602       0.00      0.00      0.00         1
         604       0.00      0.00      0.00         1
         607       0.00      0.00      0.00         1
         609       0.00      0.00      0.00         1
         610       0.00      0.00      0.00         1
         611       0.00      0.00      0.00         1
         612       0.00      0.00      0.00         1
         613       0.00      0.00      0.00         1
         614       0.00      0.00      0.00         2
         618       0.00      0.00      0.00         2
         620       0.00      0.00      0.00         2
         622       0.00      0.00      0.00         2
         623       0.00      0.00      0.00         2
         625       0.00      0.00      0.00         2
         626       0.20      1.00      0.33         1
         627       0.00      0.00      0.00         1
         628       0.00      0.00      0.00         1
         631       0.00      0.00      0.00         2
         632       0.00      0.00      0.00         0
         633       0.00      0.00      0.00         1
         634       0.00      0.00      0.00         2
         636       0.00      0.00      0.00         1
         638       0.00      0.00      0.00         1
         640       0.00      0.00      0.00         0
         641       0.00      0.00      0.00         2
         643       0.00      0.00      0.00         2
         644       0.00      0.00      0.00         2
         645       0.00      0.00      0.00         1
         646       0.00      0.00      0.00         1
         647       0.00      0.00      0.00         1
         648       0.00      0.00      0.00         1
         649       0.00      0.00      0.00         0
         651       0.00      0.00      0.00         1
         653       0.00      0.00      0.00         0
         654       0.50      1.00      0.67         2
         660       0.00      0.00      0.00         1
         662       0.00      0.00      0.00         2
         667       0.00      0.00      0.00         1
         668       0.33      1.00      0.50         1
         670       0.00      0.00      0.00         1
         671       0.00      0.00      0.00         0
         672       0.00      0.00      0.00         1
         675       0.00      0.00      0.00         1
         676       0.00      0.00      0.00         2
         678       0.00      0.00      0.00         3
         679       0.00      0.00      0.00         1
         681       0.00      0.00      0.00         0
         682       0.00      0.00      0.00         1
         684       0.00      0.00      0.00         2
         686       0.00      0.00      0.00         0
         688       0.00      0.00      0.00         1
         691       0.00      0.00      0.00         1
         693       0.00      0.00      0.00         2
         696       0.00      0.00      0.00         1
         698       0.00      0.00      0.00         1
         699       0.00      0.00      0.00         1
         700       0.00      0.00      0.00         2
         704       0.00      0.00      0.00         2
         706       0.00      0.00      0.00         1
         707       0.00      0.00      0.00         2
         709       0.00      0.00      0.00         1
         710       0.00      0.00      0.00         2
         711       0.00      0.00      0.00         1
         713       0.00      0.00      0.00         1
         715       0.00      0.00      0.00         1
         723       0.00      0.00      0.00         1
         729       0.00      0.00      0.00         2
         730       0.00      0.00      0.00         1
         733       0.00      0.00      0.00         1
         738       0.00      0.00      0.00         1
         741       0.00      0.00      0.00         1
         743       0.00      0.00      0.00         1
         745       0.00      0.00      0.00         1
         746       0.00      0.00      0.00         1
         749       0.00      0.00      0.00         1
         750       0.00      0.00      0.00         0
         752       0.00      0.00      0.00         1
         757       0.00      0.00      0.00         1
         758       0.00      0.00      0.00         1
         760       0.00      0.00      0.00         1
         761       0.00      0.00      0.00         1
         766       0.00      0.00      0.00         2
         774       0.00      0.00      0.00         1
         785       0.00      0.00      0.00         0
         788       0.00      0.00      0.00         1
         791       0.00      0.00      0.00         1
         795       0.00      0.00      0.00         2
         797       0.00      0.00      0.00         1
         798       0.00      0.00      0.00         1
         801       0.00      0.00      0.00         1
         804       0.00      0.00      0.00         1
         805       0.00      0.00      0.00         1
         808       0.00      0.00      0.00         1
         809       0.00      0.00      0.00         1
         812       0.00      0.00      0.00         2
         813       0.00      0.00      0.00         1
         814       0.00      0.00      0.00         1
         820       0.00      0.00      0.00         1
         823       0.00      0.00      0.00         1
         827       0.00      0.00      0.00         0
         830       0.00      0.00      0.00         1
         831       0.00      0.00      0.00         1
         839       0.00      0.00      0.00         1
         844       0.00      0.00      0.00         1
         849       0.00      0.00      0.00         1
         852       0.00      0.00      0.00         1
         858       0.00      0.00      0.00         1
         863       0.00      0.00      0.00         1
         872       0.00      0.00      0.00         2
         884       0.00      0.00      0.00         0
         886       0.00      0.00      0.00         1
         891       0.00      0.00      0.00         1
         900       0.00      0.00      0.00         0
         938       0.00      0.00      0.00         1
         948       0.00      0.00      0.00         1
         953       0.00      0.00      0.00         0
         967       0.00      0.00      0.00         1
         977       0.00      0.00      0.00         1

    accuracy                           0.30      3476
   macro avg       0.11      0.17      0.11      3476
weighted avg       0.26      0.30      0.24      3476
```

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Recall and F-score are ill-defined and being set to 0.0 in labels with no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
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  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.py:1245: UndefinedMetricWarning: Recall and F-score are ill-defined and being set to 0.0 in labels with no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

For the third model the accuracy reduced to 30%. It's clear that hyperparameters has direct effect on the model accuracy. The model ca be improved by imputing the target by grouping every 100 bike to one level.

Task 2

In [54]:
```
# Read dataset to pandas dataframe
card = pd.read_csv('creditcard.csv')
```

In [59]:
```
card.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 284807 entries, 0 to 284806
Data columns (total 31 columns):
 #   Column  Non-Null Count   Dtype  
---  ------  --------------   -----  
 0   Time    284807 non-null  float64
 1   V1      284807 non-null  float64
 2   V2      284807 non-null  float64
 3   V3      284807 non-null  float64
 4   V4      284807 non-null  float64
 5   V5      284807 non-null  float64
 6   V6      284807 non-null  float64
 7   V7      284807 non-null  float64
 8   V8      284807 non-null  float64
 9   V9      284807 non-null  float64
 10  V10     284807 non-null  float64
 11  V11     284807 non-null  float64
 12  V12     284807 non-null  float64
 13  V13     284807 non-null  float64
 14  V14     284807 non-null  float64
 15  V15     284807 non-null  float64
 16  V16     284807 non-null  float64
 17  V17     284807 non-null  float64
 18  V18     284807 non-null  float64
 19  V19     284807 non-null  float64
 20  V20     284807 non-null  float64
 21  V21     284807 non-null  float64
 22  V22     284807 non-null  float64
 23  V23     284807 non-null  float64
 24  V24     284807 non-null  float64
 25  V25     284807 non-null  float64
 26  V26     284807 non-null  float64
 27  V27     284807 non-null  float64
 28  V28     284807 non-null  float64
 29  Amount  284807 non-null  float64
 30  Class   284807 non-null  int64  
dtypes: float64(30), int64(1)
memory usage: 67.4 MB
```

In [60]:
```
card.head()
```

Out[60]:

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

5 rows × 31 columns

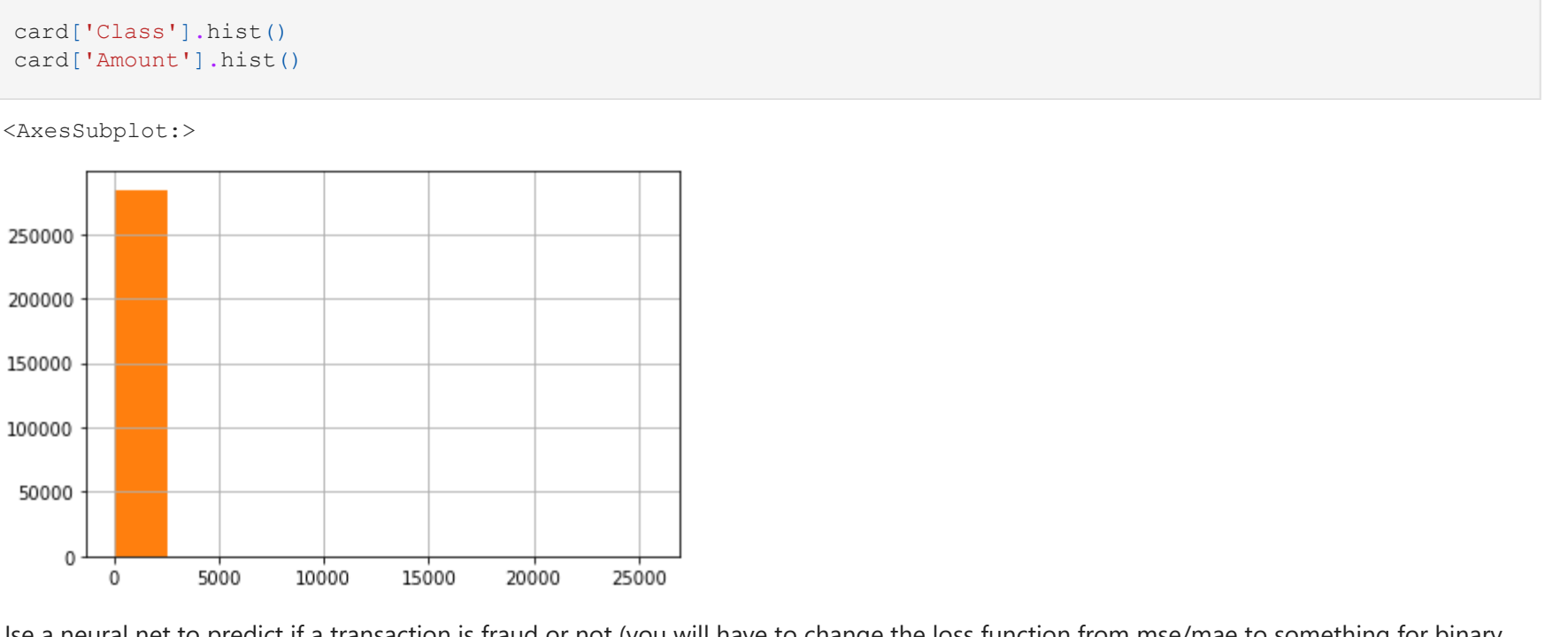
In [61]:
```
card.describe(include='all')
```

Out[61]:

	Time	V1	V2	V3	V4	V5	V6	V7	V8
count	284807.000000	2.848070e+05	2.848070e+05	2.848070e+05	2.848070e+05	2.848070e+05	2.848070e+05	2.848070e+05	2.848070e+05
mean	94813.859575	3.918649e-15	5.682686e-16	-8.761736e-15	2.811118e-15	-1.552103e-15	2.040130e-15	-1.698953e-15	-1.893285e-16
std	47488.145955	1.958696e+00	1.651309e+00	1.516255e+00	1.415869e+00	1.380247e+00	1.332271e+00	1.237094e+00	1.194353e+00
min	0.000000	-5.640751e+01	-7.271573e+01	-4.832559e+01	-5.683171e+00	-1.137433e+02	-2.616051e+01	-4.355724e+01	-7.321672e+01
25%	54201.500000	-9.203734e-01	-5.985499e-01	-8.903648e-01	-8.486401e-01	-6.915971e-01	-7.682956e-01	-5.540759e-01	-2.086297e-01
50%	84692.000000	1.810880e-02	6.548556e-02	1.798463e-01	-1.984653e-02	-5.433583e-02	-2.741871e-01	4.010308e-02	2.235804e-02
75%	139320.500000	1.315642e+00	8.037239e-01	1.027196e+00	7.433413e-01	6.119264e-01	3.985649e-01	5.704361e-01	3.273459e-01
max	172792.000000	2.454930e+00	2.205773e+01	9.382558e+00	1.687534e+01	3.480167e+01	7.330163e+01	1.205895e+02	2.000721e+01

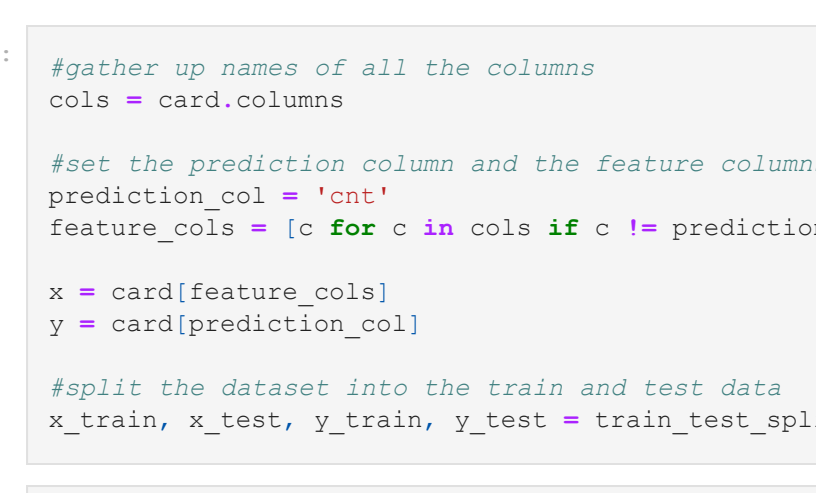
8 rows × 31 columns

In [62]:
```
plt.figure(figsize=(16, 6))
_ = sns.heatmap(card.corr(), vmin=-1, vmax=1, annot=True)
```



In [64]:
```
card['Class'].hist()
card['Amount'].hist()
```

Out[64]: <AxesSubplot:>



Use a neural net to predict if a transaction is fraud or not (you will have to change the loss function from mse/mae to something for binary classification)

In [ ]:
```
#gather up names of all the columns
cols = card.columns

#set the prediction column and the feature columns for KNN
prediction_col = 'cnt'
feature_cols = [c for c in cols if c != prediction_col]

x = card[feature_cols]
y = card[prediction_col]

#split the dataset into the train and test data
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, random_state=41)
```

In [ ]:
```
scaler = StandardScaler()
scaler.fit(x_train)

x_train = scaler.transform(x_train)
x_test = scaler.transform(x_test)
```

In [ ]:
```
mlp = MLPClassifier(hidden_layer_sizes=(10, 10, 10), max_iter=1000)
mlp.fit(x_train, y_train.values.ravel())
```

In [ ]:
```
predictions = mlp.predict(x_test)
```

In [ ]:

References

https://www.geeksforgeeks.org/python-pandas-split-strings-into-two-list-columns-using-str-split/

https://stackoverflow.com/questions/39173813/pandas-convert-dtype-object-to-int