

Test Cases of Hand Written Text

By: Hrithik Jerath

102383014

k = 2, Test Ratio = 0.4

Accuracy: 0.9211904761904762

Classification Report:

	precision	recall	f1-score	support
0	0.92	0.99	0.95	1626
1	0.93	0.99	0.96	1851
2	0.91	0.93	0.92	1694
3	0.87	0.94	0.91	1776
4	0.90	0.94	0.92	1633
5	0.90	0.88	0.89	1467
6	0.97	0.94	0.95	1694
7	0.91	0.93	0.92	1773
8	0.97	0.82	0.89	1639
9	0.94	0.83	0.88	1647
accuracy		0.92		16800
macro avg	0.92	0.92	0.92	16800
weighted avg	0.92	0.92	0.92	16800

Confusion Matrix:

```
[[1609  0  3  0  2  3  7  1  1  0]
 [ 1836  9  0  0  1  2  2  0  0]
 [ 32 271582 23  6  3  5 10  4  2]
 [ 7  5 371673  0 21  2 12 14  5]
```

```
[ 3 23 23 2 1538 5 6 10 1 22]
[ 18 9 8 101 7 1288 15 6 6 9]
[ 53 7 17 2 9 21 1584 0 1 0]
[ 3 28 18 14 33 0 0 1644 0 33]
[ 22 28 24 75 26 86 13 4 1350 11]
[ 8 6 14 25 79 11 0 121 11 1372]]
```

k = 2, Test Ratio = 0.3

Accuracy: 0.923968253968254

Classification Report:

	precision	recall	f1-score	support
0	0.92	0.99	0.95	1200
1	0.94	0.99	0.97	1389
2	0.91	0.93	0.92	1294
3	0.87	0.94	0.91	1355
4	0.90	0.94	0.92	1222
5	0.90	0.88	0.89	1085
6	0.97	0.94	0.95	1256
7	0.92	0.92	0.92	1359
8	0.97	0.84	0.90	1209
9	0.95	0.84	0.89	1231
accuracy		0.92		12600
macro avg	0.93	0.92	0.92	12600
weighted avg	0.93	0.92	0.92	12600

Confusion Matrix:

```
[[1189  0  3  0  1  1  5  1  0  0]
 [ 11378  7  0  0  1  1  1  0  0]
 [ 25 181208 17  7  3  4  8  4  0]
 [  6  3 281273  0 17  2 10 11  5]
 [  1 12 19  21154  4  5  7  1 17]
 [ 11  5  5 80  6 957 11  4  4  2]
 [ 39  4 13  2  8 151175  0  0  0]
 [  1 24 13 14 24  0  01257  0 26]
 [ 10 16 16 50 20 65 11  31011  7]
 [  9  3  9 18 61  5  0 77  91040]]
```

k = 2, Test Ratio = 0.25

Accuracy: 0.9264761904761905

Classification Report:

	precision	recall	f1-score	support
0	0.92	0.99	0.96	1025
1	0.94	0.99	0.96	1146
2	0.92	0.93	0.93	1072
3	0.89	0.94	0.91	1151
4	0.91	0.95	0.93	1024
5	0.89	0.90	0.90	898
6	0.97	0.94	0.95	1010
7	0.93	0.92	0.93	1135
8	0.97	0.83	0.90	1005
9	0.95	0.84	0.89	1034

accuracy	0.93	10500
macro avg	0.93	0.93 0.93 10500
weighted avg	0.93	0.93 0.93 10500

Confusion Matrix:

```
[[1017  0  3  0  0  1  4  0  0  0]
 [ 11137  5  0  0  1  1  1  0  0]
 [ 21 181001 11  7  3  4  4  3  0]
 [  5  3 211081  0 14  2  9 11  5]
 [  1  9 16  2 975  2  5  3  0 11]
 [  9  4  3 54  4 807 10  1  4  2]
 [ 31  3  9  2  3 13 949  0  0  0]
 [  1 22 11 10 19  1  01049  0 22]
 [ 10 16 12 41 17 57  6  3 839  4]
 [  8  2 10 16 52  4  0 62  7 873]]
```

k = 2, Test Ratio = 0.2

Accuracy: 0.9295238095238095

Classification Report:

	precision	recall	f1-score	support
0	0.93	0.99	0.96	816
1	0.94	0.99	0.96	909
2	0.93	0.93	0.93	846
3	0.89	0.94	0.91	937
4	0.91	0.96	0.93	839

5	0.90	0.91	0.90	702
6	0.96	0.95	0.96	785
7	0.93	0.93	0.93	893
8	0.97	0.83	0.89	835
9	0.96	0.86	0.90	838

accuracy			0.93	8400
macro avg	0.93	0.93	0.93	8400
weighted avg	0.93	0.93	0.93	8400

Confusion Matrix:

```
[[809  0  2  0  0  1  4  0  0  0]
 [ 1901  5  0  0  1  1  0  0  0]
 [ 12 16790  9  7  3  2  3  3  1]
 [  4  3 16878  0 11  2  6 12  5]
 [  1  6  8 2806  1  4  4  0  7]
 [  6  3  3 36 3638  8  1  2  2]
 [ 22  1  7  2  2 7744  0  0  0]
 [  1 15  8  8 14  1  0831  0 15]
 [ 10 15  8 34 16 46  6  3694  3]
 [  6  2  4 14 40  3  0 46  6717]]
```

k = 2, Test Ratio = 0.1

Accuracy: 0.9321428571428572

Classification Report:

	precision	recall	f1-score	support
--	-----------	--------	----------	---------

0	0.93	0.99	0.96	408
1	0.94	1.00	0.97	471
2	0.95	0.95	0.95	420
3	0.90	0.94	0.92	506
4	0.92	0.97	0.95	397
5	0.88	0.92	0.90	339
6	0.96	0.95	0.95	402
7	0.92	0.93	0.93	438
8	0.97	0.81	0.88	403
9	0.95	0.85	0.90	416

accuracy			0.93	4200
macro avg	0.93	0.93	0.93	4200
weighted avg	0.93	0.93	0.93	4200

Confusion Matrix:

```
[[405  0  0  0  0  0  0  3  0  0  0]
 [ 0 469  1  0  0  0  1  0  0  0]
 [ 5  6 397  4  3  0  2  1  1  1]
 [ 1  3  5 478  0  6  0  5  6  2]
 [ 0  1  4  0 385  0  2  0  0  5]
 [ 2  0  0 18  1 311  3  1  1  2]
 [16  0  2  1  0  3 380  0  0  0]
 [ 1 11  3  3  5  1  0 408  0  6]
 [ 3  7  6 16  7 29  4  2 327  2]
 [ 4  0  1 10 16  2  0 26  2 355]]
```

k = 2, Test Ratio = 0.05

Accuracy: 0.9376190476190476

Classification Report:

	precision	recall	f1-score	support
0	0.95	1.00	0.97	216
1	0.93	1.00	0.96	234
2	0.95	0.95	0.95	222
3	0.92	0.96	0.94	260
4	0.91	0.96	0.94	196
5	0.90	0.92	0.91	160
6	0.97	0.95	0.96	199
7	0.94	0.94	0.94	230
8	0.97	0.81	0.88	191
9	0.93	0.86	0.89	192
accuracy		0.94		2100
macro avg	0.94	0.93	0.93	2100
weighted avg	0.94	0.94	0.94	2100

Confusion Matrix:

```
[[215  0  0  0  0  0  1  0  0  0]
 [  0 233  1  0  0  0  0  0  0  0]
 [  1  5 211  0  3  0  1  0  1  0]
 [  0  1  3 249  0  0  0  2  3  2]
 [  0  1  2  0 189  0  0  1  0  3]
 [  0  0  0  9  0 147  1  1  0  2]
 [  7  0  0  0  0  2 190  0  0  0]
```

```
[ 0 5 1 2 0 1 0 216 0 5]
[ 1 5 4 8 4 12 3 0 154 0]
[ 3 0 0 2 11 1 0 10 0 165]]
```

k = 4, Test Ratio = 0.4

Accuracy: 0.9311904761904762

Classification Report:

	precision	recall	f1-score	support
0	0.93	0.98	0.96	1626
1	0.94	0.99	0.96	1851
2	0.94	0.92	0.93	1694
3	0.90	0.94	0.92	1776
4	0.93	0.93	0.93	1633
5	0.91	0.90	0.91	1467
6	0.95	0.95	0.95	1694
7	0.92	0.93	0.93	1773
8	0.97	0.86	0.91	1639
9	0.91	0.88	0.90	1647
accuracy		0.93		16800
macro avg	0.93	0.93	0.93	16800
weighted avg	0.93	0.93	0.93	16800

Confusion Matrix:

```
[[1598  2  4  1  1  4 13  1  1  1]
 [ 0 1835  7  0  0  0  5  0  3  1]
```



```
[ 26 23 1566 25 5 3 11 18 9 8]
[ 7 7 19 1677 0 24 1 15 15 11]
[ 4 23 18 1 1525 6 7 5 2 42]
[ 10 11 5 68 5 1316 26 4 10 12]
[ 43 4 11 0 10 19 1605 0 2 0]
[ 3 30 9 9 23 0 0 1652 0 47]
[ 18 20 14 57 20 64 13 3 1415 15]
[ 10 6 10 20 45 4 0 88 9 1455]]
```

k = 4, Test Ratio = 0.3

Accuracy: 0.9351587301587302

Classification Report:

	precision	recall	f1-score	support
0	0.93	0.98	0.96	1200
1	0.94	0.99	0.97	1389
2	0.94	0.93	0.94	1294
3	0.91	0.94	0.93	1355
4	0.94	0.94	0.94	1222
5	0.91	0.90	0.91	1085
6	0.96	0.95	0.96	1256
7	0.94	0.93	0.93	1359
8	0.97	0.87	0.92	1209
9	0.93	0.89	0.91	1231
accuracy		0.94		12600
macro avg	0.94	0.93	0.93	12600

weighted avg 0.94 0.94 0.93 12600

Confusion Matrix:

```
[[1182  0  3  0  1  2 11  0  0  1]
 [ 0 1379  5  0  0  1  2  0  2  0]
 [ 24 161206 14  1  3  7 11  9  3]
 [  6  5 151278  0 21  0 12 10  8]
 [  1 14 16  11151  4  6  5  1 23]
 [  7  4  4 52  2980 19  3  6  8]
 [ 29  3  9  0  5 131197  0  0  0]
 [  1 25  8  8 20  0  01262  0 35]
 [ 13 17  9 35 17 49  7  21050 10]
 [ 12  3  7 16 33  1  0 54  71098]]
```

k = 4, Test Ratio = 0.25

Accuracy: 0.9373333333333334

Classification Report:

	precision	recall	f1-score	support
0	0.93	0.99	0.96	1025
1	0.93	0.99	0.96	1146
2	0.94	0.93	0.94	1072
3	0.92	0.94	0.93	1151
4	0.94	0.95	0.95	1024
5	0.91	0.92	0.92	898
6	0.96	0.95	0.96	1010
7	0.94	0.93	0.93	1135

8	0.97	0.87	0.91	1005
9	0.93	0.90	0.91	1034

accuracy		0.94		10500
macro avg	0.94	0.94	0.94	10500
weighted avg	0.94	0.94	0.94	10500

Confusion Matrix:

```
[[1012  0  3  0  0  1  9  0  0  0]
 [  0 1138  3  0  0  1  2  0  2  0]
 [ 20  16 997  9  2  3  8  8  6  3]
 [  5  4 1210 86  0 14  0 12 10  8]
 [  1 12 12  1 971  2  5  4  1 15]
 [  5  3  2 35  2 825 14  1  6  5]
 [ 23  2  7  0  2 13 963  0  0  0]
 [  1 24  6  6 14  0  01054  0 30]
 [ 11 17  9 28 13 43  5  2 870  7]
 [  8  3  7 14 26  1  0 43  6 926]]
```

k = 4, Test Ratio = 0.2

Accuracy: 0.939047619047619

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.98	0.96	816
1	0.94	0.99	0.97	909
2	0.95	0.93	0.94	846

3	0.92	0.95	0.93	937
4	0.94	0.96	0.95	839
5	0.91	0.92	0.91	702
6	0.95	0.96	0.96	785
7	0.94	0.93	0.93	893
8	0.97	0.87	0.91	835
9	0.93	0.90	0.91	838

accuracy			0.94	8400
macro avg	0.94	0.94	0.94	8400
weighted avg	0.94	0.94	0.94	8400

Confusion Matrix:

```
[[802  0  2  1  0  2  9  0  0  0]
 [ 0 901  3  0  0  1  2  0  1  1]
 [13 13 790  6  1  3  6  6  6  2]
 [ 3  4  7 886  0 12  1  7  9  8]
 [ 2  6  7  1 803  1  4  4  0 11]
 [ 5  1  2 27  3 643 10  1  5  5]
 [16  1  5  0  1  9 753  0  0  0]
 [ 1 15  4  5 12  0  0 832  0 24]
 [ 7 14  9 21 13 34  5  2 725  5]
 [ 6  3  3 12 19  2  0 35  5 753]]
```

k = 4, Test Ratio = 0.1

Accuracy: 0.9421428571428572

Classification Report:

	precision	recall	f1-score	support
--	-----------	--------	----------	---------

0	0.94	0.99	0.96	408
1	0.94	0.99	0.96	471
2	0.96	0.94	0.95	420
3	0.94	0.95	0.94	506
4	0.95	0.96	0.96	397
5	0.91	0.94	0.92	339
6	0.96	0.96	0.96	402
7	0.94	0.93	0.93	438
8	0.97	0.85	0.91	403
9	0.93	0.90	0.92	416

accuracy			0.94	4200
----------	--	--	------	------

macro avg	0.94	0.94	0.94	4200
-----------	------	------	------	------

weighted avg	0.94	0.94	0.94	4200
--------------	------	------	------	------

Confusion Matrix:

```
[[404 0 0 0 0 0 0 4 0 0 0]
 [ 0 467 1 0 0 0 2 0 1 0]
 [ 6 6 393 3 1 0 4 4 2 1]
 [ 1 2 3 482 1 6 0 4 3 4]
 [ 0 1 3 0 383 1 2 1 0 6]
 [ 2 0 1 11 2 317 3 0 0 3]
 [11 0 1 0 0 4 386 0 0 0]
 [ 1 11 3 2 4 0 0 406 0 11]
 [ 2 9 6 10 7 20 2 1 343 3]
 [ 4 1 0 7 6 1 0 17 4 376]]
```

k = 4, Test Ratio = 0.05

Accuracy: 0.9480952380952381

Classification Report:

	precision	recall	f1-score	support
0	0.96	0.99	0.97	216
1	0.94	0.99	0.96	234
2	0.96	0.95	0.96	222
3	0.94	0.96	0.95	260
4	0.94	0.98	0.96	196
5	0.92	0.93	0.92	160
6	0.96	0.97	0.96	199
7	0.96	0.93	0.95	230
8	0.98	0.87	0.92	191
9	0.92	0.90	0.91	192
accuracy			0.95	2100
macro avg	0.95	0.95	0.95	2100
weighted avg	0.95	0.95	0.95	2100

Confusion Matrix:

```
[[213  0  0  0  0  0  3  0  0  0]
 [  0 232  1  0  0  0  0  0  1  0]
 [  1  5 211  0  1  0  2  0  1  1]
 [  0  1  2 249  1  1  0  2  2  2]
 [  0  1  1  0 192  0  0  0  0  2]
```

```
[ 0 0 0 7 1 148 1 0 0 3]
[ 4 0 0 0 0 2 193 0 0 0]
[ 0 5 1 2 1 0 0 214 0 7]
[ 1 3 3 4 2 9 2 0 166 1]
[ 3 1 0 2 6 1 0 6 0 173]]
```

k = 5, Test Ratio = 0.4

Accuracy: 0.93375

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.98	0.96	1626
1	0.94	0.99	0.96	1851
2	0.95	0.92	0.94	1694
3	0.91	0.94	0.93	1776
4	0.94	0.93	0.93	1633
5	0.92	0.90	0.91	1467
6	0.95	0.96	0.96	1694
7	0.93	0.92	0.93	1773
8	0.96	0.88	0.92	1639
9	0.90	0.90	0.90	1647
accuracy		0.93		16800
macro avg	0.93	0.93	0.93	16800
weighted avg	0.93	0.93	0.93	16800

Confusion Matrix:

```

[[1597  1  5  1  2  3 13  1  2  1]
 [ 0 1836  6  0  0  0  6  0  2  1]
 [ 21  24 1560 31  9  3 12 14 14  6]
 [  7  6 111676  0 28  1 18 20  9]
 [  3 22  13  3 1513  8  8  6  2 55]
 [ 10 10  8 58  6 1323 29  5  8 10]
 [ 28  4  7  0  8 161629  0  2  0]
 [  2 30  9 10 20  0  0 1633  0 69]
 [ 18 19 10 45 18 57 12  3 1443 14]
 [  8  7 10 23 34  6  0 74  8 1477]]

```

k = 5, Test Ratio = 0.3

Accuracy: 0.9380952380952381

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.96	1200
1	0.94	0.99	0.97	1389
2	0.95	0.93	0.94	1294
3	0.91	0.94	0.93	1355
4	0.95	0.93	0.94	1222
5	0.91	0.91	0.91	1085
6	0.95	0.96	0.96	1256
7	0.94	0.92	0.93	1359
8	0.97	0.89	0.92	1209
9	0.90	0.91	0.91	1231

accuracy		0.94	12600
macro avg	0.94	0.94	0.94 12600
weighted avg	0.94	0.94	0.94 12600

Confusion Matrix:

```
[[1183  0  3  0  0  2 11  0  0  1]
 [ 0 1381  4  0  0  1  2  0  1  0]
 [ 15  14 1205 21  2  3  9  9 11  5]
 [  5  4  7 1273  0 25  1 15 16  9]
 [  2 12 13  2 1142  6  7  4  0 34]
 [  5  5  6  44  2 986 22  3  3  9]
 [ 20  4  7  0  5 10 1209  0  1  0]
 [  2 24  9  7 16  0  0 1250  0 51]
 [ 10 15  6 29 14 45  7  2 1070 11]
 [ 10  3  7 16 20  3  0 45  6 1121]]
```

k = 5, Test Ratio = 0.25

Accuracy: 0.938

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.96	1025
1	0.94	0.99	0.97	1146
2	0.95	0.93	0.94	1072
3	0.92	0.94	0.93	1151
4	0.95	0.93	0.94	1024
5	0.91	0.92	0.91	898

6	0.95	0.96	0.96	1010
7	0.94	0.92	0.93	1135
8	0.97	0.88	0.92	1005
9	0.91	0.91	0.91	1034

accuracy			0.94	10500
macro avg	0.94	0.94	0.94	10500
weighted avg	0.94	0.94	0.94	10500

Confusion Matrix:

```
[[1010  0  3  0  2  1  9  0  0  0]
 [  0 1140  2  0  0  1  2  0  1  0]
 [ 16  14 992 16  3  3  8  7  8  5]
 [  5  4  4 1084  0 19  1 13 12  9]
 [  2  9 11  1 957  4  7  3  1 29]
 [  4  3  4  32  2 825 19  1  3  5]
 [ 17  3  5  0  2 11 971  0  1  0]
 [  2 23  8  7 12  0  0 1043  0 40]
 [  8 17  7 24 12 41  5  2 882  7]
 [  7  3  7 14 15  2  0  36  5 945]]
```

k = 5, Test Ratio = 0.2

Accuracy: 0.9391666666666667

Classification Report:

	precision	recall	f1-score	support
0	0.95	0.98	0.96	816

1	0.94	0.99	0.97	909
2	0.96	0.93	0.94	846
3	0.92	0.94	0.93	937
4	0.95	0.94	0.95	839
5	0.91	0.92	0.91	702
6	0.95	0.97	0.96	785
7	0.94	0.92	0.93	893
8	0.97	0.87	0.92	835
9	0.91	0.92	0.91	838

accuracy			0.94	8400
macro avg	0.94	0.94	0.94	8400
weighted avg	0.94	0.94	0.94	8400

Confusion Matrix:

```
[[802  0  3  0  0  1 10  0  0  0]
 [ 0 903  2  0  0  1  2  0  1  0]
 [10 12 787 12  2  3  5  4  8  3]
 [ 4  4  2 883  0 16  1  9  9  9]
 [ 2  6  5  2 788  2  4  3  0 27]
 [ 4  1  3 26  2 645 12  1  3  5]
 [12  1  3  0  1  8 760  0  0  0]
 [ 2 17  6  6 11  0  0 823  0 28]
 [ 6 14  7 19 13 35  5  2 729  5]
 [ 6  3  3 13 10  1  0 29  4 769]]
```

k = 5, Test Ratio = 0.1

Accuracy: 0.9411904761904762

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.97	408
1	0.94	0.99	0.97	471
2	0.97	0.93	0.95	420
3	0.93	0.95	0.94	506
4	0.95	0.94	0.95	397
5	0.91	0.93	0.92	339
6	0.95	0.97	0.96	402
7	0.95	0.92	0.93	438
8	0.96	0.87	0.91	403
9	0.91	0.92	0.91	416
accuracy		0.94		4200
macro avg	0.94	0.94	0.94	4200
weighted avg	0.94	0.94	0.94	4200

Confusion Matrix:

```
[[403  0  0  0  0  0  0  5  0  0  0]
 [ 0 467  1  0  0  0  2  0  1  0]
 [ 4  6 392  5  1  0  4  3  3  2]
 [ 1  3  1 482  1  6  0  5  4  3]
 [ 0  1  3  0 374  2  2  1  0 14]
 [ 1  0  0 10  2 316  5  0  2  3]
 [ 9  0  1  0  0  4 388  0  0  0]
 [ 2 11  3  3  4  0  0 401  0 14]
```

```
[ 2 7 5 10 6 19 3 1 349 1]
[ 5 1 0 8 4 1 0 13 3 381]]
```

k = 5, Test Ratio = 0.05

Accuracy: 0.9471428571428572

Classification Report:

	precision	recall	f1-score	support
0	0.96	0.99	0.97	216
1	0.94	0.99	0.96	234
2	0.97	0.95	0.96	222
3	0.94	0.96	0.95	260
4	0.95	0.96	0.95	196
5	0.93	0.94	0.93	160
6	0.96	0.96	0.96	199
7	0.96	0.92	0.94	230
8	0.97	0.88	0.93	191
9	0.90	0.91	0.90	192
accuracy		0.95		2100
macro avg	0.95	0.95	0.95	2100
weighted avg	0.95	0.95	0.95	2100

Confusion Matrix:

```
[[213 0 0 0 0 0 3 0 0 0]
 [ 0 232 1 0 0 0 0 0 1 0]
 [ 1 5 210 1 1 0 2 0 1 1]
```

```
[ 0 1 0 249 1 2 0 2 3 2]
[ 0 1 1 0 188 0 0 1 0 5]
[ 0 0 0 5 1 150 1 0 0 3]
[ 5 0 0 0 0 2 192 0 0 0]
[ 0 5 1 3 1 0 0 211 0 9]
[ 1 3 3 4 2 7 2 0 169 0]
[ 3 1 0 3 4 1 0 5 0 175]]
```

k = 6, Test Ratio = 0.4

Accuracy: 0.930952380952381

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.98	0.96	1626
1	0.93	0.99	0.96	1851
2	0.94	0.92	0.93	1694
3	0.90	0.94	0.92	1776
4	0.93	0.93	0.93	1633
5	0.92	0.89	0.90	1467
6	0.95	0.96	0.95	1694
7	0.93	0.93	0.93	1773
8	0.96	0.87	0.91	1639
9	0.91	0.89	0.90	1647
accuracy			0.93	16800
macro avg	0.93	0.93	0.93	16800
weighted avg	0.93	0.93	0.93	16800

Confusion Matrix:

```
[[1600  1  6  3  1  3 11  0  0  1]
 [ 0 1836  6  0  0  0  6  1  2  0]
 [ 26 271554 29  9  3 13 16 13  4]
 [  7  7 121674  0 26  1 21 18 10]
 [  3 24 18  21517  8  7  3  2 49]
 [ 11 10  8 68  71312 30  3  7 11]
 [ 35  4  8  0  8 181619  0  2  0]
 [  2 32 11  9 24  0  01642  0 53]
 [ 17 26 13 53 20 59 10  31426 12]
 [ 10  8 12 24 39  4  0 81  91460]]
```

k = 6, Test Ratio = 0.3

Accuracy: 0.933968253968254

Classification Report:

	precision	recall	f1-score	support
0	0.93	0.99	0.96	1200
1	0.94	0.99	0.96	1389
2	0.95	0.93	0.94	1294
3	0.90	0.94	0.92	1355
4	0.94	0.94	0.94	1222
5	0.91	0.90	0.91	1085
6	0.96	0.96	0.96	1256
7	0.93	0.92	0.93	1359
8	0.97	0.88	0.92	1209

9	0.92	0.89	0.91	1231
---	------	------	------	------

accuracy			0.93	12600
----------	--	--	------	-------

macro avg	0.93	0.93	0.93	12600
-----------	------	------	------	-------

weighted avg	0.93	0.93	0.93	12600
--------------	------	------	------	-------

Confusion Matrix:

```
[[1185  0  3  0  1  1  9  0  0  1]
 [ 0 1379  4  0  0  1  4  0  1  0]
 [ 19  15 1200 21  4  3  8 10 10  4]
 [  5  5 111270  0 24  1 16 14  9]
 [  2 15  15  2 1146  6  7  1  1 27]
 [  7  5  5 55  1 978 21  3  3  7]
 [ 25  3  6  0  8 131200  0  1  0]
 [  2 27  8  8 22  0  0 1250  0 42]
 [ 12 20  7 32 15 45  6  2 1059 11]
 [ 12  3  7 17 27  0  0  57  7 1101]]
```

k = 6, Test Ratio = 0.25

Accuracy: 0.936

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.96	1025
1	0.93	0.99	0.96	1146
2	0.95	0.93	0.94	1072
3	0.91	0.94	0.93	1151

4	0.94	0.94	0.94	1024
5	0.91	0.91	0.91	898
6	0.95	0.96	0.95	1010
7	0.94	0.92	0.93	1135
8	0.97	0.87	0.92	1005
9	0.92	0.90	0.91	1034

accuracy			0.94	10500
macro avg	0.94	0.94	0.94	10500
weighted avg	0.94	0.94	0.94	10500

Confusion Matrix:

```
[[1013  0  3  0  1  1  7  0  0  0]
 [  0 1139  2  0  0  1  3  0  1  0]
 [ 15  14 995 14  3  3  9  7  8  4]
 [  4  4  7 1086  0 17  1 12 11  9]
 [  2 12 12  1 961  4  6  4  0 22]
 [  4  2  4 44  1 817 20  1  1  4]
 [ 19  3  5  0  4 12 966  0  1  0]
 [  2 27  6  6 14  0  0 1044  0 36]
 [ 10 20  7 26 13 42  4  2 874  7]
 [  9  3  7 13 22  0  0 41  6 933]]
```

k = 6, Test Ratio = 0.2

Accuracy: 0.9382142857142857

Classification Report:

precision	recall	f1-score	support
-----------	--------	----------	---------

0	0.94	0.99	0.96	816
1	0.94	0.99	0.97	909
2	0.96	0.94	0.95	846
3	0.92	0.94	0.93	937
4	0.94	0.94	0.94	839
5	0.90	0.91	0.91	702
6	0.95	0.97	0.96	785
7	0.94	0.92	0.93	893
8	0.96	0.87	0.92	835
9	0.92	0.91	0.91	838

accuracy			0.94	8400
macro avg	0.94	0.94	0.94	8400
weighted avg	0.94	0.94	0.94	8400

Confusion Matrix:

```
[[804 0 3 0 0 1 8 0 0 0]
 [ 0 903 2 0 0 1 2 0 1 0]
 [ 8 10 795 8 1 3 6 4 8 3]
 [ 4 4 4 879 0 16 1 9 12 8]
 [ 2 8 6 2 789 2 6 4 0 20]
 [ 4 1 4 34 1 638 14 1 1 4]
 [12 1 3 0 2 9 758 0 0 0]
 [ 2 17 4 6 12 0 0 826 0 26]
 [ 8 15 7 17 13 35 4 2 729 5]
 [ 7 3 3 11 17 1 0 31 5 760]]
```

k = 6, Test Ratio = 0.1

Accuracy: 0.9416666666666667

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.96	408
1	0.94	0.99	0.96	471
2	0.97	0.94	0.96	420
3	0.94	0.95	0.94	506
4	0.95	0.95	0.95	397
5	0.91	0.93	0.92	339
6	0.95	0.96	0.96	402
7	0.94	0.92	0.93	438
8	0.96	0.86	0.91	403
9	0.92	0.91	0.92	416
accuracy			0.94	4200
macro avg	0.94	0.94	0.94	4200
weighted avg	0.94	0.94	0.94	4200

Confusion Matrix:

```
[[404 0 0 0 0 0 4 0 0 0]
 [ 0 468 0 0 0 0 2 0 1 0]
 [ 4 6 396 1 1 0 4 3 3 2]
 [ 1 3 1 481 0 6 0 5 5 4]
 [ 0 2 2 0 378 2 1 2 0 10]
 [ 1 0 0 12 0 316 5 0 2 3]
```

```
[ 12  0  0  0  0  4 386  0  0  0]
[  2 11  3  3  6  0  0 402  0 11]
[  2  9  5 10  6 21  3  1 345  1]
[  6  1  0  7  5  0  0 15  3 379]]
```

k = 6, Test Ratio = 0.05

Accuracy: 0.9480952380952381

Classification Report:

	precision	recall	f1-score	support
0	0.95	0.99	0.97	216
1	0.94	1.00	0.96	234
2	0.98	0.95	0.97	222
3	0.95	0.96	0.95	260
4	0.96	0.95	0.96	196
5	0.90	0.94	0.92	160
6	0.96	0.96	0.96	199
7	0.96	0.93	0.94	230
8	0.97	0.87	0.92	191
9	0.90	0.91	0.91	192
accuracy		0.95		2100
macro avg	0.95	0.95	0.95	2100
weighted avg	0.95	0.95	0.95	2100

Confusion Matrix:

```
[[214  0  0  0  0  0  0  2  0  0  0]
```

```
[ 0 233 0 0 0 0 0 0 1 0]
[ 1 5 211 0 1 0 2 0 1 1]
[ 0 1 0 250 0 2 0 2 3 2]
[ 0 1 1 0 186 1 0 1 0 6]
[ 0 0 0 5 0 150 1 0 1 3]
[ 5 0 0 0 0 3 191 0 0 0]
[ 0 5 1 3 1 0 0 214 0 6]
[ 1 3 2 3 2 10 2 0 167 1]
[ 4 1 0 3 3 0 0 6 0 175]]
```

k = 7, Test Ratio = 0.4

Accuracy: 0.9302976190476191

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.98	0.96	1626
1	0.93	0.99	0.96	1851
2	0.95	0.91	0.93	1694
3	0.91	0.94	0.92	1776
4	0.94	0.92	0.93	1633
5	0.92	0.90	0.91	1467
6	0.95	0.96	0.95	1694
7	0.93	0.91	0.92	1773
8	0.96	0.88	0.92	1639
9	0.89	0.89	0.89	1647
accuracy			0.93	16800

macro avg	0.93	0.93	0.93	16800
weighted avg	0.93	0.93	0.93	16800

Confusion Matrix:

```
[[1596  2  4  2  1  4 15  0  0  2]
 [ 0 1834  7  0  1  0  6  1  2  0]
 [ 25  28 1540 32  7  3 16 21 16  6]
 [  7  6 121668  0 29  2 21 20 11]
 [  3 22 16  21505  8 10  4  2 61]
 [ 10 11  6 55  51322 32  4  9 13]
 [ 28  3  4  1  8 181628  0  4  0]
 [  2 33  7 10 23  0  01619  0 79]
 [ 20 23  9 41 18 56 11  31443 15]
 [ 11  8 12 23 33  4  0 73  91474]]
```

k = 7, Test Ratio = 0.3

Accuracy: 0.9357936507936508

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.96	1200
1	0.94	0.99	0.96	1389
2	0.95	0.92	0.94	1294
3	0.91	0.93	0.92	1355
4	0.94	0.93	0.94	1222
5	0.92	0.91	0.91	1085
6	0.95	0.97	0.96	1256

7	0.94	0.91	0.93	1359
8	0.96	0.89	0.92	1209
9	0.90	0.91	0.90	1231

accuracy			0.94	12600
macro avg	0.94	0.94	0.94	12600
weighted avg	0.94	0.94	0.94	12600

Confusion Matrix:

```
[[1184  0  2  1  1  2  9  0  0  1]
 [ 0 1380  4  0  0  1  3  0  1  0]
 [ 19  17 1195 24  3  3  9  9 11  4]
 [  6  5  11 1266  0 27  0 14 16 10]
 [  2 15 13  2 1139  7  8  1  1 34]
 [  6  6  4 43  3 985 23  3  4  8]
 [ 17  3  4  0  6 10 1215  0  1  0]
 [  2 27  9  7 22  0  0 1239  0 53]
 [ 13 18  5 27 14 37  7  2 1073 13]
 [  9  3  7 18 23  1  0 48  7 1115]]
```

k = 7, Test Ratio = 0.25

Accuracy: 0.9373333333333334

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.96	1025
1	0.93	0.99	0.96	1146

2	0.96	0.93	0.94	1072
3	0.92	0.94	0.93	1151
4	0.94	0.93	0.94	1024
5	0.92	0.92	0.92	898
6	0.95	0.97	0.96	1010
7	0.95	0.91	0.93	1135
8	0.96	0.88	0.92	1005
9	0.91	0.91	0.91	1034

accuracy			0.94	10500
macro avg	0.94	0.94	0.94	10500
weighted avg	0.94	0.94	0.94	10500

Confusion Matrix:

```
[[1011  0  2  1  2  2  7  0  0  0]
 [ 0 1139  2  0  0  0  3  0  2  0]
 [ 15  15 995 16  3  3  9  4  8  4]
 [  5  4  7 1080  0 19  1 11 14 10]
 [  2 11 10  2 957  5  7  3  0 27]
 [  5  4  2 32  3 822 20  1  3  6]
 [ 14  3  3  0  3 10 976  0  1  0]
 [  2 26  6  5 16  0  0 1036  0 44]
 [ 10 19  6 24 12 34  4  2 887  7]
 [  8  3  7 13 20  1  0 37  6 939]]
```

k = 7, Test Ratio = 0.2

Accuracy: 0.9392857142857143

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.98	0.96	816
1	0.94	0.99	0.96	909
2	0.97	0.94	0.95	846
3	0.93	0.94	0.93	937
4	0.95	0.94	0.94	839
5	0.91	0.91	0.91	702
6	0.95	0.97	0.96	785
7	0.95	0.92	0.94	893
8	0.96	0.88	0.92	835
9	0.90	0.92	0.91	838
accuracy		0.94		8400
macro avg	0.94	0.94	0.94	8400
weighted avg	0.94	0.94	0.94	8400

Confusion Matrix:

```
[[803  0  2  0  0  2  9  0  0  0]
 [ 0 903  2  0  0  0  2  0  2  0]
 [ 8 11 794  9  1  3  7  2  8  3]
 [ 5  4  4 877  0 16  1  7 14  9]
 [ 2  8  5  2 785  4  5  2  0 26]
 [ 5  1  2 25  3 641 15  1  3  6]
 [11  1  1  0  1  9 762  0  0  0]
 [ 2 17  5  5 11  0  0 820  0 33]
 [ 7 15  4 17 13 31  4  2 737  5]
```

[7 3 2 11 15 0 0 27 5 768]]

k = 7, Test Ratio = 0.1

Accuracy: 0.9428571428571428

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.96	408
1	0.94	0.99	0.97	471
2	0.98	0.94	0.96	420
3	0.94	0.95	0.94	506
4	0.95	0.94	0.95	397
5	0.92	0.94	0.93	339
6	0.95	0.96	0.95	402
7	0.95	0.91	0.93	438
8	0.96	0.88	0.92	403
9	0.91	0.92	0.91	416
accuracy		0.94		4200
macro avg	0.94	0.94	0.94	4200
weighted avg	0.94	0.94	0.94	4200

Confusion Matrix:

```
[[404 0 0 0 0 0 4 0 0 0]
 [ 0 468 0 0 0 0 2 0 1 0]
 [ 4 5 394 2 2 0 5 2 4 2]
 [ 1 3 2 481 0 6 0 4 5 4]
```

```
[ 0 2 1 0 375 2 2 0 0 15]
[ 1 0 0 10 1 317 6 0 1 3]
[11 0 0 0 0 4 387 0 0 0]
[ 2 11 2 3 6 0 0 399 0 15]
[ 2 7 4 10 6 16 3 1 353 1]
[ 6 1 1 7 4 0 0 12 3 382]]
```

k = 7, Test Ratio = 0.05

Accuracy: 0.95

Classification Report:

	precision	recall	f1-score	support
0	0.95	0.99	0.97	216
1	0.94	1.00	0.96	234
2	0.99	0.95	0.97	222
3	0.95	0.96	0.96	260
4	0.96	0.95	0.96	196
5	0.93	0.95	0.94	160
6	0.96	0.96	0.96	199
7	0.97	0.92	0.94	230
8	0.97	0.89	0.93	191
9	0.88	0.92	0.90	192
accuracy		0.95		2100
macro avg	0.95	0.95	0.95	2100
weighted avg	0.95	0.95	0.95	2100

Confusion Matrix:

```
[[214  0  0  0  0  0  2  0  0  0]
 [  0 233  0  0  0  0  0  0  1  0]
 [  1  5 210  0  1  0  3  0  1  1]
 [  0  1  0 250  0  1  0  2  3  3]
 [  0  1  0  0 187  1  0  0  0  7]
 [  0  0  0  4  0 152  1  0  0  3]
 [  5  0  0  0  0  2 192  0  0  0]
 [  0  5  1  2  1  0  0 211  0 10]
 [  1  3  2  3  2  8  2  0 170  0]
 [  4  1  0  3  3  0  0  5  0 176]]
```

k = 10, Test Ratio = 0.4

Accuracy: 0.9275595238095238

Classification Report:

	precision	recall	f1-score	support
0	0.93	0.98	0.96	1626
1	0.92	0.99	0.96	1851
2	0.95	0.90	0.92	1694
3	0.91	0.94	0.92	1776
4	0.94	0.92	0.93	1633
5	0.91	0.89	0.90	1467
6	0.95	0.96	0.95	1694
7	0.92	0.91	0.92	1773
8	0.96	0.87	0.91	1639
9	0.89	0.89	0.89	1647

accuracy	0.93	16800
macro avg	0.93	0.93 0.93 16800
weighted avg	0.93	0.93 0.93 16800

Confusion Matrix:

```
[[1598  2  4  3  0  3 14  0  0  2]
 [ 0 1837  6  0  0  1  6  1  0  0]
 [ 29  33 1524 30  8  3 16 25 21  5]
 [  7  7  12 1672  0 28  3 23 15  9]
 [  3  24  16  1 1509 10 10  5  1 54]
 [ 10  9  8  65  3 1308 33  5 10 16]
 [ 30  4  6  0  6  18 1626  0  4  0]
 [  1  38  9  4 22  1  0 1622  0 76]
 [ 20 28  7 49 17 67  9  3 1426 13]
 [ 12  8 11 22 41  1  0  81 10 1461]]
```

k = 10, Test Ratio = 0.3

Accuracy: 0.9317460317460318

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.96	1200
1	0.93	0.99	0.96	1389
2	0.95	0.91	0.93	1294
3	0.91	0.94	0.92	1355
4	0.94	0.93	0.94	1222

5	0.91	0.90	0.91	1085
6	0.95	0.96	0.96	1256
7	0.92	0.91	0.92	1359
8	0.96	0.88	0.92	1209
9	0.90	0.90	0.90	1231

accuracy			0.93	12600
macro avg	0.93	0.93	0.93	12600
weighted avg	0.93	0.93	0.93	12600

Confusion Matrix:

```
[[1183  0  2  1  0  2 11  0  0  1]
 [ 0 1380  4  0  0  1  3  0  1  0]
 [ 23  21 1175 22  4  3  9 16 16  5]
 [ 5  6 101273  0 22  1 18 11  9]
 [ 2 14 12  2 1139  7  6  2  1 37]
 [ 7  6  6 46  3 978 22  4  3 10]
 [ 22  3  4  0  7 131205  0  2  0]
 [ 1 29  8  8 20  0  01240  1 52]
 [ 10 23  3 31 16 43  7  21063 11]
 [ 11  2  7 19 23  0  0 60  51104]]
```

k = 10, Test Ratio = 0.25

Accuracy: 0.9342857142857143

Classification Report:

	precision	recall	f1-score	support
--	-----------	--------	----------	---------

0	0.94	0.99	0.96	1025
1	0.93	0.99	0.96	1146
2	0.96	0.91	0.93	1072
3	0.92	0.95	0.93	1151
4	0.94	0.93	0.94	1024
5	0.91	0.91	0.91	898
6	0.95	0.96	0.95	1010
7	0.93	0.91	0.92	1135
8	0.97	0.88	0.92	1005
9	0.90	0.90	0.90	1034

accuracy			0.93	10500
macro avg	0.93	0.93	0.93	10500
weighted avg	0.93	0.93	0.93	10500

Confusion Matrix:

```
[[1013  0  1  0  0  2  9  0  0  0]
 [  0 1138  2  0  1  1  3  0  1  0]
 [ 18 18 979 15  5  3  9  9 11  5]
 [  4  5  4 1090  0 16  1 13  9  9]
 [  2  9 11  2 956  5  7  1  0 31]
 [  6  3  3  35  4 816 20  3  3  5]
 [ 18  1  3  0  3 12 972  0  1  0]
 [  1 29  7  6 15  0  0 1034  0 43]
 [  8 23  7 25 11 37  5  2 880  7]
 [  7  3  7 15 19  1  0  46  4 932]]
```

k = 10, Test Ratio = 0.2

Accuracy: 0.9345238095238095

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.96	816
1	0.93	0.99	0.96	909
2	0.97	0.92	0.94	846
3	0.92	0.94	0.93	937
4	0.94	0.93	0.94	839
5	0.91	0.91	0.91	702
6	0.95	0.97	0.96	785
7	0.93	0.92	0.93	893
8	0.96	0.87	0.92	835
9	0.90	0.91	0.90	838
accuracy			0.93	8400
macro avg	0.93	0.93	0.93	8400
weighted avg	0.94	0.93	0.93	8400

Confusion Matrix:

```
[[805  0  1  0  0  2  8  0  0  0]
 [ 0 902  2  0  1  1  2  0  1  0]
 [ 10 15 778 10  4  3  7  6  9  4]
 [  4  5  4 883  0 13  1 10 10  7]
 [  2  7  6  2 781  4  6  2  1 28]
 [  5  2  3 30  3 636 15  1  2  5]
 [ 13  1  1  0  3  7 759  0  1  0]
```



```
[ 1 21  2  6 11  0  0 818  0 34]
[ 7 19  4 17 11 36  5  2 729  5]
[ 6  3  3 13 15  0  0 36  3 759]]
```

k = 10, Test Ratio = 0.1

Accuracy: 0.9326190476190476

Classification Report:

	precision	recall	f1-score	support
0	0.94	0.99	0.96	408
1	0.93	0.99	0.96	471
2	0.97	0.92	0.95	420
3	0.92	0.95	0.94	506
4	0.94	0.94	0.94	397
5	0.90	0.92	0.91	339
6	0.94	0.96	0.95	402
7	0.94	0.90	0.92	438
8	0.95	0.84	0.89	403
9	0.90	0.90	0.90	416
accuracy		0.93		4200
macro avg	0.93	0.93	0.93	4200
weighted avg	0.93	0.93	0.93	4200

Confusion Matrix:

```
[[404  0  0  0  0  0  4  0  0  0]
 [ 0 468  0  0  0  0  2  0  1  0]
```

```
[ 6 7 388 2 2 0 5 3 4 3]
[ 1 3 3 479 0 6 0 5 6 3]
[ 0 2 2 0 372 3 2 0 1 15]
[ 1 0 0 13 1 311 6 0 3 4]
[11 0 0 0 2 3 385 0 1 0]
[ 1 13 1 4 7 0 0 396 0 16]
[ 2 11 3 12 7 21 5 1 339 2]
[ 5 1 1 8 6 0 0 18 2 375]]
```

k = 10, Test Ratio = 0.05

Accuracy: 0.9423809523809524

Classification Report:

	precision	recall	f1-score	support
0	0.96	0.99	0.98	216
1	0.93	1.00	0.96	234
2	0.99	0.92	0.96	222
3	0.95	0.95	0.95	260
4	0.95	0.96	0.95	196
5	0.89	0.93	0.91	160
6	0.96	0.97	0.96	199
7	0.95	0.92	0.93	230
8	0.95	0.86	0.91	191
9	0.88	0.90	0.89	192
accuracy			0.94	2100
macro avg	0.94	0.94	0.94	2100

weighted avg 0.94 0.94 0.94 2100

Confusion Matrix:

```
[[214  0  0  0  0  0  0  2  0  0  0]
 [ 0 233  0  0  0  0  0  0  1  0]
 [ 1  5 205  0  2  0  3  1  3  2]
 [ 0  1  1 248  0  2  0  2  3  3]
 [ 0  1  0  0 188  2  0  0  0  5]
 [ 0  0  0  5  0 149  1  0  1  4]
 [ 3  0  0  0  1  2 193  0  0  0]
 [ 0  6  0  2  1  0  0 211  0 10]
 [ 1  4  1  3  3 12  2  0 165  0]
 [ 3  1  0  4  3  0  0  8  0 173]]
```