

**NAME: ISHITA GARG**

**ROLL NUMBER: 102203992**

**SUB GROUP: CO18**

# ELC ASSIGNMENT

## Handwritten Digit Recognition

Following are the results where K varies as [2,4,5,6,7,10] and test size [ 60:40, 70:30, 75:25, 80:20, 90:10, 95:5].

### ANALYSIS:-

Best Combination:

The combination with the highest validation accuracy is Test Size: 0.2 and K: 5, with a validation accuracy of 0.935. This means that when using 20% of the data for testing and 5 for the number of neighbours in the k-nearest neighbours algorithm, the model achieved the highest accuracy on the validation set.

Worst Combination:

The combination with the lowest validation accuracy is Test Size: 0.25 and K: 2, with a validation accuracy of 0.921. This means that when using 25% of the data for testing and 2 for the number of neighbours in the k-nearest neighbours algorithm, the model achieved the lowest accuracy on the validation set.

### Accuracy & Confusion Matrix:-

Test Size: 0.4      K: 2

Validation Accuracy: 0.9167857142857143 Confusion Matrix:

```
[[1596 0      3 3 2 5      7 0 0      1]
 [ 1 1863 3 0      0 1      0 0 2      1]
 [ 27 28 1596 22 7 2 9 12 7 3] [ 8 11 56 1679
 2 22 1 9 11 4] [ 2 35 20 3 1535 3 4 12 2 26]
 [ 13 5 6 100 9 1340 19 7      5 2]
 [ 42      4 16 1 6 24 1518      0      1 0]
 [ 3 29 19 17 31 1 0 1616      1 35]
 [ 18 25 32 71 29 105 6 11 1275 16]
 [ 10 12 9 25 95 13 0 137 11 1384]]
```

---

Test Size: 0.4      K: 4

Validation Accuracy: 0.9288095238095239 Confusion Matrix:

```
[[1587 0      2 4 0 6 13 2 1 2]
 [ 1 1860      3 0 0 1 3 1 1      1]
 [ 18 30 1593 21 9 1 12 15 9 5]
```

[ 5 10 29 1682 1 27 2 18 19 10]

1 34 14 4 1525 6 4 8 2 44] 14  
6 5 77 7 1351 25 6 7 8] 29  
4 12 3 5 13 1545 0 1 0]

1 29 11 8 27 0 0 1619 1 56]  
[ 14 22 18 41 20 76 4 8 1362 2 3]  
[ 13 6 8 20 59 6 0 92 12 1480]]

---

Test Size: 0.4 K: 5

Validation Accuracy: 0.9298214285714286 Confusion  
Matrix:

[[1582 2 3 3 0 8 13 2 2 2]  
[ 0 1857 3 0 0 1 4 1 2 3]  
[ 16 28 1577 32 11 1 13 16 13 6]  
[ 5 10 25 1681 2 33 3 18 18 8]  
[ 1 32 13 4 1513 5 3 7 4 60]  
[ 11 7 4 65 8 1358 31 5 8 9] [  
24 3 12 2 6 15 1550 0 0 0] [ 2 28 8 6 30  
0 0 1601 1 76]  
[ 13 19 18 38 17 64 5 9 1382 23]  
[ 11 7 8 19 45 6 0 68 12 1520]]

---

Test Size: 0.4 K: 6

Validation Accuracy: 0.9272619047619047 Confusion  
Matrix:

[[1584 0 3 3 0 8 14 2 1 2]  
[ 0 1858 2 0 0 1 4 2 2 2]  
[ 22 29 1576 30 8 1 14 15 11 7]  
[ 7 9 29 1676 2 30 3 17 22 8]  
[ 1 35 15 4 1513 8 4 5 3 54] [ 12 9 3 70  
8 1360 28 4 6 6]  
[ 31 3 12 3 5 14 1542 0 2 0] [ 1 35 7 7 26 0 0  
1609 1 66]  
[ 16 22 16 43 20 72 7 8 1362 2 2]  
[ 11 9 7 24 50 4 0 83 10 1498]]

---

Test Size: 0.4      K: 7

Validation Accuracy: 0.9273809523809524

Confusion Matrix:

```
[[1580 2      3 4 1      7 14 2 2 2]
 [0 1856      2 0 0      1 6 1 2      3]
      17 32 1567 35 12 1 14 17 13 5]
 [6 10 18 1683 2 30 3 19 23 9]
      1 31 14      5 1504 8 6      6      3 64]

      9  11   3 62   8 1360 31   4   9   9]
 [20   3 10   2   6 17 1552   0   2   0]
      1 33      7 7 24 0 0 1597      1 82]
      15 22 17 42 17 71 5 9 1366 2 4]
 [ 12 10 6 23 43 6 0 73 8 1515]]
```

---

Test Size: 0.4      K: 10    Validation

Accuracy: 0.925

Confusion Matrix:

```
[[1585 1      2 3 2 7 13 3 1 0]
 [ 0 1856      2 0 0 2 6 1 1 3]
 [ 18 39 1563 31 12 0 15 16 12 7]
 [ 3 14 24 1669 2 28 3 21 29 10]

 [ 1 36 16 3 1498 12 7 5 1 63]
 [ 10 11 4 58 8 1360 34 3 7 11] [ 28 3 8 3 4 18
 1545 0 3 0]

 [ 1 36 7 4 24 0 0 1600 1 79]
 [ 18 26 14      40 18 72 8 9 1360 23]
 [ 10 12 7 24 42 5 0 81 11 1504]
```

---

Test Size: 0.3      K: 2

Validation Accuracy: 0.921031746031746

Confusion Matrix:

```
[[1217 0      2 4 1 4      7 0 0      1]
 [ 0 1363      3 0 0 1      1 1 1      0]
      [ 15 20 1171 18 6 2 5 8      5 2]
```

```

[ 4 6 37 1283 1 18      1 8 8 3]
[ 1 21 17 4 1132 3      3 10 2 22]
[ 7 4 3 72      6 1016 12 6 3 3]
[ 31      2 11 1 5 15 1151      0 0 0]
[ 3 21 13 10 19 1 0 1229      1 29]
[ 12 14 18 51 19 83 4 6 980 10]
[ 9 7 7 18 66 9 0 99 9 1063]]

```

---

Test Size: 0.3      K: 4  
Validation Accuracy: 0.9315079365079365 Confusion  
Matrix:

```

[[1214 0 2 1 0 5 10 2 0 2]
 [ 0 1361      3 0 0 1 2 1 1      1]
 10 17 1165 18 5 1 8 13 8 7] 2 7 23 1280 0
 17 2 16 16 6]
      0 21 14 4 1128 3 3      7 0 35]
 7  3  2 52  7 1026 19  5  5  6]
25  3  7  3  3  8 1165  0  2  0]
 1 19  9      6 17 0 0 1229      1 44]
 8  10 13 30 16 60 4 4 1037 15]
 9  5 6 14 44 4 0 64 9 1132]]

```

---

Test Size: 0.3      K: 5 Validation  
Accuracy: 0.932063492063492 Confusion  
Matrix:

```

[[1207 0 3 3 0 6 12 2 1 2]
 [ 0 1359      3 0 0 1 2 1 2      2]
 [ 9 18 1162 21 5 0 9 12 9 7]
 [ 2 6 19 1280 0 21 2 17 16 6]
 [ 0 20 14 3 1122 2 2 6 2 44]
 [ 8 6      2 44 6 1027 22      4 6 7] [ 19
   3 6 2  5 10 117 1 0 0 0]
 [ 1 20 9 5 17 0 0 1213 1 60]
   [ 6 9 12 24 15 54 4      5 1051 17]
 [ 9 4      6 15 30 6 0 55 10 1152]]

```

---

Test Size: 0.3      K: 6

Validation Accuracy: 0.9301587301587302 Confusion Matrix:

```
[[1206 0 3 2 0 8 13 2 0 2]
 [ 0 1361      2 0 1 1 2 1 1      1]
 [ 10 20 1157 23 5 1 10 13 8 5]
 [ 3 5 20 1280 0 22 2 17 15 5]
 [ 0 21 14 3 1123 5 2 6 2 39]
  [ 8 5 2 47      6 1031 18 4 5 6]
[ 22      3 8 3      4 10 1165      0 1 0]
  [ 1 23 8 4 15 0      0 1220 1 54]
 [ 9 11 11 27 16 56 4 4 1042 17]
 [ 11      7 6 17 40 3 0 61 7 1135]]
```

---

Test Size: 0.3            K: 7

Validation Accuracy: 0.9288888888888889 Confusion Matrix:

```
[[1206 0 3 2 0 6 13 2 2 2]
 [ 0 1357      2 0 1 2 4 1 2      1]
 [ 10 21 1148 29 4 1 9 14 10 6]
  4 8 15 1276 1 24 2 17 17 5]
    0 18 13 4 1114 6      3 7 2 48]
    7 8 2 42      5 1029 22      4 4 9]
  19   3   7   2   4 9 1170   0   2   0]
```

2 23 6 4 17 0 0 12 12 1 61]  
8 10 12 28 14 61 4 6 10 37 17]  
11 6 5 17 28 4 0 54 7 11 55]]

---

Test Size: 0.3 K: 10 Validation  
Accuracy: 0.9280952380952381 Confusion  
Matrix:

[[1209 0 2 2 1 6 13 2 0 1]  
[ 0 1358 2 0 1 2 4 1 1 1]  
[ 7 23 11 52 26 7 0 10 12 9 6]  
[ 2 10 18 12 75 1 17 2 18 19 7]  
[ 0 21 11 3 11 13 7 5 7 1 47]  
[ 7 8 2 48 5 10 22 23 3 5 9] [ 23 2 5  
3 4 13 11 64 0 2 0]  
[ 1 25 9 3 13 0 0 12 15 1 59]  
[ 9 14 11 24 15 56 5 4 10 39 20]  
[ 9 8 5 16 29 5 0 61 7 11 47]]

---

Test Size: 0.25 K: 2  
Validation Accuracy: 0.9214285714285714  
Confusion Matrix:

[[1006 0 2 4 1 3 5 0 0 1]  
[ 0 1124 2 0 0 1 1 1 1 0]  
[ 14 20 983 13 7 0 6 4 5 1] [ 3 5 31 10 56 1  
17 1 5 6 3]  
[ 1 20 15 2 941 2 3 8 2 20]  
[ 4 3 2 60 6 8 35 14 6 2 2]  
[ 26 2 8 1 3 12 9 56 0 0 0]  
[ 3 18 7 6 10 1 0 10 34 1 23]  
[ 12 12 17 35 14 67 3 5 84 1 7]  
[ 7 6 7 14 57 10 0 87 8 899]]

---

Test Size: 0.25 K: 4 Validation  
Accuracy: 0.931047619047619 Confusion  
Matrix:

[[1003 0 2 1 0 4 8 2 0 2]  
[ 0 1123 2 0 0 1 2 0 1 1]  
[ 10 14 981 16 5 1 7 8 7 4]

```
[ 2 6 18 10 51 0 17 2 13 13 6]
    0 20 11 2 938 3      3 6 1 30]
  4 3      1 43 6 840 22 5 4 6]
20   3 3      3 2 8 968      0 1 0]
  1 15   6   2 10   0      0 1032 1 36]
  8      7 13 22 17 48 3 4 879 12]
  6 4 6 11 33 3 0 61 10 961]]
```

---

Test Size: 0.25      K: 5  
 Validation Accuracy: 0.9318095238095238  
 Confusion Matrix:

```
[[ 998 0 3 2 0 5 9 2 1      2]
 [ 0 1123      2 0 0 1 2 1 1      0]
 [ 8 15 978 17      5 1 7 9 8 5]
 [ 2 7 14 1047      0 19 2 18 13 6]
 [ 0 19 12 2 931 2 3 7 2 36]
 [ 5 5 1 38 5 843 23 4 3 7]
 [ 17   3 3   2   4 7 972 0 0   0]
 [ 1 15 4      3 10 0 0 1024 1 45]
 [ 6 7 11 19 13 47 4      4 889 13]
 [ 8 4      6 13 23 4 0 50 8 979]]
```

---

Test Size: 0.25      K: 6  
 Validation Accuracy: 0.9286666666666666  
 Confusion Matrix:

```
[[ 998 0 3 1 0 6 10 2 0      2]
 [ 0 1123      2 0 0 1 2 1 1      0]
 [ 7 18 976 19 4 1 9 8 7 4] [ 3 4 15 1050 0
 20 2 17 12 5]
 [ 0 19 12      2 931 5 2      6 3 34]
 [ 4 4      1 38 5 846 21      4 5 6]
 [ 19   3 4   3      3 8 967 0 1 0]
 [ 1 19 4 3 12 0 0 1023 1 40]
 [ 9 9 10 21 14 49 4      3 879 15]
 [ 9 6      6 13 33 4 0 59 7 958]]
```

---

Test Size: 0.25      K: 7



Validation Accuracy: 0.9282857142857143

Confusion Matrix:

```
[[ 996 0 3 1 0 6 11 2 1          2]
 [ 0 1120      2 0 1 2 3 0 1      1]
 [ 10 18 970 22 4 0 9 7 9 4]
 [ 4 5 13 1051 0 19 2 18 11 5]
 [ 0 17 12 2 920 5 3 9 4 42]
  4 5 1 35 6 846 22 4 4 7]
 17   3 3      2 3 7 972      0 1 0]
 1   18 4          3 13 0 0 1017 1 46]
 8   9   10 19 13 53 6 4 877 14]
 9   6 6 14 23   3 0 50 6 978]]
```

---

Test Size: 0.25 K: 10 Validation

Accuracy: 0.9261904761904762 Confusion  
Matrix:

```
[[ 999 1 2 1 0 5 10 2 1          1]
      [ 0 1120 2 0 1 2 3 0 1      1]
 [ 7 21 968 23 6 0 9 7 9 3]
 [ 2 9 16 1050 1 13 2 16 13 6]
 [ 0 19 10 3 924 7 2 7 2 40]
  [ 5 7      1 39 5 840 23 3 3 8]
  [ 16 2 3 3      3 10 970 0      1 0]
      [ 1 21 3 3 12 0 0 1016          1 46]
 [ 11 12 10 22 14 48 5 4 871 16]
  [ 8 8          5 14 27 3 0 55 8 967]]
```

---

Test Size: 0.2 K: 2

Validation Accuracy: 0.9228571428571428

Confusion Matrix:

```
[[809 0 3 0 0 4 4 0 0 1]
 [ 0 894 1 0 0 2 0 1 1 0]
 [ 12 14 803 8 7 0 5 4 4 1]
 [ 3 5 25 854 0 14 1 4 5 2]
 [ 1 16 9 2 732 2 2 7 1 19]
 [ 5 3 1 45 4 684 12 5 2 1]
 [ 21 1 8 1 3 9 765 0 0 0]
```

[ 1 14 5 4 9 1 0 826 1 19] [ 9 8 12  
26 11 51 2 4 661 5]  
[ 6 6 7 14 48 7 0 60 7 724]]

---

Test Size: 0.2            K: 4  
Validation Accuracy: 0.9326190476190476  
Confusion Matrix:  
[[808 0 2 0 0 4 6 0 0 1]  
[ 0 894 1 0 0 1 1 0 1 1]  
[ 9 10 800 12 6 0 6 5 8 2]  
[ 2 6 13 855 0 13 2 8 10 4]  
[ 0 15 8 2 731 2 3 7 1 22]  
[ 4 3 1 36 4 685 16 4 5 4]  
[ 17 1 4 2 2 7 774 0 1 0]  
  0 11 3 2 8 0 0 825 1 30]  
  6 5 11 16 11 39 2 3 689 7]  
  6 3 6 10 30 3 0 42 6 773]]

---

Test Size: 0.2      K: 5 Validation Accuracy: 0.935 Confusion Matrix:

```
[[808 0 2 0 0 4 6 0 0 1]
 [ 0 894 1 0 0 1 1 1 1 0]
 [ 6 11 798 13 6 0 7 6 8 3]
 [ 2 7 11 851 0 14 2 13 10 3]
 [ 0 15 8 2 725 2 3 8 1 27]
 [ 5 4 1 29 4 692 17 3 3 4]
 [ 15 1 3 2 3 5 779 0 0 0]
 [ 0 11 2 3 10 0 0 819 1 34]
 [ 5 6 10 11 8 34 3 3 701 8]
 [ 8 3 6 12 19 3 0 35 6 787]]
```

---

Test Size: 0.2      K: 6

Validation Accuracy: 0.9314285714285714 Confusion Matrix:

```
[[806 0 4 0 0 4 6 0 0 1]
 [ 0 894 1 0 0 1 1 1 1 0]
 [ 5 14 797 14 4 0 9 5 7 3]
 [ 2 4 12 850 0 15 2 15 10 3]
 [ 0 16 7 2 727 3 2 6 1 27]
 [ 5 3 1 30 3 691 17 4 4 4]
 [ 18 1 4 2 3 5 774 0 1 0]
 [ 0 14 3 3 11 0 0 819 1 29] [ 6 7 7 13 11 38 2 2 692 11]
 [ 9 5 6 11 25 4 0 40 5 774]]
```

---

Test Size: 0.2      K: 7

Validation Accuracy: 0.9314285714285714 Confusion Matrix:

```
[[807 0 3 0 0 4 6 0 0 1]
 [ 0 892 1 0 1 1 2 0 1 1]
 [ 8 12 794 14 5 0 9 5 9 2]
 [ 2 5 11 847 1 17 2 14 11 3]
 [ 0 14 7 2 722 3 1 8 3 31]
 [ 4 4 1 27 3 693 18 4 4 4]
 [ 15 1 3 2 3 4 779 0 1 0]
 [ 0 13 1 3 11 0 0 814 1 37]
 [ 6 6 9 12 9 41 4 3 690 9]
```

[ 8 5 6 11 20 4 0 33 6 786]]

---

Test Size: 0.2      K: 10 Validation Accuracy: 0.9263095238095238 Confusion Matrix:

[[806 1 3 0 0 3 7 0 0 1]  
[ 0 891 1 0 1 2 2 0 1 1]  
[ 6 16 788 16 9 0 9 5 7 2]  
[ 2 9 11 844 1 13 2 15 13 3]  
[ 0 14 5 2 723 5 1 8 2 31]  
[ 4 4 1 34 3 687 19 3 2 5]  
[ 15 1 4 1 3 7 776 0 1 0]  
[ 0 17 2 3 10 0 0 809 1 38]  
[ 7 9 8 14 9 40 3 3 685 11]  
[ 8 6 5 12 23 4 0 43 6 772]]

---

Test Size: 0.1      K: 2  
Validation Accuracy: 0.9238095238095239 Confusion Matrix:

[[383 0 0 0 0 2 2 1 0 1]  
[ 0 456 0 0 0 0 0 1 0 0]  
[ 5 7 415 2 5 0 3 2 2 0]  
[ 2 3 14 402 0 7 0 2 3 1] [ 0 8 3 0 381 1 1 2 0 11]  
[ 2 2 1 16 3 344 7 3 1 1]  
[ 14 0 3 1 2 4 404 0 0 0]  
[ 0 6 3 2 6 1 0 396 0 7]  
[ 8 2 2 15 7 24 1 3 344 3]  
[ 2 3 2 10 27 3 0 28 4 355]]

---

Test Size: 0.1      K: 4  
Validation Accuracy: 0.9361904761904762 Confusion Matrix:

[[382 0 0 0 0 2 3 0 0 2]  
[ 0 456 0 0 0 0 1 0 0 0]  
[ 3 4 415 5 3 0 4 2 4 1]  
[ 1 3 7 406 0 6 0 3 5 3]  
[ 0 7 2 0 377 1 1 4 0 15]  
[ 2 0 1 14 2 347 8 3 1 2]  
[ 11 0 2 2 1 4 408 0 0 0] [ 0 4 1 1 7 0 0 397 0 11]  
[ 4 2 2 6 6 15 1 2 367 4]

[ 2 2 2 9 15 2 0 22 3 377]]

---

Test Size: 0.1      K: 5

Validation Accuracy: 0.9378571428571428 Confusion Matrix:

```
[[383 0 0 0 0 2 3 0 0 1]
 [ 0 456 0 0 0 0 1 0 0 0]
 [ 2 7 410 8 4 0 5 3 1 1] [ 1 3 5 404 0 7 0 6 6 2]
 [ 0 7 3 0 376 1 1 5 0 14] [ 3 1 1 10 2 349 8 2 1 3]
 [ 9 0 2 2 1 3 411 0 0 0]
 [ 0 4 2 2 7 0 0 394 0 12]
 [ 5 3 3 5 4 14 1 3 368 3]
 [ 2 2 2 9 10 2 0 15 4 388]]
```

---

Test Size: 0.1      K: 6 Validation Accuracy: 0.935952380952381 Confusion Matrix:

```
[[383 0 0 0 0 2 3 0 0 1]
 [ 0 456 0 0 0 0 1 0 0 0]
 [ 2 6 412 7 3 0 5 3 2 1] [ 1 3 5 406 0 5 0 7 5 2]
 [ 0 7 3 0 378 1 1 5 0 12] [ 3 1 1 13 2 345 9 3 1 2]
 [ 12 0 1 2 1 3 409 0 0 0] [ 0 6 2 2 6 0 0 395 0 10]
 [ 7 2 2 5 4 16 2 3 364 4]
 [ 2 2 2 7 12 2 0 20 4 383]]
```

---

Test Size: 0.1      K: 7

Validation Accuracy: 0.9354761904761905 Confusion Matrix:

```
[[383 0 0 0 0 2 3 0 0 1]
 [ 0 455 0 0 0 0 1 0 0 1]
 [ 4 7 407 8 4 0 5 4 2 0] [ 1 3 5 405 0 5 0 8 5 2]
 [ 0 6 3 0 375 2 1 6 1 13] [ 2 1 1 12 2 347 9 2 1 3] [ 10 0 2 1 1 3 411 0
 0 0]
 [ 0 5 0 2 7 0 0 397 0 10]
 [ 6 2 2 5 4 18 2 2 362 6]
 [ 2 3 2 8 8 3 0 18 3 387]]
```

---

Test Size: 0.1      K: 10

Validation Accuracy: 0.929047619047619 Confusion Matrix:

```
[[382 0 0 0 0 2 4 0 0 1]
 [ 0 454 0 0 0 1 1 0 0 1]
 [ 3 8 404 10 5 0 6 3 2 0]
```

[ 1 5 5 402 0 7 0 7 4 3]  
[ 0 7 2 0 375 3 1 4 1 14]  
[ 2 1 1 14 2 346 10 3 0 1]  
[ 11 0 2 1 1 2 410 0 1 0] [ 0 7 1 2 8 0 0 388 0 15]  
[ 6 3 1 6 5 18 2 2 357 9]  
[ 2 3 1 7 11 2 0 19 5 384]]

---

Test Size: 0.05      K: 2

Validation Accuracy: 0.9214285714285714 Confusion Matrix:

[[208 0 0 0 0 0 1 0 0 1]  
[ 0 215 0 0 0 0 0 0 0 0]  
[ 3 1 200 0 2 0 3 1 1 0]  
[ 1 2 8 199 0 4 0 0 1 0]  
[ 0 2 0 0 181 1 1 1 0 4] [ 1 1 1 8 2 179 6 2 1 0] [ 7 0 2 1 1 2 199 0 0  
0]  
[ 0 4 2 2 4 1 0 207 0 2]  
[ 3 1 2 10 3 13 1 1 188 1]  
[ 1 2 0 7 13 3 0 14 2 159]]

---

Test Size: 0.05      K: 4

Validation Accuracy: 0.9323809523809524 Confusion Matrix:

[[207 0 0 0 0 0 2 0 0 1]  
[ 0 214 0 0 0 0 1 0 0 0]  
[ 2 2 201 0 1 0 2 1 1 1]  
[ 1 2 5 199 0 4 0 1 1 2]  
[ 0 2 0 0 180 1 1 1 0 5]  
[ 1 1 1 8 1 179 6 2 1 1]  
[ 6 0 0 2 1 1 202 0 0 0]  
[ 0 3 1 1 6 0 0 205 0 6]  
[ 3 0 2 4 2 11 0 1 198 2]  
[ 1 2 0 5 7 1 0 10 2 173]]

---

Test Size: 0.05      K: 5

Validation Accuracy: 0.9328571428571428 Confusion Matrix:

[[207 0 0 0 0 0 2 0 0 1]  
[ 0 214 0 0 0 0 1 0 0 0]  
[ 1 3 200 2 2 0 2 1 0 0]  
[ 1 1 3 201 0 4 0 3 1 1] [ 0 1 0 0 179 1 1 1 0 7]  
[ 2 1 1 5 2 180 6 1 1 2]

[ 6 0 1 2 1 1 201 0 0 0]  
[ 0 3 2 2 5 0 0 202 0 8]  
[ 2 1 3 3 2 11 0 1 198 2]  
[ 1 2 0 5 6 2 0 6 2 177]]

---

Test Size: 0.05      K: 6

Validation Accuracy: 0.9304761904761905 Confusion Matrix:

[[207 0 0 0 0 0 2 0 0 1]  
[ 0 214 0 0 0 0 1 0 0 0]  
[ 2 2 200 0 1 0 3 1 1 1]  
[ 1 2 3 199 0 4 0 4 1 1] [ 0 1 0 0 181 1 1 1 0 5] [ 2 1 1 7 2 177 7 2 1 1]  
[ 6 0 0 2 1 1 202 0 0 0]  
[ 0 4 2 2 4 0 0 204 0 6]  
[ 3 0 2 3 2 13 1 1 196 2]  
[ 1 2 0 5 6 2 0 9 2 174]]

---

Test Size: 0.05      K: 7

Validation Accuracy: 0.9314285714285714 Confusion Matrix:

[[207 0 0 0 0 0 2 0 0 1]  
[ 0 214 0 0 0 0 1 0 0 0]  
[ 3 3 197 1 2 0 3 2 0 0]  
[ 1 2 3 198 0 4 0 5 1 1] [ 0 0 0 0 182 1 1 1 0 5]  
[ 1 1 1 7 2 178 7 1 1 2]  
[ 6 0 1 1 1 1 202 0 0 0]  
[ 0 4 0 2 6 0 0 205 0 5]  
[ 3 1 2 3 3 11 0 1 197 2]  
[ 1 2 0 6 5 2 0 7 2 176]]

---

Test Size: 0.05      K: 10 Validation Accuracy: 0.9266666666666666 Confusion Matrix:

[[207 0 0 0 0 0 2 0 0 1]  
[ 0 214 0 0 0 0 1 0 0 0]  
[ 2 3 199 0 2 0 4 1 0 0]  
[ 1 2 4 199 0 3 0 4 1 1]  
[ 0 1 0 0 179 2 1 1 0 6]  
[ 1 1 1 8 2 177 7 2 0 2]  
[ 7 0 1 1 1 1 201 0 0 0]  
[ 0 5 1 2 7 0 0 201 0 6]  
[ 1 1 1 4 2 15 0 1 194 4]

[ 1 2 0 5 5 2 0 8 3 175]]

---