Momentum value: 0

Epoch 0:
Training Accuracy: 10.441666666666666
Test Accuracy: 10.280000000000001

Epoch 1:
Training Accuracy: 88.85499999999999
Test Accuracy: 93.35

Epoch 2:
Training Accuracy: 95.10333333333332
Test Accuracy: 95.3

Epoch 3:
Training Accuracy: 96.44166666666666
Test Accuracy: 96.17999999999999

Epoch 4:
Training Accuracy: 97.10666666666667
Test Accuracy: 96.61999999999999

Epoch 5:
Training Accuracy: 97.48666666666666
Test Accuracy: 96.93

Epoch 6:
Training Accuracy: 97.76166666666667
Test Accuracy: 97.03

Epoch 7:
Training Accuracy: 97.95666666666666
Test Accuracy: 97.14

Epoch 8:
Training Accuracy: 98.15833333333333
Test Accuracy: 97.2

Epoch 9:
Training Accuracy: 98.28
Test Accuracy: 97.28999999999999

Epoch 10:
Training Accuracy: 98.38166666666666
Test Accuracy: 97.31

Epoch 11:
Training Accuracy: 98.495

```
Test Accuracy:  97.32

Epoch 12:
Training Accuracy:  98.56666666666
Test Accuracy:  97.34

Epoch 13:
Training Accuracy:  98.63833333333332
Test Accuracy:  97.33000000000001

Epoch 14:
Training Accuracy:  98.705
Test Accuracy:  97.35000000000001

Epoch 15:
Training Accuracy:  98.75833333333334
Test Accuracy:  97.37

Epoch 16:
Training Accuracy:  98.81666666666666
Test Accuracy:  97.39

Epoch 17:
Training Accuracy:  98.85833333333333
Test Accuracy:  97.39999999999999

Epoch 18:
Training Accuracy:  98.90833333333333
Test Accuracy:  97.43

Epoch 19:
Training Accuracy:  98.93166666666666
Test Accuracy:  97.43

Epoch 20:
Training Accuracy:  98.97833333333334
Test Accuracy:  97.45

Epoch 21:
Training Accuracy:  99.00833333333333
Test Accuracy:  97.5

Epoch 22:
Training Accuracy:  99.05000000000001
Test Accuracy:  97.49

Epoch 23:
Training Accuracy:  99.075
Test Accuracy:  97.47
```

Epoch 24:
Training Accuracy: 99.09666666666666
Test Accuracy: 97.45

Epoch 25:
Training Accuracy: 99.11999999999999
Test Accuracy: 97.41

Epoch 26:
Training Accuracy: 99.16
Test Accuracy: 97.39999999999999

Epoch 27:
Training Accuracy: 99.185
Test Accuracy: 97.37

Epoch 28:
Training Accuracy: 99.20333333333333
Test Accuracy: 97.35000000000001

Epoch 29:
Training Accuracy: 99.22833333333332
Test Accuracy: 97.36

Epoch 30:
Training Accuracy: 99.25166666666667
Test Accuracy: 97.39999999999999

Epoch 31:
Training Accuracy: 99.265
Test Accuracy: 97.41

Epoch 32:
Training Accuracy: 99.28333333333333
Test Accuracy: 97.41

Epoch 33:
Training Accuracy: 99.3
Test Accuracy: 97.44

Epoch 34:
Training Accuracy: 99.315
Test Accuracy: 97.45

Epoch 35:
Training Accuracy: 99.33166666666666
Test Accuracy: 97.46000000000001

Epoch 36:
Training Accuracy: 99.34833333333334

Test Accuracy: 97.48

Epoch 37:
Training Accuracy: 99.36333333333334
Test Accuracy: 97.5

Epoch 38:
Training Accuracy: 99.38
Test Accuracy: 97.47

Epoch 39:
Training Accuracy: 99.385
Test Accuracy: 97.49

Epoch 40:
Training Accuracy: 99.39666666666666
Test Accuracy: 97.47

Epoch 41:
Training Accuracy: 99.41
Test Accuracy: 97.48

Epoch 42:
Training Accuracy: 99.42
Test Accuracy: 97.49

Epoch 43:
Training Accuracy: 99.43666666666667
Test Accuracy: 97.46000000000001

Epoch 44:
Training Accuracy: 99.44333333333333
Test Accuracy: 97.44

Epoch 45:
Training Accuracy: 99.455
Test Accuracy: 97.45

Epoch 46:
Training Accuracy: 99.465
Test Accuracy: 97.47

Epoch 47:
Training Accuracy: 99.47333333333333
Test Accuracy: 97.46000000000001

Epoch 48:
Training Accuracy: 99.48166666666667
Test Accuracy: 97.45

Epoch 49:
Training Accuracy: 99.495
Test Accuracy: 97.44

Epoch 50:
Training Accuracy: 99.50666666666666
Test Accuracy: 97.45

Confusion matrix on test data after training:
```
[[ 973    0    0    2    0    1    0    1    3    0]
 [   0 1123    2    3    0    1    2    2    2    0]
 [   3    3 1001    7    4    0    2    6    5    1]
 [   0    0    4  991    0    8    0    2    2    3]
 [   1    1    4    0  961    0    3    0    2   10]
 [   3    0    1    9    1  856    8    2    6    6]
 [   8    3    1    1    8    3  931    0    3    0]
 [   1    4   10    6    2    0    0  988    3   14]
 [   5    1    2    3    5    2    2    3  946    5]
 [   3    6    0    8    9    1    1    3    3  975]]
```

_____

Momentum value: 0.25

_____

Epoch 0:
Training Accuracy: 9.043333333333333
Test Accuracy: 9.04

Epoch 1:
Training Accuracy: 89.98
Test Accuracy: 93.95

Epoch 2:
Training Accuracy: 95.7
Test Accuracy: 95.92

Epoch 3:
Training Accuracy: 96.87833333333333
Test Accuracy: 96.61

Epoch 4:
Training Accuracy: 97.455
Test Accuracy: 96.88

Epoch 5:
Training Accuracy: 97.76
Test Accuracy: 97.13000000000001

Epoch 6:
Training Accuracy: 98.02
Test Accuracy: 97.3

```
Epoch 7:
Training Accuracy:  98.19833333333334
Test Accuracy:  97.39999999999999

Epoch 8:
Training Accuracy:  98.35666666666667
Test Accuracy:  97.42

Epoch 9:
Training Accuracy:  98.485
Test Accuracy:  97.45

Epoch 10:
Training Accuracy:  98.6
Test Accuracy:  97.52

Epoch 11:
Training Accuracy:  98.68
Test Accuracy:  97.53

Epoch 12:
Training Accuracy:  98.775
Test Accuracy:  97.54

Epoch 13:
Training Accuracy:  98.84666666666668
Test Accuracy:  97.58

Epoch 14:
Training Accuracy:  98.89333333333333
Test Accuracy:  97.61

Epoch 15:
Training Accuracy:  98.93166666666666
Test Accuracy:  97.64

Epoch 16:
Training Accuracy:  98.98
Test Accuracy:  97.65

Epoch 17:
Training Accuracy:  99.015
Test Accuracy:  97.65

Epoch 18:
Training Accuracy:  99.07333333333334
Test Accuracy:  97.63

Epoch 19:
```

Training Accuracy: 99.11166666666
Test Accuracy: 97.63

Epoch 20:
Training Accuracy: 99.14500000000001
Test Accuracy: 97.65

Epoch 21:
Training Accuracy: 99.17666666666666
Test Accuracy: 97.64

Epoch 22:
Training Accuracy: 99.2
Test Accuracy: 97.61999999999999

Epoch 23:
Training Accuracy: 99.22666666666666
Test Accuracy: 97.63

Epoch 24:
Training Accuracy: 99.25500000000001
Test Accuracy: 97.63

Epoch 25:
Training Accuracy: 99.28833333333333
Test Accuracy: 97.65

Epoch 26:
Training Accuracy: 99.31833333333333
Test Accuracy: 97.63

Epoch 27:
Training Accuracy: 99.335
Test Accuracy: 97.64

Epoch 28:
Training Accuracy: 99.34333333333333
Test Accuracy: 97.61

Epoch 29:
Training Accuracy: 99.35333333333334
Test Accuracy: 97.61

Epoch 30:
Training Accuracy: 99.37166666666667
Test Accuracy: 97.63

Epoch 31:
Training Accuracy: 99.38166666666667
Test Accuracy: 97.65

```
Epoch 32:
Training Accuracy:  99.4
Test Accuracy:  97.64

Epoch 33:
Training Accuracy:  99.41333333333333
Test Accuracy:  97.61999999999999

Epoch 34:
Training Accuracy:  99.42166666666667
Test Accuracy:  97.61

Epoch 35:
Training Accuracy:  99.425
Test Accuracy:  97.59

Epoch 36:
Training Accuracy:  99.44666666666667
Test Accuracy:  97.6

Epoch 37:
Training Accuracy:  99.44666666666667
Test Accuracy:  97.6

Epoch 38:
Training Accuracy:  99.45833333333334
Test Accuracy:  97.58

Epoch 39:
Training Accuracy:  99.47166666666666
Test Accuracy:  97.59

Epoch 40:
Training Accuracy:  99.48166666666667
Test Accuracy:  97.6

Epoch 41:
Training Accuracy:  99.49833333333333
Test Accuracy:  97.58

Epoch 42:
Training Accuracy:  99.51333333333334
Test Accuracy:  97.56

Epoch 43:
Training Accuracy:  99.52
Test Accuracy:  97.58

Epoch 44:
```

Training Accuracy: 99.52499999999999
Test Accuracy: 97.6

Epoch 45:
Training Accuracy: 99.53166666666667
Test Accuracy: 97.61

Epoch 46:
Training Accuracy: 99.54166666666666
Test Accuracy: 97.61999999999999

Epoch 47:
Training Accuracy: 99.555
Test Accuracy: 97.61999999999999

Epoch 48:
Training Accuracy: 99.56166666666667
Test Accuracy: 97.63

Epoch 49:
Training Accuracy: 99.57000000000001
Test Accuracy: 97.61999999999999

Epoch 50:
Training Accuracy: 99.575
Test Accuracy: 97.61999999999999

Confusion matrix on test data after training:
```
[[ 972    1    1    0    0    1    2    1    2    0]
 [   0 1121    1    4    0    2    4    1    2    0]
 [   5    1 1008    3    2    1    3    4    5    0]
 [   1    0    2  993    0    5    0    2    3    4]
 [   1    1    2    0  957    0    4    3    2   12]
 [   5    0    1   11    1  858    5    1    6    4]
 [   6    3    1    1    3    5  937    0    2    0]
 [   1    5   11    5    3    0    0  992    4    7]
 [   4    2    2    5    4    5    1    1  946    4]
 [   4    5    0    5    7    2    0    4    4  978]]
```

_____

Momentum value: 0.5

_____

Epoch 0:
Training Accuracy: 9.035
Test Accuracy: 8.92

Epoch 1:
Training Accuracy: 91.55833333333334
Test Accuracy: 94.96

```
Epoch 2:
Training Accuracy:  96.375
Test Accuracy:  96.48

Epoch 3:
Training Accuracy:  97.21666666666667
Test Accuracy:  96.73

Epoch 4:
Training Accuracy:  97.70833333333333
Test Accuracy:  96.89

Epoch 5:
Training Accuracy:  98.00999999999999
Test Accuracy:  97.16

Epoch 6:
Training Accuracy:  98.22666666666666
Test Accuracy:  97.32

Epoch 7:
Training Accuracy:  98.38833333333334
Test Accuracy:  97.39999999999999

Epoch 8:
Training Accuracy:  98.52333333333333
Test Accuracy:  97.46000000000001

Epoch 9:
Training Accuracy:  98.63833333333332
Test Accuracy:  97.45

Epoch 10:
Training Accuracy:  98.74833333333333
Test Accuracy:  97.44

Epoch 11:
Training Accuracy:  98.81
Test Accuracy:  97.47

Epoch 12:
Training Accuracy:  98.89333333333333
Test Accuracy:  97.47

Epoch 13:
Training Accuracy:  98.94500000000001
Test Accuracy:  97.53

Epoch 14:
Training Accuracy:  99.00166666666667
```

Test Accuracy: 97.54

Epoch 15:
Training Accuracy: 99.04833333333333
Test Accuracy: 97.53

Epoch 16:
Training Accuracy: 99.09
Test Accuracy: 97.55

Epoch 17:
Training Accuracy: 99.13333333333333
Test Accuracy: 97.55

Epoch 18:
Training Accuracy: 99.17333333333333
Test Accuracy: 97.56

Epoch 19:
Training Accuracy: 99.20166666666667
Test Accuracy: 97.54

Epoch 20:
Training Accuracy: 99.22833333333332
Test Accuracy: 97.56

Epoch 21:
Training Accuracy: 99.24666666666667
Test Accuracy: 97.53

Epoch 22:
Training Accuracy: 99.25833333333334
Test Accuracy: 97.52

Epoch 23:
Training Accuracy: 99.295
Test Accuracy: 97.53

Epoch 24:
Training Accuracy: 99.31333333333333
Test Accuracy: 97.52

Epoch 25:
Training Accuracy: 99.33333333333333
Test Accuracy: 97.50999999999999

Epoch 26:
Training Accuracy: 99.34666666666668
Test Accuracy: 97.52

Epoch 27:
Training Accuracy: 99.36333333333334
Test Accuracy: 97.52

Epoch 28:
Training Accuracy: 99.38
Test Accuracy: 97.52

Epoch 29:
Training Accuracy: 99.40166666666667
Test Accuracy: 97.52

Epoch 30:
Training Accuracy: 99.40666666666667
Test Accuracy: 97.52

Epoch 31:
Training Accuracy: 99.41666666666666
Test Accuracy: 97.5

Epoch 32:
Training Accuracy: 99.42999999999999
Test Accuracy: 97.48

Epoch 33:
Training Accuracy: 99.44833333333334
Test Accuracy: 97.45

Epoch 34:
Training Accuracy: 99.46333333333334
Test Accuracy: 97.46000000000001

Epoch 35:
Training Accuracy: 99.47166666666666
Test Accuracy: 97.47

Epoch 36:
Training Accuracy: 99.49166666666667
Test Accuracy: 97.5

Epoch 37:
Training Accuracy: 99.50666666666666
Test Accuracy: 97.47

Epoch 38:
Training Accuracy: 99.51666666666667
Test Accuracy: 97.46000000000001

Epoch 39:
Training Accuracy: 99.52499999999999

```
Test Accuracy:  97.46000000000001

Epoch 40:
Training Accuracy:  99.53666666666666
Test Accuracy:  97.45

Epoch 41:
Training Accuracy:  99.54833333333333
Test Accuracy:  97.42

Epoch 42:
Training Accuracy:  99.56333333333333
Test Accuracy:  97.43

Epoch 43:
Training Accuracy:  99.56833333333334
Test Accuracy:  97.41

Epoch 44:
Training Accuracy:  99.57666666666667
Test Accuracy:  97.39

Epoch 45:
Training Accuracy:  99.58333333333333
Test Accuracy:  97.38

Epoch 46:
Training Accuracy:  99.59333333333333
Test Accuracy:  97.35000000000001

Epoch 47:
Training Accuracy:  99.60666666666667
Test Accuracy:  97.33000000000001

Epoch 48:
Training Accuracy:  99.61666666666666
Test Accuracy:  97.28999999999999

Epoch 49:
Training Accuracy:  99.62166666666667
Test Accuracy:  97.31

Epoch 50:
Training Accuracy:  99.625
Test Accuracy:  97.31

Confusion matrix on test data after training:
[[ 971    1    1    1    0    0    2    1    3    0]
 [   0 1123    6    1    0    2    1    0    2    0]
 [   6    1 1004    3    0    0    3    6    7    2]
```

```
 [   1    0    6  980    0   10    1    5    4    3]
 [   3    0    1    1  955    0    5    0    1   16]
 [   4    0    0    8    1  864    5    1    7    2]
 [  10    3    1    0    4    2  931    1    6    0]
 [   1    3    9    1    3    1    0  994    4   12]
 [   7    1    2    4    3   11    1    3  939    3]
 [   3    6    1    4   12    2    0    5    6  970]]
Run time: 133.2255760351817 min

Process finished with exit code 0
```