

BASE

Training dataset size: 50000

Test dataset size: 10000

Start by dividing the data into subsets and applying the transform to these subsets

Training subset size: 5000

Test subset size: 1000

Features loaded from saved files.

Training the MLP model...

Epoch [1/10], Loss: 38.6486

Epoch [2/10], Loss: 17.9683

Epoch [3/10], Loss: 15.2736

Epoch [4/10], Loss: 13.1189

Epoch [5/10], Loss: 11.1622

Epoch [6/10], Loss: 9.9324

Epoch [7/10], Loss: 8.9793

Epoch [8/10], Loss: 9.1623

Epoch [9/10], Loss: 7.6168

Epoch [10/10], Loss: 6.0768

MLP model saved to file

Evaluating the MLP model...

MLP Accuracy: 83.90%

Confusion Matrix (rows = true labels 0-9, columns = predictions):

```
[[87 0 3 1 0 0 0 1 6 2]
 [ 3 91 0 1 0 0 0 0 0 5]
 [ 6 0 71 5 1 6 9 1 1 0]
 [ 1 0 3 76 1 11 7 0 1 0]
 [ 3 0 4 4 78 3 1 7 0 0]
 [ 0 0 5 11 2 76 2 3 1 0]
 [ 1 0 0 4 3 3 88 0 1 0]
 [ 0 0 1 4 4 2 0 89 0 0]
 [ 7 0 1 0 0 0 0 0 89 3]
 [ 0 3 0 0 0 0 0 0 3 94]]
```

Classification Report:

	precision	recall	f1-score	support
0	0.81	0.87	0.84	100
1	0.97	0.91	0.94	100
2	0.81	0.71	0.76	100
3	0.72	0.76	0.74	100
4	0.88	0.78	0.83	100
5	0.75	0.76	0.76	100
6	0.82	0.88	0.85	100
7	0.88	0.89	0.89	100

8	0.87	0.89	0.88	100
9	0.90	0.94	0.92	100

accuracy			0.84	1000
macro avg	0.84	0.84	0.84	1000
weighted avg	0.84	0.84	0.84	1000

NO THIRD LAYER

```
"/Users/mariothomasesposito/Desktop/F2024/COMP
472/ai_project/COMP472Project/.venv/bin/python"
/Users/mariothomasesposito/Desktop/F2024/COMP
472/ai_project/COMP472Project/MLP.py
```

Training dataset size: 50000

Test dataset size: 10000

Start by dividing the data into subsets and applying the transform to these subsets

Training subset size: 5000

Test subset size: 1000

Features loaded from saved files.

Training the MLP model...

Epoch [1/10], Loss: 180.8830

Epoch [2/10], Loss: 103.4373

Epoch [3/10], Loss: 64.3921

Epoch [4/10], Loss: 44.2686

Epoch [5/10], Loss: 34.6322

Epoch [6/10], Loss: 28.8853

Epoch [7/10], Loss: 24.4977

Epoch [8/10], Loss: 21.0033

Epoch [9/10], Loss: 18.0624

Epoch [10/10], Loss: 16.2502

MLP model saved to file

Evaluating the MLP model...

MLP Accuracy: 82.90%

Confusion Matrix (rows = true labels 0-9, columns = predictions):

```
[[85 2 1 2 0 0 0 1 5 4]
 [ 3 90 0 1 0 0 0 0 0 6]
 [ 6 0 76 8 3 4 3 0 0 0]
 [ 0 0 4 70 1 14 9 2 0 0]
 [ 1 0 5 7 75 4 3 4 1 0]
 [ 0 1 6 14 1 74 2 2 0 0]
 [ 1 0 4 3 1 0 90 0 1 0]
 [ 1 0 0 5 8 3 0 83 0 0]
 [ 6 0 1 0 0 0 0 0 91 2]
 [ 1 4 0 0 0 0 0 0 0 95]]
```

Classification Report:

	precision	recall	f1-score	support
0	0.82	0.85	0.83	100
1	0.93	0.90	0.91	100
2	0.78	0.76	0.77	100
3	0.64	0.70	0.67	100
4	0.84	0.75	0.79	100
5	0.75	0.74	0.74	100
6	0.84	0.90	0.87	100
7	0.90	0.83	0.86	100
8	0.93	0.91	0.92	100
9	0.89	0.95	0.92	100
accuracy			0.83	1000
macro avg	0.83	0.83	0.83	1000
weighted avg	0.83	0.83	0.83	1000

EXTRA LAYER ADDED IN BETWEEN 2 AND 3

Training dataset size: 50000

Test dataset size: 10000

Start by dividing the data into subsets and applying the transform to these subsets

Training subset size: 5000

Test subset size: 1000

Features loaded from saved files.

Training the MLP model...

Epoch [1/10], Loss: 57.9382

Epoch [2/10], Loss: 22.1348

Epoch [3/10], Loss: 17.3813

Epoch [4/10], Loss: 14.2459

Epoch [5/10], Loss: 13.2699

Epoch [6/10], Loss: 12.6799

Epoch [7/10], Loss: 10.0642

Epoch [8/10], Loss: 8.7180

Epoch [9/10], Loss: 6.9494

Epoch [10/10], Loss: 6.1210

MLP model saved to file

Evaluating the MLP model...

MLP Accuracy: 82.60%

Confusion Matrix (rows = true labels 0-9, columns = predictions):

```
[[87 0 3 2 0 0 1 0 5 2]
 [ 3 89 0 1 0 0 0 0 0 7]
 [ 6 0 67 8 7 4 7 0 1 0]
```

```
[ 1 0 1 79 3 10 4 1 1 0]
[ 3 0 2 6 81 3 0 5 0 0]
[ 0 0 7 13 3 72 2 2 1 0]
[ 1 0 1 3 7 2 86 0 0 0]
[ 1 0 1 4 11 1 0 82 0 0]
[ 8 0 1 1 0 0 0 0 90 0]
[ 2 2 0 2 0 0 0 0 1 93]]
```

Classification Report:

	precision	recall	f1-score	support
0	0.78	0.87	0.82	100
1	0.98	0.89	0.93	100
2	0.81	0.67	0.73	100
3	0.66	0.79	0.72	100
4	0.72	0.81	0.76	100
5	0.78	0.72	0.75	100
6	0.86	0.86	0.86	100
7	0.91	0.82	0.86	100
8	0.91	0.90	0.90	100
9	0.91	0.93	0.92	100
accuracy			0.83	1000
macro avg	0.83	0.83	0.83	1000
weighted avg	0.83	0.83	0.83	1000

LARGER HIDDEN LAYERS (SIZE = 1024)

Training dataset size: 50000

Test dataset size: 10000

Start by dividing the data into subsets and applying the transform to these subsets

Training subset size: 5000

Test subset size: 1000

Features loaded from saved files.

Training the MLP model...

Epoch [1/10], Loss: 32.9073

Epoch [2/10], Loss: 16.8892

Epoch [3/10], Loss: 13.7007

Epoch [4/10], Loss: 11.3261

Epoch [5/10], Loss: 9.1437

Epoch [6/10], Loss: 7.4597

Epoch [7/10], Loss: 5.9302

Epoch [8/10], Loss: 4.8341

Epoch [9/10], Loss: 4.7302

Epoch [10/10], Loss: 4.2863

MLP model saved to file

Evaluating the MLP model...

MLP Accuracy: 82.80%

Confusion Matrix (rows = true labels 0-9, columns = predictions):

```
[[79 0 1 3 0 0 0 1 13 3]
 [388 0 1 0 0 0 0 0 0 8]
 [5 0 72 7 7 4 4 1 0 0]
 [1 0 174 3 13 6 1 1 0]
 [2 0 2 678 2 1 9 0 0]
 [0 0 6 14 174 2 2 1 0]
 [1 0 2 5 3 385 1 0 0]
 [0 0 1 3 1 3 0 92 0 0]
 [4 0 1 1 0 0 0 0 94 0]
 [1 2 0 2 0 0 1 0 2 92]]
```

Classification Report:

	precision	recall	f1-score	support
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0	0.82	0.79	0.81	100
1	0.98	0.88	0.93	100
2	0.84	0.72	0.77	100
3	0.64	0.74	0.69	100
4	0.84	0.78	0.81	100
5	0.75	0.74	0.74	100
6	0.86	0.85	0.85	100
7	0.86	0.92	0.89	100
8	0.85	0.94	0.89	100
9	0.89	0.92	0.91	100

accuracy			0.83	1000
macro avg	0.83	0.83	0.83	1000
weighted avg	0.83	0.83	0.83	1000

SMALLER HIDDEN LAYERS (SIZE = 256)

Training dataset size: 50000

Test dataset size: 10000

Start by dividing the data into subsets and applying the transform to these subsets

Training subset size: 5000

Test subset size: 1000

Features loaded from saved files.

Training the MLP model...

Epoch [1/10], Loss: 44.8750

Epoch [2/10], Loss: 21.6521

Epoch [3/10], Loss: 17.3382

Epoch [4/10], Loss: 15.0551
Epoch [5/10], Loss: 13.7823
Epoch [6/10], Loss: 13.0527
Epoch [7/10], Loss: 12.3275
Epoch [8/10], Loss: 10.9098
Epoch [9/10], Loss: 9.8252
Epoch [10/10], Loss: 8.7211

MLP model saved to file

Evaluating the MLP model...

MLP Accuracy: 82.70%

Confusion Matrix (rows = true labels 0-9, columns = predictions):

```
[[89 0 3 1 0 0 0 0 4 3]
 [3 90 0 1 0 0 0 0 0 6]
 [5 0 69 10 5 4 7 0 0 0]
 [0 0 4 77 3 9 6 1 0 0]
 [3 0 2 8 81 1 0 5 0 0]
 [0 0 4 18 1 72 2 2 1 0]
 [1 0 1 3 4 0 90 1 0 0]
 [2 0 0 6 11 3 0 78 0 0]
 [9 0 1 1 0 0 0 0 88 1]
 [2 3 0 2 0 0 0 0 0 93]]
```

Classification Report:

	precision	recall	f1-score	support
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0	0.78	0.89	0.83	100
1	0.97	0.90	0.93	100
2	0.82	0.69	0.75	100
3	0.61	0.77	0.68	100
4	0.77	0.81	0.79	100
5	0.81	0.72	0.76	100
6	0.86	0.90	0.88	100
7	0.90	0.78	0.83	100
8	0.95	0.88	0.91	100
9	0.90	0.93	0.92	100

accuracy			0.83	1000
macro avg	0.84	0.83	0.83	1000
weighted avg	0.84	0.83	0.83	1000