```
"C:\Program Files\Python310\python.exe" "D:/□□□□□
□□□□□ □□□□ □□□/□□□□ 2025/□□□□□ □/□□□□□ □□□□□□□ □□□□□
□□□□□ □□□□□/□□□□□□/targil_1/
04_keras_mnist_classification.py"
2025-05-06 14:51:21.357628: I tensorflow/core/util/
port.cc:153] oneDNN custom operations are on. You may
 see slightly different numerical results due to
floating-point round-off errors from different
computation orders. To turn them off, set the
environment variable `TF_ENABLE_ONEDNN_OPTS=0`.
2025-05-06 14:51:24.901420: I tensorflow/core/util/
port.cc:153] oneDNN custom operations are on. You may
 see slightly different numerical results due to
floating-point round-off errors from different
computation orders. To turn them off, set the
environment variable `TF_ENABLE_ONEDNN_OPTS=0`.
37.445728


========== Training: 1. Without augmentation
 ==========
C:\Users\shlom\AppData\Roaming\Python\Python310\site-
packages\keras\src\layers\convolutional\base_conv.py:
107: UserWarning: Do not pass an `input_shape`/`
input_dim` argument to a layer. When using Sequential
 models, prefer using an `Input(shape)` object as the
 first layer in the model instead.
  super().__init__(activity_regularizer=
activity_regularizer, **kwargs)
2025-05-06 14:52:07.304654: I tensorflow/core/
platform/cpu_feature_guard.cc:210] This TensorFlow
binary is optimized to use available CPU instructions
 in performance-critical operations.
To enable the following instructions: SSE3 SSE4.1
SSE4.2 AVX AVX2 AVX512F AVX512_VNNI FMA, in other
operations, rebuild TensorFlow with the appropriate
compiler flags.
Model: "sequential"
┏━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━
━━━━━━┳━━━━━━━━━━━━━━━━━━━┓
┃ Layer (type)                         ┃ Output Shape
              ┃       Param # ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━
━━━━━━╇━━━━━━━━━━━━━━━━━━━┩
```

```
16 | conv2d (Conv2D)                    | (None, 32, 32, 32
   )      |            320 |
17 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
18 | conv2d_1 (Conv2D)                  | (None, 32, 32, 32
   )      |          9,248 |
19 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
20 | max_pooling2d (MaxPooling2D)       | (None, 16, 16, 32
   )      |              0 |
21 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
22 | dropout (Dropout)                  | (None, 16, 16, 32
   )      |              0 |
23 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
24 | conv2d_2 (Conv2D)                  | (None, 16, 16, 64
   )      |         18,496 |
25 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
26 | conv2d_3 (Conv2D)                  | (None, 16, 16, 64
   )      |         36,928 |
27 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
28 | max_pooling2d_1 (MaxPooling2D)     | (None, 8, 8, 64
   )       |              0 |
29 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
30 | dropout_1 (Dropout)                | (None, 8, 8, 64
   )       |              0 |
31 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
32 | conv2d_4 (Conv2D)                  | (None, 8, 8, 128
   )      |         73,856 |
33 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
34 | conv2d_5 (Conv2D)                  | (None, 8, 8, 128
   )      |        147,584 |
35 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
36 | max_pooling2d_2 (MaxPooling2D)     | (None, 4, 4, 128
   )      |              0 |
37 ├──────────────────────────────────────┼──────────────────
   ──────┼──────────────────┤
```

```
38 | dropout_2 (Dropout)                 | (None, 4, 4, 128
   )      |              0 |
39 ├─────────────────────────────────────┼──────────────────
   ──────┼─────────────────┤
40 | flatten (Flatten)                   | (None, 2048
   )           |              0 |
41 ├─────────────────────────────────────┼──────────────────
   ──────┼─────────────────┤
42 | dense (Dense)                       | (None, 512
   )             |      1,049,088 |
43 ├─────────────────────────────────────┼──────────────────
   ──────┼─────────────────┤
44 | dropout_3 (Dropout)                 | (None, 512
   )             |              0 |
45 ├─────────────────────────────────────┼──────────────────
   ──────┼─────────────────┤
46 | dense_1 (Dense)                     | (None, 27
   )             |         13,851 |
47 └─────────────────────────────────────┴──────────────────
   ──────┴─────────────────┘

48  Total params: 1,349,371 (5.15 MB)
49  Trainable params: 1,349,371 (5.15 MB)
50  Non-trainable params: 0 (0.00 B)
51 Epoch 1/50
52 64/64 ━━━━━━━━━━━━━━━━━━━━ 7s 73ms/step - accuracy: 0
   .1617 - loss: 2.9164 - val_accuracy: 0.6482 -
   val_loss: 1.1210
53 Epoch 2/50
54 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 71ms/step - accuracy: 0
   .6191 - loss: 1.2532 - val_accuracy: 0.7945 -
   val_loss: 0.7997
55 Epoch 3/50
56 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 71ms/step - accuracy: 0
   .7159 - loss: 0.9293 - val_accuracy: 0.8261 -
   val_loss: 0.5986
57 Epoch 4/50
58 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 78ms/step - accuracy: 0
   .7650 - loss: 0.7712 - val_accuracy: 0.8577 -
   val_loss: 0.5188
59 Epoch 5/50
60 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 85ms/step - accuracy: 0
   .7979 - loss: 0.6555 - val_accuracy: 0.8498 -
   val_loss: 0.4824
61 Epoch 6/50
```

```
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 78ms/step - accuracy:
0.8149 - loss: 0.6199 - val_accuracy: 0.8577 -
val_loss: 0.4838
Epoch 7/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 77ms/step - accuracy:
0.8549 - loss: 0.4777 - val_accuracy: 0.8814 -
val_loss: 0.4270
Epoch 8/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 72ms/step - accuracy:
0.8511 - loss: 0.4477 - val_accuracy: 0.8893 -
val_loss: 0.4302
Epoch 9/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 73ms/step - accuracy:
0.8668 - loss: 0.4228 - val_accuracy: 0.8854 -
val_loss: 0.4573
Epoch 10/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 74ms/step - accuracy:
0.8728 - loss: 0.3864 - val_accuracy: 0.8696 -
val_loss: 0.4229
Epoch 11/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 73ms/step - accuracy:
0.8924 - loss: 0.3324 - val_accuracy: 0.8775 -
val_loss: 0.4469
Epoch 12/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 74ms/step - accuracy:
0.8939 - loss: 0.3141 - val_accuracy: 0.8814 -
val_loss: 0.5048
Epoch 13/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 78ms/step - accuracy:
0.9018 - loss: 0.2803 - val_accuracy: 0.8814 -
val_loss: 0.5088
Epoch 14/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 79ms/step - accuracy:
0.9064 - loss: 0.2829 - val_accuracy: 0.8735 -
val_loss: 0.4524
Epoch 15/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 78ms/step - accuracy:
0.9188 - loss: 0.2529 - val_accuracy: 0.8893 -
val_loss: 0.4337
Epoch 16/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 73ms/step - accuracy:
0.9200 - loss: 0.2186 - val_accuracy: 0.8933 -
val_loss: 0.5291
Epoch 17/50
```

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 84 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 72ms/step - accuracy:
    0.9343 - loss: 0.2056 - val_accuracy: 0.8933 -
    val_loss: 0.4608
 85 Epoch 18/50
 86 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 72ms/step - accuracy:
    0.9220 - loss: 0.2174 - val_accuracy: 0.8933 -
    val_loss: 0.4404
 87 Epoch 19/50
 88 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 74ms/step - accuracy:
    0.9311 - loss: 0.1922 - val_accuracy: 0.8893 -
    val_loss: 0.5229
 89 Epoch 20/50
 90 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 73ms/step - accuracy:
    0.9349 - loss: 0.1814 - val_accuracy: 0.9051 -
    val_loss: 0.4171
 91 Epoch 21/50
 92 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 75ms/step - accuracy:
    0.9420 - loss: 0.1782 - val_accuracy: 0.9130 -
    val_loss: 0.4127
 93 Epoch 22/50
 94 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 75ms/step - accuracy:
    0.9526 - loss: 0.1401 - val_accuracy: 0.9091 -
    val_loss: 0.5958
 95 Epoch 23/50
 96 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 77ms/step - accuracy:
    0.9432 - loss: 0.1653 - val_accuracy: 0.9051 -
    val_loss: 0.4011
 97 Epoch 24/50
 98 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 76ms/step - accuracy:
    0.9495 - loss: 0.1406 - val_accuracy: 0.8893 -
    val_loss: 0.5741
 99 Epoch 25/50
100 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 79ms/step - accuracy:
    0.9509 - loss: 0.1369 - val_accuracy: 0.8972 -
    val_loss: 0.6121
101 Epoch 26/50
102 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 77ms/step - accuracy:
    0.9585 - loss: 0.1316 - val_accuracy: 0.8854 -
    val_loss: 0.5046
103 Epoch 27/50
104 64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 78ms/step - accuracy:
    0.9619 - loss: 0.1125 - val_accuracy: 0.8933 -
    val_loss: 0.4936
105 Epoch 28/50
```

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64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 81ms/step - accuracy: 0.9538 - loss: 0.1259 - val_accuracy: 0.8775 - val_loss: 0.5369
Epoch 29/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 81ms/step - accuracy: 0.9562 - loss: 0.1360 - val_accuracy: 0.8854 - val_loss: 0.6164
Epoch 30/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 75ms/step - accuracy: 0.9554 - loss: 0.1248 - val_accuracy: 0.8893 - val_loss: 0.5156
Epoch 31/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 74ms/step - accuracy: 0.9673 - loss: 0.1012 - val_accuracy: 0.8735 - val_loss: 0.6816
Epoch 32/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 76ms/step - accuracy: 0.9604 - loss: 0.1141 - val_accuracy: 0.8696 - val_loss: 0.6605
Epoch 33/50
64/64 ━━━━━━━━━━━━━━━━━━━━ 5s 77ms/step - accuracy: 0.9647 - loss: 0.0989 - val_accuracy: 0.8893 - val_loss: 0.5783
Epoch 33: early stopping
Restoring model weights from the end of the best epoch: 23.
Accuracy on test set: 0.8854
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 19ms/step
Per-letter accuracy:
Letter 0: 0.9167
Letter 1: 0.9000
Letter 2: 0.9200
Letter 3: 0.7826
Letter 4: 0.8947
Letter 5: 0.7500
Letter 6: 0.9375
Letter 7: 0.9474
Letter 8: 0.8800
Letter 9: 0.9375
Letter 10: 0.8696
Letter 11: 0.8571
Letter 12: 0.9474
Letter 13: 0.9500
Letter 14: 1.0000
```

```
Letter 15: 0.9412
Letter 16: 0.8667
Letter 17: 1.0000
Letter 18: 0.9167
Letter 19: 0.8182
Letter 20: 0.6000
Letter 21: 0.9500
Letter 22: 0.6471
Letter 23: 0.9167
Letter 24: 0.9565
Letter 25: 0.8750
Letter 26: 0.8000

Average accuracy across all letters: 0.8807
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 12ms/step
Confusion matrix saved to confusion_matrix.csv


========== Training: 2. With augmentation ==========
C:\Users\shlom\AppData\Roaming\Python\Python310\site-packages\keras\src\layers\convolutional\base_conv.py:107: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
Model: "sequential_1"
┌─────────────────────────────────┬────────────────────────┬───────────────┐
│ Layer (type)                    │ Output Shape           │       Param # │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ conv2d_6 (Conv2D)               │ (None, 32, 32, 32)     │           320 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ conv2d_7 (Conv2D)               │ (None, 32, 32, 32)     │         9,248 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ max_pooling2d_3 (MaxPooling2D)  │ (None, 16, 16, 32)     │             0 │
```

```
┏━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━┓
┃ dropout_4 (Dropout)                  ┃ (None, 16, 16, 32)          ┃               0 ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━┩
│ conv2d_8 (Conv2D)                    │ (None, 16, 16, 64)          │          18,496 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ conv2d_9 (Conv2D)                    │ (None, 16, 16, 64)          │          36,928 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ max_pooling2d_4 (MaxPooling2D)       │ (None, 8, 8, 64)            │               0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ dropout_5 (Dropout)                  │ (None, 8, 8, 64)            │               0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ conv2d_10 (Conv2D)                   │ (None, 8, 8, 128)           │          73,856 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ conv2d_11 (Conv2D)                   │ (None, 8, 8, 128)           │         147,584 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ max_pooling2d_5 (MaxPooling2D)       │ (None, 4, 4, 128)           │               0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ dropout_6 (Dropout)                  │ (None, 4, 4, 128)           │               0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ flatten_1 (Flatten)                  │ (None, 2048)                │               0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ dense_2 (Dense)                      │ (None, 512)                 │       1,049,088 │
```

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┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┿━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┿━━━━━━━━━━━━━━━━━┩
│ dropout_7 (Dropout)                  │ (None, 512)                 │               0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ dense_3 (Dense)                      │ (None, 27)                  │          13,851 │
└──────────────────────────────────────┴─────────────────────────────┴─────────────────┘
 Total params: 1,349,371 (5.15 MB)
 Trainable params: 1,349,371 (5.15 MB)
 Non-trainable params: 0 (0.00 B)
C:\Users\shlom\AppData\Roaming\Python\Python310\site-packages\keras\src\trainers\data_adapters\py_dataset_adapter.py:121: UserWarning: Your `PyDataset` class should call `super().__init__(**kwargs)` in its constructor. `**kwargs` can include `workers`, `use_multiprocessing`, `max_queue_size`. Do not pass these arguments to `fit()`, as they will be ignored.
  self._warn_if_super_not_called()
Epoch 1/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 6s 74ms/step - accuracy: 0.0352 - loss: 3.2958 - val_accuracy: 0.0198 - val_loss: 3.2955
Epoch 2/50
 1/63 ━━━━━━━━━━━━━━━━━━━━ 2s 48ms/step - accuracy: 0.0156 - loss: 3.2955C:\Users\shlom\AppData\Roaming\Python\Python310\site-packages\keras\src\trainers\epoch_iterator.py:107: UserWarning: Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches. You may need to use the `.repeat()` function when building your dataset.
  self._interrupted_warning()
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.0156 - loss: 3.2955 - val_accuracy: 0.0198 - val_loss: 3.2955
Epoch 3/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 84ms/step - accuracy: 0.0426 - loss: 3.2953 - val_accuracy: 0.0474 - val_loss: 3.2948
```

```
Epoch 4/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.0312 - loss: 3.2968 - val_accuracy: 0.0514 - val_loss: 3.2948
Epoch 5/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 6s 88ms/step - accuracy: 0.0404 - loss: 3.2955 - val_accuracy: 0.0435 - val_loss: 3.2942
Epoch 6/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.0156 - loss: 3.2994 - val_accuracy: 0.0435 - val_loss: 3.2941
Epoch 7/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 86ms/step - accuracy: 0.0445 - loss: 3.2944 - val_accuracy: 0.0553 - val_loss: 3.2933
Epoch 8/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.0469 - loss: 3.3002 - val_accuracy: 0.0553 - val_loss: 3.2933
Epoch 9/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 81ms/step - accuracy: 0.0439 - loss: 3.2941 - val_accuracy: 0.0553 - val_loss: 3.2927
Epoch 10/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.0156 - loss: 3.2954 - val_accuracy: 0.0553 - val_loss: 3.2928
Epoch 11/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 84ms/step - accuracy: 0.0430 - loss: 3.2936 - val_accuracy: 0.0553 - val_loss: 3.2928
Epoch 12/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.0469 - loss: 3.2953 - val_accuracy: 0.0553 - val_loss: 3.2927
Epoch 13/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 78ms/step - accuracy: 0.0436 - loss: 3.2942 - val_accuracy: 0.0553 - val_loss: 3.2925
Epoch 14/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.0625 - loss: 3.2942 - val_accuracy: 0.0553 - val_loss: 3.2925
```

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Epoch 15/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 80ms/step - accuracy:
    0.0450 - loss: 3.2939 - val_accuracy: 0.0553 -
    val_loss: 3.2919
Epoch 16/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0
    .0156 - loss: 3.3012 - val_accuracy: 0.0553 -
    val_loss: 3.2919
Epoch 17/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 84ms/step - accuracy:
    0.0465 - loss: 3.2928 - val_accuracy: 0.0553 -
    val_loss: 3.2915
Epoch 18/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0
    .0156 - loss: 3.2936 - val_accuracy: 0.0553 -
    val_loss: 3.2915
Epoch 19/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 86ms/step - accuracy:
    0.0465 - loss: 3.2931 - val_accuracy: 0.0553 -
    val_loss: 3.2917
Epoch 20/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0
    .0156 - loss: 3.2950 - val_accuracy: 0.0553 -
    val_loss: 3.2917
Epoch 21/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 85ms/step - accuracy:
    0.0389 - loss: 3.2942 - val_accuracy: 0.0553 -
    val_loss: 3.2913
Epoch 22/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0
    .0469 - loss: 3.2907 - val_accuracy: 0.0553 -
    val_loss: 3.2913
Epoch 23/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 79ms/step - accuracy:
    0.0394 - loss: 3.2937 - val_accuracy: 0.0553 -
    val_loss: 3.2911
Epoch 24/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0
    .0469 - loss: 3.2962 - val_accuracy: 0.0553 -
    val_loss: 3.2911
Epoch 25/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 6s 90ms/step - accuracy:
    0.0420 - loss: 3.2930 - val_accuracy: 0.0553 -
    val_loss: 3.2910
```

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Epoch 26/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0
    .0312 - loss: 3.2973 - val_accuracy: 0.0553 -
    val_loss: 3.2910
Epoch 27/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 6s 98ms/step - accuracy:
    0.0441 - loss: 3.2932 - val_accuracy: 0.0553 -
    val_loss: 3.2907
Epoch 28/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0
    .0312 - loss: 3.2872 - val_accuracy: 0.0553 -
    val_loss: 3.2907
Epoch 29/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 7s 118ms/step - accuracy
    : 0.0395 - loss: 3.2940 - val_accuracy: 0.0553 -
    val_loss: 3.2907
Epoch 30/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0
    .0781 - loss: 3.2924 - val_accuracy: 0.0553 -
    val_loss: 3.2906
Epoch 31/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 7s 106ms/step - accuracy
    : 0.0396 - loss: 3.2942 - val_accuracy: 0.0553 -
    val_loss: 3.2907
Epoch 32/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0
    .0781 - loss: 3.2923 - val_accuracy: 0.0553 -
    val_loss: 3.2907
Epoch 33/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 80ms/step - accuracy:
    0.0494 - loss: 3.2910 - val_accuracy: 0.0553 -
    val_loss: 3.2903
Epoch 34/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0
    .0625 - loss: 3.3016 - val_accuracy: 0.0553 -
    val_loss: 3.2903
Epoch 35/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 79ms/step - accuracy:
    0.0415 - loss: 3.2949 - val_accuracy: 0.0553 -
    val_loss: 3.2904
Epoch 36/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0
    .0469 - loss: 3.2926 - val_accuracy: 0.0553 -
    val_loss: 3.2904
```

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Epoch 37/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 86ms/step - accuracy:
    0.0441 - loss: 3.2934 - val_accuracy: 0.0553 -
    val_loss: 3.2903
Epoch 38/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0
    .0156 - loss: 3.3012 - val_accuracy: 0.0553 -
    val_loss: 3.2903
Epoch 39/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 84ms/step - accuracy:
    0.0400 - loss: 3.2945 - val_accuracy: 0.0553 -
    val_loss: 3.2905
Epoch 40/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0
    .0938 - loss: 3.2883 - val_accuracy: 0.0553 -
    val_loss: 3.2905
Epoch 41/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 5s 85ms/step - accuracy:
    0.0388 - loss: 3.2940 - val_accuracy: 0.0553 -
    val_loss: 3.2901
Epoch 42/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0
    .0312 - loss: 3.2954 - val_accuracy: 0.0553 -
    val_loss: 3.2901
Epoch 43/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 6s 101ms/step - accuracy
    : 0.0469 - loss: 3.2926 - val_accuracy: 0.0553 -
    val_loss: 3.2899
Epoch 44/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 1s 8ms/step - accuracy: 0
    .0469 - loss: 3.3025 - val_accuracy: 0.0553 -
    val_loss: 3.2899
Epoch 45/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 7s 108ms/step - accuracy
    : 0.0404 - loss: 3.2929 - val_accuracy: 0.0553 -
    val_loss: 3.2899
Epoch 46/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0
    .0469 - loss: 3.2896 - val_accuracy: 0.0553 -
    val_loss: 3.2899
Epoch 47/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 7s 106ms/step - accuracy
    : 0.0434 - loss: 3.2940 - val_accuracy: 0.0553 -
    val_loss: 3.2898
```

```
Epoch 48/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.0625 - loss: 3.2789 - val_accuracy: 0.0553 - val_loss: 3.2898
Epoch 49/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 6s 100ms/step - accuracy: 0.0432 - loss: 3.2931 - val_accuracy: 0.0553 - val_loss: 3.2898
Epoch 50/50
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.0625 - loss: 3.2823 - val_accuracy: 0.0553 - val_loss: 3.2898
Restoring model weights from the end of the best epoch: 49.
Accuracy on test set: 0.0455


===== Results Summary =====
Configuration: 1. Without augmentation, Test Accuracy: 0.8854
Configuration: 2. With augmentation, Test Accuracy: 0.0455

Process finished with exit code 0

```