

```

Time
#
Log Message
6.3s 0 0.00s - Debugger warning: It seems that frozen modules are being used, which may
6.3s 1 0.00s - make the debugger miss breakpoints. Please pass -Xfrozen_modules=off
6.3s 2 0.00s - to python to disable frozen modules.
6.3s 3 0.00s - Note: Debugging will proceed. Set PYDEVD_DISABLE_FILE_VALIDATION=1 to disable this validation.
6.8s 4 0.00s - Debugger warning: It seems that frozen modules are being used, which may
6.8s 5 0.00s - make the debugger miss breakpoints. Please pass -Xfrozen_modules=off
6.8s 6 0.00s - to python to disable frozen modules.
6.8s 7 0.00s - Note: Debugging will proceed. Set PYDEVD_DISABLE_FILE_VALIDATION=1 to disable this validation.
20.0s 8 Using device: cuda
20.0s 9
20.3s 10 Dataset downloaded to: /kaggle/input/asl-alphabet
20.3s 11
20.3s 12 Training path: /kaggle/input/asl-alphabet/asl_alphabet_train/asl_alphabet_train
20.3s 13 Test path: /kaggle/input/asl-alphabet/asl_alphabet_test/asl_alphabet_test
20.3s 14
160.4s 15 ✓ Training set loaded: 87000 images
160.4s 16 ✓ Number of classes: 29
160.4s 17 ✓ Classes: ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'M', 'N', 'O', 'P', 'Q', 'R', 'S', 'T', 'U', 'V', 'W', 'X', 'Y', 'Z',
'del', 'nothing', 'space']
160.4s 18
160.4s 19 ✓ Train/Val split created:
160.4s 20 Train: 69600 images
160.4s 21 Val: 17400 images
160.4s 22
160.4s 23 =====
160.4s 24 DATA AUGMENTATION STRATEGY
160.4s 25 =====
160.4s 26
160.4s 27 Training Set Augmentations:
160.4s 28 1. Geometric:
160.4s 29 - Random horizontal flip (50%)
160.4s 30 - Random rotation ( $\pm 15^\circ$ )
160.4s 31 - Random translation ( $\pm 10\%$ )
160.4s 32
160.4s 33 2. Color/Brightness:
160.4s 34 - Brightness ( $\pm 30\%$ )
160.4s 35 - Contrast ( $\pm 30\%$ )
160.4s 36 - Saturation ( $\pm 20\%$ )
160.4s 37 - Hue ( $\pm 10\%$ )
160.4s 38
160.4s 39 3. Blur: Gaussian blur for camera simulation
160.4s 40
160.4s 41 Validation & Test: No augmentation (consistent evaluation)
160.4s 42
160.4s 43 =====
160.4s 44
229.6s 45 Found 28 test images
229.6s 46 ✓ Test set loaded: 28 images
229.6s 47
229.6s 48 =====
229.6s 49 HYPERPARAMETER CONFIGURATION
229.6s 50 =====
229.6s 51
229.6s 52 T-A:
229.6s 53 num_epochs : 5
229.6s 54 batch_size : 128
229.6s 55 lr : 0.01
229.6s 56 weight_decay : 1e-05

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229.6s 57 optimizer : Adam
229.6s 58
229.6s 59 T-B:
229.6s 60 num_epochs : 5
229.6s 61 batch_size : 64
229.6s 62 lr : 0.0005
229.6s 63 weight_decay : 0.0001
229.6s 64 optimizer : Adam
229.6s 65
229.6s 66 T-C:
229.6s 67 num_epochs : 5
229.6s 68 batch_size : 64
229.6s 69 lr : 0.0001
229.6s 70 weight_decay : 0.0001
229.6s 71 optimizer : Adam
229.6s 72
229.6s 73 S-A:
229.6s 74 num_epochs : 5
229.6s 75 batch_size : 32
229.6s 76 lr : 0.001
229.6s 77 weight_decay : 0.0001
229.6s 78 optimizer : SGD
229.6s 79
229.8s 80 =====
229.8s 81 TRAINING: T-A (Head Only)
229.8s 82 =====
229.8s 83 LR=0.01, BatchSize=128, Optimizer=Adam, Epochs=5
229.8s 84
303.9s 85 Downloading: "https://download.pytorch.org/models/resnet18-f37072fd.pth" to
/root/.cache/torch/hub/checkpoints/resnet18-f37072fd.pth
303.9s 86
303.9s 87 Downloading: "https://download.pytorch.org/models/resnet18-f37072fd.pth" to
/root/.cache/torch/hub/checkpoints/resnet18-f37072fd.pth
303.9s 88
0%| | 0.00/44.7M [00:00<?, ?B/s]
304.0s 89
0%| | 0.00/44.7M [00:00<?, ?B/s]
16%|█ | 7.12M/44.7M [00:00<00:00, 74.2MB/s]
304.1s 90
16%|█ | 7.12M/44.7M [00:00<00:00, 74.2MB/s]
57%|█████ | 25.2M/44.7M [00:00<00:00, 142MB/s]
304.2s 91
57%|█████ | 25.2M/44.7M [00:00<00:00, 142MB/s]
97%|█████████ | 43.2M/44.7M [00:00<00:00, 163MB/s]
304.2s 92
97%|█████████ | 43.2M/44.7M [00:00<00:00, 163MB/s]
100%|██████████ | 44.7M/44.7M [00:00<00:00, 152MB/s]
304.3s 93
100%|██████████ | 44.7M/44.7M [00:00<00:00, 152MB/s]
304.3s 94
304.3s 95
304.5s 96 ✓ Created ResNet-18 with ImageNet weights
304.5s 97 Policy T-A: 14,877 / 11,191,389 parameters trainable
944.7s 98 [T-A] Epoch 01/05 | Train Loss: 1.1893, Acc: 0.6616, F1: 0.6604 | Val Loss: 0.6347, Acc: 0.7940, F1: 0.7920
1426.7s 99 [T-A] Epoch 02/05 | Train Loss: 0.7789, Acc: 0.7566, F1: 0.7562 | Val Loss: 0.6477, Acc: 0.7903, F1: 0.7886
1906.2s 100 [T-A] Epoch 03/05 | Train Loss: 0.7453, Acc: 0.7699, F1: 0.7695 | Val Loss: 0.6779, Acc: 0.7841, F1: 0.7825
2391.4s 101 [T-A] Epoch 04/05 | Train Loss: 0.7525, Acc: 0.7730, F1: 0.7727 | Val Loss: 0.4674, Acc: 0.8451, F1: 0.8450
2880.9s 102 [T-A] Epoch 05/05 | Train Loss: 0.7066, Acc: 0.7885, F1: 0.7883 | Val Loss: 0.5344, Acc: 0.8228, F1: 0.8225
2880.9s 103
2880.9s 104 [T-A] Best val macro-F1: 0.8450
2880.9s 105

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2880.9s 106      ✓ Saved T-A checkpoint
2880.9s 107
2881.1s 108      =====
2881.1s 109      TRAINING: T-B (Last Block + Head)
2881.1s 110      =====
2881.1s 111      LR=0.0005, BatchSize=64, Optimizer=Adam, Epochs=5
2881.1s 112
2949.0s 113      ✓ Created ResNet-18 with ImageNet weights
2949.0s 114      Policy T-B: 8,408,605 / 11,191,389 parameters trainable
3437.3s 115      [T-B] Epoch 01/05 | Train Loss: 0.1386, Acc: 0.9634, F1: 0.9634 | Val Loss: 0.0239, Acc: 0.9924, F1: 0.9924
6.3s    116      0.00s - Debugger warning: It seems that frozen modules are being used, which may
6.3s    117      0.00s - make the debugger miss breakpoints. Please pass -Xfrozen_modules=off
6.3s    118      0.00s - to python to disable frozen modules.
6.3s    119      0.00s - Note: Debugging will proceed. Set PYDEVD_DISABLE_FILE_VALIDATION=1 to disable this validation.
6.8s    120      0.00s - Debugger warning: It seems that frozen modules are being used, which may
6.8s    121      0.00s - make the debugger miss breakpoints. Please pass -Xfrozen_modules=off
6.8s    122      0.00s - to python to disable frozen modules.
6.8s    123      0.00s - Note: Debugging will proceed. Set PYDEVD_DISABLE_FILE_VALIDATION=1 to disable this validation.
303.9s  124      Downloading: "https://download.pytorch.org/models/resnet18-f37072fd.pth" to
/root/.cache/torch/hub/checkpoints/resnet18-f37072fd.pth
303.9s  125
303.9s  126      Downloading: "https://download.pytorch.org/models/resnet18-f37072fd.pth" to
/root/.cache/torch/hub/checkpoints/resnet18-f37072fd.pth
303.9s  127
0%|      | 0.00/44.7M [00:00<?, ?B/s]
304.0s  128
0%|      | 0.00/44.7M [00:00<?, ?B/s]
16%|█    | 7.12M/44.7M [00:00<00:00, 74.2MB/s]
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57%|███   | 25.2M/44.7M [00:00<00:00, 142MB/s]
97%|█████ | 43.2M/44.7M [00:00<00:00, 163MB/s]
304.2s  131
97%|█████ | 43.2M/44.7M [00:00<00:00, 163MB/s]
100%|█████| 44.7M/44.7M [00:00<00:00, 152MB/s]
304.3s  132
100%|█████| 44.7M/44.7M [00:00<00:00, 152MB/s]
304.3s  133
304.3s  134
11278.1s 135      /usr/local/lib/python3.11/dist-packages/traitlets/traitlets.py:2915: FutureWarning:
--Exporter.preprocessors=["remove_papermill_header.RemovePapermillHeader"] for containers is deprecated in traitlets 5.0. You
can pass `--Exporter.preprocessors item` ... multiple times to add items to a list.
11278.1s 136      warn(
11278.1s 137      [NbConvertApp] Converting notebook __notebook__.ipynb to notebook
11278.4s 138      [NbConvertApp] Writing 469372 bytes to __notebook__.ipynb
11280.9s 139      /usr/local/lib/python3.11/dist-packages/traitlets/traitlets.py:2915: FutureWarning:
--Exporter.preprocessors=["nbconvert.preprocessors.ExtractOutputPreprocessor"] for containers is deprecated in traitlets 5.0. You
can pass `--Exporter.preprocessors item` ... multiple times to add items to a list.
11280.9s 140      warn(
11281.0s 141      [NbConvertApp] Converting notebook __notebook__.ipynb to html
11281.8s 142      [NbConvertApp] Support files will be in __results__files/
11281.8s 143      [NbConvertApp] Making directory __results__files
11281.8s 144      [NbConvertApp] Making directory __results__files
11281.8s 145      [NbConvertApp] Making directory __results__files
11281.8s 146      [NbConvertApp] Writing 477437 bytes to __results__.html
20.0s   147      Using device: cuda
20.0s   148
20.3s   149      Dataset downloaded to: /kaggle/input/asl-alphabet
20.3s   150

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20.3s 151 Training path: /kaggle/input/asl-alphabet/asl_alphabet_train/asl_alphabet_train
20.3s 152 Test path: /kaggle/input/asl-alphabet/asl_alphabet_test/asl_alphabet_test
20.3s 153
160.4s 154 ✓ Training set loaded: 87000 images
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'del', 'nothing', 'space']
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160.4s 160 Val: 17400 images
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160.4s 162 =====
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160.4s 165
160.4s 166 Training Set Augmentations:
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160.4s 174 - Contrast ( $\pm 30\%$ )
160.4s 175 - Saturation ( $\pm 20\%$ )
160.4s 176 - Hue ( $\pm 10\%$ )
160.4s 177
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160.4s 180 Validation & Test: No augmentation (consistent evaluation)
160.4s 181
160.4s 182 =====
160.4s 183
229.6s 184 Found 28 test images
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229.6s 187 =====
229.6s 188 HYPERPARAMETER CONFIGURATION
229.6s 189 =====
229.6s 190
229.6s 191 T-A:
229.6s 192 num_epochs : 5
229.6s 193 batch_size : 128
229.6s 194 lr : 0.01
229.6s 195 weight_decay : 1e-05
229.6s 196 optimizer : Adam
229.6s 197
229.6s 198 T-B:
229.6s 199 num_epochs : 5
229.6s 200 batch_size : 64
229.6s 201 lr : 0.0005
229.6s 202 weight_decay : 0.0001
229.6s 203 optimizer : Adam
229.6s 204
229.6s 205 T-C:
229.6s 206 num_epochs : 5
229.6s 207 batch_size : 64
229.6s 208 lr : 0.0001
229.6s 209 weight_decay : 0.0001
229.6s 210 optimizer : Adam
```

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229.6s 211
229.6s 212 S-A:
229.6s 213     num_epochs : 5
229.6s 214     batch_size : 32
229.6s 215     lr         : 0.001
229.6s 216     weight_decay : 0.0001
229.6s 217     optimizer   : SGD
229.6s 218
229.8s 219 =====
229.8s 220 TRAINING: T-A (Head Only)
229.8s 221 =====
229.8s 222 LR=0.01, BatchSize=128, Optimizer=Adam, Epochs=5
229.8s 223
304.5s 224 ✓ Created ResNet-18 with ImageNet weights
304.5s 225 Policy T-A: 14,877 / 11,191,389 parameters trainable
944.7s 226 [T-A] Epoch 01/05 | Train Loss: 1.1893, Acc: 0.6616, F1: 0.6604 | Val Loss: 0.6347, Acc: 0.7940, F1: 0.7920
1426.7s 227 [T-A] Epoch 02/05 | Train Loss: 0.7789, Acc: 0.7566, F1: 0.7562 | Val Loss: 0.6477, Acc: 0.7903, F1: 0.7886
1906.2s 228 [T-A] Epoch 03/05 | Train Loss: 0.7453, Acc: 0.7699, F1: 0.7695 | Val Loss: 0.6779, Acc: 0.7841, F1: 0.7825
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2880.9s 230 [T-A] Epoch 05/05 | Train Loss: 0.7066, Acc: 0.7885, F1: 0.7883 | Val Loss: 0.5344, Acc: 0.8228, F1: 0.8225
2880.9s 231
2880.9s 232 [T-A] Best val macro-F1: 0.8450
2880.9s 233
2880.9s 234 ✓ Saved T-A checkpoint
2880.9s 235
2881.1s 236 =====
2881.1s 237 TRAINING: T-B (Last Block + Head)
2881.1s 238 =====
2881.1s 239 LR=0.0005, BatchSize=64, Optimizer=Adam, Epochs=5
2881.1s 240
2949.0s 241 ✓ Created ResNet-18 with ImageNet weights
2949.0s 242 Policy T-B: 8,408,605 / 11,191,389 parameters trainable
3437.3s 243 [T-B] Epoch 01/05 | Train Loss: 0.1386, Acc: 0.9634, F1: 0.9634 | Val Loss: 0.0239, Acc: 0.9924, F1: 0.9924
4117.0s 244 [T-B] Epoch 02/05 | Train Loss: 0.0398, Acc: 0.9879, F1: 0.9879 | Val Loss: 0.0122, Acc: 0.9972, F1: 0.9972
5002.5s 245 [T-B] Epoch 03/05 | Train Loss: 0.0311, Acc: 0.9910, F1: 0.9910 | Val Loss: 0.0174, Acc: 0.9944, F1: 0.9944
5500.2s 246 [T-B] Epoch 04/05 | Train Loss: 0.0274, Acc: 0.9920, F1: 0.9920 | Val Loss: 0.0103, Acc: 0.9963, F1: 0.9963
5981.9s 247 [T-B] Epoch 05/05 | Train Loss: 0.0267, Acc: 0.9925, F1: 0.9925 | Val Loss: 0.0096, Acc: 0.9975, F1: 0.9975
5981.9s 248
5981.9s 249 [T-B] Best val macro-F1: 0.9975
5981.9s 250
5981.9s 251 ✓ Saved T-B checkpoint
5981.9s 252
5981.9s 253 =====
5981.9s 254 TRAINING: T-C (Progressive Unfreezing)
5981.9s 255 =====
5981.9s 256 LR=0.0001, BatchSize=64, Optimizer=Adam, Epochs=5
5981.9s 257
6027.6s 258 ✓ Created ResNet-18 with ImageNet weights
6027.6s 259 Loaded T-B checkpoint from epoch 5 (val F1: 0.9975)
6027.6s 260
6027.6s 261 Policy T-C: 10,508,317 / 11,191,389 parameters trainable
6509.9s 262 [T-C] Epoch 01/05 | Train Loss: 0.0115, Acc: 0.9968, F1: 0.9968 | Val Loss: 0.0011, Acc: 0.9999, F1: 0.9999
7002.6s 263 [T-C] Epoch 02/05 | Train Loss: 0.0070, Acc: 0.9980, F1: 0.9980 | Val Loss: 0.0027, Acc: 0.9993, F1: 0.9993
7492.6s 264 [T-C] Epoch 03/05 | Train Loss: 0.0049, Acc: 0.9988, F1: 0.9988 | Val Loss: 0.0017, Acc: 0.9998, F1: 0.9998
7979.4s 265 [T-C] Epoch 04/05 | Train Loss: 0.0054, Acc: 0.9987, F1: 0.9987 | Val Loss: 0.0007, Acc: 0.9999, F1: 0.9999
8475.0s 266 [T-C] Epoch 05/05 | Train Loss: 0.0057, Acc: 0.9988, F1: 0.9988 | Val Loss: 0.0012, Acc: 0.9998, F1: 0.9998
8475.0s 267
8475.0s 268 [T-C] Best val macro-F1: 0.9999
8475.0s 269
8475.0s 270 ✓ Saved T-C checkpoint
8475.0s 271

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8475.0s 272 =====
8475.0s 273 TRAINING: S-A (Train from Scratch)
8475.0s 274 =====
8475.0s 275 LR=0.001, BatchSize=32, Optimizer=SGD, Epochs=5
8475.0s 276
8536.6s 277 ✓ Created ResNet-18 from scratch
8536.6s 278 Policy S-A: 11,191,389 / 11,191,389 parameters trainable
9065.9s 279 [S-A] Epoch 01/05 | Train Loss: 2.1557, Acc: 0.3599, F1: 0.3528 | Val Loss: 0.7004, Acc: 0.7931, F1: 0.7903
9581.6s 280 [S-A] Epoch 02/05 | Train Loss: 0.5709, Acc: 0.8237, F1: 0.8232 | Val Loss: 0.1734, Acc: 0.9460, F1: 0.9461
10101.0s 281 [S-A] Epoch 03/05 | Train Loss: 0.2290, Acc: 0.9323, F1: 0.9323 | Val Loss: 0.0730, Acc: 0.9806, F1: 0.9806
10616.9s 282 [S-A] Epoch 04/05 | Train Loss: 0.1313, Acc: 0.9623, F1: 0.9623 | Val Loss: 0.0584, Acc: 0.9851, F1: 0.9852
11131.4s 283 [S-A] Epoch 05/05 | Train Loss: 0.0824, Acc: 0.9769, F1: 0.9769 | Val Loss: 0.0444, Acc: 0.9872, F1: 0.9872
11131.4s 284
11131.4s 285 [S-A] Best val macro-F1: 0.9872
11131.4s 286
11131.4s 287 ✓ Saved S-A checkpoint
11131.4s 288
11131.5s 289 =====
11131.5s 290 ABLATION STUDY: Comparing All 4 Models on Validation Set
11131.5s 291 =====
11131.5s 292
11131.6s 293 ✓ Created ResNet-18 with ImageNet weights
11163.0s 294 T-A | Loss: 0.5344 | Acc: 0.8228 | F1: 0.8225
11163.1s 295 ✓ Created ResNet-18 with ImageNet weights
11194.8s 296 T-B | Loss: 0.0096 | Acc: 0.9975 | F1: 0.9975
11194.8s 297 ✓ Created ResNet-18 with ImageNet weights
11227.2s 298 T-C | Loss: 0.0012 | Acc: 0.9998 | F1: 0.9998
11227.2s 299 ✓ Created ResNet-18 from scratch
11258.6s 300 S-A | Loss: 0.0444 | Acc: 0.9872 | F1: 0.9872
11258.6s 301
11258.6s 302 ✓ Best model: T-C (F1: 0.9998)
11258.6s 303
11260.5s 304 ✓ Training curves saved to training_curves.png
11260.5s 305
11260.7s 306 =====
11260.7s 307 EVALUATING BEST MODEL ON ORIGINAL TEST SET (28 IMAGES)
11260.7s 308 =====
11260.7s 309
11260.7s 310 ✓ Found checkpoint: T-A
11260.7s 311 ✓ Found checkpoint: T-B
11260.7s 312 ✓ Found checkpoint: T-C
11260.7s 313 ✓ Found checkpoint: S-A
11260.7s 314
11260.7s 315 Using T-C as best model
11260.7s 316
11260.7s 317 Loading checkpoint: checkpoints/resnet18_T-C_best.pth
11260.7s 318
11260.9s 319 ✓ Created ResNet-18 with ImageNet weights
11260.9s 320 Loaded T-C model from epoch 1
11260.9s 321 (Val F1 at checkpoint: 0.9999)
11260.9s 322
11261.9s 323 Test Set Results (T-C):
11261.9s 324 Accuracy: 1.0000
11261.9s 325 Macro-F1: 1.0000
11261.9s 326 Images tested: 28
11261.9s 327 Confusion Matrix shape: (28, 28)
11261.9s 328
11261.9s 329 Individual Test Predictions:
11261.9s 330 -----
11261.9s 331 ✓ CORRECT | File: A_test.jpg | Predicted: A | True: A
11261.9s 332 ✓ CORRECT | File: B_test.jpg | Predicted: B | True: B

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11261.9s 333      ✓ CORRECT | File: C_test.jpg      | Predicted: C      | True: C
11261.9s 334      ✓ CORRECT | File: D_test.jpg      | Predicted: D      | True: D
11261.9s 335      ✓ CORRECT | File: E_test.jpg      | Predicted: E      | True: E
11261.9s 336      ✓ CORRECT | File: F_test.jpg      | Predicted: F      | True: F
11261.9s 337      ✓ CORRECT | File: G_test.jpg      | Predicted: G      | True: G
11261.9s 338      ✓ CORRECT | File: H_test.jpg      | Predicted: H      | True: H
11261.9s 339      ✓ CORRECT | File: I_test.jpg      | Predicted: I      | True: I
11261.9s 340      ✓ CORRECT | File: J_test.jpg      | Predicted: J      | True: J
11261.9s 341      ✓ CORRECT | File: K_test.jpg      | Predicted: K      | True: K
11261.9s 342      ✓ CORRECT | File: L_test.jpg      | Predicted: L      | True: L
11261.9s 343      ✓ CORRECT | File: M_test.jpg      | Predicted: M      | True: M
11261.9s 344      ✓ CORRECT | File: N_test.jpg      | Predicted: N      | True: N
11261.9s 345      ✓ CORRECT | File: O_test.jpg      | Predicted: O      | True: O
11261.9s 346      ✓ CORRECT | File: P_test.jpg      | Predicted: P      | True: P
11261.9s 347      ✓ CORRECT | File: Q_test.jpg      | Predicted: Q      | True: Q
11261.9s 348      ✓ CORRECT | File: R_test.jpg      | Predicted: R      | True: R
11261.9s 349      ✓ CORRECT | File: S_test.jpg      | Predicted: S      | True: S
11261.9s 350      ✓ CORRECT | File: T_test.jpg      | Predicted: T      | True: T
11261.9s 351      ✓ CORRECT | File: U_test.jpg      | Predicted: U      | True: U
11261.9s 352      ✓ CORRECT | File: V_test.jpg      | Predicted: V      | True: V
11261.9s 353      ✓ CORRECT | File: W_test.jpg      | Predicted: W      | True: W
11261.9s 354      ✓ CORRECT | File: X_test.jpg      | Predicted: X      | True: X
11261.9s 355      ✓ CORRECT | File: Y_test.jpg      | Predicted: Y      | True: Y
11261.9s 356      ✓ CORRECT | File: Z_test.jpg      | Predicted: Z      | True: Z
11261.9s 357      ✓ CORRECT | File: nothing_test.jpg | Predicted: nothing | True: nothing
11261.9s 358      ✓ CORRECT | File: space_test.jpg  | Predicted: space   | True: space
11261.9s 359
11261.9s 360      -----
11261.9s 361      Summary: 28/28 correct (100.0%)
11261.9s 362
11264.8s 363      ✓ Test confusion matrix saved
11264.8s 364
11264.9s 365      =====
11264.9s 366      CUSTOM TEST SET EVALUATION
11264.9s 367      =====
11264.9s 368
11264.9s 369      ✓ Custom test set found at: /kaggle/input/try-custom2/custom_test_set
11264.9s 370
11264.9s 371      Custom test set loaded:
11264.9s 372      Total images: 27
11264.9s 373      Classes: ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'M', 'N', 'O', 'P', 'Q', 'R', 'S', 'T', 'U', 'V', 'W', 'X', 'Y', 'Z',
'nothing']
11264.9s 374
11269.8s 375      Custom Test Set Results (T-C):
11269.8s 376      Accuracy: 0.5926
11269.8s 377      Macro-F1: 0.4943
11269.8s 378      Images tested: 27
11269.8s 379
11269.8s 380      Per-Class Results:
11269.8s 381      -----
11269.8s 382      ✓ A      : 1.0000 (1/1)
11269.8s 383      ✓ B      : 1.0000 (1/1)
11269.8s 384      ✓ C      : 1.0000 (1/1)
11269.8s 385      ✓ D      : 1.0000 (1/1)
11269.8s 386      ✓ E      : 1.0000 (1/1)
11269.8s 387      ✗ F      : 0.0000 (0/1)
11269.8s 388      ✓ G      : 1.0000 (1/1)
11269.8s 389      ✓ H      : 1.0000 (1/1)
11269.8s 390      ✗ I      : 0.0000 (0/1)
11269.8s 391      ✓ J      : 1.0000 (1/1)
11269.8s 392      ✓ K      : 1.0000 (1/1)

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11269.8s 393      ✓ L      : 1.0000 (1/1)
11269.8s 394      ✗ M      : 0.0000 (0/1)
11269.8s 395      ✓ N      : 1.0000 (1/1)
11269.8s 396      ✓ O      : 1.0000 (1/1)
11269.8s 397      ✓ P      : 1.0000 (1/1)
11269.8s 398      ✗ Q      : 0.0000 (0/1)
11269.8s 399      ✓ R      : 1.0000 (1/1)
11269.8s 400      ✗ S      : 0.0000 (0/1)
11269.8s 401      ✗ T      : 0.0000 (0/1)
11269.8s 402      ✓ U      : 1.0000 (1/1)
11269.8s 403      ✗ V      : 0.0000 (0/1)
11269.8s 404      ✗ W      : 0.0000 (0/1)
11269.8s 405      ✗ X      : 0.0000 (0/1)
11269.8s 406      ✓ Y      : 1.0000 (1/1)
11269.8s 407      ✗ Z      : 0.0000 (0/1)
11269.8s 408      ✗ nothing : 0.0000 (0/1)
11269.8s 409
11272.6s 410      ✓ Custom test confusion matrix saved
11272.6s 411
11272.6s 412      =====
11272.6s 413      COMPARISON: Original vs Custom Test Set
11272.6s 414      =====
11272.6s 415      Original Test (28 images): Acc=1.0000 | F1=1.0000
11272.6s 416      Custom Test (27 images): Acc=0.5926 | F1=0.4943
11272.6s 417
11272.6s 418      Difference (Custom - Original):
11272.6s 419      Accuracy: -0.4074
11272.6s 420      Macro-F1: -0.5057
11272.6s 421      ⚠ Custom test performs WORSE than original (may indicate overfitting)
11272.6s 422
11272.6s 423      =====
11272.6s 424      FINAL SUMMARY - PHASE 1 COMPLETE
11272.6s 425      =====
11272.6s 426
11272.6s 427      Ablation Study Results (Validation Set):
11272.6s 428      -----
11272.6s 429      Policy   Val Loss   Val Acc   Val F1
11272.6s 430      -----
11272.6s 431      T-A      0.5344    0.8228    0.8225
11272.6s 432      T-B      0.0096    0.9975    0.9975
11272.6s 433      T-C      0.0012    0.9998    0.9998
11272.6s 434      S-A      0.0444    0.9872    0.9872
11272.6s 435
11272.6s 436
11272.6s 437      =====
11272.6s 438      BEST MODEL: T-C
11272.6s 439      =====
11272.6s 440      Val Loss: 0.0012
11272.6s 441      Val Accuracy: 0.9998
11272.6s 442      Val Macro-F1: 0.9998
11272.6s 443
11272.6s 444      Test Set Performance:
11272.6s 445      -----
11272.6s 446      Original Test (28 images):
11272.6s 447      - Accuracy: 1.0000
11272.6s 448      - Macro-F1: 1.0000
11272.6s 449
11272.6s 501      =====
11272.6s 502      ✓ PHASE 1 COMPLETE - All Models Trained & Evaluated!
11272.6s 503
```