**IMPORTANT NOTE:** This is a very rough file and not really intended to be seen or evaluated by the instructors. This is only being submitted with the rest of the files in case we later need any more details of the performance metrics at different points of the tuning cycle. Therefore, it is very unformatted (but contains meaningful information).

**With one pair (first and third image) for every stack:**

Over 50 samples:

Epoch 1/10

4/4 [==============================] - 83s 11s/step - loss: 1.3514 - accuracy: 0.5278 - precision: 0.5517 - recall: 0.4444 - val\_loss: 0.8375 - val\_accuracy: 0.7500 - val\_precision: 0.7500 - val\_recall: 0.7500

Epoch 2/10

4/4 [==============================] - 41s 10s/step - loss: 0.3565 - accuracy: 0.8611 - precision: 0.8857 - recall: 0.8611 - val\_loss: 0.7085 - val\_accuracy: 0.7500 - val\_precision: 0.7500 - val\_recall: 0.7500

Epoch 3/10

4/4 [==============================] - 44s 11s/step - loss: 0.1636 - accuracy: 0.9722 - precision: 0.9722 - recall: 0.9722 - val\_loss: 0.5332 - val\_accuracy: 0.7500 - val\_precision: 0.7500 - val\_recall: 0.7500

Epoch 4/10

4/4 [==============================] - 46s 11s/step - loss: 0.0584 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 0.5610 - val\_accuracy: 0.7500 - val\_precision: 0.7500 - val\_recall: 0.7500

Epoch 5/10

4/4 [==============================] - 49s 12s/step - loss: 0.0233 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 0.6208 - val\_accuracy: 0.7500 - val\_precision: 0.7500 - val\_recall: 0.7500

Epoch 6/10

4/4 [==============================] - 47s 12s/step - loss: 0.0109 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 0.6368 - val\_accuracy: 0.7500 - val\_precision: 0.7500 - val\_recall: 0.7500

Epoch 7/10

4/4 [==============================] - 47s 11s/step - loss: 0.0067 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 0.6245 - val\_accuracy: 0.7500 - val\_precision: 0.7500 - val\_recall: 0.7500

Epoch 8/10

4/4 [==============================] - 46s 11s/step - loss: 0.0038 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 0.6337 - val\_accuracy: 0.7500 - val\_precision: 0.7500 - val\_recall: 0.7500

Epoch 9/10

4/4 [==============================] - 49s 12s/step - loss: 0.0020 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 0.6468 - val\_accuracy: 0.7500 - val\_precision: 0.7500 - val\_recall: 0.7500

Epoch 10/10

4/4 [==============================] - 46s 11s/step - loss: 0.0016 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 0.6570 - val\_accuracy: 0.7500 - val\_precision: 0.7500 - val\_recall: 0.7500

1/1 [==============================] - 4s 4s/step - loss: 0.1848 - accuracy: 0.9000 - precision: 0.9000 - recall: 0.9000

Test Loss: 0.18484704196453094

Test Accuracy: 0.8999999761581421

Test Precision: 0.8999999761581421

Test Recall: 0.8999999761581421

200 samples:

Epoch 1/10

15/15 [==============================] - 241s 13s/step - loss: 1.3537 - accuracy: 0.4931 - precision: 0.5405 - recall: 0.4167 - val\_loss: 1.0419 - val\_accuracy: 0.5625 - val\_precision: 0.5625 - val\_recall: 0.5625

Epoch 2/10

15/15 [==============================] - 199s 13s/step - loss: 0.6894 - accuracy: 0.7292 - precision: 0.7597 - recall: 0.6806 - val\_loss: 1.2225 - val\_accuracy: 0.5625 - val\_precision: 0.6000 - val\_recall: 0.5625

Epoch 3/10

15/15 [==============================] - 191s 13s/step - loss: 0.3513 - accuracy: 0.8611 - precision: 0.8832 - recall: 0.8403 - val\_loss: 0.9311 - val\_accuracy: 0.6250 - val\_precision: 0.6000 - val\_recall: 0.5625

Epoch 4/10

15/15 [==============================] - 191s 13s/step - loss: 0.2141 - accuracy: 0.9167 - precision: 0.9362 - recall: 0.9167 - val\_loss: 0.7938 - val\_accuracy: 0.8125 - val\_precision: 0.8125 - val\_recall: 0.8125

Epoch 5/10

15/15 [==============================] - 202s 13s/step - loss: 0.1104 - accuracy: 0.9583 - precision: 0.9583 - recall: 0.9583 - val\_loss: 0.8000 - val\_accuracy: 0.8125 - val\_precision: 0.8125 - val\_recall: 0.8125

Epoch 6/10

15/15 [==============================] - 196s 13s/step - loss: 0.0563 - accuracy: 0.9792 - precision: 0.9792 - recall: 0.9792 - val\_loss: 1.0340 - val\_accuracy: 0.6250 - val\_precision: 0.6250 - val\_recall: 0.6250

Epoch 7/10

15/15 [==============================] - 195s 13s/step - loss: 0.0333 - accuracy: 0.9931 - precision: 0.9931 - recall: 0.9931 - val\_loss: 1.1628 - val\_accuracy: 0.6250 - val\_precision: 0.6250 - val\_recall: 0.6250

Epoch 8/10

15/15 [==============================] - 192s 13s/step - loss: 0.0046 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 0.7497 - val\_accuracy: 0.8125 - val\_precision: 0.8125 - val\_recall: 0.8125

Epoch 9/10

15/15 [==============================] - 192s 13s/step - loss: 0.0044 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 0.8710 - val\_accuracy: 0.8125 - val\_precision: 0.8125 - val\_recall: 0.8125

Epoch 10/10

15/15 [==============================] - 192s 13s/step - loss: 0.0018 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 1.0605 - val\_accuracy: 0.6875 - val\_precision: 0.6875 - val\_recall: 0.6875

2/2 [==============================] - 17s 4s/step - loss: 1.4897 - accuracy: 0.6500 - precision: 0.6500 - recall: 0.6500

Test Loss: 1.4896962642669678

Test Accuracy: 0.6499999761581421

Test Precision: 0.6499999761581421

Test Recall: 0.6499999761581421

All samples

Epoch 1/10

61/61 [==============================] - 141s 1s/step - loss: 1.0523 - accuracy: 0.6173 - precision: 0.6433 - recall: 0.5641 - val\_loss: 0.9294 - val\_accuracy: 0.5821 - val\_precision: 0.6230 - val\_recall: 0.5672

Epoch 2/10

61/61 [==============================] - 70s 1s/step - loss: 0.7536 - accuracy: 0.7022 - precision: 0.7133 - recall: 0.6622 - val\_loss: 0.9064 - val\_accuracy: 0.6269 - val\_precision: 0.6557 - val\_recall: 0.5970

Epoch 3/10

61/61 [==============================] - 70s 1s/step - loss: 0.6929 - accuracy: 0.7454 - precision: 0.7553 - recall: 0.7088 - val\_loss: 0.8473 - val\_accuracy: 0.6567 - val\_precision: 0.6667 - val\_recall: 0.6567

Epoch 4/10

61/61 [==============================] - 70s 1s/step - loss: 0.4383 - accuracy: 0.8319 - precision: 0.8439 - recall: 0.8186 - val\_loss: 0.6753 - val\_accuracy: 0.7910 - val\_precision: 0.7910 - val\_recall: 0.7910

Epoch 5/10

61/61 [==============================] - 70s 1s/step - loss: 0.2752 - accuracy: 0.9002 - precision: 0.9085 - recall: 0.8918 - val\_loss: 0.6289 - val\_accuracy: 0.8060 - val\_precision: 0.8060 - val\_recall: 0.8060

Epoch 6/10

61/61 [==============================] - 70s 1s/step - loss: 0.1611 - accuracy: 0.9468 - precision: 0.9497 - recall: 0.9418 - val\_loss: 0.5866 - val\_accuracy: 0.7910 - val\_precision: 0.8000 - val\_recall: 0.7761

Epoch 7/10

61/61 [==============================] - 70s 1s/step - loss: 0.0679 - accuracy: 0.9817 - precision: 0.9817 - recall: 0.9817 - val\_loss: 0.7374 - val\_accuracy: 0.7761 - val\_precision: 0.7727 - val\_recall: 0.7612

Epoch 8/10

61/61 [==============================] - 70s 1s/step - loss: 0.0590 - accuracy: 0.9784 - precision: 0.9800 - recall: 0.9784 - val\_loss: 0.8062 - val\_accuracy: 0.7761 - val\_precision: 0.7846 - val\_recall: 0.7612

Epoch 9/10

61/61 [==============================] - 73s 1s/step - loss: 0.0512 - accuracy: 0.9850 - precision: 0.9850 - recall: 0.9850 - val\_loss: 1.0586 - val\_accuracy: 0.7612 - val\_precision: 0.7612 - val\_recall: 0.7612

Epoch 10/10

61/61 [==============================] - 70s 1s/step - loss: 0.0880 - accuracy: 0.9750 - precision: 0.9750 - recall: 0.9734 - val\_loss: 0.9489 - val\_accuracy: 0.8060 - val\_precision: 0.8060 - val\_recall: 0.8060

6/6 [==============================] - 6s 956ms/step - loss: 1.4340 - accuracy: 0.6667 - precision: 0.6768 - recall: 0.6607

Test Loss: 1.4339580535888672

Test Accuracy: 0.6666666865348816

Test Precision: 0.6768292784690857

Test Recall: 0.6607142686843872

**After making three pairs and ensuring they’re in different data splits:**

50 samples:

Epoch 1/10

11/11 [==============================] - 77s 2s/step - loss: 0.8682 - accuracy: 0.6762 - precision: 0.6932 - recall: 0.5810 - val\_loss: 1.4717 - val\_accuracy: 0.8000 - val\_precision: 0.8000 - val\_recall: 0.8000

Epoch 2/10

11/11 [==============================] - 13s 1s/step - loss: 0.1452 - accuracy: 0.9238 - precision: 0.9417 - recall: 0.9238 - val\_loss: 2.0014 - val\_accuracy: 0.6000 - val\_precision: 0.6000 - val\_recall: 0.6000

Epoch 3/10

11/11 [==============================] - 13s 1s/step - loss: 0.0342 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 1.8610 - val\_accuracy: 0.8000 - val\_precision: 0.8000 - val\_recall: 0.8000

Epoch 4/10

11/11 [==============================] - 13s 1s/step - loss: 0.0184 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 1.7011 - val\_accuracy: 0.8000 - val\_precision: 0.8000 - val\_recall: 0.8000

Epoch 5/10

11/11 [==============================] - 13s 1s/step - loss: 0.0055 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 2.6058 - val\_accuracy: 0.2667 - val\_precision: 0.2667 - val\_recall: 0.2667

Epoch 6/10

11/11 [==============================] - 13s 1s/step - loss: 0.0034 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 1.9799 - val\_accuracy: 0.5333 - val\_precision: 0.5333 - val\_recall: 0.5333

Epoch 7/10

11/11 [==============================] - 13s 1s/step - loss: 8.4579e-04 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 1.8818 - val\_accuracy: 0.6667 - val\_precision: 0.6667 - val\_recall: 0.6667

Epoch 8/10

11/11 [==============================] - 13s 1s/step - loss: 8.4506e-04 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 1.8710 - val\_accuracy: 0.6667 - val\_precision: 0.6667 - val\_recall: 0.6667

Epoch 9/10

11/11 [==============================] - 13s 1s/step - loss: 5.5589e-04 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 1.8825 - val\_accuracy: 0.6667 - val\_precision: 0.6667 - val\_recall: 0.6667

Epoch 10/10

11/11 [==============================] - 13s 1s/step - loss: 5.2287e-04 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 1.9030 - val\_accuracy: 0.6667 - val\_precision: 0.6667 - val\_recall: 0.6667

1/1 [==============================] - 1s 1s/step - loss: 1.0369 - accuracy: 0.7333 - precision: 0.7333 - recall: 0.7333

Test Loss: 1.0368679761886597

Test Accuracy: 0.7333333492279053

Test Precision: 0.7333333492279053

Test Recall: 0.7333333492279053

All data:

Epoch 1/10

176/176 [==============================] - 284s 1s/step - loss: 0.8105 - accuracy: 0.6735 - precision: 0.6911 - recall: 0.6296 - val\_loss: 0.8219 - val\_accuracy: 0.6508 - val\_precision: 0.6502 - val\_recall: 0.6270

Epoch 2/10

176/176 [==============================] - 213s 1s/step - loss: 0.5545 - accuracy: 0.7683 - precision: 0.7903 - recall: 0.7420 - val\_loss: 0.9762 - val\_accuracy: 0.6786 - val\_precision: 0.6760 - val\_recall: 0.6706

Epoch 3/10

176/176 [==============================] - 213s 1s/step - loss: 0.3221 - accuracy: 0.8739 - precision: 0.8847 - recall: 0.8630 - val\_loss: 1.1308 - val\_accuracy: 0.6865 - val\_precision: 0.6840 - val\_recall: 0.6786

Epoch 4/10

176/176 [==============================] - 213s 1s/step - loss: 0.2242 - accuracy: 0.9167 - precision: 0.9194 - recall: 0.9110 - val\_loss: 1.1350 - val\_accuracy: 0.6944 - val\_precision: 0.6972 - val\_recall: 0.6944

Epoch 5/10

176/176 [==============================] - 212s 1s/step - loss: 0.1277 - accuracy: 0.9572 - precision: 0.9592 - recall: 0.9532 - val\_loss: 1.2991 - val\_accuracy: 0.6667 - val\_precision: 0.6802 - val\_recall: 0.6667

Epoch 6/10

176/176 [==============================] - 213s 1s/step - loss: 0.1257 - accuracy: 0.9538 - precision: 0.9548 - recall: 0.9532 - val\_loss: 1.1697 - val\_accuracy: 0.6865 - val\_precision: 0.6935 - val\_recall: 0.6825

Epoch 7/10

176/176 [==============================] - 213s 1s/step - loss: 0.0458 - accuracy: 0.9857 - precision: 0.9857 - recall: 0.9857 - val\_loss: 1.4613 - val\_accuracy: 0.6508 - val\_precision: 0.6494 - val\_recall: 0.6468

Epoch 8/10

176/176 [==============================] - 213s 1s/step - loss: 0.0149 - accuracy: 0.9966 - precision: 0.9966 - recall: 0.9960 - val\_loss: 1.6467 - val\_accuracy: 0.6865 - val\_precision: 0.6867 - val\_recall: 0.6786

Epoch 9/10

176/176 [==============================] - 213s 1s/step - loss: 0.0011 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 1.7408 - val\_accuracy: 0.6825 - val\_precision: 0.6825 - val\_recall: 0.6825

Epoch 10/10

176/176 [==============================] - 213s 1s/step - loss: 3.6460e-04 - accuracy: 1.0000 - precision: 1.0000 - recall: 1.0000 - val\_loss: 1.8026 - val\_accuracy: 0.6865 - val\_precision: 0.6865 - val\_recall: 0.6865

16/16 [==============================] - 19s 1s/step - loss: 1.7764 - accuracy: 0.7063 - precision: 0.7078 - recall: 0.7063

Test Loss: 1.7763571739196777

Test Accuracy: 0.7063491940498352

Test Precision: 0.7077534794807434

Test Recall: 0.7063491940498352

**Hyperparameter search with 5 samples:**

Trial 18 Complete [00h 03m 51s]

val\_accuracy: 0.0

Best val\_accuracy So Far: 0.6666666865348816

Total elapsed time: 00h 38m 01s

The hyperparameter search is complete. The optimal number of units in the first dense layer is 64.

The optimal dropout rate is 0.5.

**After using right hyperparameters with early stop:**

Epoch 1/20

176/176 [==============================] - 163s 629ms/step - loss: 0.8034 - accuracy: 0.6735 - precision: 0.6934 - recall: 0.6364 - val\_loss: 0.9704 - val\_accuracy: 0.5754 - val\_precision: 0.5781 - val\_recall: 0.5437

Epoch 2/20

176/176 [==============================] - 104s 591ms/step - loss: 0.4988 - accuracy: 0.8037 - precision: 0.8178 - recall: 0.7865 - val\_loss: 0.9776 - val\_accuracy: 0.6270 - val\_precision: 0.6337 - val\_recall: 0.6111

Epoch 3/20

176/176 [==============================] - 104s 590ms/step - loss: 0.2739 - accuracy: 0.8921 - precision: 0.8984 - recall: 0.8836 - val\_loss: 1.3472 - val\_accuracy: 0.6706 - val\_precision: 0.6720 - val\_recall: 0.6667

Epoch 4/20

176/176 [==============================] - 104s 590ms/step - loss: 0.1718 - accuracy: 0.9395 - precision: 0.9437 - recall: 0.9372 - val\_loss: 1.3116 - val\_accuracy: 0.6786 - val\_precision: 0.6840 - val\_recall: 0.6786

Epoch 5/20

176/176 [==============================] - 104s 590ms/step - loss: 0.0772 - accuracy: 0.9766 - precision: 0.9771 - recall: 0.9760 - val\_loss: 1.5894 - val\_accuracy: 0.5833 - val\_precision: 0.5975 - val\_recall: 0.5714

Epoch 6/20

176/176 [==============================] - 105s 597ms/step - loss: 0.0693 - accuracy: 0.9760 - precision: 0.9777 - recall: 0.9743 - val\_loss: 1.4384 - val\_accuracy: 0.7063 - val\_precision: 0.7092 - val\_recall: 0.7063

Test Loss: 0.7682406902313232

Test Accuracy: 0.6686508059501648

Test Precision: 0.6800000071525574

Test Recall: 0.6408730149269104

**After using the right hyperparameters WITHOUT early stopping:**

Epoch 1/10

176/176 [==============================] - 163s 624ms/step - loss: 0.8278 - accuracy: 0.6592 - precision: 0.6796 - recall: 0.6284 - val\_loss: 0.9701 - val\_accuracy: 0.5992 - val\_precision: 0.6008 - val\_recall: 0.5794

Epoch 2/10

176/176 [==============================] - 104s 590ms/step - loss: 0.5443 - accuracy: 0.7825 - precision: 0.8035 - recall: 0.7563 - val\_loss: 1.0814 - val\_accuracy: 0.5675 - val\_precision: 0.5890 - val\_recall: 0.5516

Epoch 3/10

176/176 [==============================] - 104s 589ms/step - loss: 0.3697 - accuracy: 0.8550 - precision: 0.8615 - recall: 0.8413 - val\_loss: 1.1758 - val\_accuracy: 0.6270 - val\_precision: 0.6292 - val\_recall: 0.5992

Epoch 4/10

176/176 [==============================] - 104s 590ms/step - loss: 0.2313 - accuracy: 0.9115 - precision: 0.9192 - recall: 0.9092 - val\_loss: 1.3201 - val\_accuracy: 0.6310 - val\_precision: 0.6356 - val\_recall: 0.6230

Epoch 5/10

176/176 [==============================] - 104s 589ms/step - loss: 0.1506 - accuracy: 0.9435 - precision: 0.9461 - recall: 0.9418 - val\_loss: 1.3644 - val\_accuracy: 0.6706 - val\_precision: 0.6693 - val\_recall: 0.6667

Epoch 6/10

176/176 [==============================] - 104s 589ms/step - loss: 0.0762 - accuracy: 0.9772 - precision: 0.9771 - recall: 0.9743 - val\_loss: 2.0345 - val\_accuracy: 0.6786 - val\_precision: 0.6813 - val\_recall: 0.6786

Epoch 7/10

176/176 [==============================] - 104s 589ms/step - loss: 0.1063 - accuracy: 0.9629 - precision: 0.9628 - recall: 0.9606 - val\_loss: 1.7216 - val\_accuracy: 0.5913 - val\_precision: 0.5960 - val\_recall: 0.5913

Epoch 8/10

176/176 [==============================] - 104s 590ms/step - loss: 0.0289 - accuracy: 0.9926 - precision: 0.9943 - recall: 0.9920 - val\_loss: 2.0630 - val\_accuracy: 0.6429 - val\_precision: 0.6429 - val\_recall: 0.6429

Epoch 9/10

176/176 [==============================] - 104s 590ms/step - loss: 0.0361 - accuracy: 0.9874 - precision: 0.9886 - recall: 0.9874 - val\_loss: 2.2900 - val\_accuracy: 0.6667 - val\_precision: 0.6693 - val\_recall: 0.6667

Epoch 10/10

176/176 [==============================] - 104s 589ms/step - loss: 0.0581 - accuracy: 0.9834 - precision: 0.9834 - recall: 0.9823 - val\_loss: 1.7348 - val\_accuracy: 0.6429 - val\_precision: 0.6452 - val\_recall: 0.6349

Test Loss: 1.4784631729125977

Test Accuracy: 0.7123016119003296

Test Precision: 0.71257483959198

Test Recall: 0.7083333134651184

**Using entire dataset of three cities WITH early stopping:**

Epoch 1/10

140/140 [==============================] - 138s 615ms/step - loss: 1.0757 - accuracy: 0.5172 - precision: 0.5998 - recall: 0.3897 - val\_loss: 0.8511 - val\_accuracy: 0.6250 - val\_precision: 0.7303 - val\_recall: 0.5550

Epoch 2/10

140/140 [==============================] - 83s 592ms/step - loss: 0.7602 - accuracy: 0.6819 - precision: 0.7521 - recall: 0.5781 - val\_loss: 0.7581 - val\_accuracy: 0.6750 - val\_precision: 0.7160 - val\_recall: 0.5800

Epoch 3/10

140/140 [==============================] - 83s 591ms/step - loss: 0.6152 - accuracy: 0.7622 - precision: 0.7982 - recall: 0.6884 - val\_loss: 0.7055 - val\_accuracy: 0.7150 - val\_precision: 0.7412 - val\_recall: 0.6300

Epoch 4/10

140/140 [==============================] - 82s 589ms/step - loss: 0.4917 - accuracy: 0.8116 - precision: 0.8518 - recall: 0.7536 - val\_loss: 0.7204 - val\_accuracy: 0.6950 - val\_precision: 0.7416 - val\_recall: 0.6600

Epoch 5/10

140/140 [==============================] - 82s 589ms/step - loss: 0.4088 - accuracy: 0.8524 - precision: 0.8804 - recall: 0.8173 - val\_loss: 0.7190 - val\_accuracy: 0.7150 - val\_precision: 0.7430 - val\_recall: 0.6650

Epoch 6/10

140/140 [==============================] - 82s 589ms/step - loss: 0.3048 - accuracy: 0.8968 - precision: 0.9151 - recall: 0.8725 - val\_loss: 0.7864 - val\_accuracy: 0.6950 - val\_precision: 0.7143 - val\_recall: 0.6750

Epoch 7/10

140/140 [==============================] - 82s 589ms/step - loss: 0.2347 - accuracy: 0.9234 - precision: 0.9342 - recall: 0.9054 - val\_loss: 0.7573 - val\_accuracy: 0.7200 - val\_precision: 0.7486 - val\_recall: 0.6850

Epoch 8/10

140/140 [==============================] - 83s 591ms/step - loss: 0.1667 - accuracy: 0.9620 - precision: 0.9679 - recall: 0.9513 - val\_loss: 0.8219 - val\_accuracy: 0.7100 - val\_precision: 0.7254 - val\_recall: 0.7000

Test Loss: 0.7269970774650574

Test Accuracy: 0.6800000071525574

Test Precision: 0.7341389656066895

Test Recall: 0.6075000166893005

**Using entire dataset of three cities WITHOUT early stopping:**

Epoch 1/10

140/140 [==============================] - 138s 613ms/step - loss: 1.0918 - accuracy: 0.5236 - precision: 0.5917 - recall: 0.3883 - val\_loss: 0.8972 - val\_accuracy: 0.6200 - val\_precision: 0.6800 - val\_recall: 0.5100

Epoch 2/10

140/140 [==============================] - 82s 589ms/step - loss: 0.7670 - accuracy: 0.6612 - precision: 0.7297 - recall: 0.5802 - val\_loss: 0.7850 - val\_accuracy: 0.6650 - val\_precision: 0.7273 - val\_recall: 0.5600

Epoch 3/10

140/140 [==============================] - 82s 589ms/step - loss: 0.5978 - accuracy: 0.7557 - precision: 0.8162 - recall: 0.6841 - val\_loss: 0.8027 - val\_accuracy: 0.6750 - val\_precision: 0.7101 - val\_recall: 0.6000

Epoch 4/10

140/140 [==============================] - 82s 589ms/step - loss: 0.5125 - accuracy: 0.8001 - precision: 0.8375 - recall: 0.7421 - val\_loss: 0.8050 - val\_accuracy: 0.6550 - val\_precision: 0.6919 - val\_recall: 0.5950

Epoch 5/10

140/140 [==============================] - 82s 589ms/step - loss: 0.3989 - accuracy: 0.8517 - precision: 0.8813 - recall: 0.8188 - val\_loss: 0.7734 - val\_accuracy: 0.7050 - val\_precision: 0.7542 - val\_recall: 0.6750

Epoch 6/10

140/140 [==============================] - 82s 589ms/step - loss: 0.3054 - accuracy: 0.9062 - precision: 0.9221 - recall: 0.8739 - val\_loss: 0.7834 - val\_accuracy: 0.7000 - val\_precision: 0.7312 - val\_recall: 0.6800

Epoch 7/10

140/140 [==============================] - 82s 589ms/step - loss: 0.2460 - accuracy: 0.9219 - precision: 0.9346 - recall: 0.9011 - val\_loss: 0.8490 - val\_accuracy: 0.6900 - val\_precision: 0.7151 - val\_recall: 0.6650

Epoch 8/10

140/140 [==============================] - 82s 589ms/step - loss: 0.1824 - accuracy: 0.9542 - precision: 0.9627 - recall: 0.9420 - val\_loss: 0.8353 - val\_accuracy: 0.6800 - val\_precision: 0.7059 - val\_recall: 0.6600

Epoch 9/10

140/140 [==============================] - 82s 589ms/step - loss: 0.1331 - accuracy: 0.9713 - precision: 0.9753 - recall: 0.9620 - val\_loss: 0.8591 - val\_accuracy: 0.7100 - val\_precision: 0.7225 - val\_recall: 0.6900

Epoch 10/10

140/140 [==============================] - 82s 588ms/step - loss: 0.0943 - accuracy: 0.9850 - precision: 0.9877 - recall: 0.9814 - val\_loss: 0.8705 - val\_accuracy: 0.7050 - val\_precision: 0.7211 - val\_recall: 0.6850

Test Loss: 0.8182976245880127

Test Accuracy: 0.7225000262260437

Test Precision: 0.7329843044281006

Test Recall: 0.699999988079071

**With batch normalization** (this was tested near the beginning before most of these other sequential improvement)**:**

Epoch 1/10

4/4 [==============================] - 4s 564ms/step - loss: 1002.7195

Epoch 2/10

4/4 [==============================] - 2s 577ms/step - loss: 1400.5128

Epoch 3/10

4/4 [==============================] - 3s 586ms/step - loss: 624.1463

Epoch 4/10

4/4 [==============================] - 3s 584ms/step - loss: 522.6783

Epoch 5/10

4/4 [==============================] - 3s 584ms/step - loss: 209.0273

Epoch 6/10

4/4 [==============================] - 2s 579ms/step - loss: 162.5594

Epoch 7/10

4/4 [==============================] - 3s 592ms/step - loss: 87.5882

Epoch 8/10

4/4 [==============================] - 3s 586ms/step - loss: 21.0859

Epoch 9/10

4/4 [==============================] - 3s 581ms/step - loss: 38.9853

Epoch 10/10

4/4 [==============================] - 3s 591ms/step - loss: 6.4880

**without batch normalization:**

Epoch 1/10

4/4 [==============================] - 3s 433ms/step - loss: 1.1148

Epoch 2/10

4/4 [==============================] - 2s 425ms/step - loss: 0.8615

Epoch 3/10

4/4 [==============================] - 2s 430ms/step - loss: 0.7701

Epoch 4/10

4/4 [==============================] - 2s 415ms/step - loss: 1.0197

Epoch 5/10

4/4 [==============================] - 2s 417ms/step - loss: 0.8350

Epoch 6/10

4/4 [==============================] - 2s 414ms/step - loss: 0.7815

Epoch 7/10

4/4 [==============================] - 2s 420ms/step - loss: 0.8771

Epoch 8/10

4/4 [==============================] - 2s 425ms/step - loss: 0.8814

Epoch 9/10

4/4 [==============================] - 2s 437ms/step - loss: 0.8620

Epoch 10/10

4/4 [==============================] - 2s 427ms/step - loss: 0.7343