

comparition

May 12, 2019

0.1 Importing Packages

```
[1]: import numpy as np
import matplotlib.pyplot as plt
```

0.2 Hyper Parameters

```
[ ]: msg_total = 8
channel = 4
epochs = 1000
batch_size = 1024
x=np.random.randint(0,8,10000)
```

1 Supervised Learning

```
[2]: from keras.models import Sequential
from keras.layers import Dense, GaussianNoise
from keras.wrappers.scikit_learn import KerasClassifier

def func():
    model = Sequential()
    model.add(Dense(msg_total,input_dim=1,activation='relu'))
    model.add(Dense(2*channel, activation = 'linear'))
    model.add(GaussianNoise(1))
    model.add(Dense(msg_total, activation = 'softmax'))
    model.compile(loss='categorical_crossentropy',
    →optimizer='adam',metrics=['acc'])
    return model

estimator=KerasClassifier(build_fn=func,epochs=epochs,batch_size=batch_size,verbose=1)
```

Using TensorFlow backend.

```
[3]: history=estimator.fit(x,x)
      loss_supervised=history.history['loss']
      acc=history.history['acc']
```

```
Epoch 1/1000
10000/10000 [=====] - 1s 66us/step - loss: 2.9448 -
acc: 0.1303
Epoch 2/1000
10000/10000 [=====] - 0s 10us/step - loss: 2.8114 -
acc: 0.1289
Epoch 3/1000
10000/10000 [=====] - 0s 9us/step - loss: 2.6696 - acc:
0.1367
Epoch 4/1000
10000/10000 [=====] - 0s 9us/step - loss: 2.5622 - acc:
0.1434
Epoch 5/1000
10000/10000 [=====] - 0s 9us/step - loss: 2.4697 - acc:
0.1399
Epoch 6/1000
10000/10000 [=====] - 0s 9us/step - loss: 2.4058 - acc:
0.1426
Epoch 7/1000
10000/10000 [=====] - 0s 9us/step - loss: 2.3182 - acc:
0.1498
Epoch 8/1000
10000/10000 [=====] - 0s 10us/step - loss: 2.2512 -
acc: 0.1479
Epoch 9/1000
10000/10000 [=====] - 0s 11us/step - loss: 2.2026 -
acc: 0.1444
Epoch 10/1000
10000/10000 [=====] - 0s 9us/step - loss: 2.1687 - acc:
0.1496
Epoch 11/1000
10000/10000 [=====] - 0s 10us/step - loss: 2.1285 -
acc: 0.1680
Epoch 12/1000
10000/10000 [=====] - 0s 8us/step - loss: 2.0993 - acc:
0.1753
Epoch 13/1000
10000/10000 [=====] - 0s 7us/step - loss: 2.0944 - acc:
0.1682
Epoch 14/1000
10000/10000 [=====] - 0s 7us/step - loss: 2.0690 - acc:
0.1777
Epoch 15/1000
```

10000/10000 [=====] - 0s 8us/step - loss: 2.0332 - acc:
 0.1890
 Epoch 16/1000
 10000/10000 [=====] - 0s 8us/step - loss: 2.0151 - acc:
 0.1939
 Epoch 17/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.9993 - acc:
 0.1981
 Epoch 18/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.9789 - acc:
 0.2037
 Epoch 19/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.9697 - acc:
 0.2039
 Epoch 20/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.9414 - acc:
 0.2134
 Epoch 21/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.9284 - acc:
 0.2147
 Epoch 22/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.9102 - acc:
 0.2209
 Epoch 23/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.9036 - acc:
 0.2142
 Epoch 24/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.8875 - acc:
 0.2240
 Epoch 25/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.8679 - acc:
 0.2282
 Epoch 26/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.8491 - acc:
 0.2340
 Epoch 27/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.8258 - acc:
 0.2514
 Epoch 28/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.8281 - acc:
 0.2435
 Epoch 29/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.8133 - acc:
 0.2428
 Epoch 30/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.7907 - acc:
 0.2575
 Epoch 31/1000

10000/10000 [=====] - 0s 6us/step - loss: 1.7932 - acc:
 0.2498
 Epoch 32/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.7649 - acc:
 0.2610
 Epoch 33/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.7588 - acc:
 0.2698
 Epoch 34/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.7533 - acc:
 0.2704
 Epoch 35/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.7288 - acc:
 0.2809
 Epoch 36/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.7234 - acc:
 0.2789
 Epoch 37/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.7106 - acc:
 0.2814
 Epoch 38/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.6928 - acc:
 0.2908
 Epoch 39/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.6888 - acc:
 0.2895
 Epoch 40/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.6724 - acc:
 0.2986
 Epoch 41/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.6653 - acc:
 0.2999
 Epoch 42/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.6482 - acc:
 0.3097
 Epoch 43/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.6396 - acc:
 0.3072
 Epoch 44/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.6244 - acc:
 0.3099
 Epoch 45/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.6197 - acc:
 0.3180
 Epoch 46/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.5963 - acc:
 0.3300
 Epoch 47/1000

10000/10000 [=====] - 0s 7us/step - loss: 1.5921 - acc:
 0.3269
 Epoch 48/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.5723 - acc:
 0.3348
 Epoch 49/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.5672 - acc:
 0.3368
 Epoch 50/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.5540 - acc:
 0.3400
 Epoch 51/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.5415 - acc:
 0.3504
 Epoch 52/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.5398 - acc:
 0.3406
 Epoch 53/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.5241 - acc:
 0.3592
 Epoch 54/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.5101 - acc:
 0.3688
 Epoch 55/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.5044 - acc:
 0.3643
 Epoch 56/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.4822 - acc:
 0.3756
 Epoch 57/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.4747 - acc:
 0.3785
 Epoch 58/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.4742 - acc:
 0.3836
 Epoch 59/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.4643 - acc:
 0.3818
 Epoch 60/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.4451 - acc:
 0.3897
 Epoch 61/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.4257 - acc:
 0.4104
 Epoch 62/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.4223 - acc:
 0.4071
 Epoch 63/1000

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10000/10000 [=====] - 0s 7us/step - loss: 1.4126 - acc:
0.4116
Epoch 64/1000
10000/10000 [=====] - 0s 6us/step - loss: 1.4096 - acc:
0.4106
Epoch 65/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.3905 - acc:
0.4234
Epoch 66/1000
10000/10000 [=====] - 0s 6us/step - loss: 1.3840 - acc:
0.4201
Epoch 67/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.3716 - acc:
0.4322
Epoch 68/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.3582 - acc:
0.4446
Epoch 69/1000
10000/10000 [=====] - 0s 8us/step - loss: 1.3555 - acc:
0.4392
Epoch 70/1000
10000/10000 [=====] - 0s 6us/step - loss: 1.3370 - acc:
0.4491
Epoch 71/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.3279 - acc:
0.4562
Epoch 72/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.3207 - acc:
0.4589
Epoch 73/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.3066 - acc:
0.4733
Epoch 74/1000
10000/10000 [=====] - 0s 6us/step - loss: 1.2982 - acc:
0.4769
Epoch 75/1000
10000/10000 [=====] - 0s 6us/step - loss: 1.2834 - acc:
0.4795
Epoch 76/1000
10000/10000 [=====] - 0s 8us/step - loss: 1.2749 - acc:
0.4839
Epoch 77/1000
10000/10000 [=====] - 0s 6us/step - loss: 1.2598 - acc:
0.4936
Epoch 78/1000
10000/10000 [=====] - 0s 6us/step - loss: 1.2483 - acc:
0.4991
Epoch 79/1000

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10000/10000 [=====] - 0s 6us/step - loss: 1.2427 - acc:
 0.4998
 Epoch 80/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.2343 - acc:
 0.5049
 Epoch 81/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.2204 - acc:
 0.5123
 Epoch 82/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.2080 - acc:
 0.5198
 Epoch 83/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.2019 - acc:
 0.5248
 Epoch 84/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.1887 - acc:
 0.5247
 Epoch 85/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.1723 - acc:
 0.5433
 Epoch 86/1000
 10000/10000 [=====] - 0s 8us/step - loss: 1.1684 - acc:
 0.5378
 Epoch 87/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.1469 - acc:
 0.5583
 Epoch 88/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.1419 - acc:
 0.5611
 Epoch 89/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.1357 - acc:
 0.5571
 Epoch 90/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.1281 - acc:
 0.5626
 Epoch 91/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.1068 - acc:
 0.5732
 Epoch 92/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.1015 - acc:
 0.5802
 Epoch 93/1000
 10000/10000 [=====] - 0s 6us/step - loss: 1.0916 - acc:
 0.5856
 Epoch 94/1000
 10000/10000 [=====] - 0s 7us/step - loss: 1.0799 - acc:
 0.5899
 Epoch 95/1000

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10000/10000 [=====] - 0s 7us/step - loss: 1.0675 - acc:
0.6000
Epoch 96/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.0581 - acc:
0.6024
Epoch 97/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.0494 - acc:
0.6070
Epoch 98/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.0334 - acc:
0.6129
Epoch 99/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.0219 - acc:
0.6273
Epoch 100/1000
10000/10000 [=====] - 0s 7us/step - loss: 1.0078 - acc:
0.6311
Epoch 101/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.9971 - acc:
0.6425
Epoch 102/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.9930 - acc:
0.6463
Epoch 103/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.9817 - acc:
0.6499
Epoch 104/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.9715 - acc:
0.6547
Epoch 105/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.9557 - acc:
0.6723
Epoch 106/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.9451 - acc:
0.6605
Epoch 107/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.9361 - acc:
0.6850
Epoch 108/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.9270 - acc:
0.6778
Epoch 109/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.9134 - acc:
0.6910
Epoch 110/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.9032 - acc:
0.6883
Epoch 111/1000

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10000/10000 [=====] - 0s 6us/step - loss: 0.9010 - acc:
 0.6942
 Epoch 112/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.8836 - acc:
 0.6967
 Epoch 113/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.8741 - acc:
 0.7171
 Epoch 114/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.8671 - acc:
 0.7177
 Epoch 115/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.8568 - acc:
 0.7152
 Epoch 116/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.8439 - acc:
 0.7343
 Epoch 117/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.8310 - acc:
 0.7320
 Epoch 118/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.8211 - acc:
 0.7418
 Epoch 119/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.8175 - acc:
 0.7396
 Epoch 120/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.8040 - acc:
 0.7464
 Epoch 121/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.7989 - acc:
 0.7518
 Epoch 122/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.7900 - acc:
 0.7557
 Epoch 123/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.7750 - acc:
 0.7667
 Epoch 124/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.7650 - acc:
 0.7649
 Epoch 125/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.7575 - acc:
 0.7752
 Epoch 126/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.7450 - acc:
 0.7782
 Epoch 127/1000

10000/10000 [=====] - 0s 7us/step - loss: 0.7401 - acc:
 0.7813
 Epoch 128/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.7301 - acc:
 0.7773
 Epoch 129/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.7210 - acc:
 0.7964
 Epoch 130/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.7085 - acc:
 0.7950
 Epoch 131/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.7046 - acc:
 0.8007
 Epoch 132/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.6954 - acc:
 0.8049
 Epoch 133/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.6841 - acc:
 0.8063
 Epoch 134/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.6756 - acc:
 0.8117
 Epoch 135/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.6742 - acc:
 0.8169
 Epoch 136/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.6601 - acc:
 0.8223
 Epoch 137/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.6555 - acc:
 0.8221
 Epoch 138/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.6459 - acc:
 0.8231
 Epoch 139/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.6427 - acc:
 0.8239
 Epoch 140/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.6309 - acc:
 0.8401
 Epoch 141/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.6263 - acc:
 0.8299
 Epoch 142/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.6186 - acc:
 0.8353
 Epoch 143/1000

10000/10000 [=====] - 0s 7us/step - loss: 0.6082 - acc:
 0.8443
 Epoch 144/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.6039 - acc:
 0.8450
 Epoch 145/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.5925 - acc:
 0.8508
 Epoch 146/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.5859 - acc:
 0.8502
 Epoch 147/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.5786 - acc:
 0.8504
 Epoch 148/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.5700 - acc:
 0.8622
 Epoch 149/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.5681 - acc:
 0.8558
 Epoch 150/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.5593 - acc:
 0.8665
 Epoch 151/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.5534 - acc:
 0.8664
 Epoch 152/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.5465 - acc:
 0.8663
 Epoch 153/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.5381 - acc:
 0.8771
 Epoch 154/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.5330 - acc:
 0.8747
 Epoch 155/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.5255 - acc:
 0.8764
 Epoch 156/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.5195 - acc:
 0.8818
 Epoch 157/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.5039 - acc:
 0.8893
 Epoch 158/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.5040 - acc:
 0.8864
 Epoch 159/1000

10000/10000 [=====] - 0s 7us/step - loss: 0.5028 - acc:
 0.8892
 Epoch 160/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.4946 - acc:
 0.8870
 Epoch 161/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.4879 - acc:
 0.8880
 Epoch 162/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.4857 - acc:
 0.8894
 Epoch 163/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.4777 - acc:
 0.8945
 Epoch 164/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.4754 - acc:
 0.8983
 Epoch 165/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.4658 - acc:
 0.8978
 Epoch 166/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.4591 - acc:
 0.9079
 Epoch 167/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.4506 - acc:
 0.9056
 Epoch 168/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.4471 - acc:
 0.9048
 Epoch 169/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.4406 - acc:
 0.9121
 Epoch 170/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.4423 - acc:
 0.9039
 Epoch 171/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.4328 - acc:
 0.9062
 Epoch 172/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.4291 - acc:
 0.9125
 Epoch 173/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.4221 - acc:
 0.9145
 Epoch 174/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.4202 - acc:
 0.9138
 Epoch 175/1000

10000/10000 [=====] - 0s 8us/step - loss: 0.4108 - acc:
 0.9185
 Epoch 176/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.4052 - acc:
 0.9182
 Epoch 177/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.4025 - acc:
 0.9193
 Epoch 178/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.3966 - acc:
 0.9240
 Epoch 179/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.3918 - acc:
 0.9252
 Epoch 180/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.3867 - acc:
 0.9277
 Epoch 181/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.3826 - acc:
 0.9272
 Epoch 182/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.3776 - acc:
 0.9297
 Epoch 183/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.3745 - acc:
 0.9304
 Epoch 184/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.3683 - acc:
 0.9311
 Epoch 185/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.3659 - acc:
 0.9306
 Epoch 186/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.3596 - acc:
 0.9326
 Epoch 187/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.3550 - acc:
 0.9395
 Epoch 188/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.3529 - acc:
 0.9380
 Epoch 189/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.3481 - acc:
 0.9356
 Epoch 190/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.3416 - acc:
 0.9383
 Epoch 191/1000

10000/10000 [=====] - 0s 7us/step - loss: 0.3397 - acc:
0.9381
Epoch 192/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.3311 - acc:
0.9467
Epoch 193/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.3272 - acc:
0.9435
Epoch 194/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.3264 - acc:
0.9407
Epoch 195/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.3235 - acc:
0.9428
Epoch 196/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.3174 - acc:
0.9475
Epoch 197/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.3137 - acc:
0.9497
Epoch 198/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.3093 - acc:
0.9540
Epoch 199/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.3048 - acc:
0.9514
Epoch 200/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.3004 - acc:
0.9549
Epoch 201/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2952 - acc:
0.9555
Epoch 202/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2967 - acc:
0.9537
Epoch 203/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2888 - acc:
0.9543
Epoch 204/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.2841 - acc:
0.9557
Epoch 205/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2832 - acc:
0.9572
Epoch 206/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.2800 - acc:
0.9553
Epoch 207/1000

```

10000/10000 [=====] - 0s 6us/step - loss: 0.2755 - acc:
0.9594
Epoch 208/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2690 - acc:
0.9644
Epoch 209/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2719 - acc:
0.9607
Epoch 210/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.2644 - acc:
0.9623
Epoch 211/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2599 - acc:
0.9645
Epoch 212/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.2602 - acc:
0.9628
Epoch 213/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2530 - acc:
0.9634
Epoch 214/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2500 - acc:
0.9665
Epoch 215/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.2468 - acc:
0.9671
Epoch 216/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.2444 - acc:
0.9643
Epoch 217/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.2395 - acc:
0.9687
Epoch 218/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.2411 - acc:
0.9633
Epoch 219/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2346 - acc:
0.9695
Epoch 220/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.2337 - acc:
0.9691
Epoch 221/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.2271 - acc:
0.9716
Epoch 222/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.2266 - acc:
0.9697
Epoch 223/1000

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10000/10000 [=====] - 0s 7us/step - loss: 0.2229 - acc:
 0.9734
 Epoch 224/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.2199 - acc:
 0.9718
 Epoch 225/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.2183 - acc:
 0.9733
 Epoch 226/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.2112 - acc:
 0.9735
 Epoch 227/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.2113 - acc:
 0.9746
 Epoch 228/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.2091 - acc:
 0.9738
 Epoch 229/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.2057 - acc:
 0.9749
 Epoch 230/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.2028 - acc:
 0.9776
 Epoch 231/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1970 - acc:
 0.9790
 Epoch 232/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1987 - acc:
 0.9756
 Epoch 233/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1959 - acc:
 0.9761
 Epoch 234/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1904 - acc:
 0.9804
 Epoch 235/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1881 - acc:
 0.9787
 Epoch 236/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1885 - acc:
 0.9782
 Epoch 237/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1836 - acc:
 0.9783
 Epoch 238/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1815 - acc:
 0.9816
 Epoch 239/1000

10000/10000 [=====] - 0s 7us/step - loss: 0.1789 - acc:
 0.9814
 Epoch 240/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1814 - acc:
 0.9771
 Epoch 241/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1746 - acc:
 0.9819
 Epoch 242/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1726 - acc:
 0.9827
 Epoch 243/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1700 - acc:
 0.9841
 Epoch 244/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1662 - acc:
 0.9820
 Epoch 245/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.1658 - acc:
 0.9837
 Epoch 246/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.1613 - acc:
 0.9846
 Epoch 247/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1608 - acc:
 0.9860
 Epoch 248/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1604 - acc:
 0.9823
 Epoch 249/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1581 - acc:
 0.9838
 Epoch 250/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1545 - acc:
 0.9860
 Epoch 251/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1526 - acc:
 0.9854
 Epoch 252/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1498 - acc:
 0.9866
 Epoch 253/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1459 - acc:
 0.9872
 Epoch 254/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.1491 - acc:
 0.9839
 Epoch 255/1000

10000/10000 [=====] - 0s 6us/step - loss: 0.1449 - acc:
 0.9864
 Epoch 256/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1450 - acc:
 0.9864
 Epoch 257/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1410 - acc:
 0.9863
 Epoch 258/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.1397 - acc:
 0.9854
 Epoch 259/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1394 - acc:
 0.9859
 Epoch 260/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1367 - acc:
 0.9868
 Epoch 261/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1336 - acc:
 0.9875
 Epoch 262/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1310 - acc:
 0.9898
 Epoch 263/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1306 - acc:
 0.9901
 Epoch 264/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1287 - acc:
 0.9878
 Epoch 265/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1264 - acc:
 0.9900
 Epoch 266/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1267 - acc:
 0.9884
 Epoch 267/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1250 - acc:
 0.9885
 Epoch 268/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1221 - acc:
 0.9893
 Epoch 269/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1201 - acc:
 0.9906
 Epoch 270/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1185 - acc:
 0.9900
 Epoch 271/1000

10000/10000 [=====] - 0s 6us/step - loss: 0.1163 - acc:
 0.9899
 Epoch 272/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1150 - acc:
 0.9904
 Epoch 273/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1133 - acc:
 0.9909
 Epoch 274/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1125 - acc:
 0.9909
 Epoch 275/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.1094 - acc:
 0.9912
 Epoch 276/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1086 - acc:
 0.9925
 Epoch 277/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1073 - acc:
 0.9928
 Epoch 278/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1048 - acc:
 0.9922
 Epoch 279/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.1057 - acc:
 0.9934
 Epoch 280/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1057 - acc:
 0.9912
 Epoch 281/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.1026 - acc:
 0.9916
 Epoch 282/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0995 - acc:
 0.9937
 Epoch 283/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.1001 - acc:
 0.9922
 Epoch 284/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0981 - acc:
 0.9918
 Epoch 285/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0961 - acc:
 0.9947
 Epoch 286/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0955 - acc:
 0.9935
 Epoch 287/1000

10000/10000 [=====] - 0s 6us/step - loss: 0.0948 - acc:
 0.9939
 Epoch 288/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0920 - acc:
 0.9941
 Epoch 289/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0916 - acc:
 0.9945
 Epoch 290/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0913 - acc:
 0.9939
 Epoch 291/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0888 - acc:
 0.9943
 Epoch 292/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0893 - acc:
 0.9932
 Epoch 293/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0899 - acc:
 0.9933
 Epoch 294/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0856 - acc:
 0.9960
 Epoch 295/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0876 - acc:
 0.9929
 Epoch 296/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0840 - acc:
 0.9939
 Epoch 297/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0827 - acc:
 0.9936
 Epoch 298/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0820 - acc:
 0.9948
 Epoch 299/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0822 - acc:
 0.9940
 Epoch 300/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0800 - acc:
 0.9951
 Epoch 301/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0784 - acc:
 0.9948
 Epoch 302/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0781 - acc:
 0.9941
 Epoch 303/1000

10000/10000 [=====] - 0s 8us/step - loss: 0.0773 - acc:
0.9950
Epoch 304/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0764 - acc:
0.9949
Epoch 305/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0766 - acc:
0.9946
Epoch 306/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0729 - acc:
0.9959
Epoch 307/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0725 - acc:
0.9958
Epoch 308/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0732 - acc:
0.9955
Epoch 309/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0713 - acc:
0.9956
Epoch 310/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0718 - acc:
0.9959
Epoch 311/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0710 - acc:
0.9951
Epoch 312/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0697 - acc:
0.9953
Epoch 313/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0677 - acc:
0.9957
Epoch 314/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0672 - acc:
0.9962
Epoch 315/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0665 - acc:
0.9966
Epoch 316/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0661 - acc:
0.9956
Epoch 317/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0657 - acc:
0.9959
Epoch 318/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0649 - acc:
0.9966
Epoch 319/1000

10000/10000 [=====] - 0s 7us/step - loss: 0.0623 - acc:
 0.9971
 Epoch 320/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0625 - acc:
 0.9965
 Epoch 321/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.0625 - acc:
 0.9960
 Epoch 322/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0608 - acc:
 0.9959
 Epoch 323/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0596 - acc:
 0.9970
 Epoch 324/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0590 - acc:
 0.9966
 Epoch 325/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0585 - acc:
 0.9969
 Epoch 326/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0583 - acc:
 0.9974
 Epoch 327/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0574 - acc:
 0.9973
 Epoch 328/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0579 - acc:
 0.9965
 Epoch 329/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0564 - acc:
 0.9970
 Epoch 330/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0579 - acc:
 0.9954
 Epoch 331/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0537 - acc:
 0.9970
 Epoch 332/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0546 - acc:
 0.9968
 Epoch 333/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0535 - acc:
 0.9974
 Epoch 334/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0534 - acc:
 0.9975
 Epoch 335/1000

10000/10000 [=====] - 0s 7us/step - loss: 0.0533 - acc:
 0.9962
 Epoch 336/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0513 - acc:
 0.9984
 Epoch 337/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0509 - acc:
 0.9978
 Epoch 338/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0514 - acc:
 0.9970
 Epoch 339/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0492 - acc:
 0.9977
 Epoch 340/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0483 - acc:
 0.9979
 Epoch 341/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0487 - acc:
 0.9970
 Epoch 342/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.0483 - acc:
 0.9971
 Epoch 343/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0478 - acc:
 0.9987
 Epoch 344/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0466 - acc:
 0.9980
 Epoch 345/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0464 - acc:
 0.9983
 Epoch 346/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0468 - acc:
 0.9976
 Epoch 347/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0452 - acc:
 0.9978
 Epoch 348/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.0443 - acc:
 0.9982
 Epoch 349/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0450 - acc:
 0.9984
 Epoch 350/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0455 - acc:
 0.9971
 Epoch 351/1000

10000/10000 [=====] - 0s 6us/step - loss: 0.0439 - acc:
 0.9984
 Epoch 352/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0418 - acc:
 0.9988
 Epoch 353/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0424 - acc:
 0.9985
 Epoch 354/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0435 - acc:
 0.9974
 Epoch 355/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0427 - acc:
 0.9975
 Epoch 356/1000
 10000/10000 [=====] - 0s 8us/step - loss: 0.0425 - acc:
 0.9970
 Epoch 357/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0411 - acc:
 0.9985
 Epoch 358/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0390 - acc:
 0.9986
 Epoch 359/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0390 - acc:
 0.9987
 Epoch 360/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0395 - acc:
 0.9976
 Epoch 361/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0391 - acc:
 0.9981
 Epoch 362/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0386 - acc:
 0.9983
 Epoch 363/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0379 - acc:
 0.9984
 Epoch 364/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0376 - acc:
 0.9981
 Epoch 365/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0371 - acc:
 0.9982
 Epoch 366/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0369 - acc:
 0.9988
 Epoch 367/1000


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10000/10000 [=====] - 0s 6us/step - loss: 0.0367 - acc:
0.9983
Epoch 368/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0364 - acc:
0.9983
Epoch 369/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0355 - acc:
0.9989
Epoch 370/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0353 - acc:
0.9984
Epoch 371/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0334 - acc:
0.9993
Epoch 372/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0344 - acc:
0.9982
Epoch 373/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0343 - acc:
0.9981
Epoch 374/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0335 - acc:
0.9985
Epoch 375/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0329 - acc:
0.9989
Epoch 376/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0338 - acc:
0.9986
Epoch 377/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0337 - acc:
0.9990
Epoch 378/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0325 - acc:
0.9986
Epoch 379/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0324 - acc:
0.9985
Epoch 380/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0308 - acc:
0.9988
Epoch 381/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0318 - acc:
0.9983
Epoch 382/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0311 - acc:
0.9993
Epoch 383/1000

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10000/10000 [=====] - 0s 7us/step - loss: 0.0310 - acc:
0.9988
Epoch 384/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0302 - acc:
0.9986
Epoch 385/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0302 - acc:
0.9985
Epoch 386/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0314 - acc:
0.9978
Epoch 387/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0295 - acc:
0.9993
Epoch 388/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0303 - acc:
0.9985
Epoch 389/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0295 - acc:
0.9990
Epoch 390/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0279 - acc:
0.9992
Epoch 391/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0289 - acc:
0.9987
Epoch 392/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0280 - acc:
0.9988
Epoch 393/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0281 - acc:
0.9988
Epoch 394/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0280 - acc:
0.9988
Epoch 395/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0279 - acc:
0.9983
Epoch 396/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0269 - acc:
0.9990
Epoch 397/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0254 - acc:
0.9997
Epoch 398/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0260 - acc:
0.9994
Epoch 399/1000

10000/10000 [=====] - 0s 7us/step - loss: 0.0254 - acc:
0.9991
Epoch 400/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0265 - acc:
0.9987
Epoch 401/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0256 - acc:
0.9989
Epoch 402/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0254 - acc:
0.9996
Epoch 403/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0253 - acc:
0.9992
Epoch 404/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0253 - acc:
0.9990
Epoch 405/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0245 - acc:
0.9991
Epoch 406/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0244 - acc:
0.9994
Epoch 407/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0245 - acc:
0.9990
Epoch 408/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0238 - acc:
0.9987
Epoch 409/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0234 - acc:
0.9991
Epoch 410/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0234 - acc:
0.9989
Epoch 411/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0229 - acc:
0.9992
Epoch 412/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0224 - acc:
0.9993
Epoch 413/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0219 - acc:
0.9995
Epoch 414/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0232 - acc:
0.9988
Epoch 415/1000

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10000/10000 [=====] - 0s 8us/step - loss: 0.0217 - acc:
0.9994
Epoch 416/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0216 - acc:
0.9993
Epoch 417/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0220 - acc:
0.9990
Epoch 418/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0218 - acc:
0.9990
Epoch 419/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0220 - acc:
0.9992
Epoch 420/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0214 - acc:
0.9993
Epoch 421/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0208 - acc:
0.9990
Epoch 422/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0212 - acc:
0.9989
Epoch 423/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0204 - acc:
0.9994
Epoch 424/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0206 - acc:
0.9990
Epoch 425/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0199 - acc:
0.9994
Epoch 426/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0192 - acc:
0.9995
Epoch 427/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0199 - acc:
0.9995
Epoch 428/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0199 - acc:
0.9995
Epoch 429/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0194 - acc:
0.9995
Epoch 430/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0200 - acc:
0.9991
Epoch 431/1000

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10000/10000 [=====] - 0s 8us/step - loss: 0.0198 - acc:
0.9986
Epoch 432/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0191 - acc:
0.9991
Epoch 433/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0189 - acc:
0.9992
Epoch 434/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0187 - acc:
0.9994
Epoch 435/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0187 - acc:
0.9994
Epoch 436/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0181 - acc:
0.9997
Epoch 437/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0179 - acc:
0.9992
Epoch 438/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0176 - acc:
0.9994
Epoch 439/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0181 - acc:
0.9990
Epoch 440/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0173 - acc:
0.9995
Epoch 441/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0170 - acc:
0.9995
Epoch 442/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0176 - acc:
0.9990
Epoch 443/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0168 - acc:
0.9997
Epoch 444/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0174 - acc:
0.9993
Epoch 445/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0167 - acc:
0.9994
Epoch 446/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0162 - acc:
0.9999
Epoch 447/1000

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10000/10000 [=====] - 0s 7us/step - loss: 0.0169 - acc:
 0.9992
 Epoch 448/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0164 - acc:
 0.9997
 Epoch 449/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0159 - acc:
 0.9996
 Epoch 450/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0155 - acc:
 1.0000
 Epoch 451/1000
 10000/10000 [=====] - ETA: 0s - loss: 0.0161 - acc:
 0.999 - 0s 7us/step - loss: 0.0162 - acc: 0.9997
 Epoch 452/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0161 - acc:
 0.9990
 Epoch 453/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0155 - acc:
 0.9997
 Epoch 454/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0153 - acc:
 0.9998
 Epoch 455/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0160 - acc:
 0.9991
 Epoch 456/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0154 - acc:
 0.9996
 Epoch 457/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0153 - acc:
 0.9994
 Epoch 458/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0149 - acc:
 0.9996
 Epoch 459/1000
 10000/10000 [=====] - 0s 7us/step - loss: 0.0140 - acc:
 0.9996
 Epoch 460/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0156 - acc:
 0.9993
 Epoch 461/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0143 - acc:
 0.9995
 Epoch 462/1000
 10000/10000 [=====] - 0s 6us/step - loss: 0.0146 - acc:
 0.9994
 Epoch 463/1000

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10000/10000 [=====] - 0s 6us/step - loss: 0.0143 - acc:
0.9994
Epoch 464/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0141 - acc:
0.9997
Epoch 465/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0141 - acc:
0.9996
Epoch 466/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0139 - acc:
0.9998
Epoch 467/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0141 - acc:
0.9996
Epoch 468/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0136 - acc:
0.9996
Epoch 469/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0135 - acc:
0.9993
Epoch 470/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0137 - acc:
0.9997
Epoch 471/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0137 - acc:
0.9996
Epoch 472/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0131 - acc:
0.9996
Epoch 473/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0131 - acc:
0.9998
Epoch 474/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0127 - acc:
0.9998
Epoch 475/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0124 - acc:
0.9999
Epoch 476/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0124 - acc:
0.9998
Epoch 477/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0122 - acc:
0.9997
Epoch 478/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0122 - acc:
0.9997
Epoch 479/1000

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10000/10000 [=====] - 0s 6us/step - loss: 0.0123 - acc:
0.9999
Epoch 480/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0117 - acc:
0.9999
Epoch 481/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0121 - acc:
0.9998
Epoch 482/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0121 - acc:
0.9998
Epoch 483/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0117 - acc:
1.0000
Epoch 484/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0116 - acc:
0.9999
Epoch 485/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0110 - acc:
0.9999
Epoch 486/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0116 - acc:
0.9996
Epoch 487/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0119 - acc:
0.9997
Epoch 488/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0115 - acc:
0.9998
Epoch 489/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0112 - acc:
0.9998
Epoch 490/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0113 - acc:
0.9997
Epoch 491/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0112 - acc:
0.9995
Epoch 492/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0109 - acc:
0.9998
Epoch 493/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0112 - acc:
0.9998
Epoch 494/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0108 - acc:
0.9998
Epoch 495/1000

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10000/10000 [=====] - 0s 7us/step - loss: 0.0116 - acc:
0.9994
Epoch 496/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0110 - acc:
0.9995
Epoch 497/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0108 - acc:
0.9998
Epoch 498/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0109 - acc:
0.9996
Epoch 499/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0105 - acc:
0.9998
Epoch 500/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0103 - acc:
0.9998
Epoch 501/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0102 - acc:
0.9998
Epoch 502/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0104 - acc:
0.9995
Epoch 503/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0097 - acc:
1.0000
Epoch 504/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0099 - acc:
0.9999
Epoch 505/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0094 - acc:
1.0000
Epoch 506/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0098 - acc:
0.9997
Epoch 507/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0103 - acc:
0.9996
Epoch 508/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0095 - acc:
1.0000
Epoch 509/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0095 - acc:
0.9998
Epoch 510/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0091 - acc:
1.0000
Epoch 511/1000

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10000/10000 [=====] - 0s 7us/step - loss: 0.0093 - acc:
0.9996
Epoch 512/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0088 - acc:
1.0000
Epoch 513/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0096 - acc:
0.9998
Epoch 514/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0091 - acc:
0.9999
Epoch 515/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0092 - acc:
0.9997
Epoch 516/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0089 - acc:
0.9998
Epoch 517/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0090 - acc:
0.9998
Epoch 518/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0090 - acc:
0.9997
Epoch 519/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0091 - acc:
0.9997
Epoch 520/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0090 - acc:
0.9997
Epoch 521/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0083 - acc:
0.9999
Epoch 522/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0087 - acc:
0.9997
Epoch 523/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0082 - acc:
0.9998
Epoch 524/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0087 - acc:
0.9997
Epoch 525/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0080 - acc:
0.9998
Epoch 526/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0087 - acc:
0.9998
Epoch 527/1000

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10000/10000 [=====] - 0s 7us/step - loss: 0.0085 - acc:
0.9999
Epoch 528/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0081 - acc:
1.0000
Epoch 529/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0082 - acc:
0.9999
Epoch 530/1000
10000/10000 [=====] - ETA: 0s - loss: 0.0083 - acc:
0.999 - 0s 7us/step - loss: 0.0084 - acc: 0.9998
Epoch 531/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0080 - acc:
0.9999
Epoch 532/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0078 - acc:
0.9998
Epoch 533/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0077 - acc:
1.0000
Epoch 534/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0077 - acc:
0.9997
Epoch 535/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0084 - acc:
0.9994
Epoch 536/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0073 - acc:
1.0000
Epoch 537/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0080 - acc:
0.9997
Epoch 538/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0076 - acc:
0.9999
Epoch 539/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0076 - acc:
0.9998
Epoch 540/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0074 - acc:
0.9997
Epoch 541/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0075 - acc:
0.9999
Epoch 542/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0068 - acc:
0.9999
Epoch 543/1000

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10000/10000 [=====] - 0s 6us/step - loss: 0.0074 - acc:
0.9998
Epoch 544/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0074 - acc:
0.9999
Epoch 545/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0073 - acc:
0.9996
Epoch 546/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0071 - acc:
0.9999
Epoch 547/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0070 - acc:
0.9998
Epoch 548/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0077 - acc:
0.9995
Epoch 549/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0070 - acc:
0.9999
Epoch 550/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0068 - acc:
1.0000
Epoch 551/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0066 - acc:
1.0000
Epoch 552/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0069 - acc:
0.9997
Epoch 553/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0070 - acc:
0.9998
Epoch 554/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0069 - acc:
0.9997
Epoch 555/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0072 - acc:
0.9997
Epoch 556/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0064 - acc:
1.0000
Epoch 557/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0066 - acc:
0.9998
Epoch 558/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0065 - acc:
0.9998
Epoch 559/1000

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10000/10000 [=====] - 0s 7us/step - loss: 0.0066 - acc:
0.9997
Epoch 560/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0068 - acc:
0.9999
Epoch 561/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0065 - acc:
0.9998
Epoch 562/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0062 - acc:
1.0000
Epoch 563/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0058 - acc:
1.0000
Epoch 564/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0063 - acc:
0.9996
Epoch 565/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0060 - acc:
0.9999
Epoch 566/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0059 - acc:
0.9999
Epoch 567/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0061 - acc:
0.9999
Epoch 568/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0060 - acc:
0.9999
Epoch 569/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0061 - acc:
0.9998
Epoch 570/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0060 - acc:
0.9998
Epoch 571/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0059 - acc:
0.9999
Epoch 572/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0060 - acc:
0.9999
Epoch 573/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0058 - acc:
1.0000
Epoch 574/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0059 - acc:
1.0000
Epoch 575/1000

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10000/10000 [=====] - 0s 7us/step - loss: 0.0056 - acc:
1.0000
Epoch 576/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0060 - acc:
0.9997
Epoch 577/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0055 - acc:
0.9999
Epoch 578/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0057 - acc:
0.9999
Epoch 579/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0058 - acc:
0.9997
Epoch 580/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0057 - acc:
0.9997
Epoch 581/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0055 - acc:
0.9999
Epoch 582/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0053 - acc:
0.9998
Epoch 583/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0056 - acc:
0.9999
Epoch 584/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0052 - acc:
1.0000
Epoch 585/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0055 - acc:
1.0000
Epoch 586/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0052 - acc:
0.9999
Epoch 587/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0054 - acc:
0.9998
Epoch 588/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0050 - acc:
0.9999
Epoch 589/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0052 - acc:
1.0000
Epoch 590/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0052 - acc:
0.9999
Epoch 591/1000

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10000/10000 [=====] - 0s 6us/step - loss: 0.0053 - acc:
0.9998
Epoch 592/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0051 - acc:
0.9998
Epoch 593/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0052 - acc:
1.0000
Epoch 594/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0049 - acc:
1.0000
Epoch 595/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0048 - acc:
0.9999
Epoch 596/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0051 - acc:
1.0000
Epoch 597/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0051 - acc:
0.9998
Epoch 598/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0049 - acc:
0.9999
Epoch 599/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0046 - acc:
1.0000
Epoch 600/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0049 - acc:
0.9998
Epoch 601/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0049 - acc:
0.9998
Epoch 602/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0048 - acc:
0.9998
Epoch 603/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0045 - acc:
1.0000
Epoch 604/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0043 - acc:
0.9999
Epoch 605/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0044 - acc:
1.0000
Epoch 606/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0045 - acc:
1.0000
Epoch 607/1000

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10000/10000 [=====] - 0s 6us/step - loss: 0.0047 - acc:
0.9999
Epoch 608/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0042 - acc:
0.9999
Epoch 609/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0048 - acc:
0.9998
Epoch 610/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0043 - acc:
1.0000
Epoch 611/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0044 - acc:
1.0000
Epoch 612/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0043 - acc:
0.9999
Epoch 613/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0044 - acc:
0.9997
Epoch 614/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0044 - acc:
0.9999
Epoch 615/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0041 - acc:
1.0000
Epoch 616/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0041 - acc:
1.0000
Epoch 617/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0041 - acc:
1.0000
Epoch 618/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0044 - acc:
0.9998
Epoch 619/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0042 - acc:
0.9999
Epoch 620/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0040 - acc:
0.9999
Epoch 621/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0042 - acc:
1.0000
Epoch 622/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0040 - acc:
1.0000
Epoch 623/1000


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10000/10000 [=====] - 0s 6us/step - loss: 0.0041 - acc:
0.9999
Epoch 624/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0042 - acc:
1.0000
Epoch 625/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0041 - acc:
0.9999
Epoch 626/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0039 - acc:
0.9999
Epoch 627/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0040 - acc:
1.0000
Epoch 628/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0038 - acc:
1.0000
Epoch 629/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0046 - acc:
0.9998
Epoch 630/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0038 - acc:
1.0000
Epoch 631/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0038 - acc:
1.0000
Epoch 632/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0040 - acc:
0.9999
Epoch 633/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0038 - acc:
1.0000
Epoch 634/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0039 - acc:
0.9999
Epoch 635/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0037 - acc:
0.9999
Epoch 636/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0042 - acc:
0.9997
Epoch 637/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0036 - acc:
0.9999
Epoch 638/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0035 - acc:
1.0000
Epoch 639/1000

```

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10000/10000 [=====] - 0s 7us/step - loss: 0.0037 - acc:
1.0000
Epoch 640/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0036 - acc:
0.9999
Epoch 641/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0037 - acc:
0.9999
Epoch 642/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0034 - acc:
1.0000
Epoch 643/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0034 - acc:
1.0000
Epoch 644/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0035 - acc:
0.9999
Epoch 645/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0035 - acc:
1.0000
Epoch 646/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0033 - acc:
1.0000
Epoch 647/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0033 - acc:
0.9999
Epoch 648/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0033 - acc:
1.0000
Epoch 649/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0033 - acc:
1.0000
Epoch 650/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0032 - acc:
1.0000
Epoch 651/1000
10000/10000 [=====] - ETA: 0s - loss: 0.0037 - acc:
1.000 - 0s 7us/step - loss: 0.0033 - acc: 1.0000
Epoch 652/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0031 - acc:
0.9999
Epoch 653/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0035 - acc:
0.9999
Epoch 654/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0031 - acc:
1.0000
Epoch 655/1000

```

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10000/10000 [=====] - 0s 6us/step - loss: 0.0033 - acc:
1.0000
Epoch 656/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0033 - acc:
1.0000
Epoch 657/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0032 - acc:
0.9999
Epoch 658/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0034 - acc:
0.9999
Epoch 659/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0032 - acc:
0.9998
Epoch 660/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0030 - acc:
1.0000
Epoch 661/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0035 - acc:
0.9998
Epoch 662/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0030 - acc:
1.0000
Epoch 663/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0032 - acc:
0.9999
Epoch 664/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0028 - acc:
1.0000
Epoch 665/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0032 - acc:
1.0000
Epoch 666/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0029 - acc:
1.0000
Epoch 667/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0030 - acc:
1.0000
Epoch 668/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0027 - acc:
1.0000
Epoch 669/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0029 - acc:
1.0000
Epoch 670/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0026 - acc:
1.0000
Epoch 671/1000

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10000/10000 [=====] - 0s 8us/step - loss: 0.0029 - acc:
0.9998
Epoch 672/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0027 - acc:
1.0000
Epoch 673/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0028 - acc:
1.0000
Epoch 674/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0028 - acc:
1.0000
Epoch 675/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0027 - acc:
1.0000
Epoch 676/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0028 - acc:
1.0000
Epoch 677/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0028 - acc:
0.9999
Epoch 678/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0025 - acc:
1.0000
Epoch 679/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0026 - acc:
1.0000
Epoch 680/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0025 - acc:
1.0000
Epoch 681/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0029 - acc:
0.9998
Epoch 682/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0027 - acc:
1.0000
Epoch 683/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0025 - acc:
1.0000
Epoch 684/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0026 - acc:
1.0000
Epoch 685/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0027 - acc:
1.0000
Epoch 686/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0027 - acc:
0.9999
Epoch 687/1000

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10000/10000 [=====] - 0s 6us/step - loss: 0.0027 - acc:
0.9999
Epoch 688/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0025 - acc:
1.0000
Epoch 689/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0024 - acc:
1.0000
Epoch 690/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0024 - acc:
1.0000
Epoch 691/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0023 - acc:
1.0000
Epoch 692/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0024 - acc:
1.0000
Epoch 693/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0025 - acc:
0.9999
Epoch 694/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0025 - acc:
0.9999
Epoch 695/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0024 - acc:
1.0000
Epoch 696/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0024 - acc:
1.0000
Epoch 697/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0027 - acc:
0.9998
Epoch 698/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0024 - acc:
1.0000
Epoch 699/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0022 - acc:
1.0000
Epoch 700/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0023 - acc:
1.0000
Epoch 701/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0023 - acc:
1.0000
Epoch 702/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0024 - acc:
1.0000
Epoch 703/1000

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10000/10000 [=====] - 0s 6us/step - loss: 0.0024 - acc:
1.0000
Epoch 704/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0023 - acc:
1.0000
Epoch 705/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0024 - acc:
0.9999
Epoch 706/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0023 - acc:
1.0000
Epoch 707/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0022 - acc:
1.0000
Epoch 708/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0023 - acc:
0.9999
Epoch 709/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0022 - acc:
1.0000
Epoch 710/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0022 - acc:
0.9999
Epoch 711/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0021 - acc:
1.0000
Epoch 712/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0022 - acc:
0.9999
Epoch 713/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0020 - acc:
1.0000
Epoch 714/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0022 - acc:
1.0000
Epoch 715/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0021 - acc:
1.0000
Epoch 716/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0021 - acc:
1.0000
Epoch 717/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0023 - acc:
0.9998
Epoch 718/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0020 - acc:
1.0000
Epoch 719/1000

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10000/10000 [=====] - 0s 7us/step - loss: 0.0021 - acc:
1.0000
Epoch 720/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0020 - acc:
1.0000
Epoch 721/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0020 - acc:
1.0000
Epoch 722/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0020 - acc:
1.0000
Epoch 723/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0021 - acc:
0.9999
Epoch 724/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0020 - acc:
1.0000
Epoch 725/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0019 - acc:
1.0000
Epoch 726/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0021 - acc:
1.0000
Epoch 727/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0021 - acc:
1.0000
Epoch 728/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0020 - acc:
1.0000
Epoch 729/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0018 - acc:
1.0000
Epoch 730/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0018 - acc:
1.0000
Epoch 731/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0020 - acc:
1.0000
Epoch 732/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0020 - acc:
1.0000
Epoch 733/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0018 - acc:
1.0000
Epoch 734/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0018 - acc:
1.0000
Epoch 735/1000

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10000/10000 [=====] - 0s 6us/step - loss: 0.0018 - acc:
1.0000
Epoch 736/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0019 - acc:
1.0000
Epoch 737/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0018 - acc:
1.0000
Epoch 738/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0018 - acc:
1.0000
Epoch 739/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0020 - acc:
0.9999
Epoch 740/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0017 - acc:
1.0000
Epoch 741/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0018 - acc:
1.0000
Epoch 742/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0017 - acc:
1.0000
Epoch 743/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0021 - acc:
1.0000
Epoch 744/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0017 - acc:
1.0000
Epoch 745/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0017 - acc:
1.0000
Epoch 746/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0017 - acc:
1.0000
Epoch 747/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0017 - acc:
1.0000
Epoch 748/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0017 - acc:
1.0000
Epoch 749/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0016 - acc:
1.0000
Epoch 750/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0018 - acc:
1.0000
Epoch 751/1000

```



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10000/10000 [=====] - 0s 6us/step - loss: 0.0016 - acc:
1.0000
Epoch 752/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0017 - acc:
1.0000
Epoch 753/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0018 - acc:
1.0000
Epoch 754/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0016 - acc:
1.0000
Epoch 755/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0016 - acc:
1.0000
Epoch 756/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0018 - acc:
0.9999
Epoch 757/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0015 - acc:
1.0000
Epoch 758/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0016 - acc:
1.0000
Epoch 759/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0016 - acc:
1.0000
Epoch 760/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0017 - acc:
1.0000
Epoch 761/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0017 - acc:
1.0000
Epoch 762/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0016 - acc:
1.0000
Epoch 763/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0014 - acc:
1.0000
Epoch 764/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0017 - acc:
1.0000
Epoch 765/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0017 - acc:
0.9999
Epoch 766/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0015 - acc:
1.0000
Epoch 767/1000

```

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10000/10000 [=====] - 0s 7us/step - loss: 0.0016 - acc:
0.9999
Epoch 768/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0014 - acc:
1.0000
Epoch 769/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0014 - acc:
1.0000
Epoch 770/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0016 - acc:
1.0000
Epoch 771/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0014 - acc:
1.0000
Epoch 772/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0015 - acc:
1.0000
Epoch 773/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0015 - acc:
1.0000
Epoch 774/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0015 - acc:
1.0000
Epoch 775/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0014 - acc:
1.0000
Epoch 776/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0013 - acc:
1.0000
Epoch 777/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0014 - acc:
1.0000
Epoch 778/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0013 - acc:
1.0000
Epoch 779/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0013 - acc:
1.0000
Epoch 780/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0014 - acc:
1.0000
Epoch 781/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0015 - acc:
0.9999
Epoch 782/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0014 - acc:
1.0000
Epoch 783/1000

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10000/10000 [=====] - 0s 6us/step - loss: 0.0013 - acc:
1.0000
Epoch 784/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0013 - acc:
1.0000
Epoch 785/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0014 - acc:
1.0000
Epoch 786/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0014 - acc:
1.0000
Epoch 787/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0012 - acc:
1.0000
Epoch 788/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0013 - acc:
1.0000
Epoch 789/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0014 - acc:
1.0000
Epoch 790/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0014 - acc:
1.0000
Epoch 791/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0012 - acc:
1.0000
Epoch 792/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0013 - acc:
1.0000
Epoch 793/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0014 - acc:
1.0000
Epoch 794/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0013 - acc:
1.0000
Epoch 795/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0012 - acc:
1.0000
Epoch 796/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0013 - acc:
1.0000
Epoch 797/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0014 - acc:
0.9999
Epoch 798/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0012 - acc:
1.0000
Epoch 799/1000

```

```

10000/10000 [=====] - 0s 7us/step - loss: 0.0012 - acc:
1.0000
Epoch 800/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0012 - acc:
1.0000
Epoch 801/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0012 - acc:
1.0000
Epoch 802/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0012 - acc:
1.0000
Epoch 803/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0012 - acc:
1.0000
Epoch 804/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0012 - acc:
1.0000
Epoch 805/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0012 - acc:
1.0000
Epoch 806/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0012 - acc:
1.0000
Epoch 807/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0012 - acc:
1.0000
Epoch 808/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0012 - acc:
0.9999
Epoch 809/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0012 - acc:
1.0000
Epoch 810/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0011 - acc:
1.0000
Epoch 811/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0010 - acc:
1.0000
Epoch 812/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0011 - acc:
1.0000
Epoch 813/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0012 - acc:
1.0000
Epoch 814/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0012 - acc:
1.0000
Epoch 815/1000

```

```

10000/10000 [=====] - 0s 7us/step - loss: 0.0011 - acc:
1.0000
Epoch 816/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0010 - acc:
1.0000
Epoch 817/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0011 - acc:
1.0000
Epoch 818/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0011 - acc:
1.0000
Epoch 819/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0011 - acc:
1.0000
Epoch 820/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0010 - acc:
1.0000
Epoch 821/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0011 - acc:
1.0000
Epoch 822/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0011 - acc:
1.0000
Epoch 823/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0011 - acc:
1.0000
Epoch 824/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0011 - acc:
1.0000
Epoch 825/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0012 - acc:
1.0000
Epoch 826/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0011 - acc:
1.0000
Epoch 827/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0011 - acc:
1.0000
Epoch 828/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0013 - acc:
0.9999
Epoch 829/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0011 - acc:
0.9999
Epoch 830/1000
10000/10000 [=====] - 0s 6us/step - loss: 9.7796e-04 -
acc: 1.0000
Epoch 831/1000

```

```

10000/10000 [=====] - 0s 6us/step - loss: 0.0011 - acc:
1.0000
Epoch 832/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0011 - acc:
1.0000
Epoch 833/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0012 - acc:
0.9999
Epoch 834/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0011 - acc:
1.0000
Epoch 835/1000
10000/10000 [=====] - 0s 7us/step - loss: 9.5653e-04 -
acc: 1.0000
Epoch 836/1000
10000/10000 [=====] - 0s 7us/step - loss: 9.7703e-04 -
acc: 1.0000
Epoch 837/1000
10000/10000 [=====] - 0s 7us/step - loss: 9.5146e-04 -
acc: 1.0000
Epoch 838/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0010 - acc:
1.0000
Epoch 839/1000
10000/10000 [=====] - 0s 6us/step - loss: 9.4380e-04 -
acc: 1.0000
Epoch 840/1000
10000/10000 [=====] - 0s 7us/step - loss: 9.9976e-04 -
acc: 1.0000
Epoch 841/1000
10000/10000 [=====] - 0s 6us/step - loss: 9.9034e-04 -
acc: 0.9999
Epoch 842/1000
10000/10000 [=====] - 0s 8us/step - loss: 9.6129e-04 -
acc: 1.0000
Epoch 843/1000
10000/10000 [=====] - 0s 8us/step - loss: 9.2853e-04 -
acc: 1.0000
Epoch 844/1000
10000/10000 [=====] - 0s 6us/step - loss: 9.9801e-04 -
acc: 1.0000
Epoch 845/1000
10000/10000 [=====] - 0s 6us/step - loss: 0.0011 - acc:
0.9999
Epoch 846/1000
10000/10000 [=====] - 0s 6us/step - loss: 9.6889e-04 -
acc: 1.0000
Epoch 847/1000

```

```

10000/10000 [=====] - 0s 6us/step - loss: 9.0765e-04 -
acc: 1.0000
Epoch 848/1000
10000/10000 [=====] - 0s 7us/step - loss: 9.2017e-04 -
acc: 1.0000
Epoch 849/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.5538e-04 -
acc: 1.0000
Epoch 850/1000
10000/10000 [=====] - 0s 8us/step - loss: 0.0010 - acc:
0.9999
Epoch 851/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.3244e-04 -
acc: 1.0000
Epoch 852/1000
10000/10000 [=====] - 0s 7us/step - loss: 9.8225e-04 -
acc: 1.0000
Epoch 853/1000
10000/10000 [=====] - 0s 7us/step - loss: 9.6366e-04 -
acc: 1.0000
Epoch 854/1000
10000/10000 [=====] - 0s 7us/step - loss: 9.4013e-04 -
acc: 1.0000
Epoch 855/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.6118e-04 -
acc: 1.0000
Epoch 856/1000
10000/10000 [=====] - 0s 6us/step - loss: 8.5434e-04 -
acc: 1.0000
Epoch 857/1000
10000/10000 [=====] - 0s 6us/step - loss: 9.4866e-04 -
acc: 1.0000
Epoch 858/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.1661e-04 -
acc: 1.0000
Epoch 859/1000
10000/10000 [=====] - 0s 7us/step - loss: 0.0010 - acc:
0.9999
Epoch 860/1000
10000/10000 [=====] - 0s 6us/step - loss: 8.7122e-04 -
acc: 1.0000
Epoch 861/1000
10000/10000 [=====] - 0s 6us/step - loss: 9.9466e-04 -
acc: 1.0000
Epoch 862/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.7024e-04 -
acc: 1.0000
Epoch 863/1000

```

```

10000/10000 [=====] - 0s 6us/step - loss: 8.2755e-04 -
acc: 1.0000
Epoch 864/1000
10000/10000 [=====] - 0s 6us/step - loss: 8.6356e-04 -
acc: 1.0000
Epoch 865/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.9247e-04 -
acc: 1.0000
Epoch 866/1000
10000/10000 [=====] - 0s 6us/step - loss: 8.1799e-04 -
acc: 1.0000
Epoch 867/1000
10000/10000 [=====] - 0s 6us/step - loss: 8.2162e-04 -
acc: 1.0000
Epoch 868/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.1519e-04 -
acc: 1.0000
Epoch 869/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.1274e-04 -
acc: 1.0000
Epoch 870/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.5895e-04 -
acc: 0.9999
Epoch 871/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.4583e-04 -
acc: 1.0000
Epoch 872/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.2195e-04 -
acc: 1.0000
Epoch 873/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.0731e-04 -
acc: 1.0000
Epoch 874/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.0871e-04 -
acc: 1.0000
Epoch 875/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.9175e-04 -
acc: 1.0000
Epoch 876/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.5523e-04 -
acc: 1.0000
Epoch 877/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.8941e-04 -
acc: 1.0000
Epoch 878/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.1663e-04 -
acc: 1.0000
Epoch 879/1000

```



```

10000/10000 [=====] - 0s 7us/step - loss: 7.6332e-04 -
acc: 1.0000
Epoch 880/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.9203e-04 -
acc: 1.0000
Epoch 881/1000
10000/10000 [=====] - 0s 8us/step - loss: 7.8557e-04 -
acc: 1.0000
Epoch 882/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.0814e-04 -
acc: 1.0000
Epoch 883/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.5503e-04 -
acc: 1.0000
Epoch 884/1000
10000/10000 [=====] - 0s 8us/step - loss: 7.4491e-04 -
acc: 1.0000
Epoch 885/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.2770e-04 -
acc: 1.0000
Epoch 886/1000
10000/10000 [=====] - 0s 7us/step - loss: 8.0026e-04 -
acc: 1.0000
Epoch 887/1000
10000/10000 [=====] - 0s 11us/step - loss: 7.4260e-04 -
acc: 1.0000
Epoch 888/1000
10000/10000 [=====] - 0s 8us/step - loss: 7.2425e-04 -
acc: 1.0000
Epoch 889/1000
10000/10000 [=====] - 0s 8us/step - loss: 7.4050e-04 -
acc: 1.0000
Epoch 890/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.5353e-04 -
acc: 1.0000
Epoch 891/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.9769e-04 -
acc: 1.0000
Epoch 892/1000
10000/10000 [=====] - 0s 6us/step - loss: 7.4664e-04 -
acc: 1.0000
Epoch 893/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.3929e-04 -
acc: 1.0000
Epoch 894/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.2615e-04 -
acc: 1.0000
Epoch 895/1000

```

```

10000/10000 [=====] - 0s 8us/step - loss: 6.3535e-04 -
acc: 1.0000
Epoch 896/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.9382e-04 -
acc: 1.0000
Epoch 897/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.7312e-04 -
acc: 1.0000
Epoch 898/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.5730e-04 -
acc: 1.0000
Epoch 899/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.3930e-04 -
acc: 1.0000
Epoch 900/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.1639e-04 -
acc: 1.0000
Epoch 901/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.2550e-04 -
acc: 1.0000
Epoch 902/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.8132e-04 -
acc: 1.0000
Epoch 903/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.5014e-04 -
acc: 1.0000
Epoch 904/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.5689e-04 -
acc: 1.0000
Epoch 905/1000
10000/10000 [=====] - 0s 8us/step - loss: 6.8253e-04 -
acc: 1.0000
Epoch 906/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.7193e-04 -
acc: 1.0000
Epoch 907/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.3112e-04 -
acc: 1.0000
Epoch 908/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.6056e-04 -
acc: 1.0000
Epoch 909/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.0685e-04 -
acc: 1.0000
Epoch 910/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.0324e-04 -
acc: 1.0000
Epoch 911/1000

```

```

10000/10000 [=====] - 0s 6us/step - loss: 7.0980e-04 -
acc: 0.9999
Epoch 912/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.8733e-04 -
acc: 1.0000
Epoch 913/1000
10000/10000 [=====] - 0s 6us/step - loss: 7.9201e-04 -
acc: 0.9999
Epoch 914/1000
10000/10000 [=====] - 0s 6us/step - loss: 7.5426e-04 -
acc: 1.0000
Epoch 915/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.7570e-04 -
acc: 1.0000
Epoch 916/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.3874e-04 -
acc: 1.0000
Epoch 917/1000
10000/10000 [=====] - 0s 8us/step - loss: 5.6242e-04 -
acc: 1.0000
Epoch 918/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.9963e-04 -
acc: 1.0000
Epoch 919/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.2854e-04 -
acc: 1.0000
Epoch 920/1000
10000/10000 [=====] - 0s 6us/step - loss: 7.3278e-04 -
acc: 1.0000
Epoch 921/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.1581e-04 -
acc: 1.0000
Epoch 922/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.4258e-04 -
acc: 1.0000
Epoch 923/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.0973e-04 -
acc: 1.0000
Epoch 924/1000
10000/10000 [=====] - 0s 6us/step - loss: 5.6431e-04 -
acc: 1.0000
Epoch 925/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.0517e-04 -
acc: 1.0000
Epoch 926/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.6433e-04 -
acc: 0.9999
Epoch 927/1000

```

```

10000/10000 [=====] - 0s 6us/step - loss: 5.9605e-04 -
acc: 1.0000
Epoch 928/1000
10000/10000 [=====] - 0s 6us/step - loss: 5.4659e-04 -
acc: 1.0000
Epoch 929/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.2358e-04 -
acc: 1.0000
Epoch 930/1000
10000/10000 [=====] - 0s 8us/step - loss: 6.0844e-04 -
acc: 1.0000
Epoch 931/1000
10000/10000 [=====] - 0s 7us/step - loss: 7.1945e-04 -
acc: 0.9999
Epoch 932/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.6019e-04 -
acc: 1.0000
Epoch 933/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.1655e-04 -
acc: 1.0000
Epoch 934/1000
10000/10000 [=====] - 0s 6us/step - loss: 5.5265e-04 -
acc: 1.0000
Epoch 935/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.2364e-04 -
acc: 1.0000
Epoch 936/1000
10000/10000 [=====] - 0s 6us/step - loss: 5.1277e-04 -
acc: 1.0000
Epoch 937/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.0763e-04 -
acc: 1.0000
Epoch 938/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.1693e-04 -
acc: 1.0000
Epoch 939/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.3103e-04 -
acc: 1.0000
Epoch 940/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.1472e-04 -
acc: 1.0000
Epoch 941/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.2660e-04 -
acc: 1.0000
Epoch 942/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.5885e-04 -
acc: 1.0000
Epoch 943/1000

```

```

10000/10000 [=====] - 0s 7us/step - loss: 5.5244e-04 -
acc: 0.9999
Epoch 944/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.0708e-04 -
acc: 1.0000
Epoch 945/1000
10000/10000 [=====] - 0s 6us/step - loss: 5.1102e-04 -
acc: 1.0000
Epoch 946/1000
10000/10000 [=====] - 0s 6us/step - loss: 6.1541e-04 -
acc: 1.0000
Epoch 947/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.1822e-04 -
acc: 1.0000
Epoch 948/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.0502e-04 -
acc: 1.0000
Epoch 949/1000
10000/10000 [=====] - 0s 6us/step - loss: 5.1441e-04 -
acc: 1.0000
Epoch 950/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.5732e-04 -
acc: 0.9999
Epoch 951/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.7270e-04 -
acc: 1.0000
Epoch 952/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.8285e-04 -
acc: 1.0000
Epoch 953/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.8750e-04 -
acc: 1.0000
Epoch 954/1000
10000/10000 [=====] - 0s 7us/step - loss: 6.0997e-04 -
acc: 1.0000
Epoch 955/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.1992e-04 -
acc: 1.0000
Epoch 956/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.8657e-04 -
acc: 1.0000
Epoch 957/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.2028e-04 -
acc: 1.0000
Epoch 958/1000
10000/10000 [=====] - 0s 6us/step - loss: 5.1080e-04 -
acc: 1.0000
Epoch 959/1000

```

```

10000/10000 [=====] - 0s 6us/step - loss: 4.9186e-04 -
acc: 1.0000
Epoch 960/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.8540e-04 -
acc: 1.0000
Epoch 961/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.3548e-04 -
acc: 1.0000
Epoch 962/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.5065e-04 -
acc: 1.0000
Epoch 963/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.6034e-04 -
acc: 1.0000
Epoch 964/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.5507e-04 -
acc: 1.0000
Epoch 965/1000
10000/10000 [=====] - 0s 7us/step - loss: 5.4031e-04 -
acc: 1.0000
Epoch 966/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.8536e-04 -
acc: 1.0000
Epoch 967/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.3765e-04 -
acc: 1.0000
Epoch 968/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.4974e-04 -
acc: 1.0000
Epoch 969/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.2459e-04 -
acc: 1.0000
Epoch 970/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.3823e-04 -
acc: 1.0000
Epoch 971/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.0135e-04 -
acc: 1.0000
Epoch 972/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.2195e-04 -
acc: 1.0000
Epoch 973/1000
10000/10000 [=====] - 0s 8us/step - loss: 4.2514e-04 -
acc: 1.0000
Epoch 974/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.2084e-04 -
acc: 1.0000
Epoch 975/1000

```

```

10000/10000 [=====] - 0s 7us/step - loss: 4.4070e-04 -
acc: 1.0000
Epoch 976/1000
10000/10000 [=====] - 0s 7us/step - loss: 3.7261e-04 -
acc: 1.0000
Epoch 977/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.0616e-04 -
acc: 1.0000
Epoch 978/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.1858e-04 -
acc: 1.0000
Epoch 979/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.2439e-04 -
acc: 1.0000
Epoch 980/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.8174e-04 -
acc: 1.0000
Epoch 981/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.5236e-04 -
acc: 1.0000
Epoch 982/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.6714e-04 -
acc: 1.0000
Epoch 983/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.2806e-04 -
acc: 1.0000
Epoch 984/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.2464e-04 -
acc: 1.0000
Epoch 985/1000
10000/10000 [=====] - 0s 6us/step - loss: 3.8178e-04 -
acc: 1.0000
Epoch 986/1000
10000/10000 [=====] - 0s 7us/step - loss: 3.8933e-04 -
acc: 1.0000
Epoch 987/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.5417e-04 -
acc: 1.0000
Epoch 988/1000
10000/10000 [=====] - 0s 7us/step - loss: 4.2199e-04 -
acc: 1.0000
Epoch 989/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.1795e-04 -
acc: 1.0000
Epoch 990/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.2314e-04 -
acc: 1.0000
Epoch 991/1000

```

```

10000/10000 [=====] - 0s 7us/step - loss: 4.2970e-04 -
acc: 1.0000
Epoch 992/1000
10000/10000 [=====] - 0s 6us/step - loss: 4.1025e-04 -
acc: 1.0000
Epoch 993/1000
10000/10000 [=====] - 0s 8us/step - loss: 4.0805e-04 -
acc: 1.0000
Epoch 994/1000
10000/10000 [=====] - 0s 7us/step - loss: 3.5179e-04 -
acc: 1.0000
Epoch 995/1000
10000/10000 [=====] - 0s 7us/step - loss: 3.7906e-04 -
acc: 1.0000
Epoch 996/1000
10000/10000 [=====] - 0s 7us/step - loss: 3.8326e-04 -
acc: 1.0000
Epoch 997/1000
10000/10000 [=====] - 0s 6us/step - loss: 3.6553e-04 -
acc: 1.0000
Epoch 998/1000
10000/10000 [=====] - 0s 7us/step - loss: 3.4998e-04 -
acc: 1.0000
Epoch 999/1000
10000/10000 [=====] - 0s 6us/step - loss: 3.9863e-04 -
acc: 1.0000
Epoch 1000/1000
10000/10000 [=====] - 0s 6us/step - loss: 3.6468e-04 -
acc: 1.0000

```

```

[4]: x_test=np.random.randint(0,8,10)
      print(x_test)
      y_test=estimator.predict(x_test)
      print(y_test)

```

```

[6 4 5 4 4 2 2 0 2 1]
10/10 [=====] - 0s 7ms/step
[6 4 5 4 4 2 2 0 2 1]

```

1.1 Alternate learning code

```

[5]: import tensorflow as tf
      from tensorflow import keras
      from tensorflow.keras import layers
      from tensorflow.keras.layers import *
      from sklearn import preprocessing
      import tensorflow.keras.backend as K

```



```

from sklearn.metrics import mean_squared_error

Pert_variance = 1e-4

def perturbation(x):
    w = K.random_normal(shape = (channel,2),
        mean=0.0,stddev=Pert_variance**0.5,dtype=None,seed=None)
    xp = ((1-Pert_variance)**0.5)*x + w
    return xp

def loss_tx(y_true, y_pred):
    return -y_true*y_pred

def get_policy(inp):
    xp = inp[0]
    x = inp[1]
    w = xp - x
    policy = -K.sum(w*w)
    return policy

tx_inp = Input((1,))
embeddings_layer = Dense(msg_total, activation = 'relu')(tx_inp)
layer_dense = Dense(2*channel, activation = 'relu')(embeddings_layer)
to_complex = Reshape((channel,2))(layer_dense)
x = Lambda(lambda x: keras.backend.l2_normalize(x))(to_complex)
xp = Lambda(perturbation)(to_complex)
policy = Lambda(get_policy)([xp,x])

model_policy = keras.models.Model(inputs=tx_inp, outputs=policy)
model_tx = keras.models.Model(inputs=tx_inp, outputs=xp)

model_policy.compile(loss=loss_tx, optimizer=tf.keras.optimizers.SGD(lr = 1e-5))
print(model_policy.summary())

rx_inp = Input((channel,2))
to_flat = Reshape((2*channel,))(rx_inp)
fc = Dense(msg_total, activation = 'relu')(to_flat)
softmax = Dense(msg_total, activation = 'softmax')(fc)

model_rx = keras.models.Model(inputs=rx_inp, outputs=softmax)

model_rx.compile(loss='mse', optimizer=tf.keras.optimizers.SGD(lr = 1e-5))
print(model_rx.summary())

loss_tx = []

```

```

loss_rx = []
for epoch in range(epochs):
    raw_input = np.random.randint(0,8,(batch_size))
    label = np.zeros((batch_size, 8))
    label[np.arange(batch_size), raw_input] = 1
    tx_input = raw_input/8.0
    xp = model_tx.predict(tx_input)
    y = xp + np.random.normal(0,1,(batch_size, channel,2))
    pred = model_rx.predict(y)
    loss = np.sum(np.square(label - pred), axis = 1)
    # print('epoch: ', epoch)
    history_tx = model_policy.fit(tx_input, loss, batch_size=batch_size,
    epochs=1, verbose=0)
    loss_tx.append(history_tx.history['loss'][0])
    history_rx = model_rx.fit(xp, label, batch_size=batch_size, epochs=1,
    verbose=1)
    loss_rx.append(history_rx.history['loss'][0])

```

```

-----
-----
Layer (type)                Output Shape          Param #    Connected to
=====
=====
input_1 (InputLayer)        (None, 1)             0
-----
dense (Dense)                (None, 8)             16         input_1[0][0]
-----
dense_1 (Dense)              (None, 8)             72         dense[0][0]
-----
reshape (Reshape)           (None, 4, 2)          0          dense_1[0][0]
-----
lambda_1 (Lambda)           (None, 4, 2)          0          reshape[0][0]
-----
lambda (Lambda)              (None, 4, 2)          0          reshape[0][0]
-----
lambda_2 (Lambda)           ()                     0          lambda_1[0][0]
                                lambda[0][0]
=====
=====
Total params: 88
Trainable params: 88

```

Non-trainable params: 0

None

Layer (type)	Output Shape	Param #
input_2 (InputLayer)	(None, 4, 2)	0
reshape_1 (Reshape)	(None, 8)	0
dense_2 (Dense)	(None, 8)	72
dense_3 (Dense)	(None, 8)	72

Total params: 144

Trainable params: 144

Non-trainable params: 0

None

Epoch 1/1

1024/1024 [=====] - 0s 405us/step - loss: 0.1090

Epoch 1/1

1024/1024 [=====] - 0s 6us/step - loss: 0.1087

Epoch 1/1

1024/1024 [=====] - 0s 5us/step - loss: 0.1087

Epoch 1/1

1024/1024 [=====] - 0s 6us/step - loss: 0.1089

Epoch 1/1

1024/1024 [=====] - 0s 6us/step - loss: 0.1088

Epoch 1/1

1024/1024 [=====] - 0s 6us/step - loss: 0.1089

Epoch 1/1

1024/1024 [=====] - 0s 5us/step - loss: 0.1089

Epoch 1/1

1024/1024 [=====] - 0s 5us/step - loss: 0.1088

Epoch 1/1

1024/1024 [=====] - 0s 4us/step - loss: 0.1088

Epoch 1/1

1024/1024 [=====] - 0s 5us/step - loss: 0.1089

Epoch 1/1

1024/1024 [=====] - 0s 5us/step - loss: 0.1089

Epoch 1/1

1024/1024 [=====] - 0s 5us/step - loss: 0.1088

Epoch 1/1

1024/1024 [=====] - 0s 4us/step - loss: 0.1090

Epoch 1/1

1024/1024 [=====] - 0s 6us/step - loss: 0.1089

```

Epoch 1/1
1024/1024 [=====] - 0s 7us/step - loss: 0.1090
Epoch 1/1
1024/1024 [=====] - 0s 7us/step - loss: 0.1090
Epoch 1/1
1024/1024 [=====] - 0s 5us/step - loss: 0.1091
Epoch 1/1
1024/1024 [=====] - 0s 4us/step - loss: 0.1090
Epoch 1/1
1024/1024 [=====] - 0s 5us/step - loss: 0.1090
Epoch 1/1
1024/1024 [=====] - 0s 5us/step - loss: 0.1090
Epoch 1/1
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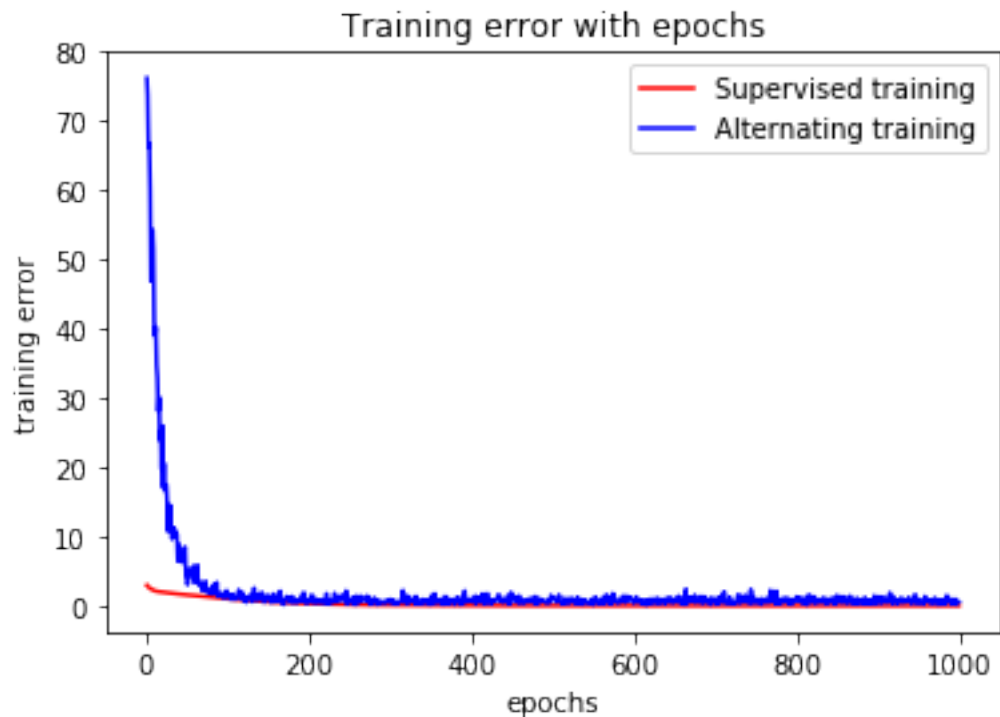
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2 Comparision

```
[8]: epoch_arr=range(1,epochs+1)  
plt.title('Training error with epochs')  
plt.plot(epoch_arr,loss_supervised,'r',label='Supervised training')  
plt.plot(epoch_arr,loss_tx,'b',label='Alternating training')  
plt.xlabel('epochs')  
plt.ylabel('training error')  
plt.legend()  
plt.show()
```



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