

ml_task1

March 19, 2020

```
[3]: import numpy as np
import tensorflow as tf

npz_file = np.load('QIS_EXAM_200Events.npz', allow_pickle =True)
print(npz_file.files)
training_ip = npz_file['training_input']
testing_ip = npz_file['test_input']
# print(testing_ip)

a = training_ip[()]
b= testing_ip[()]
x_test = np.vstack((b['0'], b['1']))
x_train = np.vstack((a['0'], a['1']))
# print(b['0'].shape)
# exit()

y_test = np.vstack((np.zeros((50,1)), np.ones((50,1))))
y_train = np.vstack((np.zeros((50,1)), np.ones((50,1))))
c=np.hstack((x_train,y_train))
np.random.shuffle(c)
x_train=c[:, :5]
x_train_n = (x_train - x_train.min(0)) / x_train.ptp(0)
x_test_n = (x_test - x_test.min(0)) / x_test.ptp(0)

x_train_n = x_train_n[:, :4]
x_test_n= x_test_n[:, :4]

print(x_train_n)
# exit()

y_train=c[:,5]
# print(y_train)
# exit()
# print(y_train.shape)
y_train = tf.keras.utils.to_categorical(y_train)
y_test = tf.keras.utils.to_categorical(y_test)
print(y_train)
# exit()
```

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model = tf.keras.Sequential([
    tf.keras.layers.Dense(500, activation=tf.nn.relu, input_shape=x_train_n[0].
    ↪shape),
    # tf.keras.layers.Dense(700, activation=tf.nn.relu),
    # tf.keras.layers.Dropout(0.2),
    tf.keras.layers.Dense(500, activation=tf.nn.relu),
    tf.keras.layers.Dropout(0.5),
    tf.keras.layers.Dense(2, activation='softmax')
])

# adam = tf.keras.optimizers.Adam(learning_rate=0.001, beta_1=0.9, beta_2=0.
    ↪999, amsgrad=False)
sgd = tf.keras.optimizers.SGD(lr=0.059, decay=1e-6, momentum=0.75,
    ↪nesterov=True)
model.compile(optimizer=sgd,
               loss='categorical_crossentropy',
               metrics=['accuracy'])
model.summary()
model.fit(x_train_n, y_train, shuffle=True, validation_split=0.2, epochs=200)

pred_train= model.predict(x_train_n)
scores = model.evaluate(x_train_n, y_train, verbose=0)
print('Accuracy on training data: {} \n Error on training data: {}'.
    ↪format(scores[1], 1 - scores[1]))

pred_test= model.predict(x_test_n)
scores2 = model.evaluate(x_test_n, y_test, verbose=0)
print('Accuracy on test data: {} \n Error on test data: {}'.format(scores2[1],
    ↪1 - scores2[1]))

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 [4.72860067e-04 3.18739954e-04 5.41914619e-01 1.09979689e-01]
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Model: "sequential_2"

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Layer (type)	Output Shape	Param #
dense_6 (Dense)	(None, 500)	2500
dense_7 (Dense)	(None, 500)	250500

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-----
dropout_2 (Dropout)                (None, 500)                0
-----
dense_8 (Dense)                    (None, 2)                   1002
=====
Total params: 254,002
Trainable params: 254,002
Non-trainable params: 0
-----
Train on 80 samples, validate on 20 samples
Epoch 1/200
80/80 [=====] - 0s 2ms/sample - loss: 0.6894 - acc:
0.4750 - val_loss: 0.6736 - val_acc: 0.8000
Epoch 2/200
80/80 [=====] - 0s 294us/sample - loss: 0.6784 - acc:
0.6375 - val_loss: 0.6503 - val_acc: 0.8000
Epoch 3/200
80/80 [=====] - 0s 300us/sample - loss: 0.6647 - acc:
0.7125 - val_loss: 0.6360 - val_acc: 0.7500
Epoch 4/200
80/80 [=====] - 0s 359us/sample - loss: 0.6376 - acc:
0.7375 - val_loss: 0.6255 - val_acc: 0.7500
Epoch 5/200
80/80 [=====] - 0s 377us/sample - loss: 0.6278 - acc:
0.7250 - val_loss: 0.5998 - val_acc: 0.7500
Epoch 6/200
80/80 [=====] - 0s 389us/sample - loss: 0.6140 - acc:
0.7625 - val_loss: 0.5781 - val_acc: 0.7500
Epoch 7/200
80/80 [=====] - 0s 378us/sample - loss: 0.5899 - acc:
0.7750 - val_loss: 0.5688 - val_acc: 0.7500
Epoch 8/200
80/80 [=====] - 0s 397us/sample - loss: 0.5703 - acc:
0.7625 - val_loss: 0.5651 - val_acc: 0.7500
Epoch 9/200
80/80 [=====] - 0s 408us/sample - loss: 0.5737 - acc:
0.7625 - val_loss: 0.5589 - val_acc: 0.7500
Epoch 10/200
80/80 [=====] - 0s 355us/sample - loss: 0.5651 - acc:
0.7875 - val_loss: 0.5353 - val_acc: 0.7500
Epoch 11/200
80/80 [=====] - 0s 397us/sample - loss: 0.5480 - acc:
0.7625 - val_loss: 0.5248 - val_acc: 0.7500
Epoch 12/200
80/80 [=====] - 0s 310us/sample - loss: 0.5367 - acc:
0.7625 - val_loss: 0.5317 - val_acc: 0.7500
Epoch 13/200
80/80 [=====] - 0s 331us/sample - loss: 0.5417 - acc:

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0.7625 - val_loss: 0.5235 - val_acc: 0.7500
Epoch 14/200
80/80 [=====] - 0s 394us/sample - loss: 0.5277 - acc:
0.7875 - val_loss: 0.5014 - val_acc: 0.7500
Epoch 15/200
80/80 [=====] - 0s 386us/sample - loss: 0.5350 - acc:
0.7625 - val_loss: 0.4985 - val_acc: 0.7500
Epoch 16/200
80/80 [=====] - 0s 406us/sample - loss: 0.5313 - acc:
0.7625 - val_loss: 0.4935 - val_acc: 0.7500
Epoch 17/200
80/80 [=====] - 0s 445us/sample - loss: 0.5406 - acc:
0.7625 - val_loss: 0.4914 - val_acc: 0.7500
Epoch 18/200
80/80 [=====] - 0s 234us/sample - loss: 0.5544 - acc:
0.7500 - val_loss: 0.5107 - val_acc: 0.7500
Epoch 19/200
80/80 [=====] - 0s 321us/sample - loss: 0.5346 - acc:
0.7875 - val_loss: 0.5060 - val_acc: 0.7500
Epoch 20/200
80/80 [=====] - 0s 255us/sample - loss: 0.5300 - acc:
0.7500 - val_loss: 0.4959 - val_acc: 0.7500
Epoch 21/200
80/80 [=====] - 0s 324us/sample - loss: 0.5303 - acc:
0.7500 - val_loss: 0.4923 - val_acc: 0.7500
Epoch 22/200
80/80 [=====] - 0s 375us/sample - loss: 0.5466 - acc:
0.7500 - val_loss: 0.4949 - val_acc: 0.7500
Epoch 23/200
80/80 [=====] - 0s 417us/sample - loss: 0.5346 - acc:
0.7500 - val_loss: 0.5045 - val_acc: 0.8000
Epoch 24/200
80/80 [=====] - 0s 366us/sample - loss: 0.5158 - acc:
0.8000 - val_loss: 0.5061 - val_acc: 0.8000
Epoch 25/200
80/80 [=====] - 0s 351us/sample - loss: 0.5453 - acc:
0.7250 - val_loss: 0.4768 - val_acc: 0.8000
Epoch 26/200
80/80 [=====] - 0s 374us/sample - loss: 0.5430 - acc:
0.7625 - val_loss: 0.4771 - val_acc: 0.8000
Epoch 27/200
80/80 [=====] - 0s 356us/sample - loss: 0.5214 - acc:
0.7750 - val_loss: 0.4796 - val_acc: 0.8000
Epoch 28/200
80/80 [=====] - 0s 408us/sample - loss: 0.5079 - acc:
0.7875 - val_loss: 0.4720 - val_acc: 0.8000
Epoch 29/200
80/80 [=====] - 0s 548us/sample - loss: 0.5267 - acc:

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0.7750 - val_loss: 0.4661 - val_acc: 0.8000
Epoch 30/200
80/80 [=====] - 0s 397us/sample - loss: 0.5275 - acc:
0.7500 - val_loss: 0.4665 - val_acc: 0.8000
Epoch 31/200
80/80 [=====] - 0s 252us/sample - loss: 0.5207 - acc:
0.7750 - val_loss: 0.4619 - val_acc: 0.8000
Epoch 32/200
80/80 [=====] - 0s 385us/sample - loss: 0.5308 - acc:
0.7500 - val_loss: 0.4580 - val_acc: 0.8000
Epoch 33/200
80/80 [=====] - 0s 387us/sample - loss: 0.5245 - acc:
0.7500 - val_loss: 0.4611 - val_acc: 0.8000
Epoch 34/200
80/80 [=====] - 0s 434us/sample - loss: 0.5125 - acc:
0.7625 - val_loss: 0.4767 - val_acc: 0.7500
Epoch 35/200
80/80 [=====] - 0s 430us/sample - loss: 0.5355 - acc:
0.7375 - val_loss: 0.4904 - val_acc: 0.8000
Epoch 36/200
80/80 [=====] - 0s 275us/sample - loss: 0.5234 - acc:
0.7750 - val_loss: 0.4739 - val_acc: 0.7500
Epoch 37/200
80/80 [=====] - 0s 246us/sample - loss: 0.5491 - acc:
0.7500 - val_loss: 0.4718 - val_acc: 0.8000
Epoch 38/200
80/80 [=====] - 0s 376us/sample - loss: 0.4999 - acc:
0.7500 - val_loss: 0.4545 - val_acc: 0.8000
Epoch 39/200
80/80 [=====] - 0s 291us/sample - loss: 0.5056 - acc:
0.7500 - val_loss: 0.4525 - val_acc: 0.8000
Epoch 40/200
80/80 [=====] - 0s 377us/sample - loss: 0.5155 - acc:
0.7625 - val_loss: 0.4764 - val_acc: 0.8000
Epoch 41/200
80/80 [=====] - 0s 391us/sample - loss: 0.5363 - acc:
0.8000 - val_loss: 0.4744 - val_acc: 0.8000
Epoch 42/200
80/80 [=====] - 0s 354us/sample - loss: 0.5185 - acc:
0.8000 - val_loss: 0.4582 - val_acc: 0.8000
Epoch 43/200
80/80 [=====] - 0s 403us/sample - loss: 0.4987 - acc:
0.7750 - val_loss: 0.4618 - val_acc: 0.8500
Epoch 44/200
80/80 [=====] - 0s 360us/sample - loss: 0.5130 - acc:
0.7750 - val_loss: 0.4631 - val_acc: 0.8500
Epoch 45/200
80/80 [=====] - 0s 342us/sample - loss: 0.5382 - acc:

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0.7875 - val_loss: 0.4506 - val_acc: 0.8000
 Epoch 46/200
 80/80 [=====] - 0s 360us/sample - loss: 0.5537 - acc:
 0.7500 - val_loss: 0.4470 - val_acc: 0.8000
 Epoch 47/200
 80/80 [=====] - 0s 337us/sample - loss: 0.5274 - acc:
 0.7750 - val_loss: 0.4614 - val_acc: 0.8000
 Epoch 48/200
 80/80 [=====] - 0s 417us/sample - loss: 0.5030 - acc:
 0.7750 - val_loss: 0.4747 - val_acc: 0.8500
 Epoch 49/200
 80/80 [=====] - 0s 322us/sample - loss: 0.5321 - acc:
 0.7875 - val_loss: 0.4742 - val_acc: 0.8500
 Epoch 50/200
 80/80 [=====] - 0s 273us/sample - loss: 0.5165 - acc:
 0.7875 - val_loss: 0.4481 - val_acc: 0.8000
 Epoch 51/200
 80/80 [=====] - 0s 286us/sample - loss: 0.4948 - acc:
 0.7625 - val_loss: 0.4438 - val_acc: 0.8000
 Epoch 52/200
 80/80 [=====] - 0s 294us/sample - loss: 0.5328 - acc:
 0.7125 - val_loss: 0.4411 - val_acc: 0.8000
 Epoch 53/200
 80/80 [=====] - 0s 273us/sample - loss: 0.5584 - acc:
 0.7500 - val_loss: 0.4451 - val_acc: 0.8000
 Epoch 54/200
 80/80 [=====] - 0s 318us/sample - loss: 0.5094 - acc:
 0.7625 - val_loss: 0.4432 - val_acc: 0.8000
 Epoch 55/200
 80/80 [=====] - 0s 383us/sample - loss: 0.5035 - acc:
 0.7500 - val_loss: 0.4394 - val_acc: 0.8000
 Epoch 56/200
 80/80 [=====] - 0s 332us/sample - loss: 0.5057 - acc:
 0.7625 - val_loss: 0.4578 - val_acc: 0.8500
 Epoch 57/200
 80/80 [=====] - 0s 380us/sample - loss: 0.5208 - acc:
 0.7750 - val_loss: 0.4788 - val_acc: 0.8000
 Epoch 58/200
 80/80 [=====] - 0s 362us/sample - loss: 0.5240 - acc:
 0.7875 - val_loss: 0.4649 - val_acc: 0.8000
 Epoch 59/200
 80/80 [=====] - 0s 405us/sample - loss: 0.5263 - acc:
 0.8000 - val_loss: 0.4441 - val_acc: 0.8000
 Epoch 60/200
 80/80 [=====] - 0s 453us/sample - loss: 0.5365 - acc:
 0.7625 - val_loss: 0.4454 - val_acc: 0.8500
 Epoch 61/200
 80/80 [=====] - 0s 337us/sample - loss: 0.4954 - acc:

0.7875 - val_loss: 0.4394 - val_acc: 0.8000
 Epoch 62/200
 80/80 [=====] - 0s 325us/sample - loss: 0.5106 - acc:
 0.7875 - val_loss: 0.4316 - val_acc: 0.8000
 Epoch 63/200
 80/80 [=====] - 0s 365us/sample - loss: 0.5113 - acc:
 0.7625 - val_loss: 0.4295 - val_acc: 0.8000
 Epoch 64/200
 80/80 [=====] - 0s 377us/sample - loss: 0.4955 - acc:
 0.7750 - val_loss: 0.4430 - val_acc: 0.8500
 Epoch 65/200
 80/80 [=====] - 0s 317us/sample - loss: 0.4986 - acc:
 0.8000 - val_loss: 0.4335 - val_acc: 0.8500
 Epoch 66/200
 80/80 [=====] - 0s 317us/sample - loss: 0.4888 - acc:
 0.7500 - val_loss: 0.4271 - val_acc: 0.8000
 Epoch 67/200
 80/80 [=====] - 0s 427us/sample - loss: 0.5255 - acc:
 0.7750 - val_loss: 0.4452 - val_acc: 0.8000
 Epoch 68/200
 80/80 [=====] - 0s 464us/sample - loss: 0.4917 - acc:
 0.7750 - val_loss: 0.4254 - val_acc: 0.8000
 Epoch 69/200
 80/80 [=====] - 0s 434us/sample - loss: 0.5001 - acc:
 0.7625 - val_loss: 0.4299 - val_acc: 0.8000
 Epoch 70/200
 80/80 [=====] - 0s 389us/sample - loss: 0.4996 - acc:
 0.7875 - val_loss: 0.4369 - val_acc: 0.8500
 Epoch 71/200
 80/80 [=====] - 0s 273us/sample - loss: 0.5228 - acc:
 0.7625 - val_loss: 0.4310 - val_acc: 0.8000
 Epoch 72/200
 80/80 [=====] - 0s 262us/sample - loss: 0.5078 - acc:
 0.7750 - val_loss: 0.4355 - val_acc: 0.8500
 Epoch 73/200
 80/80 [=====] - 0s 415us/sample - loss: 0.4980 - acc:
 0.7625 - val_loss: 0.4343 - val_acc: 0.8500
 Epoch 74/200
 80/80 [=====] - 0s 402us/sample - loss: 0.4843 - acc:
 0.7875 - val_loss: 0.4377 - val_acc: 0.8000
 Epoch 75/200
 80/80 [=====] - 0s 405us/sample - loss: 0.4987 - acc:
 0.8250 - val_loss: 0.4371 - val_acc: 0.8000
 Epoch 76/200
 80/80 [=====] - 0s 280us/sample - loss: 0.5079 - acc:
 0.7625 - val_loss: 0.4244 - val_acc: 0.8000
 Epoch 77/200
 80/80 [=====] - 0s 272us/sample - loss: 0.5139 - acc:

```

0.7375 - val_loss: 0.4248 - val_acc: 0.8000
Epoch 78/200
80/80 [=====] - 0s 350us/sample - loss: 0.5014 - acc:
0.7750 - val_loss: 0.4204 - val_acc: 0.8000
Epoch 79/200
80/80 [=====] - 0s 397us/sample - loss: 0.5336 - acc:
0.7375 - val_loss: 0.4335 - val_acc: 0.8000
Epoch 80/200
80/80 [=====] - 0s 402us/sample - loss: 0.5264 - acc:
0.7625 - val_loss: 0.4173 - val_acc: 0.8000
Epoch 81/200
80/80 [=====] - 0s 346us/sample - loss: 0.5236 - acc:
0.7375 - val_loss: 0.4179 - val_acc: 0.8500
Epoch 82/200
80/80 [=====] - 0s 441us/sample - loss: 0.5100 - acc:
0.7625 - val_loss: 0.4144 - val_acc: 0.8000
Epoch 83/200
80/80 [=====] - 0s 286us/sample - loss: 0.5254 - acc:
0.7500 - val_loss: 0.4205 - val_acc: 0.8500
Epoch 84/200
80/80 [=====] - 0s 379us/sample - loss: 0.5044 - acc:
0.7625 - val_loss: 0.4188 - val_acc: 0.8000
Epoch 85/200
80/80 [=====] - 0s 430us/sample - loss: 0.4899 - acc:
0.7750 - val_loss: 0.4232 - val_acc: 0.8500
Epoch 86/200
80/80 [=====] - 0s 351us/sample - loss: 0.4908 - acc:
0.7750 - val_loss: 0.4207 - val_acc: 0.8500
Epoch 87/200
80/80 [=====] - 0s 371us/sample - loss: 0.4951 - acc:
0.7500 - val_loss: 0.4228 - val_acc: 0.8500
Epoch 88/200
80/80 [=====] - 0s 442us/sample - loss: 0.5240 - acc:
0.7500 - val_loss: 0.4175 - val_acc: 0.8000
Epoch 89/200
80/80 [=====] - 0s 309us/sample - loss: 0.4946 - acc:
0.7750 - val_loss: 0.4171 - val_acc: 0.8000
Epoch 90/200
80/80 [=====] - 0s 276us/sample - loss: 0.4899 - acc:
0.7375 - val_loss: 0.4211 - val_acc: 0.8500
Epoch 91/200
80/80 [=====] - 0s 303us/sample - loss: 0.4908 - acc:
0.7875 - val_loss: 0.4229 - val_acc: 0.8000
Epoch 92/200
80/80 [=====] - 0s 414us/sample - loss: 0.4861 - acc:
0.7750 - val_loss: 0.4175 - val_acc: 0.8500
Epoch 93/200
80/80 [=====] - 0s 382us/sample - loss: 0.5048 - acc:

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0.7875 - val_loss: 0.4127 - val_acc: 0.8500
 Epoch 94/200
 80/80 [=====] - 0s 358us/sample - loss: 0.5106 - acc:
 0.7625 - val_loss: 0.4176 - val_acc: 0.8500
 Epoch 95/200
 80/80 [=====] - 0s 320us/sample - loss: 0.4956 - acc:
 0.7750 - val_loss: 0.4185 - val_acc: 0.8000
 Epoch 96/200
 80/80 [=====] - 0s 393us/sample - loss: 0.5065 - acc:
 0.7875 - val_loss: 0.4184 - val_acc: 0.8500
 Epoch 97/200
 80/80 [=====] - 0s 321us/sample - loss: 0.5130 - acc:
 0.7625 - val_loss: 0.4166 - val_acc: 0.8500
 Epoch 98/200
 80/80 [=====] - 0s 400us/sample - loss: 0.5031 - acc:
 0.7375 - val_loss: 0.4196 - val_acc: 0.8000
 Epoch 99/200
 80/80 [=====] - 0s 511us/sample - loss: 0.4837 - acc:
 0.7750 - val_loss: 0.4163 - val_acc: 0.8500
 Epoch 100/200
 80/80 [=====] - 0s 460us/sample - loss: 0.5038 - acc:
 0.7875 - val_loss: 0.4115 - val_acc: 0.8000
 Epoch 101/200
 80/80 [=====] - 0s 312us/sample - loss: 0.4903 - acc:
 0.7750 - val_loss: 0.4085 - val_acc: 0.8500
 Epoch 102/200
 80/80 [=====] - 0s 412us/sample - loss: 0.4870 - acc:
 0.7375 - val_loss: 0.4095 - val_acc: 0.8500
 Epoch 103/200
 80/80 [=====] - 0s 352us/sample - loss: 0.4859 - acc:
 0.7750 - val_loss: 0.4225 - val_acc: 0.8000
 Epoch 104/200
 80/80 [=====] - 0s 453us/sample - loss: 0.5040 - acc:
 0.7875 - val_loss: 0.4139 - val_acc: 0.8500
 Epoch 105/200
 80/80 [=====] - 0s 423us/sample - loss: 0.5106 - acc:
 0.8000 - val_loss: 0.4291 - val_acc: 0.8000
 Epoch 106/200
 80/80 [=====] - 0s 429us/sample - loss: 0.4924 - acc:
 0.8000 - val_loss: 0.4160 - val_acc: 0.8500
 Epoch 107/200
 80/80 [=====] - 0s 381us/sample - loss: 0.5079 - acc:
 0.7875 - val_loss: 0.4120 - val_acc: 0.9000
 Epoch 108/200
 80/80 [=====] - 0s 529us/sample - loss: 0.5050 - acc:
 0.7750 - val_loss: 0.4180 - val_acc: 0.8000
 Epoch 109/200
 80/80 [=====] - 0s 360us/sample - loss: 0.5092 - acc:

0.7375 - val_loss: 0.4015 - val_acc: 0.8500
 Epoch 110/200
 80/80 [=====] - 0s 454us/sample - loss: 0.4977 - acc:
 0.7750 - val_loss: 0.4044 - val_acc: 0.8500
 Epoch 111/200
 80/80 [=====] - 0s 425us/sample - loss: 0.4933 - acc:
 0.7500 - val_loss: 0.4096 - val_acc: 0.8000
 Epoch 112/200
 80/80 [=====] - 0s 287us/sample - loss: 0.4846 - acc:
 0.7625 - val_loss: 0.4187 - val_acc: 0.8000
 Epoch 113/200
 80/80 [=====] - 0s 424us/sample - loss: 0.4913 - acc:
 0.7750 - val_loss: 0.4214 - val_acc: 0.8000
 Epoch 114/200
 80/80 [=====] - 0s 413us/sample - loss: 0.5012 - acc:
 0.7750 - val_loss: 0.4086 - val_acc: 0.8500
 Epoch 115/200
 80/80 [=====] - 0s 356us/sample - loss: 0.5151 - acc:
 0.7500 - val_loss: 0.4222 - val_acc: 0.8000
 Epoch 116/200
 80/80 [=====] - 0s 486us/sample - loss: 0.5084 - acc:
 0.7500 - val_loss: 0.4101 - val_acc: 0.8500
 Epoch 117/200
 80/80 [=====] - 0s 395us/sample - loss: 0.4862 - acc:
 0.7875 - val_loss: 0.4091 - val_acc: 0.8500
 Epoch 118/200
 80/80 [=====] - 0s 397us/sample - loss: 0.4957 - acc:
 0.7750 - val_loss: 0.4128 - val_acc: 0.8000
 Epoch 119/200
 80/80 [=====] - 0s 342us/sample - loss: 0.4798 - acc:
 0.7875 - val_loss: 0.4092 - val_acc: 0.8000
 Epoch 120/200
 80/80 [=====] - 0s 313us/sample - loss: 0.5016 - acc:
 0.7750 - val_loss: 0.4095 - val_acc: 0.8500
 Epoch 121/200
 80/80 [=====] - 0s 399us/sample - loss: 0.5074 - acc:
 0.7625 - val_loss: 0.4184 - val_acc: 0.8000
 Epoch 122/200
 80/80 [=====] - 0s 366us/sample - loss: 0.4850 - acc:
 0.8000 - val_loss: 0.4012 - val_acc: 0.8500
 Epoch 123/200
 80/80 [=====] - 0s 286us/sample - loss: 0.4943 - acc:
 0.7875 - val_loss: 0.3979 - val_acc: 0.8500
 Epoch 124/200
 80/80 [=====] - 0s 354us/sample - loss: 0.4875 - acc:
 0.7750 - val_loss: 0.4022 - val_acc: 0.8000
 Epoch 125/200
 80/80 [=====] - 0s 324us/sample - loss: 0.4958 - acc:

0.8000 - val_loss: 0.4057 - val_acc: 0.8000
 Epoch 126/200
 80/80 [=====] - 0s 421us/sample - loss: 0.4855 - acc:
 0.7750 - val_loss: 0.4029 - val_acc: 0.9000
 Epoch 127/200
 80/80 [=====] - 0s 362us/sample - loss: 0.4956 - acc:
 0.7625 - val_loss: 0.4004 - val_acc: 0.9000
 Epoch 128/200
 80/80 [=====] - 0s 336us/sample - loss: 0.4854 - acc:
 0.7875 - val_loss: 0.4030 - val_acc: 0.8500
 Epoch 129/200
 80/80 [=====] - 0s 484us/sample - loss: 0.4792 - acc:
 0.7625 - val_loss: 0.4047 - val_acc: 0.8500
 Epoch 130/200
 80/80 [=====] - 0s 361us/sample - loss: 0.4869 - acc:
 0.7875 - val_loss: 0.4124 - val_acc: 0.8000
 Epoch 131/200
 80/80 [=====] - 0s 357us/sample - loss: 0.5016 - acc:
 0.7875 - val_loss: 0.4068 - val_acc: 0.8000
 Epoch 132/200
 80/80 [=====] - 0s 470us/sample - loss: 0.4869 - acc:
 0.7750 - val_loss: 0.4007 - val_acc: 0.9000
 Epoch 133/200
 80/80 [=====] - 0s 365us/sample - loss: 0.4777 - acc:
 0.7750 - val_loss: 0.3998 - val_acc: 0.8500
 Epoch 134/200
 80/80 [=====] - 0s 381us/sample - loss: 0.4866 - acc:
 0.8125 - val_loss: 0.3979 - val_acc: 0.8500
 Epoch 135/200
 80/80 [=====] - 0s 323us/sample - loss: 0.4899 - acc:
 0.7625 - val_loss: 0.3971 - val_acc: 0.8000
 Epoch 136/200
 80/80 [=====] - 0s 305us/sample - loss: 0.5116 - acc:
 0.7875 - val_loss: 0.4105 - val_acc: 0.8000
 Epoch 137/200
 80/80 [=====] - 0s 239us/sample - loss: 0.4734 - acc:
 0.7875 - val_loss: 0.4012 - val_acc: 0.9000
 Epoch 138/200
 80/80 [=====] - 0s 377us/sample - loss: 0.4890 - acc:
 0.8125 - val_loss: 0.3998 - val_acc: 0.8500
 Epoch 139/200
 80/80 [=====] - 0s 398us/sample - loss: 0.5004 - acc:
 0.7750 - val_loss: 0.3992 - val_acc: 0.8000
 Epoch 140/200
 80/80 [=====] - 0s 402us/sample - loss: 0.4913 - acc:
 0.7375 - val_loss: 0.3950 - val_acc: 0.8500
 Epoch 141/200
 80/80 [=====] - 0s 420us/sample - loss: 0.4605 - acc:

0.7875 - val_loss: 0.3995 - val_acc: 0.8000
 Epoch 142/200
 80/80 [=====] - 0s 327us/sample - loss: 0.4880 - acc:
 0.8125 - val_loss: 0.3920 - val_acc: 0.8500
 Epoch 143/200
 80/80 [=====] - 0s 331us/sample - loss: 0.4949 - acc:
 0.7750 - val_loss: 0.3987 - val_acc: 0.8000
 Epoch 144/200
 80/80 [=====] - 0s 384us/sample - loss: 0.4736 - acc:
 0.8000 - val_loss: 0.3930 - val_acc: 0.9000
 Epoch 145/200
 80/80 [=====] - 0s 397us/sample - loss: 0.4790 - acc:
 0.7750 - val_loss: 0.3966 - val_acc: 0.8500
 Epoch 146/200
 80/80 [=====] - 0s 208us/sample - loss: 0.4770 - acc:
 0.8125 - val_loss: 0.4021 - val_acc: 0.8500
 Epoch 147/200
 80/80 [=====] - 0s 296us/sample - loss: 0.4647 - acc:
 0.8000 - val_loss: 0.4009 - val_acc: 0.8500
 Epoch 148/200
 80/80 [=====] - 0s 480us/sample - loss: 0.5000 - acc:
 0.8000 - val_loss: 0.4035 - val_acc: 0.8500
 Epoch 149/200
 80/80 [=====] - 0s 296us/sample - loss: 0.4758 - acc:
 0.7875 - val_loss: 0.4046 - val_acc: 0.8000
 Epoch 150/200
 80/80 [=====] - 0s 362us/sample - loss: 0.4881 - acc:
 0.7875 - val_loss: 0.3915 - val_acc: 0.9000
 Epoch 151/200
 80/80 [=====] - 0s 385us/sample - loss: 0.4795 - acc:
 0.7875 - val_loss: 0.3922 - val_acc: 0.8500
 Epoch 152/200
 80/80 [=====] - 0s 367us/sample - loss: 0.5000 - acc:
 0.7625 - val_loss: 0.4073 - val_acc: 0.8000
 Epoch 153/200
 80/80 [=====] - 0s 411us/sample - loss: 0.5156 - acc:
 0.7875 - val_loss: 0.4111 - val_acc: 0.8500
 Epoch 154/200
 80/80 [=====] - 0s 315us/sample - loss: 0.4782 - acc:
 0.8000 - val_loss: 0.4086 - val_acc: 0.8500
 Epoch 155/200
 80/80 [=====] - 0s 328us/sample - loss: 0.4764 - acc:
 0.8250 - val_loss: 0.4244 - val_acc: 0.8000
 Epoch 156/200
 80/80 [=====] - 0s 322us/sample - loss: 0.4921 - acc:
 0.7875 - val_loss: 0.4028 - val_acc: 0.8500
 Epoch 157/200
 80/80 [=====] - 0s 317us/sample - loss: 0.4907 - acc:

0.8125 - val_loss: 0.3987 - val_acc: 0.9000
 Epoch 158/200
 80/80 [=====] - 0s 358us/sample - loss: 0.4934 - acc:
 0.7875 - val_loss: 0.4119 - val_acc: 0.8000
 Epoch 159/200
 80/80 [=====] - 0s 597us/sample - loss: 0.4724 - acc:
 0.7875 - val_loss: 0.3956 - val_acc: 0.9000
 Epoch 160/200
 80/80 [=====] - 0s 352us/sample - loss: 0.4689 - acc:
 0.8125 - val_loss: 0.3987 - val_acc: 0.8500
 Epoch 161/200
 80/80 [=====] - 0s 335us/sample - loss: 0.4747 - acc:
 0.7875 - val_loss: 0.4069 - val_acc: 0.8000
 Epoch 162/200
 80/80 [=====] - 0s 466us/sample - loss: 0.4846 - acc:
 0.7750 - val_loss: 0.4041 - val_acc: 0.8500
 Epoch 163/200
 80/80 [=====] - 0s 340us/sample - loss: 0.4809 - acc:
 0.8125 - val_loss: 0.4023 - val_acc: 0.8500
 Epoch 164/200
 80/80 [=====] - 0s 415us/sample - loss: 0.4789 - acc:
 0.7875 - val_loss: 0.3932 - val_acc: 0.8500
 Epoch 165/200
 80/80 [=====] - 0s 368us/sample - loss: 0.4711 - acc:
 0.8000 - val_loss: 0.3938 - val_acc: 0.8500
 Epoch 166/200
 80/80 [=====] - 0s 408us/sample - loss: 0.4659 - acc:
 0.8125 - val_loss: 0.3975 - val_acc: 0.8500
 Epoch 167/200
 80/80 [=====] - 0s 450us/sample - loss: 0.5006 - acc:
 0.7750 - val_loss: 0.4000 - val_acc: 0.8500
 Epoch 168/200
 80/80 [=====] - 0s 359us/sample - loss: 0.4612 - acc:
 0.8375 - val_loss: 0.4000 - val_acc: 0.8500
 Epoch 169/200
 80/80 [=====] - 0s 326us/sample - loss: 0.4731 - acc:
 0.7750 - val_loss: 0.3992 - val_acc: 0.8500
 Epoch 170/200
 80/80 [=====] - 0s 289us/sample - loss: 0.4595 - acc:
 0.8125 - val_loss: 0.3906 - val_acc: 0.8500
 Epoch 171/200
 80/80 [=====] - 0s 423us/sample - loss: 0.4886 - acc:
 0.8000 - val_loss: 0.4038 - val_acc: 0.8000
 Epoch 172/200
 80/80 [=====] - 0s 435us/sample - loss: 0.4873 - acc:
 0.7875 - val_loss: 0.4151 - val_acc: 0.8000
 Epoch 173/200
 80/80 [=====] - 0s 405us/sample - loss: 0.5453 - acc:

0.7750 - val_loss: 0.4167 - val_acc: 0.8000
 Epoch 174/200
 80/80 [=====] - 0s 358us/sample - loss: 0.4695 - acc:
 0.8000 - val_loss: 0.4072 - val_acc: 0.8500
 Epoch 175/200
 80/80 [=====] - 0s 342us/sample - loss: 0.4889 - acc:
 0.8000 - val_loss: 0.4117 - val_acc: 0.8500
 Epoch 176/200
 80/80 [=====] - 0s 424us/sample - loss: 0.4778 - acc:
 0.8125 - val_loss: 0.4099 - val_acc: 0.8500
 Epoch 177/200
 80/80 [=====] - 0s 369us/sample - loss: 0.4589 - acc:
 0.8125 - val_loss: 0.4016 - val_acc: 0.8500
 Epoch 178/200
 80/80 [=====] - 0s 417us/sample - loss: 0.4928 - acc:
 0.7875 - val_loss: 0.3982 - val_acc: 0.8500
 Epoch 179/200
 80/80 [=====] - 0s 437us/sample - loss: 0.4560 - acc:
 0.8125 - val_loss: 0.4015 - val_acc: 0.8000
 Epoch 180/200
 80/80 [=====] - 0s 374us/sample - loss: 0.4777 - acc:
 0.8000 - val_loss: 0.3971 - val_acc: 0.8000
 Epoch 181/200
 80/80 [=====] - 0s 295us/sample - loss: 0.4542 - acc:
 0.8125 - val_loss: 0.3998 - val_acc: 0.8500
 Epoch 182/200
 80/80 [=====] - 0s 326us/sample - loss: 0.4857 - acc:
 0.7875 - val_loss: 0.3949 - val_acc: 0.8500
 Epoch 183/200
 80/80 [=====] - 0s 382us/sample - loss: 0.4671 - acc:
 0.7875 - val_loss: 0.3876 - val_acc: 0.8500
 Epoch 184/200
 80/80 [=====] - 0s 327us/sample - loss: 0.4774 - acc:
 0.8000 - val_loss: 0.3893 - val_acc: 0.8500
 Epoch 185/200
 80/80 [=====] - 0s 414us/sample - loss: 0.4899 - acc:
 0.7750 - val_loss: 0.3871 - val_acc: 0.8500
 Epoch 186/200
 80/80 [=====] - 0s 359us/sample - loss: 0.5304 - acc:
 0.7625 - val_loss: 0.4190 - val_acc: 0.8000
 Epoch 187/200
 80/80 [=====] - 0s 367us/sample - loss: 0.5043 - acc:
 0.8000 - val_loss: 0.4136 - val_acc: 0.8500
 Epoch 188/200
 80/80 [=====] - 0s 277us/sample - loss: 0.4645 - acc:
 0.8250 - val_loss: 0.4180 - val_acc: 0.8500
 Epoch 189/200
 80/80 [=====] - 0s 358us/sample - loss: 0.4734 - acc:

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0.8250 - val_loss: 0.4089 - val_acc: 0.8500
Epoch 190/200
80/80 [=====] - 0s 419us/sample - loss: 0.5320 - acc:
0.8000 - val_loss: 0.4157 - val_acc: 0.8500
Epoch 191/200
80/80 [=====] - 0s 351us/sample - loss: 0.4908 - acc:
0.7750 - val_loss: 0.4350 - val_acc: 0.7500
Epoch 192/200
80/80 [=====] - 0s 445us/sample - loss: 0.5125 - acc:
0.7750 - val_loss: 0.3916 - val_acc: 0.8500
Epoch 193/200
80/80 [=====] - 0s 394us/sample - loss: 0.4737 - acc:
0.7875 - val_loss: 0.3899 - val_acc: 0.8000
Epoch 194/200
80/80 [=====] - 0s 376us/sample - loss: 0.4856 - acc:
0.8000 - val_loss: 0.3920 - val_acc: 0.8500
Epoch 195/200
80/80 [=====] - 0s 368us/sample - loss: 0.4800 - acc:
0.8125 - val_loss: 0.3962 - val_acc: 0.8000
Epoch 196/200
80/80 [=====] - 0s 320us/sample - loss: 0.4841 - acc:
0.8125 - val_loss: 0.4056 - val_acc: 0.8500
Epoch 197/200
80/80 [=====] - 0s 252us/sample - loss: 0.5105 - acc:
0.7750 - val_loss: 0.4020 - val_acc: 0.8000
Epoch 198/200
80/80 [=====] - 0s 354us/sample - loss: 0.5008 - acc:
0.7875 - val_loss: 0.4068 - val_acc: 0.8000
Epoch 199/200
80/80 [=====] - 0s 346us/sample - loss: 0.4760 - acc:
0.8000 - val_loss: 0.3977 - val_acc: 0.8000
Epoch 200/200
80/80 [=====] - 0s 454us/sample - loss: 0.4809 - acc:
0.8000 - val_loss: 0.3994 - val_acc: 0.8500
Accuracy on training data: 0.8199999928474426
Error on training data: 0.18000000715255737
Accuracy on test data: 0.7400000095367432
Error on test data: 0.25999999046325684

```

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