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

#use tensorflow version 1.x features
import tensorflow.compat.v1 as tf
tf.disable_v2_behavior()
```

```
WARNING:tensorflow:From /Users/anmol/anaconda3/lib/python3.7/site-
packages/tensorflow_core/python/compat/v2_compat.py:88:
disable_resource_variables (from tensorflow.python.ops.variable_scope) is
deprecated and will be removed in a future version.
Instructions for updating:
non-resource variables are not supported in the long term
```

0.0.1 read iris dataset

[2]:
```
columns = ['sepal_length', 'sepal_width', 'petal_length', 'petal_width',␣
↪'species']

#separate feature and labels
features = columns[:-1]
label = columns[-1]

iris_train = pd.read_csv('iris_training.csv', header = None, names = columns)
iris_test = pd.read_csv('iris_test.csv', header = None, names = columns)
```

[3]:
```
iris_train.sample(5)
```

[3]:

	sepal_length	sepal_width	petal_length	petal_width	species
109	4.8	3.1	1.6	0.2	0
46	4.8	3.4	1.6	0.2	0
42	6.7	3.0	5.2	2.3	2
118	4.8	3.0	1.4	0.1	0
3	4.9	3.1	1.5	0.1	0

[4]:
```
X_train = iris_train.iloc[:, :-1]

#one hot encode labels
y_train = iris_train.iloc[:, -1:]
y_train = pd.get_dummies(y_train.species)

X_test = iris_test.iloc[:, :-1]

#one hot encode labels
y_test = iris_test.iloc[:, -1:]
y_test = pd.get_dummies(y_test.species)
```

0.0.2 2. Create a simple softmax classifier with 3 neurons in output layer and no hidden layer using TensorFlow Core APIs. Save it as iris_softmax.py

Ref - - https://steadforce.com/first-steps-tensorflow-part-2/ - https://www.tensorflow.org/api_docs/python/tf/ma
- https://www.kaggle.com/vijayshinva/iris-tensorflow-basic-softmax-regression

[5]:
```
print(X_train.shape)
print(y_train.shape)
print(X_test.shape)
print(y_test.shape)
```

```
(120, 4)
(120, 3)
(30, 4)
(30, 3)
```

[6]:
```
df = pd.DataFrame(columns=['Run Count', 'Epoch', 'Learn Rate', 'Mean Accuracy',␣
 ↪'Standard Deviation'])

def declare_weight(shape):
    #use 1/np.sqrt(4) as SD for random initialization
    initialize = tf.truncated_normal(shape, stddev=0.5)
    return tf.Variable(initialize)

def declare_bias(shape):
    initialize = tf.constant(0.5, shape=shape)
    return tf.Variable(initialize)

#run whole thing 10 times
for i in range(1,11) :
    sess = tf.InteractiveSession()
    x = tf.placeholder(tf.float32, shape=[None, 4])  #four features
    y = tf.placeholder(tf.float32, shape=[None, 3])  #three classes
```

```
    #placeholders for weights and biasesyui
    weight = declare_weight([4,3])
    bias = declare_bias([3])

    #define softmax using tensorflow
    y_predicted = tf.nn.softmax(tf.matmul(x, weight) + bias)

    #try with different learn rate and iterations for gradient descent
    learn_rate = 0.01
    epochs = 1000

    #define cost function
    cross_entropy_cost = tf.reduce_mean(-tf.reduce_sum(y * tf.log(y_predicted),␣
↪axis=1))

    optimizer = tf.train.GradientDescentOptimizer(learning_rate=learn_rate).
↪minimize(cross_entropy_cost)
    sess.run(tf.global_variables_initializer())

    for epoch in range(epochs) :
        sess.run([optimizer], feed_dict={x:X_train, y:y_train})

    weight_hat, bias_hat = sess.run([weight, bias])
    prediction_accuracy = tf.equal(tf.argmax(y_predicted, 1), tf.argmax(y,1))

    mean_accuracy = sess.run(tf.reduce_mean(tf.cast(prediction_accuracy, tf.
↪float32)),
                                            feed_dict={weight:weight_hat, bias:
↪bias_hat,
                                                                    x: X_test, y:
↪ y_test})
    std = sess.run(tf.math.reduce_std(tf.cast(prediction_accuracy, tf.float32)),
                   feed_dict={weight:weight_hat, bias:bias_hat,
                              x: X_test, y: y_test})
    df = df.append({'Run Count': i, 'Epoch': epochs, 'Learn Rate': learn_rate,
                    'Mean Accuracy': mean_accuracy, 'Standard Deviation': std},␣
↪ignore_index=True)

df.head(10)
```

```
/Users/anmol/anaconda3/lib/python3.7/site-
packages/tensorflow_core/python/client/session.py:1752: UserWarning: An
interactive session is already active. This can cause out-of-memory errors in
some cases. You must explicitly call `InteractiveSession.close()` to release
resources held by the other session(s).
  warnings.warn('An interactive session is already active. This can '
```

[6]:

	Run Count	Epoch	Learn Rate	Mean Accuracy	Standard Deviation
0	1.0	1000.0	0.01	0.900000	0.300000
1	2.0	1000.0	0.01	0.933333	0.249444
2	3.0	1000.0	0.01	0.900000	0.300000
3	4.0	1000.0	0.01	0.900000	0.300000
4	5.0	1000.0	0.01	0.933333	0.249444
5	6.0	1000.0	0.01	0.933333	0.249444
6	7.0	1000.0	0.01	0.900000	0.300000
7	8.0	1000.0	0.01	0.966667	0.179505
8	9.0	1000.0	0.01	0.933333	0.249444
9	10.0	1000.0	0.01	0.933333	0.249444

[7]:
```
print("Mean Accuracy across all 10 runs : ", df['Mean Accuracy'].mean())
print("Mean Standard Deviation across all 10 runs : ", df['Standard Deviation'].
↪mean())
```

```
Mean Accuracy across all 10 runs :  0.9233333230018616
Mean Standard Deviation across all 10 runs :  0.26267244964838027
```

0.0.3 3. Create an MLP classifier with 3 hidden layers of sizes 5, 10, 5 using tensorflow Core APIs. Save it as iris_mlp_tf.py

References : - https://towardsdatascience.com/multi-layer-perceptron-using-tensorflow-9f3e218a4809 - https://becominghuman.ai/creating-your-own-neural-network-using-tensorflow-fa8ca7cc4d0e - https://github.com/aymericdamien/TensorFlow-Examples/blob/master/examples/3_NeuralNetworks/multilayer_perceptron.py - https://www.javatpoint.com/multi-layer-perceptron-in-tensorflow - https://steadforce.com/first-steps-tensorflow-part-3/

[8]:
```
#define mlp model with three hidden layers
def mlp_model(x, n_h1, n_h2, n_h3):
    n_f = 4  #No of features
    n_labels = 3  #No of classes

    #hidden layer 1
    with tf.name_scope('hidden_layer1'):
        hidden_layer1_weight = tf.Variable(tf.truncated_normal([n_f, n_h1],
                                                               mean=0,
                                                               stddev=1/np.
↪sqrt(n_f)),
                                           name='hidden_layer1_weight')
        hidden_layer1_bias = tf.Variable(tf.zeros([n_h1]),␣
↪name='hidden_layer1_bias')
        hidden_layer1 = tf.nn.relu(tf.matmul(x, hidden_layer1_weight) +␣
↪hidden_layer1_bias)
```

```
    #hidden layer 2
    with tf.name_scope('hidden_layer2'):
        hidden_layer2_weight = tf.Variable(tf.truncated_normal([n_h1, n_h2],
                                                               mean=0,
                                                               stddev=1/np.
↪sqrt(n_h1)),
                                           name='hidden_layer2_weight')
        hidden_layer2_bias = tf.Variable(tf.zeros([n_h2]),␣
↪name='hidden_layer2_bias')
        hidden_layer2 = tf.nn.relu(tf.matmul(hidden_layer1,␣
↪hidden_layer2_weight) + hidden_layer2_bias)

    #hidden layer 3
    with tf.name_scope('hidden_layer3'):
        hidden_layer3_weight = tf.Variable(tf.truncated_normal([n_h2, n_h3],
                                                               mean=0,
                                                               stddev=1/np.
↪sqrt(n_h2)),
                                           name='hidden_layer3_weight')
        hidden_layer3_bias = tf.Variable(tf.zeros([n_h3]),␣
↪name='hidden_layer3_bias')
        hidden_layer3 = tf.nn.relu(tf.matmul(hidden_layer2,␣
↪hidden_layer3_weight) + hidden_layer3_bias)

    #output layer
    with tf.name_scope('output_layer'):
        output_layer_weight = tf.Variable(tf.truncated_normal([n_h3, n_labels],
                                                              mean=0,
                                                              stddev=1/np.sqrt(n_h3)),
                                          name='output_layer_weight')
        output_layer_bias = tf.Variable(tf.zeros([3]), name='output_layer_bias')
        output_layer = tf.sigmoid(tf.matmul(hidden_layer3, output_layer_weight)␣
↪+ output_layer_bias)

    weight_histogram = tf.summary.histogram("weights", output_layer_weight)
    bias_histogram = tf.summary.histogram("biases", output_layer_bias)
    return output_layer
```

[9]:
```
df = pd.DataFrame(columns=['Run Count', 'Epoch', 'Cost', 'Mean Accuracy',␣
↪'Standard Deviation'])
learn_rate = 0.01
log_dir = 'logs'

for i in range(1,11) :
    tf.reset_default_graph()
    g = tf.Graph()
```

```
    log_dir = 'logs' + str(i)

    with g.as_default() :
        x = tf.placeholder(tf.float32, shape=[None, 4])  #four features
        y = tf.placeholder(tf.float32, [None, 3])
        y_predicted = mlp_model(x, 5, 10, 5)

        #cross entropy cost function
        with tf.name_scope("cost_function") as scope :
            cost = tf.reduce_mean(tf.nn.
↪softmax_cross_entropy_with_logits_v2(logits=y_predicted,
                                                                    ␣
↪       labels=y))
            tf.summary.scalar("cost_function", cost)

        with tf.name_scope("train") as scope:
            optimizer = tf.train.AdamOptimizer(learn_rate).minimize(cost)

        correct_prediction = tf.equal(tf.argmax(y_train,1), tf.
↪argmax(y_predicted,1))
        accuracy = tf.reduce_mean(tf.cast(correct_prediction, tf.float32))

    with tf.Session(graph=g) as sess:
        sess.run(tf.global_variables_initializer())

        merged_summary = tf.summary.merge_all()
        summary_writer = tf.summary.FileWriter(log_dir, graph=g)

        for epochs in range(1000):
            _, c= sess.run([optimizer,cost],feed_dict = {x: X_train, y:␣
↪y_train})

            #write to tf summary every 100 iterations
            if(epochs + 1) % 100 == 0:
                summary_str = sess.run(merged_summary, feed_dict={x: X_train, y:
↪ y_train})
                summary_writer.add_summary(summary_str, epochs+1)

            #print results for each of 10 runs
            if(epochs + 1) % 1000 == 0:
                test_result = sess.run(y_predicted, feed_dict = {x: X_train})
                correct_prediction = tf.equal(tf.argmax(test_result,1),tf.
↪argmax(y_train,1))
                mean_accuracy = tf.reduce_mean(tf.
↪cast(correct_prediction,"float"))
```

```
                mean_std = tf.math.reduce_std(tf.cast(correct_prediction,␣
↪"float"))

                print("Epoch:",epochs+1,"Cost:", c)
                print("Mean Accuracy across epoch :", mean_accuracy.eval({x:␣
↪X_test, y: y_test}))
                print("Mean Standard Deviation across epoch :", mean_std.
↪eval({x: X_test, y: y_test}))

                df = df.append({'Run Count': i, 'Epoch': 1000, 'Cost': c,
                                'Mean Accuracy': mean_accuracy.eval({x: X_test,␣
↪y: y_test}),
                                'Standard Deviation': mean_std.eval({x: X_test,␣
↪y: y_test})},
                               ignore_index=True)

df.head(10)
```

```
Epoch: 1000 Cost: 0.6631516
Mean Accuracy across epoch : 0.65833336
Mean Standard Deviation across epoch : 0.47426847
Epoch: 1000 Cost: 0.66362226
Mean Accuracy across epoch : 0.65
Mean Standard Deviation across epoch : 0.47696957
Epoch: 1000 Cost: 0.66310525
Mean Accuracy across epoch : 0.65
Mean Standard Deviation across epoch : 0.47696957
Epoch: 1000 Cost: 0.66302675
Mean Accuracy across epoch : 0.65
Mean Standard Deviation across epoch : 0.47696957
Epoch: 1000 Cost: 0.6629896
Mean Accuracy across epoch : 0.65
Mean Standard Deviation across epoch : 0.47696957
Epoch: 1000 Cost: 0.5602482
Mean Accuracy across epoch : 0.9916667
Mean Standard Deviation across epoch : 0.090905935
Epoch: 1000 Cost: 0.6704168
Mean Accuracy across epoch : 0.65
Mean Standard Deviation across epoch : 0.47696957
Epoch: 1000 Cost: 0.6637848
Mean Accuracy across epoch : 0.65
Mean Standard Deviation across epoch : 0.47696957
Epoch: 1000 Cost: 0.5600778
Mean Accuracy across epoch : 0.9916667
Mean Standard Deviation across epoch : 0.090905935
Epoch: 1000 Cost: 0.6634417
Mean Accuracy across epoch : 0.65
```

```
Mean Standard Deviation across epoch : 0.47696957
```

[9]:

	Run Count	Epoch	Cost	Mean Accuracy	Standard Deviation
0	1.0	1000.0	0.663152	0.658333	0.474268
1	2.0	1000.0	0.663622	0.650000	0.476970
2	3.0	1000.0	0.663105	0.650000	0.476970
3	4.0	1000.0	0.663027	0.650000	0.476970
4	5.0	1000.0	0.662990	0.650000	0.476970
5	6.0	1000.0	0.560248	0.991667	0.090906
6	7.0	1000.0	0.670417	0.650000	0.476970
7	8.0	1000.0	0.663785	0.650000	0.476970
8	9.0	1000.0	0.560078	0.991667	0.090906
9	10.0	1000.0	0.663442	0.650000	0.476970

[10]:
```
print("Mean Accuracy across all 10 runs : ", df['Mean Accuracy'].mean())
print("Mean Standard Deviation across all 10 runs : ", df['Standard Deviation'].
 ↪mean())
```

```
Mean Accuracy across all 10 runs :  0.7191666543483735
Mean Standard Deviation across all 10 runs :  0.39948673248291017
```

0.0.4 4. Save the snapshot of the graph and loss function plot from tensorboard

[11]:
```
%load_ext tensorboard
```

[12]:
```
%tensorboard --logdir logs6
```

```
Reusing TensorBoard on port 6009 (pid 22117), started 0:14:09 ago. (Use '!kill 22117' to kill
```

```
<IPython.core.display.HTML object>
```

0.0.5 5. Create an MLP classifier with 3 hidden layers of sizes 5, 10, 5 using Keras.

Ref : - https://machinelearningmastery.com/tutorial-first-neural-network-python-keras/ - https://machinelearningmastery.com/multi-class-classification-tutorial-keras-deep-learning-library/ - https://machinelearningmastery.com/how-to-choose-loss-functions-when-training-deep-learning-neural-networks/

[13]:
```
import tensorflow.compat.v1 as tf
tf.disable_v2_behavior()

tf.reset_default_graph()

#rest session - https://stackoverflow.com/questions/34454721/
 ↪how-to-reset-tensorboard-data-after-killing-tensorflow-instance
```

```
from keras.backend import clear_session
clear_session()
```

```
WARNING:tensorflow:From /Users/anmol/anaconda3/lib/python3.7/site-
packages/tensorflow_core/python/compat/v2_compat.py:88:
disable_resource_variables (from tensorflow.python.ops.variable_scope) is
deprecated and will be removed in a future version.
Instructions for updating:
non-resource variables are not supported in the long term
```

[14]:
```
from sklearn.preprocessing import LabelEncoder

import pandas as pd

import keras
from keras.models import Sequential
from keras.layers import Dense, Dropout, Activation
from keras.wrappers.scikit_learn import KerasClassifier
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import KFold
from keras.optimizers import SGD
from keras.utils import np_utils
```

[15]:
```
columns = ['sepal_length', 'sepal_width', 'petal_length', 'petal_width',␣
 ↪'species']

#separate feature and labels
features = columns[:-1]
label = columns[-1]

iris_train = pd.read_csv('iris_training.csv', header = None, names = columns)
iris_test = pd.read_csv('iris_test.csv', header = None, names = columns)

X_train = iris_train.iloc[:, :-1]

#one hot encode labels
y_train = iris_train.iloc[:, -1:]
y_train = pd.get_dummies(y_train.species)
X_test = iris_test.iloc[:, :-1]

#one hot encode labels
y_test = iris_test.iloc[:, -1:]
y_test = pd.get_dummies(y_test.species)
```

[16]:
```
model = Sequential()
model.add(Dense(5, input_dim=4, activation='relu'))
model.add(Dense(10, activation='relu'))
```

```
model.add(Dense(5, activation='relu'))
model.add(Dense(3, activation='sigmoid'))

model.compile(loss='categorical_crossentropy', optimizer='adam',␣
 ↪metrics=['accuracy'])

print('Keras model summary')
print(model.summary())

df = pd.DataFrame(columns=['Run Count', 'Epoch', 'Loss Value', 'Accuracy'])

for i in range(1,11) :
    model.fit(X_train, y_train, batch_size=5, epochs=100)
    results = model.evaluate(X_test, y_test)

    print('Mean loss function value {:2f}'.format(results[0]))
    print('Accuracy : {:2f}'.format(results[1]))

    df = df.append({'Run Count': i, 'Epoch': 100, 'Loss Value': results[0],
                    'Accuracy': results[1]}, ignore_index=True)
```

```
WARNING:tensorflow:From /Users/anmol/anaconda3/lib/python3.7/site-
packages/tensorflow_core/python/ops/resource_variable_ops.py:1635: calling
BaseResourceVariable.__init__ (from tensorflow.python.ops.resource_variable_ops)
with constraint is deprecated and will be removed in a future version.
Instructions for updating:
If using Keras pass *_constraint arguments to layers.
Keras model summary
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_1 (Dense)              (None, 5)                 25
_________________________________________________________________
dense_2 (Dense)              (None, 10)                60
_________________________________________________________________
dense_3 (Dense)              (None, 5)                 55
_________________________________________________________________
dense_4 (Dense)              (None, 3)                 18
=================================================================
Total params: 158
Trainable params: 158
Non-trainable params: 0
_________________________________________________________________
None
Epoch 1/100
120/120 [==============================] - 0s 1ms/step - loss: 1.0493 -
```

```
accuracy: 0.7000
Epoch 2/100
120/120 [==============================] - 0s 268us/step - loss: 1.0153 -
accuracy: 0.8167
Epoch 3/100
120/120 [==============================] - 0s 285us/step - loss: 0.9851 -
accuracy: 0.8583
Epoch 4/100
120/120 [==============================] - 0s 291us/step - loss: 0.9555 -
accuracy: 0.7333
Epoch 5/100
120/120 [==============================] - 0s 273us/step - loss: 0.9242 -
accuracy: 0.7083
Epoch 6/100
120/120 [==============================] - 0s 265us/step - loss: 0.8882 -
accuracy: 0.6667
Epoch 7/100
120/120 [==============================] - 0s 267us/step - loss: 0.8538 -
accuracy: 0.6583
Epoch 8/100
120/120 [==============================] - 0s 262us/step - loss: 0.8141 -
accuracy: 0.7667
Epoch 9/100
120/120 [==============================] - 0s 267us/step - loss: 0.7763 -
accuracy: 0.8250
Epoch 10/100
120/120 [==============================] - 0s 268us/step - loss: 0.7414 -
accuracy: 0.9000
Epoch 11/100
120/120 [==============================] - 0s 267us/step - loss: 0.7092 -
accuracy: 0.9250
Epoch 12/100
120/120 [==============================] - 0s 260us/step - loss: 0.6803 -
accuracy: 0.8917
Epoch 13/100
120/120 [==============================] - 0s 299us/step - loss: 0.6502 -
accuracy: 0.7000
Epoch 14/100
120/120 [==============================] - 0s 327us/step - loss: 0.6195 -
accuracy: 0.7000
Epoch 15/100
120/120 [==============================] - 0s 272us/step - loss: 0.5894 -
accuracy: 0.7000
Epoch 16/100
120/120 [==============================] - 0s 272us/step - loss: 0.5602 -
accuracy: 0.7000
Epoch 17/100
120/120 [==============================] - 0s 268us/step - loss: 0.5316 -
```

```
accuracy: 0.7000
Epoch 18/100
120/120 [==============================] - 0s 285us/step - loss: 0.5055 -
accuracy: 0.7000
Epoch 19/100
120/120 [==============================] - 0s 273us/step - loss: 0.4823 -
accuracy: 0.7000
Epoch 20/100
120/120 [==============================] - 0s 252us/step - loss: 0.4665 -
accuracy: 0.7000
Epoch 21/100
120/120 [==============================] - 0s 308us/step - loss: 0.4510 -
accuracy: 0.7000
Epoch 22/100
120/120 [==============================] - 0s 394us/step - loss: 0.4427 -
accuracy: 0.7000
Epoch 23/100
120/120 [==============================] - 0s 335us/step - loss: 0.4348 -
accuracy: 0.7417
Epoch 24/100
120/120 [==============================] - 0s 255us/step - loss: 0.4258 -
accuracy: 0.7083
Epoch 25/100
120/120 [==============================] - 0s 245us/step - loss: 0.4206 -
accuracy: 0.7500
Epoch 26/100
120/120 [==============================] - 0s 256us/step - loss: 0.4134 -
accuracy: 0.7167
Epoch 27/100
120/120 [==============================] - 0s 234us/step - loss: 0.4083 -
accuracy: 0.7750
Epoch 28/100
120/120 [==============================] - 0s 339us/step - loss: 0.3996 -
accuracy: 0.7667
Epoch 29/100
120/120 [==============================] - 0s 243us/step - loss: 0.3946 -
accuracy: 0.7250
Epoch 30/100
120/120 [==============================] - 0s 240us/step - loss: 0.3935 -
accuracy: 0.8583
Epoch 31/100
120/120 [==============================] - 0s 219us/step - loss: 0.3823 -
accuracy: 0.7833
Epoch 32/100
120/120 [==============================] - 0s 285us/step - loss: 0.3819 -
accuracy: 0.8250
Epoch 33/100
120/120 [==============================] - 0s 301us/step - loss: 0.3708 -
```

```
accuracy: 0.8500
Epoch 34/100
120/120 [==============================] - 0s 242us/step - loss: 0.3684 -
accuracy: 0.8333
Epoch 35/100
120/120 [==============================] - 0s 370us/step - loss: 0.3595 -
accuracy: 0.8250
Epoch 36/100
120/120 [==============================] - 0s 301us/step - loss: 0.3503 -
accuracy: 0.8833
Epoch 37/100
120/120 [==============================] - 0s 206us/step - loss: 0.3475 -
accuracy: 0.9583
Epoch 38/100
120/120 [==============================] - 0s 289us/step - loss: 0.3334 -
accuracy: 0.8750
Epoch 39/100
120/120 [==============================] - 0s 284us/step - loss: 0.3188 -
accuracy: 0.9083
Epoch 40/100
120/120 [==============================] - 0s 341us/step - loss: 0.3059 -
accuracy: 0.9500
Epoch 41/100
120/120 [==============================] - 0s 246us/step - loss: 0.2930 -
accuracy: 0.9417
Epoch 42/100
120/120 [==============================] - 0s 242us/step - loss: 0.2775 -
accuracy: 0.9833
Epoch 43/100
120/120 [==============================] - 0s 206us/step - loss: 0.2685 -
accuracy: 0.9583
Epoch 44/100
120/120 [==============================] - 0s 259us/step - loss: 0.2540 -
accuracy: 0.9750
Epoch 45/100
120/120 [==============================] - 0s 265us/step - loss: 0.2483 -
accuracy: 0.9500
Epoch 46/100
120/120 [==============================] - 0s 216us/step - loss: 0.2305 -
accuracy: 0.9750
Epoch 47/100
120/120 [==============================] - 0s 188us/step - loss: 0.2181 -
accuracy: 0.9750
Epoch 48/100
120/120 [==============================] - 0s 208us/step - loss: 0.2072 -
accuracy: 0.9750
Epoch 49/100
120/120 [==============================] - 0s 183us/step - loss: 0.1924 -
```

```
accuracy: 0.9667
Epoch 50/100
120/120 [==============================] - 0s 195us/step - loss: 0.1958 -
accuracy: 0.9667
Epoch 51/100
120/120 [==============================] - 0s 182us/step - loss: 0.1830 -
accuracy: 0.9833
Epoch 52/100
120/120 [==============================] - 0s 187us/step - loss: 0.1733 -
accuracy: 0.9667
Epoch 53/100
120/120 [==============================] - 0s 180us/step - loss: 0.1633 -
accuracy: 0.9750
Epoch 54/100
120/120 [==============================] - 0s 182us/step - loss: 0.1556 -
accuracy: 0.9833
Epoch 55/100
120/120 [==============================] - 0s 193us/step - loss: 0.1490 -
accuracy: 0.9750
Epoch 56/100
120/120 [==============================] - 0s 177us/step - loss: 0.1492 -
accuracy: 0.9750
Epoch 57/100
120/120 [==============================] - 0s 184us/step - loss: 0.1385 -
accuracy: 0.9667
Epoch 58/100
120/120 [==============================] - 0s 190us/step - loss: 0.1441 -
accuracy: 0.9667
Epoch 59/100
120/120 [==============================] - 0s 189us/step - loss: 0.1307 -
accuracy: 0.9667
Epoch 60/100
120/120 [==============================] - 0s 213us/step - loss: 0.1274 -
accuracy: 0.9750
Epoch 61/100
120/120 [==============================] - 0s 224us/step - loss: 0.1298 -
accuracy: 0.9583
Epoch 62/100
120/120 [==============================] - 0s 199us/step - loss: 0.1185 -
accuracy: 0.9833
Epoch 63/100
120/120 [==============================] - 0s 193us/step - loss: 0.1181 -
accuracy: 0.9833
Epoch 64/100
120/120 [==============================] - 0s 182us/step - loss: 0.1189 -
accuracy: 0.9667
Epoch 65/100
120/120 [==============================] - 0s 182us/step - loss: 0.1152 -
```

```
accuracy: 0.9750
Epoch 66/100
120/120 [==============================] - 0s 169us/step - loss: 0.1096 -
accuracy: 0.9833
Epoch 67/100
120/120 [==============================] - 0s 181us/step - loss: 0.1099 -
accuracy: 0.9750
Epoch 68/100
120/120 [==============================] - 0s 192us/step - loss: 0.1024 -
accuracy: 0.9833
Epoch 69/100
120/120 [==============================] - 0s 172us/step - loss: 0.0992 -
accuracy: 0.9833
Epoch 70/100
120/120 [==============================] - 0s 160us/step - loss: 0.1034 -
accuracy: 0.9750
Epoch 71/100
120/120 [==============================] - 0s 172us/step - loss: 0.1140 -
accuracy: 0.9667
Epoch 72/100
120/120 [==============================] - 0s 167us/step - loss: 0.1066 -
accuracy: 0.9583
Epoch 73/100
120/120 [==============================] - 0s 183us/step - loss: 0.1014 -
accuracy: 0.9667
Epoch 74/100
120/120 [==============================] - 0s 232us/step - loss: 0.0921 -
accuracy: 0.9750
Epoch 75/100
120/120 [==============================] - 0s 246us/step - loss: 0.0959 -
accuracy: 0.9667
Epoch 76/100
120/120 [==============================] - 0s 233us/step - loss: 0.1022 -
accuracy: 0.9750
Epoch 77/100
120/120 [==============================] - 0s 241us/step - loss: 0.0921 -
accuracy: 0.9750
Epoch 78/100
120/120 [==============================] - 0s 236us/step - loss: 0.0878 -
accuracy: 0.9667
Epoch 79/100
120/120 [==============================] - 0s 230us/step - loss: 0.0887 -
accuracy: 0.9750
Epoch 80/100
120/120 [==============================] - 0s 191us/step - loss: 0.0846 -
accuracy: 0.9833
Epoch 81/100
120/120 [==============================] - 0s 179us/step - loss: 0.0874 -
```

```
accuracy: 0.9750
Epoch 82/100
120/120 [==============================] - 0s 222us/step - loss: 0.0921 -
accuracy: 0.9667
Epoch 83/100
120/120 [==============================] - 0s 171us/step - loss: 0.0817 -
accuracy: 0.9833
Epoch 84/100
120/120 [==============================] - 0s 166us/step - loss: 0.0837 -
accuracy: 0.9833
Epoch 85/100
120/120 [==============================] - 0s 174us/step - loss: 0.0866 -
accuracy: 0.9750
Epoch 86/100
120/120 [==============================] - 0s 163us/step - loss: 0.0797 -
accuracy: 0.9750
Epoch 87/100
120/120 [==============================] - 0s 165us/step - loss: 0.0778 -
accuracy: 0.9750
Epoch 88/100
120/120 [==============================] - 0s 158us/step - loss: 0.0876 -
accuracy: 0.9667
Epoch 89/100
120/120 [==============================] - 0s 180us/step - loss: 0.0817 -
accuracy: 0.9750
Epoch 90/100
120/120 [==============================] - 0s 167us/step - loss: 0.0840 -
accuracy: 0.9833
Epoch 91/100
120/120 [==============================] - 0s 170us/step - loss: 0.0768 -
accuracy: 0.9833
Epoch 92/100
120/120 [==============================] - 0s 172us/step - loss: 0.0837 -
accuracy: 0.9750
Epoch 93/100
120/120 [==============================] - 0s 171us/step - loss: 0.0818 -
accuracy: 0.9833
Epoch 94/100
120/120 [==============================] - 0s 183us/step - loss: 0.0762 -
accuracy: 0.9833
Epoch 95/100
120/120 [==============================] - 0s 181us/step - loss: 0.0797 -
accuracy: 0.9750
Epoch 96/100
120/120 [==============================] - 0s 182us/step - loss: 0.0779 -
accuracy: 0.9750
Epoch 97/100
120/120 [==============================] - 0s 181us/step - loss: 0.0755 -
```

```
accuracy: 0.9833
Epoch 98/100
120/120 [==============================] - 0s 167us/step - loss: 0.0724 -
accuracy: 0.9833
Epoch 99/100
120/120 [==============================] - 0s 169us/step - loss: 0.0771 -
accuracy: 0.9750
Epoch 100/100
120/120 [==============================] - 0s 165us/step - loss: 0.0721 -
accuracy: 0.9833
30/30 [==============================] - 0s 890us/step
Mean loss function value 0.075733
Accuracy : 0.933333
Epoch 1/100
120/120 [==============================] - 0s 172us/step - loss: 0.0800 -
accuracy: 0.9750
Epoch 2/100
120/120 [==============================] - 0s 170us/step - loss: 0.0802 -
accuracy: 0.9500
Epoch 3/100
120/120 [==============================] - 0s 171us/step - loss: 0.0736 -
accuracy: 0.9750
Epoch 4/100
120/120 [==============================] - 0s 167us/step - loss: 0.0859 -
accuracy: 0.9750
Epoch 5/100
120/120 [==============================] - 0s 164us/step - loss: 0.0704 -
accuracy: 0.9833
Epoch 6/100
120/120 [==============================] - 0s 180us/step - loss: 0.0735 -
accuracy: 0.9833
Epoch 7/100
120/120 [==============================] - 0s 241us/step - loss: 0.0721 -
accuracy: 0.9833
Epoch 8/100
120/120 [==============================] - 0s 275us/step - loss: 0.0702 -
accuracy: 0.9750
Epoch 9/100
120/120 [==============================] - 0s 224us/step - loss: 0.0723 -
accuracy: 0.9750
Epoch 10/100
120/120 [==============================] - 0s 327us/step - loss: 0.0766 -
accuracy: 0.9667
Epoch 11/100
120/120 [==============================] - 0s 309us/step - loss: 0.0663 -
accuracy: 0.9833
Epoch 12/100
120/120 [==============================] - 0s 249us/step - loss: 0.0747 -
```

```
accuracy: 0.9667
Epoch 13/100
120/120 [==============================] - 0s 281us/step - loss: 0.0742 -
accuracy: 0.9833
Epoch 14/100
120/120 [==============================] - 0s 242us/step - loss: 0.0879 -
accuracy: 0.9667
Epoch 15/100
120/120 [==============================] - 0s 233us/step - loss: 0.0690 -
accuracy: 0.9750
Epoch 16/100
120/120 [==============================] - 0s 230us/step - loss: 0.0751 -
accuracy: 0.9750
Epoch 17/100
120/120 [==============================] - 0s 198us/step - loss: 0.0782 -
accuracy: 0.9667
Epoch 18/100
120/120 [==============================] - 0s 249us/step - loss: 0.0694 -
accuracy: 0.9750
Epoch 19/100
120/120 [==============================] - 0s 224us/step - loss: 0.0647 -
accuracy: 0.9833
Epoch 20/100
120/120 [==============================] - 0s 236us/step - loss: 0.0645 -
accuracy: 0.9833
Epoch 21/100
120/120 [==============================] - 0s 244us/step - loss: 0.0690 -
accuracy: 0.9833
Epoch 22/100
120/120 [==============================] - 0s 205us/step - loss: 0.0798 -
accuracy: 0.9667
Epoch 23/100
120/120 [==============================] - 0s 257us/step - loss: 0.0698 -
accuracy: 0.9750
Epoch 24/100
120/120 [==============================] - 0s 190us/step - loss: 0.0628 -
accuracy: 0.9833
Epoch 25/100
120/120 [==============================] - 0s 249us/step - loss: 0.0691 -
accuracy: 0.9750
Epoch 26/100
120/120 [==============================] - 0s 332us/step - loss: 0.0738 -
accuracy: 0.9750
Epoch 27/100
120/120 [==============================] - 0s 226us/step - loss: 0.0604 -
accuracy: 0.9750
Epoch 28/100
120/120 [==============================] - 0s 262us/step - loss: 0.0728 -
```

```
accuracy: 0.9667
Epoch 29/100
120/120 [==============================] - 0s 223us/step - loss: 0.0647 -
accuracy: 0.9833
Epoch 30/100
120/120 [==============================] - 0s 297us/step - loss: 0.0693 -
accuracy: 0.9833
Epoch 31/100
120/120 [==============================] - 0s 259us/step - loss: 0.0745 -
accuracy: 0.9667
Epoch 32/100
120/120 [==============================] - 0s 248us/step - loss: 0.0628 -
accuracy: 0.9833
Epoch 33/100
120/120 [==============================] - 0s 253us/step - loss: 0.0614 -
accuracy: 0.9833
Epoch 34/100
120/120 [==============================] - 0s 239us/step - loss: 0.0611 -
accuracy: 0.9750
Epoch 35/100
120/120 [==============================] - 0s 231us/step - loss: 0.0620 -
accuracy: 0.9833
Epoch 36/100
120/120 [==============================] - 0s 313us/step - loss: 0.0609 -
accuracy: 0.9833
Epoch 37/100
120/120 [==============================] - 0s 231us/step - loss: 0.0657 -
accuracy: 0.9833
Epoch 38/100
120/120 [==============================] - 0s 260us/step - loss: 0.0641 -
accuracy: 0.9667
Epoch 39/100
120/120 [==============================] - 0s 261us/step - loss: 0.0723 -
accuracy: 0.9667
Epoch 40/100
120/120 [==============================] - 0s 235us/step - loss: 0.0848 -
accuracy: 0.9667
Epoch 41/100
120/120 [==============================] - 0s 253us/step - loss: 0.0666 -
accuracy: 0.9917
Epoch 42/100
120/120 [==============================] - 0s 308us/step - loss: 0.0714 -
accuracy: 0.9583
Epoch 43/100
120/120 [==============================] - 0s 286us/step - loss: 0.0809 -
accuracy: 0.9833
Epoch 44/100
120/120 [==============================] - 0s 281us/step - loss: 0.0664 -
```

```
accuracy: 0.9833
Epoch 45/100
120/120 [==============================] - 0s 236us/step - loss: 0.0572 -
accuracy: 0.9750
Epoch 46/100
120/120 [==============================] - 0s 235us/step - loss: 0.0665 -
accuracy: 0.9833
Epoch 47/100
120/120 [==============================] - 0s 211us/step - loss: 0.0661 -
accuracy: 0.9833
Epoch 48/100
120/120 [==============================] - 0s 196us/step - loss: 0.0614 -
accuracy: 0.9833
Epoch 49/100
120/120 [==============================] - 0s 190us/step - loss: 0.0548 -
accuracy: 0.9833
Epoch 50/100
120/120 [==============================] - 0s 184us/step - loss: 0.0631 -
accuracy: 0.9833
Epoch 51/100
120/120 [==============================] - 0s 184us/step - loss: 0.0616 -
accuracy: 0.9750
Epoch 52/100
120/120 [==============================] - 0s 167us/step - loss: 0.0713 -
accuracy: 0.9750
Epoch 53/100
120/120 [==============================] - 0s 169us/step - loss: 0.0635 -
accuracy: 0.9833
Epoch 54/100
120/120 [==============================] - 0s 171us/step - loss: 0.0582 -
accuracy: 0.9833
Epoch 55/100
120/120 [==============================] - 0s 165us/step - loss: 0.0622 -
accuracy: 0.9750
Epoch 56/100
120/120 [==============================] - 0s 165us/step - loss: 0.0680 -
accuracy: 0.9750
Epoch 57/100
120/120 [==============================] - 0s 164us/step - loss: 0.0584 -
accuracy: 0.9833
Epoch 58/100
120/120 [==============================] - 0s 173us/step - loss: 0.0625 -
accuracy: 0.9833
Epoch 59/100
120/120 [==============================] - 0s 168us/step - loss: 0.0546 -
accuracy: 0.9833
Epoch 60/100
120/120 [==============================] - 0s 171us/step - loss: 0.0572 -
```

```
accuracy: 0.9833
Epoch 61/100
120/120 [==============================] - 0s 172us/step - loss: 0.0730 -
accuracy: 0.9667
Epoch 62/100
120/120 [==============================] - 0s 166us/step - loss: 0.0638 -
accuracy: 0.9667
Epoch 63/100
120/120 [==============================] - 0s 163us/step - loss: 0.0636 -
accuracy: 0.9750
Epoch 64/100
120/120 [==============================] - 0s 166us/step - loss: 0.0603 -
accuracy: 0.9750
Epoch 65/100
120/120 [==============================] - 0s 166us/step - loss: 0.0663 -
accuracy: 0.9667
Epoch 66/100
120/120 [==============================] - 0s 164us/step - loss: 0.0608 -
accuracy: 0.9833
Epoch 67/100
120/120 [==============================] - 0s 170us/step - loss: 0.0577 -
accuracy: 0.9833
Epoch 68/100
120/120 [==============================] - 0s 171us/step - loss: 0.0625 -
accuracy: 0.9833
Epoch 69/100
120/120 [==============================] - 0s 172us/step - loss: 0.0554 -
accuracy: 0.9917
Epoch 70/100
120/120 [==============================] - 0s 167us/step - loss: 0.0572 -
accuracy: 0.9833
Epoch 71/100
120/120 [==============================] - 0s 163us/step - loss: 0.0578 -
accuracy: 0.9833
Epoch 72/100
120/120 [==============================] - 0s 169us/step - loss: 0.0535 -
accuracy: 0.9833
Epoch 73/100
120/120 [==============================] - 0s 163us/step - loss: 0.0595 -
accuracy: 0.9833
Epoch 74/100
120/120 [==============================] - 0s 169us/step - loss: 0.0542 -
accuracy: 0.9833
Epoch 75/100
120/120 [==============================] - 0s 170us/step - loss: 0.0613 -
accuracy: 0.9750
Epoch 76/100
120/120 [==============================] - 0s 173us/step - loss: 0.0689 -
```

```
accuracy: 0.9750
Epoch 77/100
120/120 [==============================] - 0s 163us/step - loss: 0.0547 -
accuracy: 0.9833
Epoch 78/100
120/120 [==============================] - 0s 161us/step - loss: 0.0543 -
accuracy: 0.9833
Epoch 79/100
120/120 [==============================] - 0s 168us/step - loss: 0.0603 -
accuracy: 0.9667
Epoch 80/100
120/120 [==============================] - 0s 176us/step - loss: 0.0802 -
accuracy: 0.9750
Epoch 81/100
120/120 [==============================] - 0s 162us/step - loss: 0.0591 -
accuracy: 0.9833
Epoch 82/100
120/120 [==============================] - 0s 168us/step - loss: 0.0594 -
accuracy: 0.9833
Epoch 83/100
120/120 [==============================] - 0s 169us/step - loss: 0.0581 -
accuracy: 0.9750
Epoch 84/100
120/120 [==============================] - 0s 162us/step - loss: 0.0531 -
accuracy: 0.9833
Epoch 85/100
120/120 [==============================] - 0s 168us/step - loss: 0.0543 -
accuracy: 0.9833
Epoch 86/100
120/120 [==============================] - 0s 174us/step - loss: 0.0547 -
accuracy: 0.9833
Epoch 87/100
120/120 [==============================] - 0s 165us/step - loss: 0.0582 -
accuracy: 0.9917
Epoch 88/100
120/120 [==============================] - 0s 160us/step - loss: 0.0565 -
accuracy: 0.9750
Epoch 89/100
120/120 [==============================] - 0s 160us/step - loss: 0.0571 -
accuracy: 0.9667
Epoch 90/100
120/120 [==============================] - 0s 167us/step - loss: 0.0577 -
accuracy: 0.9750
Epoch 91/100
120/120 [==============================] - 0s 166us/step - loss: 0.0639 -
accuracy: 0.9750
Epoch 92/100
120/120 [==============================] - 0s 160us/step - loss: 0.0546 -
```

```
accuracy: 0.9833
Epoch 93/100
120/120 [==============================] - 0s 164us/step - loss: 0.0518 -
accuracy: 0.9833
Epoch 94/100
120/120 [==============================] - 0s 164us/step - loss: 0.0539 -
accuracy: 0.9833
Epoch 95/100
120/120 [==============================] - 0s 169us/step - loss: 0.0567 -
accuracy: 0.9833
Epoch 96/100
120/120 [==============================] - 0s 163us/step - loss: 0.0490 -
accuracy: 0.9833
Epoch 97/100
120/120 [==============================] - 0s 163us/step - loss: 0.0655 -
accuracy: 0.9750
Epoch 98/100
120/120 [==============================] - 0s 166us/step - loss: 0.0520 -
accuracy: 0.9833
Epoch 99/100
120/120 [==============================] - 0s 168us/step - loss: 0.0561 -
accuracy: 0.9750
Epoch 100/100
120/120 [==============================] - 0s 172us/step - loss: 0.0558 -
accuracy: 0.9833
30/30 [==============================] - 0s 14us/step
Mean loss function value 0.065642
Accuracy : 0.933333
Epoch 1/100
120/120 [==============================] - 0s 172us/step - loss: 0.0559 -
accuracy: 0.9833
Epoch 2/100
120/120 [==============================] - 0s 159us/step - loss: 0.0553 -
accuracy: 0.9833
Epoch 3/100
120/120 [==============================] - 0s 162us/step - loss: 0.0609 -
accuracy: 0.9667
Epoch 4/100
120/120 [==============================] - 0s 169us/step - loss: 0.0678 -
accuracy: 0.9667
Epoch 5/100
120/120 [==============================] - 0s 171us/step - loss: 0.0555 -
accuracy: 0.9750
Epoch 6/100
120/120 [==============================] - 0s 173us/step - loss: 0.0511 -
accuracy: 0.9833
Epoch 7/100
120/120 [==============================] - 0s 173us/step - loss: 0.0517 -
```

```
accuracy: 0.9833
Epoch 8/100
120/120 [==============================] - 0s 168us/step - loss: 0.0496 -
accuracy: 0.9833
Epoch 9/100
120/120 [==============================] - 0s 172us/step - loss: 0.0521 -
accuracy: 0.9833
Epoch 10/100
120/120 [==============================] - 0s 177us/step - loss: 0.0549 -
accuracy: 0.9833
Epoch 11/100
120/120 [==============================] - 0s 169us/step - loss: 0.0538 -
accuracy: 0.9833
Epoch 12/100
120/120 [==============================] - 0s 161us/step - loss: 0.0567 -
accuracy: 0.9833
Epoch 13/100
120/120 [==============================] - 0s 167us/step - loss: 0.0534 -
accuracy: 0.9750
Epoch 14/100
120/120 [==============================] - 0s 168us/step - loss: 0.0644 -
accuracy: 0.9583
Epoch 15/100
120/120 [==============================] - 0s 169us/step - loss: 0.0686 -
accuracy: 0.9667
Epoch 16/100
120/120 [==============================] - 0s 170us/step - loss: 0.0705 -
accuracy: 0.9667
Epoch 17/100
120/120 [==============================] - 0s 172us/step - loss: 0.0529 -
accuracy: 0.9833
Epoch 18/100
120/120 [==============================] - 0s 165us/step - loss: 0.0471 -
accuracy: 0.9917
Epoch 19/100
120/120 [==============================] - 0s 160us/step - loss: 0.0691 -
accuracy: 0.9583
Epoch 20/100
120/120 [==============================] - 0s 166us/step - loss: 0.0543 -
accuracy: 0.9750
Epoch 21/100
120/120 [==============================] - 0s 172us/step - loss: 0.0532 -
accuracy: 0.9833
Epoch 22/100
120/120 [==============================] - 0s 166us/step - loss: 0.0507 -
accuracy: 0.9833
Epoch 23/100
120/120 [==============================] - 0s 160us/step - loss: 0.0573 -
```

```
accuracy: 0.9750
Epoch 24/100
120/120 [==============================] - 0s 160us/step - loss: 0.0531 -
accuracy: 0.9833
Epoch 25/100
120/120 [==============================] - 0s 168us/step - loss: 0.0512 -
accuracy: 0.9833
Epoch 26/100
120/120 [==============================] - 0s 163us/step - loss: 0.0593 -
accuracy: 0.9750
Epoch 27/100
120/120 [==============================] - 0s 162us/step - loss: 0.0538 -
accuracy: 0.9750
Epoch 28/100
120/120 [==============================] - 0s 234us/step - loss: 0.0494 -
accuracy: 0.9833
Epoch 29/100
120/120 [==============================] - 0s 277us/step - loss: 0.0536 -
accuracy: 0.9833
Epoch 30/100
120/120 [==============================] - 0s 197us/step - loss: 0.0536 -
accuracy: 0.9833
Epoch 31/100
120/120 [==============================] - 0s 177us/step - loss: 0.0583 -
accuracy: 0.9833
Epoch 32/100
120/120 [==============================] - 0s 162us/step - loss: 0.0487 -
accuracy: 0.9917
Epoch 33/100
120/120 [==============================] - 0s 161us/step - loss: 0.0513 -
accuracy: 0.9833
Epoch 34/100
120/120 [==============================] - 0s 167us/step - loss: 0.0514 -
accuracy: 0.9833
Epoch 35/100
120/120 [==============================] - 0s 161us/step - loss: 0.0567 -
accuracy: 0.9750
Epoch 36/100
120/120 [==============================] - 0s 161us/step - loss: 0.0551 -
accuracy: 0.9750
Epoch 37/100
120/120 [==============================] - 0s 163us/step - loss: 0.0592 -
accuracy: 0.9750
Epoch 38/100
120/120 [==============================] - 0s 166us/step - loss: 0.0493 -
accuracy: 0.9917
Epoch 39/100
120/120 [==============================] - 0s 163us/step - loss: 0.0541 -
```

```
accuracy: 0.9833
Epoch 40/100
120/120 [==============================] - 0s 160us/step - loss: 0.0527 -
accuracy: 0.9750
Epoch 41/100
120/120 [==============================] - 0s 159us/step - loss: 0.0525 -
accuracy: 0.9750
Epoch 42/100
120/120 [==============================] - 0s 167us/step - loss: 0.0532 -
accuracy: 0.9917
Epoch 43/100
120/120 [==============================] - 0s 167us/step - loss: 0.0500 -
accuracy: 0.9833
Epoch 44/100
120/120 [==============================] - 0s 169us/step - loss: 0.0533 -
accuracy: 0.9833
Epoch 45/100
120/120 [==============================] - 0s 164us/step - loss: 0.0487 -
accuracy: 0.9917
Epoch 46/100
120/120 [==============================] - 0s 169us/step - loss: 0.0526 -
accuracy: 0.9833
Epoch 47/100
120/120 [==============================] - 0s 164us/step - loss: 0.0567 -
accuracy: 0.9833
Epoch 48/100
120/120 [==============================] - 0s 168us/step - loss: 0.0579 -
accuracy: 0.9833
Epoch 49/100
120/120 [==============================] - 0s 163us/step - loss: 0.0482 -
accuracy: 0.9833
Epoch 50/100
120/120 [==============================] - 0s 166us/step - loss: 0.0471 -
accuracy: 0.9917
Epoch 51/100
120/120 [==============================] - 0s 165us/step - loss: 0.0511 -
accuracy: 0.9917
Epoch 52/100
120/120 [==============================] - 0s 170us/step - loss: 0.0592 -
accuracy: 0.9667
Epoch 53/100
120/120 [==============================] - 0s 168us/step - loss: 0.0555 -
accuracy: 0.9750
Epoch 54/100
120/120 [==============================] - 0s 163us/step - loss: 0.0480 -
accuracy: 0.9917
Epoch 55/100
120/120 [==============================] - 0s 160us/step - loss: 0.0497 -
```

```
accuracy: 0.9833
Epoch 56/100
120/120 [==============================] - 0s 165us/step - loss: 0.0494 -
accuracy: 0.9833
Epoch 57/100
120/120 [==============================] - 0s 168us/step - loss: 0.0494 -
accuracy: 0.9750
Epoch 58/100
120/120 [==============================] - 0s 196us/step - loss: 0.0522 -
accuracy: 0.9750
Epoch 59/100
120/120 [==============================] - 0s 195us/step - loss: 0.0559 -
accuracy: 0.9750
Epoch 60/100
120/120 [==============================] - 0s 169us/step - loss: 0.0535 -
accuracy: 0.9917
Epoch 61/100
120/120 [==============================] - 0s 187us/step - loss: 0.0556 -
accuracy: 0.9833
Epoch 62/100
120/120 [==============================] - 0s 164us/step - loss: 0.0541 -
accuracy: 0.9750
Epoch 63/100
120/120 [==============================] - 0s 179us/step - loss: 0.0632 -
accuracy: 0.9583
Epoch 64/100
120/120 [==============================] - 0s 158us/step - loss: 0.0538 -
accuracy: 0.9833
Epoch 65/100
120/120 [==============================] - 0s 180us/step - loss: 0.0540 -
accuracy: 0.9750
Epoch 66/100
120/120 [==============================] - 0s 171us/step - loss: 0.0592 -
accuracy: 0.9667
Epoch 67/100
120/120 [==============================] - 0s 163us/step - loss: 0.0577 -
accuracy: 0.9833
Epoch 68/100
120/120 [==============================] - 0s 160us/step - loss: 0.0490 -
accuracy: 0.9750
Epoch 69/100
120/120 [==============================] - 0s 169us/step - loss: 0.0614 -
accuracy: 0.9750
Epoch 70/100
120/120 [==============================] - 0s 175us/step - loss: 0.0606 -
accuracy: 0.9667
Epoch 71/100
120/120 [==============================] - 0s 162us/step - loss: 0.0687 -
```

```
accuracy: 0.9750
Epoch 72/100
120/120 [==============================] - 0s 161us/step - loss: 0.0584 -
accuracy: 0.9833
Epoch 73/100
120/120 [==============================] - 0s 166us/step - loss: 0.0522 -
accuracy: 0.9750
Epoch 74/100
120/120 [==============================] - 0s 167us/step - loss: 0.0572 -
accuracy: 0.9750
Epoch 75/100
120/120 [==============================] - 0s 169us/step - loss: 0.0464 -
accuracy: 0.9833
Epoch 76/100
120/120 [==============================] - 0s 168us/step - loss: 0.0499 -
accuracy: 0.9917
Epoch 77/100
120/120 [==============================] - 0s 162us/step - loss: 0.0562 -
accuracy: 0.9750
Epoch 78/100
120/120 [==============================] - 0s 170us/step - loss: 0.0569 -
accuracy: 0.9750
Epoch 79/100
120/120 [==============================] - 0s 167us/step - loss: 0.0485 -
accuracy: 0.9917
Epoch 80/100
120/120 [==============================] - 0s 169us/step - loss: 0.0507 -
accuracy: 0.9833
Epoch 81/100
120/120 [==============================] - 0s 162us/step - loss: 0.0492 -
accuracy: 0.9750
Epoch 82/100
120/120 [==============================] - 0s 157us/step - loss: 0.0502 -
accuracy: 0.9917
Epoch 83/100
120/120 [==============================] - 0s 159us/step - loss: 0.0505 -
accuracy: 0.9833
Epoch 84/100
120/120 [==============================] - 0s 166us/step - loss: 0.0469 -
accuracy: 0.9917
Epoch 85/100
120/120 [==============================] - 0s 164us/step - loss: 0.0515 -
accuracy: 0.9833
Epoch 86/100
120/120 [==============================] - 0s 160us/step - loss: 0.0478 -
accuracy: 0.9833
Epoch 87/100
120/120 [==============================] - 0s 162us/step - loss: 0.0468 -
```

```
accuracy: 0.9833
Epoch 88/100
120/120 [==============================] - 0s 165us/step - loss: 0.0487 -
accuracy: 0.9917
Epoch 89/100
120/120 [==============================] - 0s 164us/step - loss: 0.0543 -
accuracy: 0.9750
Epoch 90/100
120/120 [==============================] - 0s 162us/step - loss: 0.0496 -
accuracy: 0.9917
Epoch 91/100
120/120 [==============================] - 0s 158us/step - loss: 0.0585 -
accuracy: 0.9833
Epoch 92/100
120/120 [==============================] - 0s 165us/step - loss: 0.0670 -
accuracy: 0.9667
Epoch 93/100
120/120 [==============================] - 0s 164us/step - loss: 0.0414 -
accuracy: 0.9833
Epoch 94/100
120/120 [==============================] - 0s 159us/step - loss: 0.0717 -
accuracy: 0.9750
Epoch 95/100
120/120 [==============================] - 0s 162us/step - loss: 0.0627 -
accuracy: 0.9750
Epoch 96/100
120/120 [==============================] - 0s 162us/step - loss: 0.0484 -
accuracy: 0.9833
Epoch 97/100
120/120 [==============================] - 0s 165us/step - loss: 0.0485 -
accuracy: 0.9833
Epoch 98/100
120/120 [==============================] - 0s 166us/step - loss: 0.0487 -
accuracy: 0.9750
Epoch 99/100
120/120 [==============================] - 0s 167us/step - loss: 0.0473 -
accuracy: 0.9750
Epoch 100/100
120/120 [==============================] - 0s 168us/step - loss: 0.0533 -
accuracy: 0.9833
30/30 [==============================] - 0s 14us/step
Mean loss function value 0.081850
Accuracy : 0.966667
Epoch 1/100
120/120 [==============================] - 0s 176us/step - loss: 0.0463 -
accuracy: 0.9833
Epoch 2/100
120/120 [==============================] - 0s 166us/step - loss: 0.0462 -
```

```
accuracy: 0.9917
Epoch 3/100
120/120 [==============================] - 0s 173us/step - loss: 0.0638 -
accuracy: 0.9667
Epoch 4/100
120/120 [==============================] - 0s 168us/step - loss: 0.0460 -
accuracy: 0.9917
Epoch 5/100
120/120 [==============================] - 0s 162us/step - loss: 0.0450 -
accuracy: 0.9917
Epoch 6/100
120/120 [==============================] - 0s 180us/step - loss: 0.0478 -
accuracy: 0.9833
Epoch 7/100
120/120 [==============================] - 0s 177us/step - loss: 0.0438 -
accuracy: 0.9917
Epoch 8/100
120/120 [==============================] - 0s 177us/step - loss: 0.0534 -
accuracy: 0.9833
Epoch 9/100
120/120 [==============================] - 0s 185us/step - loss: 0.0478 -
accuracy: 0.9833
Epoch 10/100
120/120 [==============================] - 0s 175us/step - loss: 0.0485 -
accuracy: 0.9750
Epoch 11/100
120/120 [==============================] - 0s 170us/step - loss: 0.0590 -
accuracy: 0.9667
Epoch 12/100
120/120 [==============================] - 0s 176us/step - loss: 0.0558 -
accuracy: 0.9750
Epoch 13/100
120/120 [==============================] - 0s 165us/step - loss: 0.0636 -
accuracy: 0.9833
Epoch 14/100
120/120 [==============================] - 0s 165us/step - loss: 0.0588 -
accuracy: 0.9750
Epoch 15/100
120/120 [==============================] - 0s 172us/step - loss: 0.0527 -
accuracy: 0.9833
Epoch 16/100
120/120 [==============================] - 0s 162us/step - loss: 0.0509 -
accuracy: 0.9833
Epoch 17/100
120/120 [==============================] - 0s 162us/step - loss: 0.0508 -
accuracy: 0.9750
Epoch 18/100
120/120 [==============================] - 0s 159us/step - loss: 0.0617 -
```

```
accuracy: 0.9833
Epoch 19/100
120/120 [==============================] - 0s 171us/step - loss: 0.0559 -
accuracy: 0.9833
Epoch 20/100
120/120 [==============================] - 0s 164us/step - loss: 0.0567 -
accuracy: 0.9583
Epoch 21/100
120/120 [==============================] - 0s 160us/step - loss: 0.0596 -
accuracy: 0.9667
Epoch 22/100
120/120 [==============================] - 0s 161us/step - loss: 0.0471 -
accuracy: 0.9917
Epoch 23/100
120/120 [==============================] - 0s 167us/step - loss: 0.0477 -
accuracy: 0.9917
Epoch 24/100
120/120 [==============================] - 0s 162us/step - loss: 0.0487 -
accuracy: 0.9917
Epoch 25/100
120/120 [==============================] - 0s 165us/step - loss: 0.0489 -
accuracy: 0.9917
Epoch 26/100
120/120 [==============================] - 0s 169us/step - loss: 0.0461 -
accuracy: 0.9833
Epoch 27/100
120/120 [==============================] - 0s 171us/step - loss: 0.0589 -
accuracy: 0.9750
Epoch 28/100
120/120 [==============================] - 0s 176us/step - loss: 0.0513 -
accuracy: 0.9917
Epoch 29/100
120/120 [==============================] - 0s 173us/step - loss: 0.0508 -
accuracy: 0.9833
Epoch 30/100
120/120 [==============================] - 0s 177us/step - loss: 0.0614 -
accuracy: 0.9750
Epoch 31/100
120/120 [==============================] - 0s 170us/step - loss: 0.0512 -
accuracy: 0.9667
Epoch 32/100
120/120 [==============================] - 0s 171us/step - loss: 0.0579 -
accuracy: 0.9750
Epoch 33/100
120/120 [==============================] - 0s 169us/step - loss: 0.0472 -
accuracy: 0.9917
Epoch 34/100
120/120 [==============================] - 0s 163us/step - loss: 0.0493 -
```

```
accuracy: 0.9917
Epoch 35/100
120/120 [==============================] - 0s 159us/step - loss: 0.0468 -
accuracy: 0.9917
Epoch 36/100
120/120 [==============================] - 0s 161us/step - loss: 0.0550 -
accuracy: 0.9833
Epoch 37/100
120/120 [==============================] - 0s 168us/step - loss: 0.0613 -
accuracy: 0.9750
Epoch 38/100
120/120 [==============================] - 0s 161us/step - loss: 0.0501 -
accuracy: 0.9750
Epoch 39/100
120/120 [==============================] - 0s 159us/step - loss: 0.0503 -
accuracy: 0.9833
Epoch 40/100
120/120 [==============================] - 0s 159us/step - loss: 0.0572 -
accuracy: 0.9833
Epoch 41/100
120/120 [==============================] - 0s 160us/step - loss: 0.0469 -
accuracy: 0.9833
Epoch 42/100
120/120 [==============================] - 0s 165us/step - loss: 0.0491 -
accuracy: 0.9833
Epoch 43/100
120/120 [==============================] - 0s 164us/step - loss: 0.0453 -
accuracy: 0.9833
Epoch 44/100
120/120 [==============================] - 0s 165us/step - loss: 0.0521 -
accuracy: 0.9833
Epoch 45/100
120/120 [==============================] - 0s 170us/step - loss: 0.0458 -
accuracy: 0.9917
Epoch 46/100
120/120 [==============================] - 0s 158us/step - loss: 0.0500 -
accuracy: 0.9833
Epoch 47/100
120/120 [==============================] - 0s 163us/step - loss: 0.0566 -
accuracy: 0.9750
Epoch 48/100
120/120 [==============================] - 0s 166us/step - loss: 0.0559 -
accuracy: 0.9750
Epoch 49/100
120/120 [==============================] - 0s 163us/step - loss: 0.0662 -
accuracy: 0.9750
Epoch 50/100
120/120 [==============================] - 0s 163us/step - loss: 0.0459 -
```

```
accuracy: 0.9917
Epoch 51/100
120/120 [==============================] - 0s 160us/step - loss: 0.0439 -
accuracy: 0.9917
Epoch 52/100
120/120 [==============================] - 0s 159us/step - loss: 0.0456 -
accuracy: 0.9917
Epoch 53/100
120/120 [==============================] - 0s 167us/step - loss: 0.0454 -
accuracy: 0.9917
Epoch 54/100
120/120 [==============================] - 0s 162us/step - loss: 0.0532 -
accuracy: 0.9667
Epoch 55/100
120/120 [==============================] - 0s 162us/step - loss: 0.0519 -
accuracy: 0.9917
Epoch 56/100
120/120 [==============================] - 0s 164us/step - loss: 0.0512 -
accuracy: 0.9750
Epoch 57/100
120/120 [==============================] - 0s 166us/step - loss: 0.0544 -
accuracy: 0.9750
Epoch 58/100
120/120 [==============================] - 0s 166us/step - loss: 0.0535 -
accuracy: 0.9750
Epoch 59/100
120/120 [==============================] - 0s 160us/step - loss: 0.0573 -
accuracy: 0.9750
Epoch 60/100
120/120 [==============================] - 0s 155us/step - loss: 0.0450 -
accuracy: 0.9917
Epoch 61/100
120/120 [==============================] - 0s 165us/step - loss: 0.0522 -
accuracy: 0.9750
Epoch 62/100
120/120 [==============================] - 0s 164us/step - loss: 0.0447 -
accuracy: 0.9833
Epoch 63/100
120/120 [==============================] - 0s 165us/step - loss: 0.0498 -
accuracy: 0.9833
Epoch 64/100
120/120 [==============================] - 0s 164us/step - loss: 0.0517 -
accuracy: 0.9833
Epoch 65/100
120/120 [==============================] - 0s 167us/step - loss: 0.0476 -
accuracy: 0.9917
Epoch 66/100
120/120 [==============================] - 0s 161us/step - loss: 0.0471 -
```

```
accuracy: 0.9917
Epoch 67/100
120/120 [==============================] - 0s 155us/step - loss: 0.0546 -
accuracy: 0.9833
Epoch 68/100
120/120 [==============================] - 0s 161us/step - loss: 0.0567 -
accuracy: 0.9750
Epoch 69/100
120/120 [==============================] - 0s 161us/step - loss: 0.0469 -
accuracy: 0.9917
Epoch 70/100
120/120 [==============================] - 0s 169us/step - loss: 0.0518 -
accuracy: 0.9833
Epoch 71/100
120/120 [==============================] - 0s 163us/step - loss: 0.0480 -
accuracy: 0.9833
Epoch 72/100
120/120 [==============================] - 0s 165us/step - loss: 0.0437 -
accuracy: 0.9917
Epoch 73/100
120/120 [==============================] - 0s 165us/step - loss: 0.0445 -
accuracy: 0.9917
Epoch 74/100
120/120 [==============================] - 0s 160us/step - loss: 0.0477 -
accuracy: 0.9750
Epoch 75/100
120/120 [==============================] - 0s 161us/step - loss: 0.0619 -
accuracy: 0.9667
Epoch 76/100
120/120 [==============================] - 0s 159us/step - loss: 0.0469 -
accuracy: 0.9917
Epoch 77/100
120/120 [==============================] - 0s 165us/step - loss: 0.0463 -
accuracy: 0.9917
Epoch 78/100
120/120 [==============================] - 0s 163us/step - loss: 0.0422 -
accuracy: 0.9917
Epoch 79/100
120/120 [==============================] - 0s 174us/step - loss: 0.0489 -
accuracy: 0.9833
Epoch 80/100
120/120 [==============================] - 0s 164us/step - loss: 0.0575 -
accuracy: 0.9833
Epoch 81/100
120/120 [==============================] - 0s 167us/step - loss: 0.0655 -
accuracy: 0.9667
Epoch 82/100
120/120 [==============================] - 0s 163us/step - loss: 0.0605 -
```

```
accuracy: 0.9833
Epoch 83/100
120/120 [==============================] - 0s 162us/step - loss: 0.0468 -
accuracy: 0.9917
Epoch 84/100
120/120 [==============================] - 0s 161us/step - loss: 0.0545 -
accuracy: 0.9750
Epoch 85/100
120/120 [==============================] - 0s 166us/step - loss: 0.0470 -
accuracy: 0.9833
Epoch 86/100
120/120 [==============================] - 0s 163us/step - loss: 0.0522 -
accuracy: 0.9750
Epoch 87/100
120/120 [==============================] - 0s 159us/step - loss: 0.0476 -
accuracy: 0.9750
Epoch 88/100
120/120 [==============================] - 0s 163us/step - loss: 0.0453 -
accuracy: 0.9917
Epoch 89/100
120/120 [==============================] - 0s 166us/step - loss: 0.0510 -
accuracy: 0.9750
Epoch 90/100
120/120 [==============================] - 0s 163us/step - loss: 0.0455 -
accuracy: 0.9917
Epoch 91/100
120/120 [==============================] - 0s 166us/step - loss: 0.0455 -
accuracy: 0.9917
Epoch 92/100
120/120 [==============================] - 0s 164us/step - loss: 0.0438 -
accuracy: 0.9917
Epoch 93/100
120/120 [==============================] - 0s 174us/step - loss: 0.0437 -
accuracy: 0.9917
Epoch 94/100
120/120 [==============================] - 0s 165us/step - loss: 0.0463 -
accuracy: 0.9917
Epoch 95/100
120/120 [==============================] - 0s 161us/step - loss: 0.0411 -
accuracy: 0.9917
Epoch 96/100
120/120 [==============================] - 0s 166us/step - loss: 0.0456 -
accuracy: 0.9917
Epoch 97/100
120/120 [==============================] - 0s 166us/step - loss: 0.0468 -
accuracy: 0.9750
Epoch 98/100
120/120 [==============================] - 0s 165us/step - loss: 0.0472 -
```

```
accuracy: 0.9917
Epoch 99/100
120/120 [==============================] - 0s 162us/step - loss: 0.0468 -
accuracy: 0.9833
Epoch 100/100
120/120 [==============================] - 0s 168us/step - loss: 0.0464 -
accuracy: 0.9833
30/30 [==============================] - 0s 18us/step
Mean loss function value 0.074927
Accuracy : 0.966667
Epoch 1/100
120/120 [==============================] - 0s 189us/step - loss: 0.0471 -
accuracy: 0.9833
Epoch 2/100
120/120 [==============================] - 0s 265us/step - loss: 0.0603 -
accuracy: 0.9833
Epoch 3/100
120/120 [==============================] - 0s 348us/step - loss: 0.0475 -
accuracy: 0.9917
Epoch 4/100
120/120 [==============================] - 0s 197us/step - loss: 0.0618 -
accuracy: 0.9667
Epoch 5/100
120/120 [==============================] - 0s 172us/step - loss: 0.0558 -
accuracy: 0.9833
Epoch 6/100
120/120 [==============================] - 0s 164us/step - loss: 0.0514 -
accuracy: 0.9917
Epoch 7/100
120/120 [==============================] - 0s 168us/step - loss: 0.0491 -
accuracy: 0.9917
Epoch 8/100
120/120 [==============================] - 0s 164us/step - loss: 0.0575 -
accuracy: 0.9750
Epoch 9/100
120/120 [==============================] - 0s 164us/step - loss: 0.0578 -
accuracy: 0.9750
Epoch 10/100
120/120 [==============================] - 0s 163us/step - loss: 0.0404 -
accuracy: 0.9833
Epoch 11/100
120/120 [==============================] - 0s 164us/step - loss: 0.0438 -
accuracy: 0.9917
Epoch 12/100
120/120 [==============================] - 0s 167us/step - loss: 0.0473 -
accuracy: 0.9917
Epoch 13/100
120/120 [==============================] - 0s 165us/step - loss: 0.0490 -
```

```
accuracy: 0.9917
Epoch 14/100
120/120 [==============================] - 0s 159us/step - loss: 0.0504 -
accuracy: 0.9917
Epoch 15/100
120/120 [==============================] - 0s 162us/step - loss: 0.0491 -
accuracy: 0.9750
Epoch 16/100
120/120 [==============================] - 0s 163us/step - loss: 0.0431 -
accuracy: 0.9917
Epoch 17/100
120/120 [==============================] - 0s 167us/step - loss: 0.0459 -
accuracy: 0.9917
Epoch 18/100
120/120 [==============================] - 0s 164us/step - loss: 0.0491 -
accuracy: 0.9917
Epoch 19/100
120/120 [==============================] - 0s 164us/step - loss: 0.0535 -
accuracy: 0.9667
Epoch 20/100
120/120 [==============================] - 0s 167us/step - loss: 0.0450 -
accuracy: 0.9750
Epoch 21/100
120/120 [==============================] - 0s 164us/step - loss: 0.0424 -
accuracy: 0.9833
Epoch 22/100
120/120 [==============================] - 0s 173us/step - loss: 0.0535 -
accuracy: 0.9750
Epoch 23/100
120/120 [==============================] - 0s 171us/step - loss: 0.0412 -
accuracy: 0.9833
Epoch 24/100
120/120 [==============================] - 0s 173us/step - loss: 0.0435 -
accuracy: 0.9917
Epoch 25/100
120/120 [==============================] - 0s 168us/step - loss: 0.0428 -
accuracy: 0.9917
Epoch 26/100
120/120 [==============================] - 0s 166us/step - loss: 0.0430 -
accuracy: 0.9917
Epoch 27/100
120/120 [==============================] - 0s 169us/step - loss: 0.0565 -
accuracy: 0.9833
Epoch 28/100
120/120 [==============================] - 0s 163us/step - loss: 0.0433 -
accuracy: 0.9917
Epoch 29/100
120/120 [==============================] - 0s 161us/step - loss: 0.0438 -
```

```
accuracy: 0.9833
Epoch 30/100
120/120 [==============================] - 0s 163us/step - loss: 0.0539 -
accuracy: 0.9750
Epoch 31/100
120/120 [==============================] - 0s 171us/step - loss: 0.0487 -
accuracy: 0.9750
Epoch 32/100
120/120 [==============================] - 0s 162us/step - loss: 0.0487 -
accuracy: 0.9833
Epoch 33/100
120/120 [==============================] - 0s 165us/step - loss: 0.0372 -
accuracy: 0.9917
Epoch 34/100
120/120 [==============================] - 0s 165us/step - loss: 0.0405 -
accuracy: 0.9833
Epoch 35/100
120/120 [==============================] - 0s 169us/step - loss: 0.0623 -
accuracy: 0.9833
Epoch 36/100
120/120 [==============================] - 0s 164us/step - loss: 0.0538 -
accuracy: 0.9833
Epoch 37/100
120/120 [==============================] - 0s 160us/step - loss: 0.0563 -
accuracy: 0.9750
Epoch 38/100
120/120 [==============================] - 0s 167us/step - loss: 0.0517 -
accuracy: 0.9917
Epoch 39/100
120/120 [==============================] - 0s 174us/step - loss: 0.0526 -
accuracy: 0.9833
Epoch 40/100
120/120 [==============================] - 0s 162us/step - loss: 0.0419 -
accuracy: 0.9917
Epoch 41/100
120/120 [==============================] - 0s 167us/step - loss: 0.0396 -
accuracy: 0.9917
Epoch 42/100
120/120 [==============================] - 0s 167us/step - loss: 0.0509 -
accuracy: 0.9750
Epoch 43/100
120/120 [==============================] - 0s 165us/step - loss: 0.0516 -
accuracy: 0.9833
Epoch 44/100
120/120 [==============================] - 0s 163us/step - loss: 0.0506 -
accuracy: 0.9750
Epoch 45/100
120/120 [==============================] - 0s 161us/step - loss: 0.0484 -
```

```
accuracy: 0.9917
Epoch 46/100
120/120 [==============================] - 0s 166us/step - loss: 0.0416 -
accuracy: 0.9833
Epoch 47/100
120/120 [==============================] - 0s 169us/step - loss: 0.0774 -
accuracy: 0.9667
Epoch 48/100
120/120 [==============================] - 0s 166us/step - loss: 0.0913 -
accuracy: 0.9667
Epoch 49/100
120/120 [==============================] - 0s 163us/step - loss: 0.0552 -
accuracy: 0.9750
Epoch 50/100
120/120 [==============================] - 0s 168us/step - loss: 0.0452 -
accuracy: 0.9917
Epoch 51/100
120/120 [==============================] - 0s 161us/step - loss: 0.0411 -
accuracy: 0.9917
Epoch 52/100
120/120 [==============================] - 0s 162us/step - loss: 0.0409 -
accuracy: 0.9917
Epoch 53/100
120/120 [==============================] - 0s 161us/step - loss: 0.0472 -
accuracy: 0.9833
Epoch 54/100
120/120 [==============================] - 0s 168us/step - loss: 0.0493 -
accuracy: 0.9833
Epoch 55/100
120/120 [==============================] - 0s 161us/step - loss: 0.0551 -
accuracy: 0.9667
Epoch 56/100
120/120 [==============================] - 0s 158us/step - loss: 0.0722 -
accuracy: 0.9667
Epoch 57/100
120/120 [==============================] - 0s 161us/step - loss: 0.0470 -
accuracy: 0.9750
Epoch 58/100
120/120 [==============================] - 0s 167us/step - loss: 0.0495 -
accuracy: 0.9750
Epoch 59/100
120/120 [==============================] - 0s 166us/step - loss: 0.0505 -
accuracy: 0.9750
Epoch 60/100
120/120 [==============================] - 0s 162us/step - loss: 0.0480 -
accuracy: 0.9833
Epoch 61/100
120/120 [==============================] - 0s 164us/step - loss: 0.0414 -
```

```
accuracy: 0.9917
Epoch 62/100
120/120 [==============================] - 0s 171us/step - loss: 0.0424 -
accuracy: 0.9917
Epoch 63/100
120/120 [==============================] - 0s 166us/step - loss: 0.0427 -
accuracy: 0.9917
Epoch 64/100
120/120 [==============================] - 0s 161us/step - loss: 0.0433 -
accuracy: 0.9833
Epoch 65/100
120/120 [==============================] - 0s 159us/step - loss: 0.0388 -
accuracy: 0.9917
Epoch 66/100
120/120 [==============================] - 0s 165us/step - loss: 0.0520 -
accuracy: 0.9833
Epoch 67/100
120/120 [==============================] - 0s 162us/step - loss: 0.0504 -
accuracy: 0.9750
Epoch 68/100
120/120 [==============================] - 0s 161us/step - loss: 0.0644 -
accuracy: 0.9833
Epoch 69/100
120/120 [==============================] - 0s 162us/step - loss: 0.0553 -
accuracy: 0.9667
Epoch 70/100
120/120 [==============================] - 0s 167us/step - loss: 0.0694 -
accuracy: 0.9750
Epoch 71/100
120/120 [==============================] - 0s 162us/step - loss: 0.0435 -
accuracy: 0.9917
Epoch 72/100
120/120 [==============================] - 0s 159us/step - loss: 0.0401 -
accuracy: 0.9917
Epoch 73/100
120/120 [==============================] - 0s 165us/step - loss: 0.0501 -
accuracy: 0.9833
Epoch 74/100
120/120 [==============================] - 0s 173us/step - loss: 0.0437 -
accuracy: 0.9917
Epoch 75/100
120/120 [==============================] - 0s 166us/step - loss: 0.0469 -
accuracy: 0.9833
Epoch 76/100
120/120 [==============================] - 0s 162us/step - loss: 0.0445 -
accuracy: 0.9833
Epoch 77/100
120/120 [==============================] - 0s 163us/step - loss: 0.0433 -
```

```
accuracy: 0.9917
Epoch 78/100
120/120 [==============================] - 0s 170us/step - loss: 0.0489 -
accuracy: 0.9833
Epoch 79/100
120/120 [==============================] - 0s 163us/step - loss: 0.0485 -
accuracy: 0.9833
Epoch 80/100
120/120 [==============================] - 0s 161us/step - loss: 0.0461 -
accuracy: 0.9917
Epoch 81/100
120/120 [==============================] - 0s 162us/step - loss: 0.0416 -
accuracy: 0.9917
Epoch 82/100
120/120 [==============================] - 0s 167us/step - loss: 0.0453 -
accuracy: 0.9750
Epoch 83/100
120/120 [==============================] - 0s 162us/step - loss: 0.0488 -
accuracy: 0.9917
Epoch 84/100
120/120 [==============================] - 0s 163us/step - loss: 0.0413 -
accuracy: 0.9917
Epoch 85/100
120/120 [==============================] - 0s 163us/step - loss: 0.0422 -
accuracy: 0.9917
Epoch 86/100
120/120 [==============================] - 0s 173us/step - loss: 0.0552 -
accuracy: 0.9750
Epoch 87/100
120/120 [==============================] - 0s 163us/step - loss: 0.0489 -
accuracy: 0.9833
Epoch 88/100
120/120 [==============================] - 0s 160us/step - loss: 0.0475 -
accuracy: 0.9833
Epoch 89/100
120/120 [==============================] - 0s 157us/step - loss: 0.0537 -
accuracy: 0.9833
Epoch 90/100
120/120 [==============================] - 0s 170us/step - loss: 0.0631 -
accuracy: 0.9667
Epoch 91/100
120/120 [==============================] - 0s 160us/step - loss: 0.0406 -
accuracy: 0.9917
Epoch 92/100
120/120 [==============================] - 0s 162us/step - loss: 0.0421 -
accuracy: 0.9917
Epoch 93/100
120/120 [==============================] - 0s 162us/step - loss: 0.0435 -
```

```
accuracy: 0.9917
Epoch 94/100
120/120 [==============================] - 0s 169us/step - loss: 0.0477 -
accuracy: 0.9833
Epoch 95/100
120/120 [==============================] - 0s 163us/step - loss: 0.0450 -
accuracy: 0.9917
Epoch 96/100
120/120 [==============================] - 0s 170us/step - loss: 0.0445 -
accuracy: 0.9833
Epoch 97/100
120/120 [==============================] - 0s 160us/step - loss: 0.0452 -
accuracy: 0.9833
Epoch 98/100
120/120 [==============================] - 0s 167us/step - loss: 0.0424 -
accuracy: 0.9917
Epoch 99/100
120/120 [==============================] - 0s 164us/step - loss: 0.0413 -
accuracy: 0.9917
Epoch 100/100
120/120 [==============================] - 0s 168us/step - loss: 0.0420 -
accuracy: 0.9917
30/30 [==============================] - 0s 14us/step
Mean loss function value 0.084626
Accuracy : 0.966667
Epoch 1/100
120/120 [==============================] - 0s 178us/step - loss: 0.0407 -
accuracy: 0.9917
Epoch 2/100
120/120 [==============================] - 0s 165us/step - loss: 0.0415 -
accuracy: 0.9917
Epoch 3/100
120/120 [==============================] - 0s 161us/step - loss: 0.0472 -
accuracy: 0.9917
Epoch 4/100
120/120 [==============================] - 0s 167us/step - loss: 0.0390 -
accuracy: 0.9917
Epoch 5/100
120/120 [==============================] - 0s 161us/step - loss: 0.0418 -
accuracy: 0.9917
Epoch 6/100
120/120 [==============================] - 0s 166us/step - loss: 0.0421 -
accuracy: 0.9833
Epoch 7/100
120/120 [==============================] - 0s 163us/step - loss: 0.0448 -
accuracy: 0.9750
Epoch 8/100
120/120 [==============================] - 0s 165us/step - loss: 0.0451 -
```

```
accuracy: 0.9750
Epoch 9/100
120/120 [==============================] - 0s 161us/step - loss: 0.0592 -
accuracy: 0.9750
Epoch 10/100
120/120 [==============================] - 0s 171us/step - loss: 0.0537 -
accuracy: 0.9833
Epoch 11/100
120/120 [==============================] - 0s 167us/step - loss: 0.0400 -
accuracy: 0.9833
Epoch 12/100
120/120 [==============================] - 0s 164us/step - loss: 0.0547 -
accuracy: 0.9833
Epoch 13/100
120/120 [==============================] - 0s 158us/step - loss: 0.0448 -
accuracy: 0.9833
Epoch 14/100
120/120 [==============================] - 0s 159us/step - loss: 0.0459 -
accuracy: 0.9833
Epoch 15/100
120/120 [==============================] - 0s 167us/step - loss: 0.0458 -
accuracy: 0.9833
Epoch 16/100
120/120 [==============================] - 0s 162us/step - loss: 0.0515 -
accuracy: 0.9833
Epoch 17/100
120/120 [==============================] - 0s 160us/step - loss: 0.0552 -
accuracy: 0.9667
Epoch 18/100
120/120 [==============================] - 0s 156us/step - loss: 0.0598 -
accuracy: 0.9750
Epoch 19/100
120/120 [==============================] - 0s 166us/step - loss: 0.0486 -
accuracy: 0.9833
Epoch 20/100
120/120 [==============================] - 0s 169us/step - loss: 0.0446 -
accuracy: 0.9833
Epoch 21/100
120/120 [==============================] - 0s 166us/step - loss: 0.0431 -
accuracy: 0.9917
Epoch 22/100
120/120 [==============================] - 0s 164us/step - loss: 0.0450 -
accuracy: 0.9833
Epoch 23/100
120/120 [==============================] - 0s 169us/step - loss: 0.0406 -
accuracy: 0.9917
Epoch 24/100
120/120 [==============================] - 0s 171us/step - loss: 0.0440 -
```

```
accuracy: 0.9917
Epoch 25/100
120/120 [==============================] - 0s 162us/step - loss: 0.0455 -
accuracy: 0.9917
Epoch 26/100
120/120 [==============================] - 0s 162us/step - loss: 0.0447 -
accuracy: 0.9917
Epoch 27/100
120/120 [==============================] - 0s 168us/step - loss: 0.0483 -
accuracy: 0.9833
Epoch 28/100
120/120 [==============================] - 0s 159us/step - loss: 0.0406 -
accuracy: 0.9833
Epoch 29/100
120/120 [==============================] - 0s 160us/step - loss: 0.0436 -
accuracy: 0.9833
Epoch 30/100
120/120 [==============================] - 0s 164us/step - loss: 0.0502 -
accuracy: 0.9833
Epoch 31/100
120/120 [==============================] - 0s 167us/step - loss: 0.0407 -
accuracy: 0.9917
Epoch 32/100
120/120 [==============================] - 0s 166us/step - loss: 0.0568 -
accuracy: 0.9833
Epoch 33/100
120/120 [==============================] - 0s 163us/step - loss: 0.0608 -
accuracy: 0.9833
Epoch 34/100
120/120 [==============================] - 0s 163us/step - loss: 0.0371 -
accuracy: 0.9833
Epoch 35/100
120/120 [==============================] - 0s 166us/step - loss: 0.0411 -
accuracy: 0.9917
Epoch 36/100
120/120 [==============================] - 0s 164us/step - loss: 0.0563 -
accuracy: 0.9750
Epoch 37/100
120/120 [==============================] - 0s 158us/step - loss: 0.0415 -
accuracy: 0.9833
Epoch 38/100
120/120 [==============================] - 0s 164us/step - loss: 0.0410 -
accuracy: 0.9917
Epoch 39/100
120/120 [==============================] - 0s 164us/step - loss: 0.0416 -
accuracy: 0.9917
Epoch 40/100
120/120 [==============================] - 0s 165us/step - loss: 0.0387 -
```

```
accuracy: 0.9833
Epoch 41/100
120/120 [==============================] - 0s 158us/step - loss: 0.0540 -
accuracy: 0.9750
Epoch 42/100
120/120 [==============================] - 0s 164us/step - loss: 0.0384 -
accuracy: 0.9917
Epoch 43/100
120/120 [==============================] - 0s 163us/step - loss: 0.0467 -
accuracy: 0.9833
Epoch 44/100
120/120 [==============================] - 0s 166us/step - loss: 0.0565 -
accuracy: 0.9833
Epoch 45/100
120/120 [==============================] - 0s 159us/step - loss: 0.0464 -
accuracy: 0.9833
Epoch 46/100
120/120 [==============================] - 0s 156us/step - loss: 0.0516 -
accuracy: 0.9833
Epoch 47/100
120/120 [==============================] - 0s 161us/step - loss: 0.0388 -
accuracy: 0.9917
Epoch 48/100
120/120 [==============================] - 0s 163us/step - loss: 0.0408 -
accuracy: 0.9833
Epoch 49/100
120/120 [==============================] - 0s 162us/step - loss: 0.0446 -
accuracy: 0.9917
Epoch 50/100
120/120 [==============================] - 0s 157us/step - loss: 0.0490 -
accuracy: 0.9833
Epoch 51/100
120/120 [==============================] - 0s 166us/step - loss: 0.0592 -
accuracy: 0.9750
Epoch 52/100
120/120 [==============================] - 0s 171us/step - loss: 0.0378 -
accuracy: 0.9833
Epoch 53/100
120/120 [==============================] - 0s 168us/step - loss: 0.0415 -
accuracy: 0.9833
Epoch 54/100
120/120 [==============================] - 0s 174us/step - loss: 0.0452 -
accuracy: 0.9750
Epoch 55/100
120/120 [==============================] - 0s 167us/step - loss: 0.0447 -
accuracy: 0.9833
Epoch 56/100
120/120 [==============================] - 0s 162us/step - loss: 0.0404 -
```

```
accuracy: 0.9917
Epoch 57/100
120/120 [==============================] - 0s 163us/step - loss: 0.0411 -
accuracy: 0.9917
Epoch 58/100
120/120 [==============================] - 0s 169us/step - loss: 0.0498 -
accuracy: 0.9833
Epoch 59/100
120/120 [==============================] - 0s 164us/step - loss: 0.0555 -
accuracy: 0.9833
Epoch 60/100
120/120 [==============================] - 0s 165us/step - loss: 0.0678 -
accuracy: 0.9667
Epoch 61/100
120/120 [==============================] - 0s 159us/step - loss: 0.0397 -
accuracy: 0.9917
Epoch 62/100
120/120 [==============================] - 0s 168us/step - loss: 0.0440 -
accuracy: 0.9833
Epoch 63/100
120/120 [==============================] - 0s 164us/step - loss: 0.0430 -
accuracy: 0.9917
Epoch 64/100
120/120 [==============================] - 0s 164us/step - loss: 0.0433 -
accuracy: 0.9833
Epoch 65/100
120/120 [==============================] - 0s 160us/step - loss: 0.0647 -
accuracy: 0.9667
Epoch 66/100
120/120 [==============================] - 0s 161us/step - loss: 0.0911 -
accuracy: 0.9667
Epoch 67/100
120/120 [==============================] - 0s 165us/step - loss: 0.0601 -
accuracy: 0.9667
Epoch 68/100
120/120 [==============================] - 0s 163us/step - loss: 0.0461 -
accuracy: 0.9833
Epoch 69/100
120/120 [==============================] - 0s 160us/step - loss: 0.0448 -
accuracy: 0.9917
Epoch 70/100
120/120 [==============================] - 0s 162us/step - loss: 0.0391 -
accuracy: 0.9917
Epoch 71/100
120/120 [==============================] - 0s 169us/step - loss: 0.0491 -
accuracy: 0.9750
Epoch 72/100
120/120 [==============================] - 0s 161us/step - loss: 0.0780 -
```

```
accuracy: 0.9667
Epoch 73/100
120/120 [==============================] - 0s 159us/step - loss: 0.0381 -
accuracy: 0.9917
Epoch 74/100
120/120 [==============================] - 0s 159us/step - loss: 0.0438 -
accuracy: 0.9833
Epoch 75/100
120/120 [==============================] - 0s 171us/step - loss: 0.0485 -
accuracy: 0.9750
Epoch 76/100
120/120 [==============================] - 0s 162us/step - loss: 0.0444 -
accuracy: 0.9833
Epoch 77/100
120/120 [==============================] - 0s 157us/step - loss: 0.0421 -
accuracy: 0.9833
Epoch 78/100
120/120 [==============================] - 0s 159us/step - loss: 0.0439 -
accuracy: 0.9917
Epoch 79/100
120/120 [==============================] - 0s 165us/step - loss: 0.0403 -
accuracy: 0.9833
Epoch 80/100
120/120 [==============================] - 0s 164us/step - loss: 0.0409 -
accuracy: 0.9833
Epoch 81/100
120/120 [==============================] - 0s 159us/step - loss: 0.0395 -
accuracy: 0.9917
Epoch 82/100
120/120 [==============================] - 0s 167us/step - loss: 0.0429 -
accuracy: 0.9917
Epoch 83/100
120/120 [==============================] - 0s 163us/step - loss: 0.0483 -
accuracy: 0.9750
Epoch 84/100
120/120 [==============================] - 0s 165us/step - loss: 0.0496 -
accuracy: 0.9833
Epoch 85/100
120/120 [==============================] - 0s 164us/step - loss: 0.0428 -
accuracy: 0.9917
Epoch 86/100
120/120 [==============================] - 0s 162us/step - loss: 0.0411 -
accuracy: 0.9917
Epoch 87/100
120/120 [==============================] - 0s 162us/step - loss: 0.0536 -
accuracy: 0.9833
Epoch 88/100
120/120 [==============================] - 0s 163us/step - loss: 0.0500 -
```

```
accuracy: 0.9833
Epoch 89/100
120/120 [==============================] - 0s 163us/step - loss: 0.0412 -
accuracy: 0.9917
Epoch 90/100
120/120 [==============================] - 0s 164us/step - loss: 0.0507 -
accuracy: 0.9917
Epoch 91/100
120/120 [==============================] - 0s 167us/step - loss: 0.0411 -
accuracy: 0.9833
Epoch 92/100
120/120 [==============================] - 0s 160us/step - loss: 0.0623 -
accuracy: 0.9750
Epoch 93/100
120/120 [==============================] - 0s 164us/step - loss: 0.0384 -
accuracy: 0.9917
Epoch 94/100
120/120 [==============================] - 0s 163us/step - loss: 0.0450 -
accuracy: 0.9833
Epoch 95/100
120/120 [==============================] - 0s 167us/step - loss: 0.0435 -
accuracy: 0.9833
Epoch 96/100
120/120 [==============================] - 0s 164us/step - loss: 0.0433 -
accuracy: 0.9917
Epoch 97/100
120/120 [==============================] - 0s 161us/step - loss: 0.0436 -
accuracy: 0.9917
Epoch 98/100
120/120 [==============================] - 0s 164us/step - loss: 0.0501 -
accuracy: 0.9833
Epoch 99/100
120/120 [==============================] - 0s 164us/step - loss: 0.0437 -
accuracy: 0.9917
Epoch 100/100
120/120 [==============================] - 0s 163us/step - loss: 0.0468 -
accuracy: 0.9917
30/30 [==============================] - 0s 14us/step
Mean loss function value 0.060382
Accuracy : 0.966667
Epoch 1/100
120/120 [==============================] - 0s 161us/step - loss: 0.0399 -
accuracy: 0.9917
Epoch 2/100
120/120 [==============================] - 0s 158us/step - loss: 0.0463 -
accuracy: 0.9917
Epoch 3/100
120/120 [==============================] - 0s 160us/step - loss: 0.0408 -
```

```
accuracy: 0.9917
Epoch 4/100
120/120 [==============================] - 0s 163us/step - loss: 0.0384 -
accuracy: 0.9917
Epoch 5/100
120/120 [==============================] - 0s 165us/step - loss: 0.0412 -
accuracy: 0.9917
Epoch 6/100
120/120 [==============================] - 0s 171us/step - loss: 0.0398 -
accuracy: 0.9833
Epoch 7/100
120/120 [==============================] - 0s 160us/step - loss: 0.0397 -
accuracy: 0.9833
Epoch 8/100
120/120 [==============================] - 0s 160us/step - loss: 0.0491 -
accuracy: 0.9917
Epoch 9/100
120/120 [==============================] - 0s 160us/step - loss: 0.0439 -
accuracy: 0.9833
Epoch 10/100
120/120 [==============================] - 0s 164us/step - loss: 0.0442 -
accuracy: 0.9750
Epoch 11/100
120/120 [==============================] - 0s 164us/step - loss: 0.0458 -
accuracy: 0.9833
Epoch 12/100
120/120 [==============================] - 0s 162us/step - loss: 0.0432 -
accuracy: 0.9917
Epoch 13/100
120/120 [==============================] - 0s 164us/step - loss: 0.0416 -
accuracy: 0.9917
Epoch 14/100
120/120 [==============================] - 0s 167us/step - loss: 0.0409 -
accuracy: 0.9917
Epoch 15/100
120/120 [==============================] - 0s 161us/step - loss: 0.0413 -
accuracy: 0.9917
Epoch 16/100
120/120 [==============================] - 0s 160us/step - loss: 0.0406 -
accuracy: 0.9833
Epoch 17/100
120/120 [==============================] - 0s 161us/step - loss: 0.0498 -
accuracy: 0.9917
Epoch 18/100
120/120 [==============================] - 0s 165us/step - loss: 0.0403 -
accuracy: 0.9833
Epoch 19/100
120/120 [==============================] - 0s 161us/step - loss: 0.0427 -
```

```
accuracy: 0.9917
Epoch 20/100
120/120 [==============================] - 0s 160us/step - loss: 0.0437 -
accuracy: 0.9917
Epoch 21/100
120/120 [==============================] - 0s 165us/step - loss: 0.0358 -
accuracy: 0.9917
Epoch 22/100
120/120 [==============================] - 0s 166us/step - loss: 0.0413 -
accuracy: 0.9917
Epoch 23/100
120/120 [==============================] - 0s 165us/step - loss: 0.0462 -
accuracy: 0.9917
Epoch 24/100
120/120 [==============================] - 0s 171us/step - loss: 0.0451 -
accuracy: 0.9750
Epoch 25/100
120/120 [==============================] - 0s 169us/step - loss: 0.0383 -
accuracy: 0.9917
Epoch 26/100
120/120 [==============================] - 0s 170us/step - loss: 0.0393 -
accuracy: 0.9917
Epoch 27/100
120/120 [==============================] - 0s 166us/step - loss: 0.0440 -
accuracy: 0.9917
Epoch 28/100
120/120 [==============================] - 0s 161us/step - loss: 0.0417 -
accuracy: 0.9833
Epoch 29/100
120/120 [==============================] - 0s 159us/step - loss: 0.0393 -
accuracy: 0.9917
Epoch 30/100
120/120 [==============================] - 0s 168us/step - loss: 0.0389 -
accuracy: 0.9917
Epoch 31/100
120/120 [==============================] - 0s 160us/step - loss: 0.0370 -
accuracy: 0.9917
Epoch 32/100
120/120 [==============================] - 0s 159us/step - loss: 0.0403 -
accuracy: 0.9917
Epoch 33/100
120/120 [==============================] - 0s 158us/step - loss: 0.0398 -
accuracy: 0.9917
Epoch 34/100
120/120 [==============================] - 0s 169us/step - loss: 0.0499 -
accuracy: 0.9833
Epoch 35/100
120/120 [==============================] - 0s 161us/step - loss: 0.0381 -
```

```
accuracy: 0.9917
Epoch 36/100
120/120 [==============================] - 0s 166us/step - loss: 0.0410 -
accuracy: 0.9917
Epoch 37/100
120/120 [==============================] - 0s 162us/step - loss: 0.0475 -
accuracy: 0.9833
Epoch 38/100
120/120 [==============================] - 0s 166us/step - loss: 0.0389 -
accuracy: 0.9833
Epoch 39/100
120/120 [==============================] - 0s 158us/step - loss: 0.0431 -
accuracy: 0.9917
Epoch 40/100
120/120 [==============================] - 0s 162us/step - loss: 0.0564 -
accuracy: 0.9750
Epoch 41/100
120/120 [==============================] - 0s 157us/step - loss: 0.0508 -
accuracy: 0.9833
Epoch 42/100
120/120 [==============================] - 0s 171us/step - loss: 0.0455 -
accuracy: 0.9833
Epoch 43/100
120/120 [==============================] - 0s 165us/step - loss: 0.0379 -
accuracy: 0.9917
Epoch 44/100
120/120 [==============================] - 0s 160us/step - loss: 0.0394 -
accuracy: 0.9917
Epoch 45/100
120/120 [==============================] - 0s 161us/step - loss: 0.0440 -
accuracy: 0.9833
Epoch 46/100
120/120 [==============================] - 0s 169us/step - loss: 0.0380 -
accuracy: 0.9917
Epoch 47/100
120/120 [==============================] - 0s 164us/step - loss: 0.0400 -
accuracy: 0.9833
Epoch 48/100
120/120 [==============================] - 0s 159us/step - loss: 0.0397 -
accuracy: 0.9917
Epoch 49/100
120/120 [==============================] - 0s 160us/step - loss: 0.0449 -
accuracy: 0.9833
Epoch 50/100
120/120 [==============================] - 0s 167us/step - loss: 0.0568 -
accuracy: 0.9833
Epoch 51/100
120/120 [==============================] - 0s 162us/step - loss: 0.0400 -
```

```
accuracy: 0.9917
Epoch 52/100
120/120 [==============================] - 0s 161us/step - loss: 0.0422 -
accuracy: 0.9833
Epoch 53/100
120/120 [==============================] - 0s 164us/step - loss: 0.0395 -
accuracy: 0.9917
Epoch 54/100
120/120 [==============================] - 0s 172us/step - loss: 0.0368 -
accuracy: 0.9917
Epoch 55/100
120/120 [==============================] - 0s 166us/step - loss: 0.0403 -
accuracy: 0.9833
Epoch 56/100
120/120 [==============================] - 0s 161us/step - loss: 0.0393 -
accuracy: 0.9917
Epoch 57/100
120/120 [==============================] - 0s 161us/step - loss: 0.0439 -
accuracy: 0.9917
Epoch 58/100
120/120 [==============================] - 0s 167us/step - loss: 0.0540 -
accuracy: 0.9750
Epoch 59/100
120/120 [==============================] - 0s 164us/step - loss: 0.0494 -
accuracy: 0.9750
Epoch 60/100
120/120 [==============================] - 0s 159us/step - loss: 0.0411 -
accuracy: 0.9917
Epoch 61/100
120/120 [==============================] - 0s 159us/step - loss: 0.0438 -
accuracy: 0.9750
Epoch 62/100
120/120 [==============================] - 0s 169us/step - loss: 0.0419 -
accuracy: 0.9833
Epoch 63/100
120/120 [==============================] - 0s 162us/step - loss: 0.0394 -
accuracy: 0.9917
Epoch 64/100
120/120 [==============================] - 0s 160us/step - loss: 0.0448 -
accuracy: 0.9833
Epoch 65/100
120/120 [==============================] - 0s 160us/step - loss: 0.0772 -
accuracy: 0.9667
Epoch 66/100
120/120 [==============================] - 0s 165us/step - loss: 0.0500 -
accuracy: 0.9667
Epoch 67/100
120/120 [==============================] - 0s 166us/step - loss: 0.0403 -
```

```
accuracy: 0.9917
Epoch 68/100
120/120 [==============================] - 0s 161us/step - loss: 0.0385 -
accuracy: 0.9917
Epoch 69/100
120/120 [==============================] - 0s 166us/step - loss: 0.0392 -
accuracy: 0.9917
Epoch 70/100
120/120 [==============================] - 0s 167us/step - loss: 0.0392 -
accuracy: 0.9833
Epoch 71/100
120/120 [==============================] - 0s 161us/step - loss: 0.0415 -
accuracy: 0.9833
Epoch 72/100
120/120 [==============================] - 0s 161us/step - loss: 0.0440 -
accuracy: 0.9833
Epoch 73/100
120/120 [==============================] - 0s 164us/step - loss: 0.0441 -
accuracy: 0.9917
Epoch 74/100
120/120 [==============================] - 0s 168us/step - loss: 0.0425 -
accuracy: 0.9917
Epoch 75/100
120/120 [==============================] - 0s 168us/step - loss: 0.0423 -
accuracy: 0.9833
Epoch 76/100
120/120 [==============================] - 0s 160us/step - loss: 0.0480 -
accuracy: 0.9833
Epoch 77/100
120/120 [==============================] - 0s 165us/step - loss: 0.0422 -
accuracy: 0.9833
Epoch 78/100
120/120 [==============================] - 0s 175us/step - loss: 0.0418 -
accuracy: 0.9833
Epoch 79/100
120/120 [==============================] - 0s 161us/step - loss: 0.0674 -
accuracy: 0.9833
Epoch 80/100
120/120 [==============================] - 0s 161us/step - loss: 0.0415 -
accuracy: 0.9917
Epoch 81/100
120/120 [==============================] - 0s 159us/step - loss: 0.0408 -
accuracy: 0.9917
Epoch 82/100
120/120 [==============================] - 0s 171us/step - loss: 0.0397 -
accuracy: 0.9917
Epoch 83/100
120/120 [==============================] - 0s 163us/step - loss: 0.0395 -
```

```
accuracy: 0.9917
Epoch 84/100
120/120 [==============================] - 0s 163us/step - loss: 0.0375 -
accuracy: 0.9833
Epoch 85/100
120/120 [==============================] - 0s 165us/step - loss: 0.0532 -
accuracy: 0.9667
Epoch 86/100
120/120 [==============================] - 0s 166us/step - loss: 0.0565 -
accuracy: 0.9750
Epoch 87/100
120/120 [==============================] - 0s 166us/step - loss: 0.0805 -
accuracy: 0.9750
Epoch 88/100
120/120 [==============================] - 0s 160us/step - loss: 0.0651 -
accuracy: 0.9667
Epoch 89/100
120/120 [==============================] - 0s 163us/step - loss: 0.0567 -
accuracy: 0.9667
Epoch 90/100
120/120 [==============================] - 0s 171us/step - loss: 0.0676 -
accuracy: 0.9750
Epoch 91/100
120/120 [==============================] - 0s 164us/step - loss: 0.0506 -
accuracy: 0.9833
Epoch 92/100
120/120 [==============================] - 0s 156us/step - loss: 0.0454 -
accuracy: 0.9833
Epoch 93/100
120/120 [==============================] - 0s 160us/step - loss: 0.0546 -
accuracy: 0.9833
Epoch 94/100
120/120 [==============================] - 0s 166us/step - loss: 0.0396 -
accuracy: 0.9917
Epoch 95/100
120/120 [==============================] - 0s 165us/step - loss: 0.0453 -
accuracy: 0.9667
Epoch 96/100
120/120 [==============================] - 0s 159us/step - loss: 0.0522 -
accuracy: 0.9833
Epoch 97/100
120/120 [==============================] - 0s 163us/step - loss: 0.0445 -
accuracy: 0.9833
Epoch 98/100
120/120 [==============================] - 0s 167us/step - loss: 0.0404 -
accuracy: 0.9833
Epoch 99/100
120/120 [==============================] - 0s 166us/step - loss: 0.0388 -
```

```
accuracy: 0.9750
Epoch 100/100
120/120 [==============================] - 0s 164us/step - loss: 0.0568 -
accuracy: 0.9833
30/30 [==============================] - 0s 13us/step
Mean loss function value 0.054902
Accuracy : 0.933333
Epoch 1/100
120/120 [==============================] - 0s 168us/step - loss: 0.0436 -
accuracy: 0.9833
Epoch 2/100
120/120 [==============================] - 0s 162us/step - loss: 0.0396 -
accuracy: 0.9917
Epoch 3/100
120/120 [==============================] - 0s 161us/step - loss: 0.0437 -
accuracy: 0.9917
Epoch 4/100
120/120 [==============================] - 0s 157us/step - loss: 0.0408 -
accuracy: 0.9833
Epoch 5/100
120/120 [==============================] - 0s 168us/step - loss: 0.0444 -
accuracy: 0.9833
Epoch 6/100
120/120 [==============================] - 0s 162us/step - loss: 0.0471 -
accuracy: 0.9667
Epoch 7/100
120/120 [==============================] - 0s 157us/step - loss: 0.0577 -
accuracy: 0.9750
Epoch 8/100
120/120 [==============================] - 0s 158us/step - loss: 0.0471 -
accuracy: 0.9833
Epoch 9/100
120/120 [==============================] - 0s 166us/step - loss: 0.0442 -
accuracy: 0.9917
Epoch 10/100
120/120 [==============================] - 0s 166us/step - loss: 0.0413 -
accuracy: 0.9917
Epoch 11/100
120/120 [==============================] - 0s 165us/step - loss: 0.0375 -
accuracy: 0.9917
Epoch 12/100
120/120 [==============================] - 0s 164us/step - loss: 0.0382 -
accuracy: 0.9833
Epoch 13/100
120/120 [==============================] - 0s 171us/step - loss: 0.0667 -
accuracy: 0.9667
Epoch 14/100
120/120 [==============================] - 0s 161us/step - loss: 0.0450 -
```

```
accuracy: 0.9750
Epoch 15/100
120/120 [==============================] - 0s 164us/step - loss: 0.0395 -
accuracy: 0.9833
Epoch 16/100
120/120 [==============================] - 0s 161us/step - loss: 0.0420 -
accuracy: 0.9917
Epoch 17/100
120/120 [==============================] - 0s 170us/step - loss: 0.0395 -
accuracy: 0.9917
Epoch 18/100
120/120 [==============================] - 0s 162us/step - loss: 0.0453 -
accuracy: 0.9750
Epoch 19/100
120/120 [==============================] - 0s 164us/step - loss: 0.0525 -
accuracy: 0.9833
Epoch 20/100
120/120 [==============================] - 0s 162us/step - loss: 0.0471 -
accuracy: 0.9750
Epoch 21/100
120/120 [==============================] - 0s 168us/step - loss: 0.0450 -
accuracy: 0.9833
Epoch 22/100
120/120 [==============================] - 0s 160us/step - loss: 0.0433 -
accuracy: 0.9917
Epoch 23/100
120/120 [==============================] - 0s 161us/step - loss: 0.0383 -
accuracy: 0.9917
Epoch 24/100
120/120 [==============================] - 0s 160us/step - loss: 0.0373 -
accuracy: 0.9917
Epoch 25/100
120/120 [==============================] - 0s 176us/step - loss: 0.0369 -
accuracy: 0.9917
Epoch 26/100
120/120 [==============================] - 0s 166us/step - loss: 0.0415 -
accuracy: 0.9917
Epoch 27/100
120/120 [==============================] - 0s 165us/step - loss: 0.0504 -
accuracy: 0.9750
Epoch 28/100
120/120 [==============================] - 0s 166us/step - loss: 0.0494 -
accuracy: 0.9833
Epoch 29/100
120/120 [==============================] - 0s 162us/step - loss: 0.0405 -
accuracy: 0.9917
Epoch 30/100
120/120 [==============================] - 0s 162us/step - loss: 0.0383 -
```

```
accuracy: 0.9917
Epoch 31/100
120/120 [==============================] - 0s 165us/step - loss: 0.0549 -
accuracy: 0.9750
Epoch 32/100
120/120 [==============================] - 0s 165us/step - loss: 0.0378 -
accuracy: 0.9917
Epoch 33/100
120/120 [==============================] - 0s 167us/step - loss: 0.0413 -
accuracy: 0.9833
Epoch 34/100
120/120 [==============================] - 0s 160us/step - loss: 0.0402 -
accuracy: 0.9917
Epoch 35/100
120/120 [==============================] - 0s 179us/step - loss: 0.0379 -
accuracy: 0.9917
Epoch 36/100
120/120 [==============================] - 0s 168us/step - loss: 0.0459 -
accuracy: 0.9833
Epoch 37/100
120/120 [==============================] - 0s 203us/step - loss: 0.0501 -
accuracy: 0.9833
Epoch 38/100
120/120 [==============================] - 0s 168us/step - loss: 0.0433 -
accuracy: 0.9750
Epoch 39/100
120/120 [==============================] - 0s 185us/step - loss: 0.0439 -
accuracy: 0.9917
Epoch 40/100
120/120 [==============================] - 0s 177us/step - loss: 0.0506 -
accuracy: 0.9750
Epoch 41/100
120/120 [==============================] - 0s 168us/step - loss: 0.0508 -
accuracy: 0.9917
Epoch 42/100
120/120 [==============================] - 0s 162us/step - loss: 0.0465 -
accuracy: 0.9833
Epoch 43/100
120/120 [==============================] - 0s 165us/step - loss: 0.0436 -
accuracy: 0.9833
Epoch 44/100
120/120 [==============================] - 0s 168us/step - loss: 0.0347 -
accuracy: 0.9917
Epoch 45/100
120/120 [==============================] - 0s 169us/step - loss: 0.0459 -
accuracy: 0.9833
Epoch 46/100
120/120 [==============================] - 0s 163us/step - loss: 0.0383 -
```

```
accuracy: 0.9917
Epoch 47/100
120/120 [==============================] - 0s 159us/step - loss: 0.0432 -
accuracy: 0.9833
Epoch 48/100
120/120 [==============================] - 0s 167us/step - loss: 0.0489 -
accuracy: 0.9750
Epoch 49/100
120/120 [==============================] - 0s 174us/step - loss: 0.0393 -
accuracy: 0.9750
Epoch 50/100
120/120 [==============================] - 0s 162us/step - loss: 0.0393 -
accuracy: 0.9917
Epoch 51/100
120/120 [==============================] - 0s 162us/step - loss: 0.0386 -
accuracy: 0.9917
Epoch 52/100
120/120 [==============================] - 0s 169us/step - loss: 0.0475 -
accuracy: 0.9833
Epoch 53/100
120/120 [==============================] - 0s 180us/step - loss: 0.0400 -
accuracy: 0.9833
Epoch 54/100
120/120 [==============================] - 0s 163us/step - loss: 0.0450 -
accuracy: 0.9833
Epoch 55/100
120/120 [==============================] - 0s 162us/step - loss: 0.0379 -
accuracy: 0.9917
Epoch 56/100
120/120 [==============================] - 0s 170us/step - loss: 0.0395 -
accuracy: 0.9917
Epoch 57/100
120/120 [==============================] - 0s 160us/step - loss: 0.0642 -
accuracy: 0.9667
Epoch 58/100
120/120 [==============================] - 0s 164us/step - loss: 0.0657 -
accuracy: 0.9667
Epoch 59/100
120/120 [==============================] - 0s 163us/step - loss: 0.0525 -
accuracy: 0.9750
Epoch 60/100
120/120 [==============================] - 0s 169us/step - loss: 0.0405 -
accuracy: 0.9833
Epoch 61/100
120/120 [==============================] - 0s 162us/step - loss: 0.0347 -
accuracy: 0.9917
Epoch 62/100
120/120 [==============================] - 0s 162us/step - loss: 0.0376 -
```

```
accuracy: 0.9833
Epoch 63/100
120/120 [==============================] - 0s 171us/step - loss: 0.0427 -
accuracy: 0.9833
Epoch 64/100
120/120 [==============================] - 0s 169us/step - loss: 0.0501 -
accuracy: 0.9667
Epoch 65/100
120/120 [==============================] - 0s 164us/step - loss: 0.0468 -
accuracy: 0.9750
Epoch 66/100
120/120 [==============================] - 0s 168us/step - loss: 0.0412 -
accuracy: 0.9833
Epoch 67/100
120/120 [==============================] - 0s 168us/step - loss: 0.0456 -
accuracy: 0.9750
Epoch 68/100
120/120 [==============================] - 0s 164us/step - loss: 0.0354 -
accuracy: 0.9917
Epoch 69/100
120/120 [==============================] - 0s 161us/step - loss: 0.0403 -
accuracy: 0.9917
Epoch 70/100
120/120 [==============================] - 0s 162us/step - loss: 0.0402 -
accuracy: 0.9917
Epoch 71/100
120/120 [==============================] - 0s 168us/step - loss: 0.0415 -
accuracy: 0.9917
Epoch 72/100
120/120 [==============================] - 0s 169us/step - loss: 0.0397 -
accuracy: 0.9917
Epoch 73/100
120/120 [==============================] - 0s 164us/step - loss: 0.0364 -
accuracy: 0.9917
Epoch 74/100
120/120 [==============================] - 0s 166us/step - loss: 0.0354 -
accuracy: 0.9917
Epoch 75/100
120/120 [==============================] - 0s 171us/step - loss: 0.0408 -
accuracy: 0.9833
Epoch 76/100
120/120 [==============================] - 0s 161us/step - loss: 0.0453 -
accuracy: 0.9833
Epoch 77/100
120/120 [==============================] - 0s 162us/step - loss: 0.0382 -
accuracy: 0.9833
Epoch 78/100
120/120 [==============================] - 0s 167us/step - loss: 0.0468 -
```

```
accuracy: 0.9750
Epoch 79/100
120/120 [==============================] - 0s 169us/step - loss: 0.0473 -
accuracy: 0.9833
Epoch 80/100
120/120 [==============================] - 0s 164us/step - loss: 0.0346 -
accuracy: 0.9917
Epoch 81/100
120/120 [==============================] - 0s 158us/step - loss: 0.0385 -
accuracy: 0.9917
Epoch 82/100
120/120 [==============================] - 0s 159us/step - loss: 0.0426 -
accuracy: 0.9833
Epoch 83/100
120/120 [==============================] - 0s 168us/step - loss: 0.0433 -
accuracy: 0.9833
Epoch 84/100
120/120 [==============================] - 0s 162us/step - loss: 0.0508 -
accuracy: 0.9667
Epoch 85/100
120/120 [==============================] - 0s 165us/step - loss: 0.0341 -
accuracy: 0.9917
Epoch 86/100
120/120 [==============================] - 0s 157us/step - loss: 0.0349 -
accuracy: 0.9917
Epoch 87/100
120/120 [==============================] - 0s 170us/step - loss: 0.0424 -
accuracy: 0.9833
Epoch 88/100
120/120 [==============================] - 0s 165us/step - loss: 0.0508 -
accuracy: 0.9833
Epoch 89/100
120/120 [==============================] - 0s 164us/step - loss: 0.0378 -
accuracy: 0.9917
Epoch 90/100
120/120 [==============================] - 0s 159us/step - loss: 0.0379 -
accuracy: 0.9917
Epoch 91/100
120/120 [==============================] - 0s 170us/step - loss: 0.0377 -
accuracy: 0.9917
Epoch 92/100
120/120 [==============================] - 0s 165us/step - loss: 0.0421 -
accuracy: 0.9833
Epoch 93/100
120/120 [==============================] - 0s 163us/step - loss: 0.0358 -
accuracy: 0.9917
Epoch 94/100
120/120 [==============================] - 0s 160us/step - loss: 0.0492 -
```

```
accuracy: 0.9833
Epoch 95/100
120/120 [==============================] - 0s 174us/step - loss: 0.0709 -
accuracy: 0.9583
Epoch 96/100
120/120 [==============================] - 0s 172us/step - loss: 0.0437 -
accuracy: 0.9833
Epoch 97/100
120/120 [==============================] - 0s 172us/step - loss: 0.0451 -
accuracy: 0.9833
Epoch 98/100
120/120 [==============================] - 0s 179us/step - loss: 0.0490 -
accuracy: 0.9750
Epoch 99/100
120/120 [==============================] - 0s 162us/step - loss: 0.0478 -
accuracy: 0.9750
Epoch 100/100
120/120 [==============================] - 0s 167us/step - loss: 0.0516 -
accuracy: 0.9833
30/30 [==============================] - 0s 14us/step
Mean loss function value 0.091354
Accuracy : 0.966667
Epoch 1/100
120/120 [==============================] - 0s 171us/step - loss: 0.0414 -
accuracy: 0.9917
Epoch 2/100
120/120 [==============================] - 0s 165us/step - loss: 0.0363 -
accuracy: 0.9833
Epoch 3/100
120/120 [==============================] - 0s 163us/step - loss: 0.0403 -
accuracy: 0.9917
Epoch 4/100
120/120 [==============================] - 0s 168us/step - loss: 0.0387 -
accuracy: 0.9917
Epoch 5/100
120/120 [==============================] - 0s 162us/step - loss: 0.0368 -
accuracy: 0.9917
Epoch 6/100
120/120 [==============================] - 0s 159us/step - loss: 0.0404 -
accuracy: 0.9833
Epoch 7/100
120/120 [==============================] - 0s 158us/step - loss: 0.0373 -
accuracy: 0.9917
Epoch 8/100
120/120 [==============================] - 0s 171us/step - loss: 0.0404 -
accuracy: 0.9750
Epoch 9/100
120/120 [==============================] - 0s 162us/step - loss: 0.0480 -
```

```
accuracy: 0.9833
Epoch 10/100
120/120 [==============================] - 0s 163us/step - loss: 0.0383 -
accuracy: 0.9917
Epoch 11/100
120/120 [==============================] - 0s 160us/step - loss: 0.0361 -
accuracy: 0.9917
Epoch 12/100
120/120 [==============================] - 0s 167us/step - loss: 0.0447 -
accuracy: 0.9833
Epoch 13/100
120/120 [==============================] - 0s 162us/step - loss: 0.0339 -
accuracy: 0.9917
Epoch 14/100
120/120 [==============================] - 0s 157us/step - loss: 0.0380 -
accuracy: 0.9917
Epoch 15/100
120/120 [==============================] - 0s 160us/step - loss: 0.0373 -
accuracy: 0.9917
Epoch 16/100
120/120 [==============================] - 0s 163us/step - loss: 0.0400 -
accuracy: 0.9833
Epoch 17/100
120/120 [==============================] - 0s 164us/step - loss: 0.0547 -
accuracy: 0.9667
Epoch 18/100
120/120 [==============================] - 0s 169us/step - loss: 0.0471 -
accuracy: 0.9833
Epoch 19/100
120/120 [==============================] - 0s 172us/step - loss: 0.0407 -
accuracy: 0.9917
Epoch 20/100
120/120 [==============================] - 0s 177us/step - loss: 0.0385 -
accuracy: 0.9917
Epoch 21/100
120/120 [==============================] - 0s 163us/step - loss: 0.0493 -
accuracy: 0.9833
Epoch 22/100
120/120 [==============================] - 0s 167us/step - loss: 0.0464 -
accuracy: 0.9833
Epoch 23/100
120/120 [==============================] - 0s 160us/step - loss: 0.0424 -
accuracy: 0.9917
Epoch 24/100
120/120 [==============================] - 0s 168us/step - loss: 0.0463 -
accuracy: 0.9917
Epoch 25/100
120/120 [==============================] - 0s 167us/step - loss: 0.0474 -
```

```
accuracy: 0.9750
Epoch 26/100
120/120 [==============================] - 0s 166us/step - loss: 0.0471 -
accuracy: 0.9833
Epoch 27/100
120/120 [==============================] - 0s 170us/step - loss: 0.0384 -
accuracy: 0.9917
Epoch 28/100
120/120 [==============================] - 0s 161us/step - loss: 0.0374 -
accuracy: 0.9917
Epoch 29/100
120/120 [==============================] - 0s 159us/step - loss: 0.0348 -
accuracy: 0.9917
Epoch 30/100
120/120 [==============================] - 0s 159us/step - loss: 0.0425 -
accuracy: 0.9917
Epoch 31/100
120/120 [==============================] - 0s 164us/step - loss: 0.0357 -
accuracy: 0.9917
Epoch 32/100
120/120 [==============================] - 0s 163us/step - loss: 0.0375 -
accuracy: 0.9917
Epoch 33/100
120/120 [==============================] - 0s 164us/step - loss: 0.0393 -
accuracy: 0.9917
Epoch 34/100
120/120 [==============================] - 0s 165us/step - loss: 0.0438 -
accuracy: 0.9833
Epoch 35/100
120/120 [==============================] - 0s 164us/step - loss: 0.0502 -
accuracy: 0.9833
Epoch 36/100
120/120 [==============================] - 0s 166us/step - loss: 0.0505 -
accuracy: 0.9833
Epoch 37/100
120/120 [==============================] - 0s 159us/step - loss: 0.0360 -
accuracy: 0.9917
Epoch 38/100
120/120 [==============================] - 0s 157us/step - loss: 0.0372 -
accuracy: 0.9833
Epoch 39/100
120/120 [==============================] - 0s 165us/step - loss: 0.0434 -
accuracy: 0.9833
Epoch 40/100
120/120 [==============================] - 0s 164us/step - loss: 0.0342 -
accuracy: 0.9833
Epoch 41/100
120/120 [==============================] - 0s 166us/step - loss: 0.0417 -
```

```
accuracy: 0.9750
Epoch 42/100
120/120 [==============================] - 0s 166us/step - loss: 0.0436 -
accuracy: 0.9833
Epoch 43/100
120/120 [==============================] - 0s 171us/step - loss: 0.0356 -
accuracy: 0.9917
Epoch 44/100
120/120 [==============================] - 0s 163us/step - loss: 0.0387 -
accuracy: 0.9833
Epoch 45/100
120/120 [==============================] - 0s 160us/step - loss: 0.0488 -
accuracy: 0.9833
Epoch 46/100
120/120 [==============================] - 0s 163us/step - loss: 0.0407 -
accuracy: 0.9833
Epoch 47/100
120/120 [==============================] - 0s 168us/step - loss: 0.0351 -
accuracy: 0.9917
Epoch 48/100
120/120 [==============================] - 0s 162us/step - loss: 0.0353 -
accuracy: 0.9917
Epoch 49/100
120/120 [==============================] - 0s 158us/step - loss: 0.0395 -
accuracy: 0.9833
Epoch 50/100
120/120 [==============================] - 0s 160us/step - loss: 0.0493 -
accuracy: 0.9833
Epoch 51/100
120/120 [==============================] - 0s 166us/step - loss: 0.0462 -
accuracy: 0.9750
Epoch 52/100
120/120 [==============================] - 0s 161us/step - loss: 0.0555 -
accuracy: 0.9750
Epoch 53/100
120/120 [==============================] - 0s 162us/step - loss: 0.0367 -
accuracy: 0.9917
Epoch 54/100
120/120 [==============================] - 0s 168us/step - loss: 0.0412 -
accuracy: 0.9917
Epoch 55/100
120/120 [==============================] - 0s 167us/step - loss: 0.0409 -
accuracy: 0.9917
Epoch 56/100
120/120 [==============================] - 0s 165us/step - loss: 0.0451 -
accuracy: 0.9833
Epoch 57/100
120/120 [==============================] - 0s 159us/step - loss: 0.0404 -
```

```
accuracy: 0.9833
Epoch 58/100
120/120 [==============================] - 0s 160us/step - loss: 0.0360 -
accuracy: 0.9917
Epoch 59/100
120/120 [==============================] - 0s 163us/step - loss: 0.0440 -
accuracy: 0.9833
Epoch 60/100
120/120 [==============================] - 0s 181us/step - loss: 0.0628 -
accuracy: 0.9750
Epoch 61/100
120/120 [==============================] - 0s 185us/step - loss: 0.0364 -
accuracy: 0.9917
Epoch 62/100
120/120 [==============================] - 0s 176us/step - loss: 0.0374 -
accuracy: 0.9917
Epoch 63/100
120/120 [==============================] - 0s 167us/step - loss: 0.0411 -
accuracy: 0.9833
Epoch 64/100
120/120 [==============================] - 0s 157us/step - loss: 0.0416 -
accuracy: 0.9917
Epoch 65/100
120/120 [==============================] - 0s 164us/step - loss: 0.0463 -
accuracy: 0.9917
Epoch 66/100
120/120 [==============================] - 0s 168us/step - loss: 0.0362 -
accuracy: 0.9917
Epoch 67/100
120/120 [==============================] - 0s 166us/step - loss: 0.0365 -
accuracy: 0.9917
Epoch 68/100
120/120 [==============================] - 0s 161us/step - loss: 0.0498 -
accuracy: 0.9750
Epoch 69/100
120/120 [==============================] - 0s 160us/step - loss: 0.0362 -
accuracy: 0.9917
Epoch 70/100
120/120 [==============================] - 0s 170us/step - loss: 0.0369 -
accuracy: 0.9917
Epoch 71/100
120/120 [==============================] - 0s 163us/step - loss: 0.0358 -
accuracy: 0.9833
Epoch 72/100
120/120 [==============================] - 0s 166us/step - loss: 0.0530 -
accuracy: 0.9833
Epoch 73/100
120/120 [==============================] - 0s 160us/step - loss: 0.0464 -
```

```
accuracy: 0.9917
Epoch 74/100
120/120 [==============================] - 0s 165us/step - loss: 0.0404 -
accuracy: 0.9833
Epoch 75/100
120/120 [==============================] - 0s 170us/step - loss: 0.0390 -
accuracy: 0.9917
Epoch 76/100
120/120 [==============================] - 0s 162us/step - loss: 0.0342 -
accuracy: 0.9833
Epoch 77/100
120/120 [==============================] - 0s 163us/step - loss: 0.0377 -
accuracy: 0.9833
Epoch 78/100
120/120 [==============================] - 0s 162us/step - loss: 0.0527 -
accuracy: 0.9667
Epoch 79/100
120/120 [==============================] - 0s 160us/step - loss: 0.0475 -
accuracy: 0.9833
Epoch 80/100
120/120 [==============================] - 0s 166us/step - loss: 0.0391 -
accuracy: 0.9917
Epoch 81/100
120/120 [==============================] - 0s 165us/step - loss: 0.0363 -
accuracy: 0.9917
Epoch 82/100
120/120 [==============================] - 0s 163us/step - loss: 0.0471 -
accuracy: 0.9833
Epoch 83/100
120/120 [==============================] - 0s 162us/step - loss: 0.0353 -
accuracy: 0.9917
Epoch 84/100
120/120 [==============================] - 0s 169us/step - loss: 0.0350 -
accuracy: 0.9833
Epoch 85/100
120/120 [==============================] - 0s 167us/step - loss: 0.0575 -
accuracy: 0.9750
Epoch 86/100
120/120 [==============================] - 0s 163us/step - loss: 0.0408 -
accuracy: 0.9833
Epoch 87/100
120/120 [==============================] - 0s 161us/step - loss: 0.0522 -
accuracy: 0.9833
Epoch 88/100
120/120 [==============================] - 0s 161us/step - loss: 0.0353 -
accuracy: 0.9917
Epoch 89/100
120/120 [==============================] - 0s 166us/step - loss: 0.0520 -
```

```
accuracy: 0.9667
Epoch 90/100
120/120 [==============================] - 0s 162us/step - loss: 0.0446 -
accuracy: 0.9833
Epoch 91/100
120/120 [==============================] - 0s 168us/step - loss: 0.0329 -
accuracy: 0.9917
Epoch 92/100
120/120 [==============================] - 0s 167us/step - loss: 0.0357 -
accuracy: 0.9917
Epoch 93/100
120/120 [==============================] - 0s 171us/step - loss: 0.0350 -
accuracy: 0.9917
Epoch 94/100
120/120 [==============================] - 0s 161us/step - loss: 0.0390 -
accuracy: 0.9833
Epoch 95/100
120/120 [==============================] - 0s 158us/step - loss: 0.0538 -
accuracy: 0.9750
Epoch 96/100
120/120 [==============================] - 0s 158us/step - loss: 0.0411 -
accuracy: 0.9750
Epoch 97/100
120/120 [==============================] - 0s 162us/step - loss: 0.0522 -
accuracy: 0.9833
Epoch 98/100
120/120 [==============================] - 0s 162us/step - loss: 0.0397 -
accuracy: 0.9917
Epoch 99/100
120/120 [==============================] - 0s 159us/step - loss: 0.0386 -
accuracy: 0.9833
Epoch 100/100
120/120 [==============================] - 0s 157us/step - loss: 0.0437 -
accuracy: 0.9833
30/30 [==============================] - 0s 14us/step
Mean loss function value 0.093183
Accuracy : 0.966667
Epoch 1/100
120/120 [==============================] - 0s 169us/step - loss: 0.0407 -
accuracy: 0.9917
Epoch 2/100
120/120 [==============================] - 0s 163us/step - loss: 0.0409 -
accuracy: 0.9833
Epoch 3/100
120/120 [==============================] - 0s 166us/step - loss: 0.0412 -
accuracy: 0.9833
Epoch 4/100
120/120 [==============================] - 0s 170us/step - loss: 0.0420 -
```

```
accuracy: 0.9917
Epoch 5/100
120/120 [==============================] - 0s 161us/step - loss: 0.0506 -
accuracy: 0.9667
Epoch 6/100
120/120 [==============================] - 0s 158us/step - loss: 0.0325 -
accuracy: 0.9917
Epoch 7/100
120/120 [==============================] - 0s 157us/step - loss: 0.0395 -
accuracy: 0.9833
Epoch 8/100
120/120 [==============================] - 0s 165us/step - loss: 0.0423 -
accuracy: 0.9833
Epoch 9/100
120/120 [==============================] - 0s 165us/step - loss: 0.0450 -
accuracy: 0.9750
Epoch 10/100
120/120 [==============================] - 0s 162us/step - loss: 0.0509 -
accuracy: 0.9833
Epoch 11/100
120/120 [==============================] - 0s 165us/step - loss: 0.0435 -
accuracy: 0.9833
Epoch 12/100
120/120 [==============================] - 0s 165us/step - loss: 0.0361 -
accuracy: 0.9833
Epoch 13/100
120/120 [==============================] - 0s 161us/step - loss: 0.0366 -
accuracy: 0.9917
Epoch 14/100
120/120 [==============================] - 0s 165us/step - loss: 0.0341 -
accuracy: 0.9917
Epoch 15/100
120/120 [==============================] - 0s 176us/step - loss: 0.0355 -
accuracy: 0.9917
Epoch 16/100
120/120 [==============================] - 0s 169us/step - loss: 0.0381 -
accuracy: 0.9917
Epoch 17/100
120/120 [==============================] - 0s 162us/step - loss: 0.0418 -
accuracy: 0.9750
Epoch 18/100
120/120 [==============================] - 0s 159us/step - loss: 0.0443 -
accuracy: 0.9833
Epoch 19/100
120/120 [==============================] - 0s 160us/step - loss: 0.0358 -
accuracy: 0.9833
Epoch 20/100
120/120 [==============================] - 0s 168us/step - loss: 0.0476 -
```

```
accuracy: 0.9833
Epoch 21/100
120/120 [==============================] - 0s 163us/step - loss: 0.0533 -
accuracy: 0.9833
Epoch 22/100
120/120 [==============================] - 0s 159us/step - loss: 0.0481 -
accuracy: 0.9750
Epoch 23/100
120/120 [==============================] - 0s 159us/step - loss: 0.0410 -
accuracy: 0.9833
Epoch 24/100
120/120 [==============================] - 0s 169us/step - loss: 0.0369 -
accuracy: 0.9917
Epoch 25/100
120/120 [==============================] - 0s 165us/step - loss: 0.0360 -
accuracy: 0.9917
Epoch 26/100
120/120 [==============================] - 0s 158us/step - loss: 0.0354 -
accuracy: 0.9917
Epoch 27/100
120/120 [==============================] - 0s 161us/step - loss: 0.0388 -
accuracy: 0.9917
Epoch 28/100
120/120 [==============================] - 0s 165us/step - loss: 0.0423 -
accuracy: 0.9833
Epoch 29/100
120/120 [==============================] - 0s 163us/step - loss: 0.0413 -
accuracy: 0.9833
Epoch 30/100
120/120 [==============================] - 0s 163us/step - loss: 0.0380 -
accuracy: 0.9833
Epoch 31/100
120/120 [==============================] - 0s 165us/step - loss: 0.0608 -
accuracy: 0.9750
Epoch 32/100
120/120 [==============================] - 0s 167us/step - loss: 0.0399 -
accuracy: 0.9917
Epoch 33/100
120/120 [==============================] - 0s 160us/step - loss: 0.0354 -
accuracy: 0.9917
Epoch 34/100
120/120 [==============================] - 0s 163us/step - loss: 0.0349 -
accuracy: 0.9917
Epoch 35/100
120/120 [==============================] - 0s 162us/step - loss: 0.0388 -
accuracy: 0.9833
Epoch 36/100
120/120 [==============================] - 0s 162us/step - loss: 0.0426 -
```

```
accuracy: 0.9833
Epoch 37/100
120/120 [==============================] - 0s 162us/step - loss: 0.0354 -
accuracy: 0.9917
Epoch 38/100
120/120 [==============================] - 0s 163us/step - loss: 0.0335 -
accuracy: 0.9917
Epoch 39/100
120/120 [==============================] - 0s 170us/step - loss: 0.0391 -
accuracy: 0.9750
Epoch 40/100
120/120 [==============================] - 0s 164us/step - loss: 0.0591 -
accuracy: 0.9833
Epoch 41/100
120/120 [==============================] - 0s 165us/step - loss: 0.0369 -
accuracy: 0.9917
Epoch 42/100
120/120 [==============================] - 0s 164us/step - loss: 0.0359 -
accuracy: 0.9917
Epoch 43/100
120/120 [==============================] - 0s 159us/step - loss: 0.0448 -
accuracy: 0.9833
Epoch 44/100
120/120 [==============================] - 0s 165us/step - loss: 0.0398 -
accuracy: 0.9833
Epoch 45/100
120/120 [==============================] - 0s 161us/step - loss: 0.0380 -
accuracy: 0.9917
Epoch 46/100
120/120 [==============================] - 0s 161us/step - loss: 0.0415 -
accuracy: 0.9917
Epoch 47/100
120/120 [==============================] - 0s 158us/step - loss: 0.0435 -
accuracy: 0.9833
Epoch 48/100
120/120 [==============================] - 0s 165us/step - loss: 0.0362 -
accuracy: 0.9917
Epoch 49/100
120/120 [==============================] - 0s 163us/step - loss: 0.0413 -
accuracy: 0.9833
Epoch 50/100
120/120 [==============================] - 0s 164us/step - loss: 0.0444 -
accuracy: 0.9750
Epoch 51/100
120/120 [==============================] - 0s 163us/step - loss: 0.0419 -
accuracy: 0.9917
Epoch 52/100
120/120 [==============================] - 0s 164us/step - loss: 0.0410 -
```

```
accuracy: 0.9750
Epoch 53/100
120/120 [==============================] - 0s 167us/step - loss: 0.0756 -
accuracy: 0.9667
Epoch 54/100
120/120 [==============================] - 0s 160us/step - loss: 0.0478 -
accuracy: 0.9833
Epoch 55/100
120/120 [==============================] - 0s 156us/step - loss: 0.0416 -
accuracy: 0.9833
Epoch 56/100
120/120 [==============================] - 0s 164us/step - loss: 0.0431 -
accuracy: 0.9833
Epoch 57/100
120/120 [==============================] - 0s 166us/step - loss: 0.0459 -
accuracy: 0.9833
Epoch 58/100
120/120 [==============================] - 0s 160us/step - loss: 0.0458 -
accuracy: 0.9917
Epoch 59/100
120/120 [==============================] - 0s 166us/step - loss: 0.0338 -
accuracy: 0.9917
Epoch 60/100
120/120 [==============================] - 0s 165us/step - loss: 0.0351 -
accuracy: 0.9917
Epoch 61/100
120/120 [==============================] - 0s 161us/step - loss: 0.0387 -
accuracy: 0.9917
Epoch 62/100
120/120 [==============================] - 0s 164us/step - loss: 0.0376 -
accuracy: 0.9917
Epoch 63/100
120/120 [==============================] - 0s 169us/step - loss: 0.0370 -
accuracy: 0.9917
Epoch 64/100
120/120 [==============================] - 0s 168us/step - loss: 0.0377 -
accuracy: 0.9833
Epoch 65/100
120/120 [==============================] - 0s 162us/step - loss: 0.0353 -
accuracy: 0.9917
Epoch 66/100
120/120 [==============================] - 0s 160us/step - loss: 0.0448 -
accuracy: 0.9917
Epoch 67/100
120/120 [==============================] - 0s 157us/step - loss: 0.0412 -
accuracy: 0.9833
Epoch 68/100
120/120 [==============================] - 0s 164us/step - loss: 0.0412 -
```

```
accuracy: 0.9750
Epoch 69/100
120/120 [==============================] - 0s 162us/step - loss: 0.0424 -
accuracy: 0.9917
Epoch 70/100
120/120 [==============================] - 0s 160us/step - loss: 0.0330 -
accuracy: 0.9917
Epoch 71/100
120/120 [==============================] - 0s 162us/step - loss: 0.0348 -
accuracy: 0.9917
Epoch 72/100
120/120 [==============================] - 0s 164us/step - loss: 0.0339 -
accuracy: 0.9917
Epoch 73/100
120/120 [==============================] - 0s 171us/step - loss: 0.0345 -
accuracy: 0.9917
Epoch 74/100
120/120 [==============================] - 0s 175us/step - loss: 0.0364 -
accuracy: 0.9917
Epoch 75/100
120/120 [==============================] - 0s 210us/step - loss: 0.0379 -
accuracy: 0.9917
Epoch 76/100
120/120 [==============================] - 0s 185us/step - loss: 0.0371 -
accuracy: 0.9917
Epoch 77/100
120/120 [==============================] - 0s 167us/step - loss: 0.0387 -
accuracy: 0.9917
Epoch 78/100
120/120 [==============================] - 0s 165us/step - loss: 0.0382 -
accuracy: 0.9917
Epoch 79/100
120/120 [==============================] - 0s 163us/step - loss: 0.0277 -
accuracy: 0.9917
Epoch 80/100
120/120 [==============================] - 0s 162us/step - loss: 0.0476 -
accuracy: 0.9833
Epoch 81/100
120/120 [==============================] - 0s 160us/step - loss: 0.0416 -
accuracy: 0.9833
Epoch 82/100
120/120 [==============================] - 0s 165us/step - loss: 0.0362 -
accuracy: 0.9917
Epoch 83/100
120/120 [==============================] - 0s 161us/step - loss: 0.0340 -
accuracy: 0.9917
Epoch 84/100
120/120 [==============================] - 0s 158us/step - loss: 0.0360 -
```

```
accuracy: 0.9917
Epoch 85/100
120/120 [==============================] - 0s 159us/step - loss: 0.0375 -
accuracy: 0.9917
Epoch 86/100
120/120 [==============================] - 0s 165us/step - loss: 0.0392 -
accuracy: 0.9917
Epoch 87/100
120/120 [==============================] - 0s 162us/step - loss: 0.0341 -
accuracy: 0.9917
Epoch 88/100
120/120 [==============================] - 0s 163us/step - loss: 0.0623 -
accuracy: 0.9750
Epoch 89/100
120/120 [==============================] - 0s 167us/step - loss: 0.0759 -
accuracy: 0.9750
Epoch 90/100
120/120 [==============================] - 0s 168us/step - loss: 0.0417 -
accuracy: 0.9917
Epoch 91/100
120/120 [==============================] - 0s 163us/step - loss: 0.0437 -
accuracy: 0.9917
Epoch 92/100
120/120 [==============================] - 0s 159us/step - loss: 0.0421 -
accuracy: 0.9917
Epoch 93/100
120/120 [==============================] - 0s 158us/step - loss: 0.0476 -
accuracy: 0.9750
Epoch 94/100
120/120 [==============================] - 0s 162us/step - loss: 0.0396 -
accuracy: 0.9917
Epoch 95/100
120/120 [==============================] - 0s 164us/step - loss: 0.0511 -
accuracy: 0.9750
Epoch 96/100
120/120 [==============================] - 0s 160us/step - loss: 0.0443 -
accuracy: 0.9833
Epoch 97/100
120/120 [==============================] - 0s 165us/step - loss: 0.0437 -
accuracy: 0.9833
Epoch 98/100
120/120 [==============================] - 0s 160us/step - loss: 0.0443 -
accuracy: 0.9917
Epoch 99/100
120/120 [==============================] - 0s 170us/step - loss: 0.0595 -
accuracy: 0.9750
Epoch 100/100
120/120 [==============================] - 0s 160us/step - loss: 0.0486 -
```

```
accuracy: 0.9667
30/30 [==============================] - 0s 13us/step
Mean loss function value 0.055875
Accuracy : 0.966667
```

[17]:
```
df.head(10)
```

[17]:

	Run Count	Epoch	Loss Value	Accuracy
0	1.0	100.0	0.075733	0.933333
1	2.0	100.0	0.065642	0.933333
2	3.0	100.0	0.081850	0.966667
3	4.0	100.0	0.074927	0.966667
4	5.0	100.0	0.084626	0.966667
5	6.0	100.0	0.060382	0.966667
6	7.0	100.0	0.054902	0.933333
7	8.0	100.0	0.091354	0.966667
8	9.0	100.0	0.093183	0.966667
9	10.0	100.0	0.055875	0.966667

[18]:
```
print("Mean Accuracy across all 10 runs : ", df['Accuracy'].mean())
print("Mean Standard Deviation across all 10 runs : ", df['Accuracy'].std())
```

```
Mean Accuracy across all 10 runs :  0.9566666483879089
Mean Standard Deviation across all 10 runs :  0.016101514362372917
```