# Keras_mnist_PT

May 5, 2022

## 1 Hyperparameter tuning for Keras model with Dense Layer

### 1.0.1 Load data

[ ]:
```
import numpy as np
import tensorflow
import tensorflow.keras
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
import tensorflow
from tensorflow.python.keras import backend as K
from tensorflow.keras.optimizers import Adam
import pandas as pd
```

[ ]:
```
!pip install scikit-optimize
```

```
Collecting scikit-optimize
  Downloading scikit_optimize-0.9.0-py2.py3-none-any.whl (100 kB)
     |                  | 100 kB 6.2 MB/s
Requirement already satisfied: numpy>=1.13.3 in
/usr/local/lib/python3.7/dist-packages (from scikit-optimize) (1.21.6)
Requirement already satisfied: scipy>=0.19.1 in /usr/local/lib/python3.7/dist-
packages (from scikit-optimize) (1.4.1)
Requirement already satisfied: scikit-learn>=0.20.0 in
/usr/local/lib/python3.7/dist-packages (from scikit-optimize) (1.0.2)
Collecting pyaml>=16.9
  Downloading pyaml-21.10.1-py2.py3-none-any.whl (24 kB)
Requirement already satisfied: joblib>=0.11 in /usr/local/lib/python3.7/dist-
packages (from scikit-optimize) (1.1.0)
Requirement already satisfied: PyYAML in /usr/local/lib/python3.7/dist-packages
(from pyaml>=16.9->scikit-optimize) (3.13)
Requirement already satisfied: threadpoolctl>=2.0.0 in
/usr/local/lib/python3.7/dist-packages (from scikit-learn>=0.20.0->scikit-
optimize) (3.1.0)
Installing collected packages: pyaml, scikit-optimize
Successfully installed pyaml-21.10.1 scikit-optimize-0.9.0
```

[ ]:
```
import skopt
from skopt import gbrt_minimize, gp_minimize
from skopt.utils import use_named_args
from skopt.space import Real, Categorical, Integer
```

[ ]:
```
from keras.datasets import mnist
(X_train, y_train), (X_test, y_test) = mnist.load_data()
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-
datasets/mnist.npz
11493376/11490434 [==============================] - 0s 0us/step
11501568/11490434 [==============================] - 0s 0us/step
```

Scale the data to between 0 & 1

[ ]:
```
X_train = X_train/ 255
X_test = X_test/ 255
print(X_train.min(),X_train.max())
```

```
0.0 1.0
```

[ ]:
```
y_test[0:10]
```

[ ]:
```
array([7, 2, 1, 0, 4, 1, 4, 9, 5, 9], dtype=uint8)
```

[ ]:
```
X_train.shape
```

[ ]:
```
(60000, 28, 28)
```

Need to Flatten the Arrays

[ ]:
```
X_train = X_train.reshape(60000,784)
X_test = X_test.reshape(10000,784)
```

Convert the y's to used with softmax function

[ ]:
```
from keras.utils import np_utils
y_train = np_utils.to_categorical(y_train, 10)
y_test = np_utils.to_categorical(y_test, 10)
```

[ ]:
```
y_train.shape
```

[ ]:
```
(60000, 10)
```

[ ]:
```
input_shape= X_train[0].shape
print(input_shape)
```

```
(784,)
```

### 1.1 Checking result against a baseline

A simple 2 layer neural network

[ ]:
```
model =Sequential()
model.add(Dense(16, input_shape=input_shape, activation='relu',name =␣
↪'input_layer'))
model.add(Dense(16, activation='relu', name="hidden_layer"))

model.add(Dense(10,activation='softmax',name="output_layer"))
model.compile(optimizer = 'adam', loss='categorical_crossentropy',␣
↪metrics=["accuracy"])
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_layer (Dense)         (None, 16)                12560

 hidden_layer (Dense)        (None, 16)                272

 output_layer (Dense)        (None, 10)                170

=================================================================
Total params: 13,002
Trainable params: 13,002
Non-trainable params: 0
_________________________________________________________________
```

[ ]:
```
blackbox = model.fit(X_train, y_train, batch_size=128, epochs = 20,␣
↪validation_split=.15)
```

```
Epoch 1/20
399/399 [==============================] - 3s 3ms/step - loss: 0.7251 -
accuracy: 0.7787 - val_loss: 0.2955 - val_accuracy: 0.9132
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2948 -
accuracy: 0.9158 - val_loss: 0.2301 - val_accuracy: 0.9373
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2458 -
accuracy: 0.9292 - val_loss: 0.2058 - val_accuracy: 0.9421
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2179 -
accuracy: 0.9365 - val_loss: 0.1888 - val_accuracy: 0.9480
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2014 -
accuracy: 0.9431 - val_loss: 0.1832 - val_accuracy: 0.9500
```

```
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1885 -
accuracy: 0.9458 - val_loss: 0.1706 - val_accuracy: 0.9537
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1781 -
accuracy: 0.9480 - val_loss: 0.1685 - val_accuracy: 0.9534
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1691 -
accuracy: 0.9509 - val_loss: 0.1669 - val_accuracy: 0.9547
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1613 -
accuracy: 0.9526 - val_loss: 0.1657 - val_accuracy: 0.9550
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1549 -
accuracy: 0.9552 - val_loss: 0.1572 - val_accuracy: 0.9569
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1482 -
accuracy: 0.9562 - val_loss: 0.1590 - val_accuracy: 0.9573
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1439 -
accuracy: 0.9578 - val_loss: 0.1619 - val_accuracy: 0.9549
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1398 -
accuracy: 0.9594 - val_loss: 0.1530 - val_accuracy: 0.9583
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1364 -
accuracy: 0.9596 - val_loss: 0.1534 - val_accuracy: 0.9576
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1307 -
accuracy: 0.9617 - val_loss: 0.1522 - val_accuracy: 0.9593
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1265 -
accuracy: 0.9634 - val_loss: 0.1528 - val_accuracy: 0.9590
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1235 -
accuracy: 0.9647 - val_loss: 0.1531 - val_accuracy: 0.9574
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1224 -
accuracy: 0.9647 - val_loss: 0.1543 - val_accuracy: 0.9601
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1199 -
accuracy: 0.9642 - val_loss: 0.1550 - val_accuracy: 0.9576
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1172 -
accuracy: 0.9657 - val_loss: 0.1472 - val_accuracy: 0.9602
```

[ ]:
```
accuracy = model.evaluate(X_test,y_test)[1]
print(accuracy)
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.1592 -
accuracy: 0.9552
0.9552000164985657
```

### 1.2 Using Skopt (scikit-optimize)

Creating our search parameters.

This code focuses on: * Number of Layers * Number of Nodes per layer * Learning Rate & Weight Decay for the Adam Optimizer * activation functions * batch size

[ ]:
```
dim_learning_rate = Real(low=1e-4, high=1e-1, prior='log-uniform',
                         name='learning_rate')
dim_num_dense_layers = Integer(low=1, high=5, name='num_dense_layers')
dim_num_input_nodes = Integer(low=1, high=512, name='num_input_nodes')
dim_num_dense_nodes = Integer(low=1, high=28, name='num_dense_nodes')
dim_activation = Categorical(categories=['relu', 'sigmoid'],
                             name='activation')
dim_batch_size = Integer(low=1, high=128, name='batch_size')
dim_adam_decay = Real(low=1e-6,high=1e-2,name="adam_decay")

dimensions = [dim_learning_rate,
              dim_num_dense_layers,
              dim_num_input_nodes,
              dim_num_dense_nodes,
              dim_activation,
              dim_batch_size,
              dim_adam_decay
             ]
default_parameters = [1e-3, 1,512, 13, 'relu',64, 1e-3]
```

#### 1.2.1 Create Model

The Adam optimizer used to get the ability to adjust its learning rate and decay.

[ ]:
```
def create_model(learning_rate, num_dense_layers,num_input_nodes,
                 num_dense_nodes, activation, adam_decay):
    #start the model making process and create our first layer
    model = Sequential()
    model.add(Dense(num_input_nodes, input_shape= input_shape,␣
 ↪activation=activation
                    ))
    #create a loop making a new dense layer for the amount passed to this model.
    #naming the layers helps avoid tensorflow error deep in the stack trace.
    for i in range(num_dense_layers):
```

```
        name = 'layer_dense_{0}'.format(i+1)
        model.add(Dense(num_dense_nodes,
                  activation=activation,
                         name=name
                  ))
    #add our classification layer.
    model.add(Dense(10,activation='softmax'))

    #setup our optimizer and compile
    adam = Adam(learning_rate=learning_rate, decay= adam_decay)
    model.compile(optimizer=adam, loss='categorical_crossentropy',
                  metrics=['accuracy'])
    return model
```

[ ]:
```
@use_named_args(dimensions=dimensions)
def fitness(learning_rate, num_dense_layers, num_input_nodes,
            num_dense_nodes,activation, batch_size,adam_decay):

    model = create_model(learning_rate=learning_rate,
                         num_dense_layers=num_dense_layers,
                         num_input_nodes=num_input_nodes,
                         num_dense_nodes=num_dense_nodes,
                         activation=activation,
                         adam_decay=adam_decay
                        )


    #named blackbox becuase it represents the structure
    blackbox = model.fit(x=X_train,
                         y=y_train,
                         epochs=20,
                         batch_size=batch_size,
                         validation_split=0.15,
                         )
    #return the validation accuracy for the last epoch.
    accuracy = blackbox.history['val_accuracy'][-1]

    # Print the classification accuracy.
    print()
    print("Accuracy: {0:.2%}".format(accuracy))
    print()


    # Delete the Keras model with these hyper-parameters from memory.
    del model

    # Clear the Keras session, otherwise it will keep adding new
```

```
    # models to the same TensorFlow graph each time we create
    # a model with a different set of hyper-parameters.
    K.clear_session()
    ops.reset_default_graph()

    return -accuracy
```

### 1.2.2 Hyper parameters for hyper parameter search

For the Gaussian Project search, a few extra parameters to try to improve the search.

[ ]:
```
gp_result = gp_minimize(func=fitness,
                            dimensions=dimensions,
                            n_calls=100,
                            noise= 0.01,
                            n_jobs=-1,
                            kappa = 5,
                            x0=default_parameters)
```

```
Epoch 1/20
797/797 [==============================] - 3s 3ms/step - loss: 0.2959 -
accuracy: 0.9114 - val_loss: 0.1314 - val_accuracy: 0.9647
Epoch 2/20
797/797 [==============================] - 2s 2ms/step - loss: 0.1144 -
accuracy: 0.9662 - val_loss: 0.1036 - val_accuracy: 0.9700
Epoch 3/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0786 -
accuracy: 0.9774 - val_loss: 0.0891 - val_accuracy: 0.9746
Epoch 4/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0594 -
accuracy: 0.9835 - val_loss: 0.0818 - val_accuracy: 0.9740
Epoch 5/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0477 -
accuracy: 0.9869 - val_loss: 0.0791 - val_accuracy: 0.9763
Epoch 6/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0391 -
accuracy: 0.9898 - val_loss: 0.0749 - val_accuracy: 0.9778
Epoch 7/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0333 -
accuracy: 0.9917 - val_loss: 0.0748 - val_accuracy: 0.9788
Epoch 8/20
797/797 [==============================] - 3s 4ms/step - loss: 0.0283 -
accuracy: 0.9933 - val_loss: 0.0720 - val_accuracy: 0.9781
Epoch 9/20
797/797 [==============================] - 3s 4ms/step - loss: 0.0245 -
accuracy: 0.9948 - val_loss: 0.0716 - val_accuracy: 0.9782
Epoch 10/20
797/797 [==============================] - 2s 3ms/step - loss: 0.0215 -
```

```
accuracy: 0.9960 - val_loss: 0.0728 - val_accuracy: 0.9793
Epoch 11/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0188 -
accuracy: 0.9967 - val_loss: 0.0721 - val_accuracy: 0.9791
Epoch 12/20
797/797 [==============================] - 2s 3ms/step - loss: 0.0166 -
accuracy: 0.9972 - val_loss: 0.0702 - val_accuracy: 0.9796
Epoch 13/20
797/797 [==============================] - 2s 3ms/step - loss: 0.0150 -
accuracy: 0.9975 - val_loss: 0.0721 - val_accuracy: 0.9791
Epoch 14/20
797/797 [==============================] - 2s 3ms/step - loss: 0.0134 -
accuracy: 0.9980 - val_loss: 0.0699 - val_accuracy: 0.9796
Epoch 15/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0120 -
accuracy: 0.9983 - val_loss: 0.0708 - val_accuracy: 0.9792
Epoch 16/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0109 -
accuracy: 0.9985 - val_loss: 0.0720 - val_accuracy: 0.9793
Epoch 17/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0099 -
accuracy: 0.9988 - val_loss: 0.0705 - val_accuracy: 0.9798
Epoch 18/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0089 -
accuracy: 0.9990 - val_loss: 0.0707 - val_accuracy: 0.9793
Epoch 19/20
797/797 [==============================] - 2s 3ms/step - loss: 0.0082 -
accuracy: 0.9993 - val_loss: 0.0716 - val_accuracy: 0.9803
Epoch 20/20
797/797 [==============================] - 2s 2ms/step - loss: 0.0075 -
accuracy: 0.9992 - val_loss: 0.0711 - val_accuracy: 0.9801

Accuracy: 98.01%

Epoch 1/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.4129 -
accuracy: 0.8983 - val_loss: 0.1855 - val_accuracy: 0.9576
Epoch 2/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.1719 -
accuracy: 0.9577 - val_loss: 0.1502 - val_accuracy: 0.9632
Epoch 3/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.1405 -
accuracy: 0.9653 - val_loss: 0.1355 - val_accuracy: 0.9652
Epoch 4/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.1240 -
accuracy: 0.9695 - val_loss: 0.1274 - val_accuracy: 0.9671
Epoch 5/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.1135 -
```

```
accuracy: 0.9719 - val_loss: 0.1216 - val_accuracy: 0.9678
Epoch 6/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.1059 -
accuracy: 0.9744 - val_loss: 0.1183 - val_accuracy: 0.9681
Epoch 7/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0999 -
accuracy: 0.9756 - val_loss: 0.1148 - val_accuracy: 0.9691
Epoch 8/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0951 -
accuracy: 0.9770 - val_loss: 0.1122 - val_accuracy: 0.9694
Epoch 9/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0912 -
accuracy: 0.9778 - val_loss: 0.1102 - val_accuracy: 0.9702
Epoch 10/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0879 -
accuracy: 0.9787 - val_loss: 0.1087 - val_accuracy: 0.9706
Epoch 11/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0850 -
accuracy: 0.9796 - val_loss: 0.1073 - val_accuracy: 0.9711
Epoch 12/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0824 -
accuracy: 0.9803 - val_loss: 0.1059 - val_accuracy: 0.9716
Epoch 13/20
5667/5667 [==============================] - 14s 3ms/step - loss: 0.0802 -
accuracy: 0.9806 - val_loss: 0.1042 - val_accuracy: 0.9718
Epoch 14/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0781 -
accuracy: 0.9813 - val_loss: 0.1037 - val_accuracy: 0.9720
Epoch 15/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0763 -
accuracy: 0.9816 - val_loss: 0.1028 - val_accuracy: 0.9727
Epoch 16/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0746 -
accuracy: 0.9822 - val_loss: 0.1015 - val_accuracy: 0.9723
Epoch 17/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0731 -
accuracy: 0.9825 - val_loss: 0.1012 - val_accuracy: 0.9726
Epoch 18/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0716 -
accuracy: 0.9830 - val_loss: 0.1003 - val_accuracy: 0.9732
Epoch 19/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0703 -
accuracy: 0.9832 - val_loss: 0.0995 - val_accuracy: 0.9732
Epoch 20/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.0690 -
accuracy: 0.9838 - val_loss: 0.0991 - val_accuracy: 0.9736

Accuracy: 97.36%
```

```
Epoch 1/20
567/567 [==============================] - 2s 3ms/step - loss: 1.2700 -
accuracy: 0.5592 - val_loss: 0.6950 - val_accuracy: 0.8134
Epoch 2/20
567/567 [==============================] - 2s 3ms/step - loss: 0.5525 -
accuracy: 0.8686 - val_loss: 0.4116 - val_accuracy: 0.9364
Epoch 3/20
567/567 [==============================] - 2s 3ms/step - loss: 0.3376 -
accuracy: 0.9460 - val_loss: 0.2809 - val_accuracy: 0.9509
Epoch 4/20
567/567 [==============================] - 2s 3ms/step - loss: 0.2452 -
accuracy: 0.9585 - val_loss: 0.2339 - val_accuracy: 0.9558
Epoch 5/20
567/567 [==============================] - 2s 3ms/step - loss: 0.1990 -
accuracy: 0.9661 - val_loss: 0.2067 - val_accuracy: 0.9593
Epoch 6/20
567/567 [==============================] - 2s 3ms/step - loss: 0.1709 -
accuracy: 0.9707 - val_loss: 0.1899 - val_accuracy: 0.9609
Epoch 7/20
567/567 [==============================] - 2s 3ms/step - loss: 0.1507 -
accuracy: 0.9744 - val_loss: 0.1820 - val_accuracy: 0.9620
Epoch 8/20
567/567 [==============================] - 2s 3ms/step - loss: 0.1359 -
accuracy: 0.9772 - val_loss: 0.1719 - val_accuracy: 0.9634
Epoch 9/20
567/567 [==============================] - 2s 3ms/step - loss: 0.1241 -
accuracy: 0.9788 - val_loss: 0.1673 - val_accuracy: 0.9640
Epoch 10/20
567/567 [==============================] - 2s 3ms/step - loss: 0.1146 -
accuracy: 0.9809 - val_loss: 0.1628 - val_accuracy: 0.9648
Epoch 11/20
567/567 [==============================] - 2s 3ms/step - loss: 0.1068 -
accuracy: 0.9827 - val_loss: 0.1608 - val_accuracy: 0.9647
Epoch 12/20
567/567 [==============================] - 2s 3ms/step - loss: 0.1000 -
accuracy: 0.9841 - val_loss: 0.1578 - val_accuracy: 0.9656
Epoch 13/20
567/567 [==============================] - 2s 3ms/step - loss: 0.0942 -
accuracy: 0.9851 - val_loss: 0.1571 - val_accuracy: 0.9653
Epoch 14/20
567/567 [==============================] - 2s 3ms/step - loss: 0.0891 -
accuracy: 0.9859 - val_loss: 0.1538 - val_accuracy: 0.9656
Epoch 15/20
567/567 [==============================] - 2s 3ms/step - loss: 0.0846 -
accuracy: 0.9872 - val_loss: 0.1516 - val_accuracy: 0.9658
Epoch 16/20
567/567 [==============================] - 2s 3ms/step - loss: 0.0805 -
```

```
accuracy: 0.9876 - val_loss: 0.1519 - val_accuracy: 0.9656
Epoch 17/20
567/567 [==============================] - 2s 3ms/step - loss: 0.0767 -
accuracy: 0.9886 - val_loss: 0.1513 - val_accuracy: 0.9666
Epoch 18/20
567/567 [==============================] - 2s 3ms/step - loss: 0.0735 -
accuracy: 0.9891 - val_loss: 0.1500 - val_accuracy: 0.9666
Epoch 19/20
567/567 [==============================] - 2s 3ms/step - loss: 0.0704 -
accuracy: 0.9899 - val_loss: 0.1508 - val_accuracy: 0.9662
Epoch 20/20
567/567 [==============================] - 2s 3ms/step - loss: 0.0676 -
accuracy: 0.9902 - val_loss: 0.1484 - val_accuracy: 0.9678

Accuracy: 96.78%

Epoch 1/20
762/762 [==============================] - 3s 3ms/step - loss: 1.0237 -
accuracy: 0.7342 - val_loss: 0.3918 - val_accuracy: 0.9358
Epoch 2/20
762/762 [==============================] - 2s 3ms/step - loss: 0.3124 -
accuracy: 0.9429 - val_loss: 0.2238 - val_accuracy: 0.9573
Epoch 3/20
762/762 [==============================] - 2s 3ms/step - loss: 0.2015 -
accuracy: 0.9615 - val_loss: 0.1820 - val_accuracy: 0.9629
Epoch 4/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1521 -
accuracy: 0.9699 - val_loss: 0.1632 - val_accuracy: 0.9644
Epoch 5/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1217 -
accuracy: 0.9764 - val_loss: 0.1505 - val_accuracy: 0.9664
Epoch 6/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0997 -
accuracy: 0.9804 - val_loss: 0.1422 - val_accuracy: 0.9691
Epoch 7/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0847 -
accuracy: 0.9846 - val_loss: 0.1373 - val_accuracy: 0.9702
Epoch 8/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0735 -
accuracy: 0.9868 - val_loss: 0.1352 - val_accuracy: 0.9703
Epoch 9/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0640 -
accuracy: 0.9888 - val_loss: 0.1366 - val_accuracy: 0.9694
Epoch 10/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0564 -
accuracy: 0.9908 - val_loss: 0.1315 - val_accuracy: 0.9700
Epoch 11/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0505 -
```

```
accuracy: 0.9918 - val_loss: 0.1314 - val_accuracy: 0.9709
Epoch 12/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0454 -
accuracy: 0.9931 - val_loss: 0.1311 - val_accuracy: 0.9706
Epoch 13/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0410 -
accuracy: 0.9941 - val_loss: 0.1316 - val_accuracy: 0.9708
Epoch 14/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0370 -
accuracy: 0.9952 - val_loss: 0.1310 - val_accuracy: 0.9713
Epoch 15/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0338 -
accuracy: 0.9955 - val_loss: 0.1297 - val_accuracy: 0.9711
Epoch 16/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0307 -
accuracy: 0.9959 - val_loss: 0.1322 - val_accuracy: 0.9714
Epoch 17/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0282 -
accuracy: 0.9964 - val_loss: 0.1345 - val_accuracy: 0.9713
Epoch 18/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0258 -
accuracy: 0.9967 - val_loss: 0.1334 - val_accuracy: 0.9713
Epoch 19/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0237 -
accuracy: 0.9972 - val_loss: 0.1345 - val_accuracy: 0.9714
Epoch 20/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0216 -
accuracy: 0.9975 - val_loss: 0.1351 - val_accuracy: 0.9716

Accuracy: 97.16%

Epoch 1/20
963/963 [==============================] - 3s 3ms/step - loss: 1.2190 -
accuracy: 0.6241 - val_loss: 0.5691 - val_accuracy: 0.8900
Epoch 2/20
963/963 [==============================] - 3s 3ms/step - loss: 0.4181 -
accuracy: 0.9066 - val_loss: 0.2775 - val_accuracy: 0.9457
Epoch 3/20
963/963 [==============================] - 3s 3ms/step - loss: 0.2376 -
accuracy: 0.9502 - val_loss: 0.1923 - val_accuracy: 0.9577
Epoch 4/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1748 -
accuracy: 0.9628 - val_loss: 0.1698 - val_accuracy: 0.9611
Epoch 5/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1426 -
accuracy: 0.9688 - val_loss: 0.1496 - val_accuracy: 0.9666
Epoch 6/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1199 -
```

```
accuracy: 0.9737 - val_loss: 0.1422 - val_accuracy: 0.9664
Epoch 7/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1026 -
accuracy: 0.9782 - val_loss: 0.1395 - val_accuracy: 0.9670
Epoch 8/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0902 -
accuracy: 0.9813 - val_loss: 0.1302 - val_accuracy: 0.9698
Epoch 9/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0802 -
accuracy: 0.9835 - val_loss: 0.1298 - val_accuracy: 0.9690
Epoch 10/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0718 -
accuracy: 0.9853 - val_loss: 0.1245 - val_accuracy: 0.9710
Epoch 11/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0648 -
accuracy: 0.9869 - val_loss: 0.1243 - val_accuracy: 0.9712
Epoch 12/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0590 -
accuracy: 0.9886 - val_loss: 0.1275 - val_accuracy: 0.9716
Epoch 13/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0544 -
accuracy: 0.9900 - val_loss: 0.1243 - val_accuracy: 0.9718
Epoch 14/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0495 -
accuracy: 0.9912 - val_loss: 0.1268 - val_accuracy: 0.9711
Epoch 15/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0459 -
accuracy: 0.9923 - val_loss: 0.1234 - val_accuracy: 0.9721
Epoch 16/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0426 -
accuracy: 0.9930 - val_loss: 0.1249 - val_accuracy: 0.9719
Epoch 17/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0397 -
accuracy: 0.9939 - val_loss: 0.1240 - val_accuracy: 0.9722
Epoch 18/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0370 -
accuracy: 0.9946 - val_loss: 0.1259 - val_accuracy: 0.9723
Epoch 19/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0346 -
accuracy: 0.9953 - val_loss: 0.1251 - val_accuracy: 0.9713
Epoch 20/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0323 -
accuracy: 0.9957 - val_loss: 0.1295 - val_accuracy: 0.9720

Accuracy: 97.20%

Epoch 1/20
532/532 [==============================] - 2s 3ms/step - loss: 0.3303 -
```

```
accuracy: 0.8997 - val_loss: 0.1393 - val_accuracy: 0.9611
Epoch 2/20
532/532 [==============================] - 1s 3ms/step - loss: 0.1155 -
accuracy: 0.9668 - val_loss: 0.1051 - val_accuracy: 0.9696
Epoch 3/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0818 -
accuracy: 0.9763 - val_loss: 0.0930 - val_accuracy: 0.9741
Epoch 4/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0639 -
accuracy: 0.9819 - val_loss: 0.0887 - val_accuracy: 0.9749
Epoch 5/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0519 -
accuracy: 0.9853 - val_loss: 0.0859 - val_accuracy: 0.9751
Epoch 6/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0433 -
accuracy: 0.9885 - val_loss: 0.0845 - val_accuracy: 0.9762
Epoch 7/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0371 -
accuracy: 0.9907 - val_loss: 0.0820 - val_accuracy: 0.9776
Epoch 8/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0322 -
accuracy: 0.9924 - val_loss: 0.0830 - val_accuracy: 0.9771
Epoch 9/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0282 -
accuracy: 0.9933 - val_loss: 0.0842 - val_accuracy: 0.9774
Epoch 10/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0247 -
accuracy: 0.9943 - val_loss: 0.0833 - val_accuracy: 0.9777
Epoch 11/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0220 -
accuracy: 0.9955 - val_loss: 0.0826 - val_accuracy: 0.9773
Epoch 12/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0195 -
accuracy: 0.9959 - val_loss: 0.0858 - val_accuracy: 0.9773
Epoch 13/20
532/532 [==============================] - 2s 3ms/step - loss: 0.0174 -
accuracy: 0.9964 - val_loss: 0.0864 - val_accuracy: 0.9780
Epoch 14/20
532/532 [==============================] - 2s 3ms/step - loss: 0.0158 -
accuracy: 0.9969 - val_loss: 0.0870 - val_accuracy: 0.9777
Epoch 15/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0142 -
accuracy: 0.9975 - val_loss: 0.0887 - val_accuracy: 0.9774
Epoch 16/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0129 -
accuracy: 0.9978 - val_loss: 0.0895 - val_accuracy: 0.9767
Epoch 17/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0116 -
```

```
accuracy: 0.9978 - val_loss: 0.0898 - val_accuracy: 0.9780
Epoch 18/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0105 -
accuracy: 0.9981 - val_loss: 0.0910 - val_accuracy: 0.9773
Epoch 19/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0095 -
accuracy: 0.9983 - val_loss: 0.0913 - val_accuracy: 0.9777
Epoch 20/20
532/532 [==============================] - 1s 3ms/step - loss: 0.0086 -
accuracy: 0.9987 - val_loss: 0.0920 - val_accuracy: 0.9768

Accuracy: 97.68%

Epoch 1/20
415/415 [==============================] - 2s 3ms/step - loss: 2.0812 -
accuracy: 0.2289 - val_loss: 1.6450 - val_accuracy: 0.3706
Epoch 2/20
415/415 [==============================] - 1s 3ms/step - loss: 1.4047 -
accuracy: 0.4731 - val_loss: 1.1903 - val_accuracy: 0.6251
Epoch 3/20
415/415 [==============================] - 1s 3ms/step - loss: 1.0545 -
accuracy: 0.6511 - val_loss: 0.9350 - val_accuracy: 0.6718
Epoch 4/20
415/415 [==============================] - 1s 3ms/step - loss: 0.8705 -
accuracy: 0.7195 - val_loss: 0.7958 - val_accuracy: 0.7739
Epoch 5/20
415/415 [==============================] - 1s 3ms/step - loss: 0.7356 -
accuracy: 0.8346 - val_loss: 0.6755 - val_accuracy: 0.8624
Epoch 6/20
415/415 [==============================] - 1s 3ms/step - loss: 0.6214 -
accuracy: 0.8848 - val_loss: 0.5967 - val_accuracy: 0.9178
Epoch 7/20
415/415 [==============================] - 1s 3ms/step - loss: 0.5388 -
accuracy: 0.9239 - val_loss: 0.5243 - val_accuracy: 0.9382
Epoch 8/20
415/415 [==============================] - 1s 3ms/step - loss: 0.4759 -
accuracy: 0.9454 - val_loss: 0.4723 - val_accuracy: 0.9489
Epoch 9/20
415/415 [==============================] - 1s 3ms/step - loss: 0.4245 -
accuracy: 0.9558 - val_loss: 0.4309 - val_accuracy: 0.9514
Epoch 10/20
415/415 [==============================] - 1s 3ms/step - loss: 0.3802 -
accuracy: 0.9613 - val_loss: 0.3932 - val_accuracy: 0.9546
Epoch 11/20
415/415 [==============================] - 1s 3ms/step - loss: 0.3404 -
accuracy: 0.9647 - val_loss: 0.3613 - val_accuracy: 0.9574
Epoch 12/20
415/415 [==============================] - 1s 3ms/step - loss: 0.3062 -
```

```
accuracy: 0.9677 - val_loss: 0.3364 - val_accuracy: 0.9584
Epoch 13/20
415/415 [==============================] - 1s 3ms/step - loss: 0.2775 -
accuracy: 0.9706 - val_loss: 0.3145 - val_accuracy: 0.9600
Epoch 14/20
415/415 [==============================] - 1s 3ms/step - loss: 0.2545 -
accuracy: 0.9729 - val_loss: 0.3009 - val_accuracy: 0.9593
Epoch 15/20
415/415 [==============================] - 1s 3ms/step - loss: 0.2348 -
accuracy: 0.9750 - val_loss: 0.2847 - val_accuracy: 0.9601
Epoch 16/20
415/415 [==============================] - 1s 3ms/step - loss: 0.2171 -
accuracy: 0.9772 - val_loss: 0.2764 - val_accuracy: 0.9602
Epoch 17/20
415/415 [==============================] - 1s 3ms/step - loss: 0.2023 -
accuracy: 0.9786 - val_loss: 0.2632 - val_accuracy: 0.9621
Epoch 18/20
415/415 [==============================] - 1s 3ms/step - loss: 0.1889 -
accuracy: 0.9799 - val_loss: 0.2558 - val_accuracy: 0.9621
Epoch 19/20
415/415 [==============================] - 1s 3ms/step - loss: 0.1767 -
accuracy: 0.9815 - val_loss: 0.2475 - val_accuracy: 0.9620
Epoch 20/20
415/415 [==============================] - 1s 3ms/step - loss: 0.1656 -
accuracy: 0.9830 - val_loss: 0.2419 - val_accuracy: 0.9624

Accuracy: 96.24%

Epoch 1/20
5667/5667 [==============================] - 15s 3ms/step - loss: 2.0687 -
accuracy: 0.2105 - val_loss: 1.9398 - val_accuracy: 0.2317
Epoch 2/20
5667/5667 [==============================] - 15s 3ms/step - loss: 1.9094 -
accuracy: 0.2600 - val_loss: 1.8645 - val_accuracy: 0.2851
Epoch 3/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.8558 -
accuracy: 0.3055 - val_loss: 1.8245 - val_accuracy: 0.3108
Epoch 4/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.8233 -
accuracy: 0.3276 - val_loss: 1.7976 - val_accuracy: 0.3301
Epoch 5/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.8001 -
accuracy: 0.3389 - val_loss: 1.7776 - val_accuracy: 0.3387
Epoch 6/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.7822 -
accuracy: 0.3467 - val_loss: 1.7616 - val_accuracy: 0.3483
Epoch 7/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.7676 -
```

```
accuracy: 0.3602 - val_loss: 1.7483 - val_accuracy: 0.3733
Epoch 8/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.7554 -
accuracy: 0.3776 - val_loss: 1.7370 - val_accuracy: 0.3690
Epoch 9/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.7448 -
accuracy: 0.3788 - val_loss: 1.7272 - val_accuracy: 0.3710
Epoch 10/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.7355 -
accuracy: 0.3797 - val_loss: 1.7186 - val_accuracy: 0.3756
Epoch 11/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.7273 -
accuracy: 0.3826 - val_loss: 1.7107 - val_accuracy: 0.3771
Epoch 12/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.7199 -
accuracy: 0.3844 - val_loss: 1.7038 - val_accuracy: 0.3790
Epoch 13/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.7132 -
accuracy: 0.3860 - val_loss: 1.6973 - val_accuracy: 0.3801
Epoch 14/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.7070 -
accuracy: 0.3866 - val_loss: 1.6914 - val_accuracy: 0.3807
Epoch 15/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.7014 -
accuracy: 0.3880 - val_loss: 1.6860 - val_accuracy: 0.3824
Epoch 16/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.6961 -
accuracy: 0.3901 - val_loss: 1.6809 - val_accuracy: 0.3828
Epoch 17/20
5667/5667 [==============================] - 15s 3ms/step - loss: 1.6912 -
accuracy: 0.3906 - val_loss: 1.6762 - val_accuracy: 0.3839
Epoch 18/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.6866 -
accuracy: 0.3925 - val_loss: 1.6718 - val_accuracy: 0.3850
Epoch 19/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.6824 -
accuracy: 0.3932 - val_loss: 1.6676 - val_accuracy: 0.3859
Epoch 20/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.6783 -
accuracy: 0.3943 - val_loss: 1.6637 - val_accuracy: 0.3877

Accuracy: 38.77%

Epoch 1/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.4504 -
accuracy: 0.7338 - val_loss: 1.1102 - val_accuracy: 0.8444
Epoch 2/20
1646/1646 [==============================] - 4s 3ms/step - loss: 1.0206 -
```

```
accuracy: 0.8475 - val_loss: 0.9127 - val_accuracy: 0.8756
Epoch 3/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.8817 -
accuracy: 0.8683 - val_loss: 0.8112 - val_accuracy: 0.8866
Epoch 4/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.8019 -
accuracy: 0.8778 - val_loss: 0.7469 - val_accuracy: 0.8922
Epoch 5/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.7481 -
accuracy: 0.8840 - val_loss: 0.7016 - val_accuracy: 0.8970
Epoch 6/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.7086 -
accuracy: 0.8882 - val_loss: 0.6667 - val_accuracy: 0.8990
Epoch 7/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.6778 -
accuracy: 0.8904 - val_loss: 0.6395 - val_accuracy: 0.9026
Epoch 8/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.6530 -
accuracy: 0.8925 - val_loss: 0.6170 - val_accuracy: 0.9049
Epoch 9/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.6325 -
accuracy: 0.8944 - val_loss: 0.5979 - val_accuracy: 0.9058
Epoch 10/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.6150 -
accuracy: 0.8961 - val_loss: 0.5816 - val_accuracy: 0.9072
Epoch 11/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.6000 -
accuracy: 0.8974 - val_loss: 0.5677 - val_accuracy: 0.9086
Epoch 12/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.5868 -
accuracy: 0.8983 - val_loss: 0.5554 - val_accuracy: 0.9087
Epoch 13/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.5752 -
accuracy: 0.8997 - val_loss: 0.5444 - val_accuracy: 0.9103
Epoch 14/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.5647 -
accuracy: 0.9007 - val_loss: 0.5345 - val_accuracy: 0.9119
Epoch 15/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.5554 -
accuracy: 0.9019 - val_loss: 0.5256 - val_accuracy: 0.9127
Epoch 16/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.5469 -
accuracy: 0.9028 - val_loss: 0.5175 - val_accuracy: 0.9134
Epoch 17/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.5392 -
accuracy: 0.9037 - val_loss: 0.5101 - val_accuracy: 0.9142
Epoch 18/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.5320 -
```

```
accuracy: 0.9042 - val_loss: 0.5033 - val_accuracy: 0.9146
Epoch 19/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.5254 -
accuracy: 0.9048 - val_loss: 0.4970 - val_accuracy: 0.9147
Epoch 20/20
1646/1646 [==============================] - 4s 3ms/step - loss: 0.5194 -
accuracy: 0.9053 - val_loss: 0.4911 - val_accuracy: 0.9153

Accuracy: 91.53%

Epoch 1/20
440/440 [==============================] - 2s 3ms/step - loss: 0.9952 -
accuracy: 0.6987 - val_loss: 0.4043 - val_accuracy: 0.9011
Epoch 2/20
440/440 [==============================] - 1s 3ms/step - loss: 0.3813 -
accuracy: 0.8988 - val_loss: 0.2990 - val_accuracy: 0.9210
Epoch 3/20
440/440 [==============================] - 1s 3ms/step - loss: 0.3170 -
accuracy: 0.9130 - val_loss: 0.2665 - val_accuracy: 0.9283
Epoch 4/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2896 -
accuracy: 0.9195 - val_loss: 0.2504 - val_accuracy: 0.9311
Epoch 5/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2729 -
accuracy: 0.9231 - val_loss: 0.2388 - val_accuracy: 0.9347
Epoch 6/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2613 -
accuracy: 0.9265 - val_loss: 0.2307 - val_accuracy: 0.9361
Epoch 7/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2525 -
accuracy: 0.9288 - val_loss: 0.2274 - val_accuracy: 0.9378
Epoch 8/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2458 -
accuracy: 0.9313 - val_loss: 0.2201 - val_accuracy: 0.9400
Epoch 9/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2401 -
accuracy: 0.9320 - val_loss: 0.2159 - val_accuracy: 0.9411
Epoch 10/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2354 -
accuracy: 0.9335 - val_loss: 0.2121 - val_accuracy: 0.9420
Epoch 11/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2314 -
accuracy: 0.9348 - val_loss: 0.2096 - val_accuracy: 0.9424
Epoch 12/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2277 -
accuracy: 0.9354 - val_loss: 0.2068 - val_accuracy: 0.9421
Epoch 13/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2247 -
```

```
accuracy: 0.9363 - val_loss: 0.2046 - val_accuracy: 0.9442
Epoch 14/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2217 -
accuracy: 0.9371 - val_loss: 0.2023 - val_accuracy: 0.9449
Epoch 15/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2192 -
accuracy: 0.9380 - val_loss: 0.2007 - val_accuracy: 0.9451
Epoch 16/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2168 -
accuracy: 0.9383 - val_loss: 0.1993 - val_accuracy: 0.9457
Epoch 17/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2147 -
accuracy: 0.9391 - val_loss: 0.1976 - val_accuracy: 0.9458
Epoch 18/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2128 -
accuracy: 0.9393 - val_loss: 0.1964 - val_accuracy: 0.9467
Epoch 19/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2110 -
accuracy: 0.9398 - val_loss: 0.1950 - val_accuracy: 0.9470
Epoch 20/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2092 -
accuracy: 0.9403 - val_loss: 0.1934 - val_accuracy: 0.9471

Accuracy: 94.71%

Epoch 1/20
526/526 [==============================] - 2s 3ms/step - loss: 1.2349 -
accuracy: 0.7555 - val_loss: 0.5997 - val_accuracy: 0.9284
Epoch 2/20
526/526 [==============================] - 1s 3ms/step - loss: 0.4545 -
accuracy: 0.9325 - val_loss: 0.3334 - val_accuracy: 0.9480
Epoch 3/20
526/526 [==============================] - 1s 3ms/step - loss: 0.2967 -
accuracy: 0.9478 - val_loss: 0.2526 - val_accuracy: 0.9549
Epoch 4/20
526/526 [==============================] - 1s 3ms/step - loss: 0.2329 -
accuracy: 0.9562 - val_loss: 0.2126 - val_accuracy: 0.9586
Epoch 5/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1973 -
accuracy: 0.9609 - val_loss: 0.1882 - val_accuracy: 0.9620
Epoch 6/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1748 -
accuracy: 0.9644 - val_loss: 0.1732 - val_accuracy: 0.9637
Epoch 7/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1583 -
accuracy: 0.9677 - val_loss: 0.1627 - val_accuracy: 0.9644
Epoch 8/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1458 -
```

```
accuracy: 0.9695 - val_loss: 0.1550 - val_accuracy: 0.9656
Epoch 9/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1362 -
accuracy: 0.9713 - val_loss: 0.1486 - val_accuracy: 0.9661
Epoch 10/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1282 -
accuracy: 0.9730 - val_loss: 0.1437 - val_accuracy: 0.9658
Epoch 11/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1217 -
accuracy: 0.9741 - val_loss: 0.1399 - val_accuracy: 0.9666
Epoch 12/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1159 -
accuracy: 0.9751 - val_loss: 0.1362 - val_accuracy: 0.9669
Epoch 13/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1111 -
accuracy: 0.9759 - val_loss: 0.1330 - val_accuracy: 0.9670
Epoch 14/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1068 -
accuracy: 0.9772 - val_loss: 0.1307 - val_accuracy: 0.9677
Epoch 15/20
526/526 [==============================] - 1s 3ms/step - loss: 0.1030 -
accuracy: 0.9776 - val_loss: 0.1290 - val_accuracy: 0.9674
Epoch 16/20
526/526 [==============================] - 1s 3ms/step - loss: 0.0996 -
accuracy: 0.9784 - val_loss: 0.1264 - val_accuracy: 0.9680
Epoch 17/20
526/526 [==============================] - 1s 3ms/step - loss: 0.0965 -
accuracy: 0.9790 - val_loss: 0.1253 - val_accuracy: 0.9683
Epoch 18/20
526/526 [==============================] - 1s 3ms/step - loss: 0.0938 -
accuracy: 0.9795 - val_loss: 0.1234 - val_accuracy: 0.9681
Epoch 19/20
526/526 [==============================] - 1s 3ms/step - loss: 0.0912 -
accuracy: 0.9799 - val_loss: 0.1224 - val_accuracy: 0.9687
Epoch 20/20
526/526 [==============================] - 1s 3ms/step - loss: 0.0889 -
accuracy: 0.9808 - val_loss: 0.1208 - val_accuracy: 0.9689

Accuracy: 96.89%

Epoch 1/20
521/521 [==============================] - 2s 3ms/step - loss: 0.6346 -
accuracy: 0.8026 - val_loss: 0.4436 - val_accuracy: 0.8803
Epoch 2/20
521/521 [==============================] - 2s 3ms/step - loss: 0.3833 -
accuracy: 0.9024 - val_loss: 0.3305 - val_accuracy: 0.9258
Epoch 3/20
521/521 [==============================] - 2s 3ms/step - loss: 0.4185 -
```

```
accuracy: 0.8969 - val_loss: 0.3970 - val_accuracy: 0.8930
Epoch 4/20
521/521 [==============================] - 2s 3ms/step - loss: 1.6898 -
accuracy: 0.3845 - val_loss: 2.3013 - val_accuracy: 0.1073
Epoch 5/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3015 -
accuracy: 0.1093 - val_loss: 2.3027 - val_accuracy: 0.1034
Epoch 6/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3002 -
accuracy: 0.1108 - val_loss: 2.3062 - val_accuracy: 0.1063
Epoch 7/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3032 -
accuracy: 0.1088 - val_loss: 2.3064 - val_accuracy: 0.1063
Epoch 8/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3034 -
accuracy: 0.1087 - val_loss: 2.3035 - val_accuracy: 0.1094
Epoch 9/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3032 -
accuracy: 0.1092 - val_loss: 2.3044 - val_accuracy: 0.1064
Epoch 10/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3032 -
accuracy: 0.1088 - val_loss: 2.3055 - val_accuracy: 0.1064
Epoch 11/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3035 -
accuracy: 0.1069 - val_loss: 2.3052 - val_accuracy: 0.1029
Epoch 12/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3031 -
accuracy: 0.1062 - val_loss: 2.3041 - val_accuracy: 0.1064
Epoch 13/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3035 -
accuracy: 0.1076 - val_loss: 2.3035 - val_accuracy: 0.1064
Epoch 14/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3033 -
accuracy: 0.1083 - val_loss: 2.3028 - val_accuracy: 0.1064
Epoch 15/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3032 -
accuracy: 0.1092 - val_loss: 2.3036 - val_accuracy: 0.0959
Epoch 16/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3033 -
accuracy: 0.1082 - val_loss: 2.3044 - val_accuracy: 0.1064
Epoch 17/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3033 -
accuracy: 0.1098 - val_loss: 2.3041 - val_accuracy: 0.0959
Epoch 18/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3032 -
accuracy: 0.1091 - val_loss: 2.3038 - val_accuracy: 0.1064
Epoch 19/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3032 -
```

```
accuracy: 0.1090 - val_loss: 2.3082 - val_accuracy: 0.1064
Epoch 20/20
521/521 [==============================] - 2s 3ms/step - loss: 2.3029 -
accuracy: 0.1090 - val_loss: 2.3059 - val_accuracy: 0.1064

Accuracy: 10.64%

Epoch 1/20
429/429 [==============================] - 2s 4ms/step - loss: 2.0000 -
accuracy: 0.3688 - val_loss: 1.6843 - val_accuracy: 0.5286
Epoch 2/20
429/429 [==============================] - 1s 3ms/step - loss: 1.5234 -
accuracy: 0.5645 - val_loss: 1.3556 - val_accuracy: 0.6253
Epoch 3/20
429/429 [==============================] - 1s 3ms/step - loss: 1.2826 -
accuracy: 0.6380 - val_loss: 1.1677 - val_accuracy: 0.7021
Epoch 4/20
429/429 [==============================] - 1s 3ms/step - loss: 1.1329 -
accuracy: 0.7026 - val_loss: 1.0411 - val_accuracy: 0.7513
Epoch 5/20
429/429 [==============================] - 1s 3ms/step - loss: 1.0284 -
accuracy: 0.7427 - val_loss: 0.9501 - val_accuracy: 0.7762
Epoch 6/20
429/429 [==============================] - 1s 3ms/step - loss: 0.9527 -
accuracy: 0.7642 - val_loss: 0.8832 - val_accuracy: 0.7956
Epoch 7/20
429/429 [==============================] - 1s 3ms/step - loss: 0.8965 -
accuracy: 0.7795 - val_loss: 0.8325 - val_accuracy: 0.8029
Epoch 8/20
429/429 [==============================] - 1s 3ms/step - loss: 0.8530 -
accuracy: 0.7890 - val_loss: 0.7927 - val_accuracy: 0.8110
Epoch 9/20
429/429 [==============================] - 1s 3ms/step - loss: 0.8184 -
accuracy: 0.7955 - val_loss: 0.7605 - val_accuracy: 0.8173
Epoch 10/20
429/429 [==============================] - 1s 3ms/step - loss: 0.7901 -
accuracy: 0.8007 - val_loss: 0.7340 - val_accuracy: 0.8222
Epoch 11/20
429/429 [==============================] - 1s 3ms/step - loss: 0.7665 -
accuracy: 0.8050 - val_loss: 0.7117 - val_accuracy: 0.8262
Epoch 12/20
429/429 [==============================] - 1s 3ms/step - loss: 0.7464 -
accuracy: 0.8083 - val_loss: 0.6926 - val_accuracy: 0.8290
Epoch 13/20
429/429 [==============================] - 1s 3ms/step - loss: 0.7291 -
accuracy: 0.8115 - val_loss: 0.6761 - val_accuracy: 0.8313
Epoch 14/20
429/429 [==============================] - 1s 3ms/step - loss: 0.7140 -
```

```
accuracy: 0.8141 - val_loss: 0.6616 - val_accuracy: 0.8330
Epoch 15/20
429/429 [==============================] - 1s 3ms/step - loss: 0.7006 -
accuracy: 0.8167 - val_loss: 0.6487 - val_accuracy: 0.8350
Epoch 16/20
429/429 [==============================] - 1s 3ms/step - loss: 0.6887 -
accuracy: 0.8186 - val_loss: 0.6373 - val_accuracy: 0.8361
Epoch 17/20
429/429 [==============================] - 1s 3ms/step - loss: 0.6780 -
accuracy: 0.8207 - val_loss: 0.6270 - val_accuracy: 0.8383
Epoch 18/20
429/429 [==============================] - 1s 3ms/step - loss: 0.6683 -
accuracy: 0.8222 - val_loss: 0.6176 - val_accuracy: 0.8399
Epoch 19/20
429/429 [==============================] - 1s 3ms/step - loss: 0.6594 -
accuracy: 0.8242 - val_loss: 0.6090 - val_accuracy: 0.8411
Epoch 20/20
429/429 [==============================] - 1s 3ms/step - loss: 0.6514 -
accuracy: 0.8258 - val_loss: 0.6012 - val_accuracy: 0.8424

Accuracy: 84.24%

Epoch 1/20
2685/2685 [==============================] - 8s 3ms/step - loss: 1.3632 -
accuracy: 0.4679 - val_loss: 0.7517 - val_accuracy: 0.7623
Epoch 2/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.6627 -
accuracy: 0.8090 - val_loss: 0.5376 - val_accuracy: 0.8546
Epoch 3/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.5365 -
accuracy: 0.8468 - val_loss: 0.4710 - val_accuracy: 0.8704
Epoch 4/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.4744 -
accuracy: 0.8661 - val_loss: 0.4216 - val_accuracy: 0.8838
Epoch 5/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.4324 -
accuracy: 0.8791 - val_loss: 0.3855 - val_accuracy: 0.8967
Epoch 6/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.4030 -
accuracy: 0.8884 - val_loss: 0.3711 - val_accuracy: 0.8997
Epoch 7/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.3816 -
accuracy: 0.8952 - val_loss: 0.3578 - val_accuracy: 0.9027
Epoch 8/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.3648 -
accuracy: 0.8976 - val_loss: 0.3487 - val_accuracy: 0.9043
Epoch 9/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.3510 -
```

```
accuracy: 0.9021 - val_loss: 0.3273 - val_accuracy: 0.9133
Epoch 10/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.3326 -
accuracy: 0.9081 - val_loss: 0.3138 - val_accuracy: 0.9151
Epoch 11/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.3207 -
accuracy: 0.9108 - val_loss: 0.3101 - val_accuracy: 0.9171
Epoch 12/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.3118 -
accuracy: 0.9134 - val_loss: 0.3073 - val_accuracy: 0.9177
Epoch 13/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.3052 -
accuracy: 0.9150 - val_loss: 0.3016 - val_accuracy: 0.9197
Epoch 14/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.2993 -
accuracy: 0.9166 - val_loss: 0.2971 - val_accuracy: 0.9183
Epoch 15/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.2931 -
accuracy: 0.9182 - val_loss: 0.2969 - val_accuracy: 0.9211
Epoch 16/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.2890 -
accuracy: 0.9193 - val_loss: 0.2949 - val_accuracy: 0.9211
Epoch 17/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.2856 -
accuracy: 0.9203 - val_loss: 0.2905 - val_accuracy: 0.9217
Epoch 18/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.2811 -
accuracy: 0.9208 - val_loss: 0.2918 - val_accuracy: 0.9188
Epoch 19/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.2787 -
accuracy: 0.9217 - val_loss: 0.2882 - val_accuracy: 0.9219
Epoch 20/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.2754 -
accuracy: 0.9228 - val_loss: 0.2876 - val_accuracy: 0.9221

Accuracy: 92.21%

Epoch 1/20
8500/8500 [==============================] - 20s 2ms/step - loss: 2.3096 -
accuracy: 0.1030 - val_loss: 2.3056 - val_accuracy: 0.1063
Epoch 2/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3038 -
accuracy: 0.1076 - val_loss: 2.3034 - val_accuracy: 0.1063
Epoch 3/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3025 -
accuracy: 0.1095 - val_loss: 2.3032 - val_accuracy: 0.1063
Epoch 4/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3023 -
```

```
accuracy: 0.1122 - val_loss: 2.3027 - val_accuracy: 0.0990
Epoch 5/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3022 -
accuracy: 0.1120 - val_loss: 2.3023 - val_accuracy: 0.1063
Epoch 6/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3019 -
accuracy: 0.1116 - val_loss: 2.3026 - val_accuracy: 0.1063
Epoch 7/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3017 -
accuracy: 0.1128 - val_loss: 2.3028 - val_accuracy: 0.1063
Epoch 8/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3016 -
accuracy: 0.1131 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 9/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3017 -
accuracy: 0.1134 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 10/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3016 -
accuracy: 0.1133 - val_loss: 2.3030 - val_accuracy: 0.1063
Epoch 11/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3016 -
accuracy: 0.1134 - val_loss: 2.3026 - val_accuracy: 0.1063
Epoch 12/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3025 - val_accuracy: 0.1063
Epoch 13/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3028 - val_accuracy: 0.1063
Epoch 14/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3014 -
accuracy: 0.1134 - val_loss: 2.3023 - val_accuracy: 0.1063
Epoch 15/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3014 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 16/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3024 - val_accuracy: 0.1063
Epoch 17/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 18/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3014 -
accuracy: 0.1134 - val_loss: 2.3018 - val_accuracy: 0.1063
Epoch 19/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 20/20
8500/8500 [==============================] - 19s 2ms/step - loss: 2.3013 -
```

```
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063

Accuracy: 10.63%

Epoch 1/20
505/505 [==============================] - 2s 3ms/step - loss: 2.2957 -
accuracy: 0.1355 - val_loss: 2.2472 - val_accuracy: 0.2133
Epoch 2/20
505/505 [==============================] - 2s 3ms/step - loss: 2.1003 -
accuracy: 0.2083 - val_loss: 1.9445 - val_accuracy: 0.2189
Epoch 3/20
505/505 [==============================] - 2s 3ms/step - loss: 1.8899 -
accuracy: 0.2124 - val_loss: 1.8350 - val_accuracy: 0.2128
Epoch 4/20
505/505 [==============================] - 2s 3ms/step - loss: 1.8291 -
accuracy: 0.2125 - val_loss: 1.8023 - val_accuracy: 0.2129
Epoch 5/20
505/505 [==============================] - 1s 3ms/step - loss: 1.8064 -
accuracy: 0.2126 - val_loss: 1.7861 - val_accuracy: 0.2140
Epoch 6/20
505/505 [==============================] - 2s 3ms/step - loss: 1.7933 -
accuracy: 0.2129 - val_loss: 1.7752 - val_accuracy: 0.2158
Epoch 7/20
505/505 [==============================] - 2s 3ms/step - loss: 1.7838 -
accuracy: 0.2138 - val_loss: 1.7678 - val_accuracy: 0.2163
Epoch 8/20
505/505 [==============================] - 2s 3ms/step - loss: 1.7765 -
accuracy: 0.2167 - val_loss: 1.7611 - val_accuracy: 0.2200
Epoch 9/20
505/505 [==============================] - 2s 3ms/step - loss: 1.7704 -
accuracy: 0.2194 - val_loss: 1.7552 - val_accuracy: 0.2232
Epoch 10/20
505/505 [==============================] - 2s 3ms/step - loss: 1.7641 -
accuracy: 0.2265 - val_loss: 1.7478 - val_accuracy: 0.2423
Epoch 11/20
505/505 [==============================] - 2s 3ms/step - loss: 1.7556 -
accuracy: 0.2483 - val_loss: 1.7372 - val_accuracy: 0.2627
Epoch 12/20
505/505 [==============================] - 2s 3ms/step - loss: 1.7427 -
accuracy: 0.2676 - val_loss: 1.7207 - val_accuracy: 0.2827
Epoch 13/20
505/505 [==============================] - 2s 3ms/step - loss: 1.7245 -
accuracy: 0.2803 - val_loss: 1.6989 - val_accuracy: 0.2901
Epoch 14/20
505/505 [==============================] - 2s 3ms/step - loss: 1.7012 -
accuracy: 0.2885 - val_loss: 1.6732 - val_accuracy: 0.2990
Epoch 15/20
505/505 [==============================] - 1s 3ms/step - loss: 1.6746 -
```

```
accuracy: 0.2936 - val_loss: 1.6455 - val_accuracy: 0.3014
Epoch 16/20
505/505 [==============================] - 2s 3ms/step - loss: 1.6474 -
accuracy: 0.2953 - val_loss: 1.6195 - val_accuracy: 0.3013
Epoch 17/20
505/505 [==============================] - 2s 3ms/step - loss: 1.6223 -
accuracy: 0.2955 - val_loss: 1.5959 - val_accuracy: 0.3011
Epoch 18/20
505/505 [==============================] - 2s 3ms/step - loss: 1.5999 -
accuracy: 0.2977 - val_loss: 1.5755 - val_accuracy: 0.3011
Epoch 19/20
505/505 [==============================] - 2s 3ms/step - loss: 1.5805 -
accuracy: 0.2972 - val_loss: 1.5578 - val_accuracy: 0.3032
Epoch 20/20
505/505 [==============================] - 2s 3ms/step - loss: 1.5635 -
accuracy: 0.2987 - val_loss: 1.5422 - val_accuracy: 0.3070

Accuracy: 30.70%

Epoch 1/20
456/456 [==============================] - 2s 3ms/step - loss: 0.6883 -
accuracy: 0.8101 - val_loss: 0.3081 - val_accuracy: 0.9157
Epoch 2/20
456/456 [==============================] - 1s 3ms/step - loss: 0.3119 -
accuracy: 0.9123 - val_loss: 0.2563 - val_accuracy: 0.9288
Epoch 3/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2734 -
accuracy: 0.9237 - val_loss: 0.2356 - val_accuracy: 0.9342
Epoch 4/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2529 -
accuracy: 0.9285 - val_loss: 0.2229 - val_accuracy: 0.9376
Epoch 5/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2395 -
accuracy: 0.9326 - val_loss: 0.2130 - val_accuracy: 0.9400
Epoch 6/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2294 -
accuracy: 0.9356 - val_loss: 0.2074 - val_accuracy: 0.9416
Epoch 7/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2220 -
accuracy: 0.9377 - val_loss: 0.2014 - val_accuracy: 0.9434
Epoch 8/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2158 -
accuracy: 0.9395 - val_loss: 0.1970 - val_accuracy: 0.9447
Epoch 9/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2109 -
accuracy: 0.9408 - val_loss: 0.1930 - val_accuracy: 0.9457
Epoch 10/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2065 -
```

```
accuracy: 0.9416 - val_loss: 0.1904 - val_accuracy: 0.9460
Epoch 11/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2028 -
accuracy: 0.9430 - val_loss: 0.1875 - val_accuracy: 0.9470
Epoch 12/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1995 -
accuracy: 0.9441 - val_loss: 0.1853 - val_accuracy: 0.9476
Epoch 13/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1966 -
accuracy: 0.9450 - val_loss: 0.1824 - val_accuracy: 0.9482
Epoch 14/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1940 -
accuracy: 0.9455 - val_loss: 0.1809 - val_accuracy: 0.9479
Epoch 15/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1915 -
accuracy: 0.9462 - val_loss: 0.1786 - val_accuracy: 0.9490
Epoch 16/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1893 -
accuracy: 0.9471 - val_loss: 0.1771 - val_accuracy: 0.9496
Epoch 17/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1874 -
accuracy: 0.9475 - val_loss: 0.1762 - val_accuracy: 0.9491
Epoch 18/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1856 -
accuracy: 0.9478 - val_loss: 0.1743 - val_accuracy: 0.9502
Epoch 19/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1839 -
accuracy: 0.9485 - val_loss: 0.1730 - val_accuracy: 0.9503
Epoch 20/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1823 -
accuracy: 0.9489 - val_loss: 0.1722 - val_accuracy: 0.9503

Accuracy: 95.03%

Epoch 1/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3048 -
accuracy: 0.1064 - val_loss: 2.3033 - val_accuracy: 0.1063
Epoch 2/20
491/491 [==============================] - 1s 3ms/step - loss: 2.3028 -
accuracy: 0.1105 - val_loss: 2.3061 - val_accuracy: 0.1063
Epoch 3/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3022 -
accuracy: 0.1126 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 4/20
491/491 [==============================] - 1s 3ms/step - loss: 2.3018 -
accuracy: 0.1121 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 5/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3018 -
```

```
accuracy: 0.1120 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 6/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3016 -
accuracy: 0.1134 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 7/20
491/491 [==============================] - 1s 3ms/step - loss: 2.3015 -
accuracy: 0.1128 - val_loss: 2.3028 - val_accuracy: 0.1063
Epoch 8/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3014 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 9/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 10/20
491/491 [==============================] - 1s 3ms/step - loss: 2.3014 -
accuracy: 0.1134 - val_loss: 2.3023 - val_accuracy: 0.1063
Epoch 11/20
491/491 [==============================] - 1s 3ms/step - loss: 2.3014 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 12/20
491/491 [==============================] - 1s 3ms/step - loss: 2.3014 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 13/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 14/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 15/20
491/491 [==============================] - 1s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 16/20
491/491 [==============================] - 1s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3024 - val_accuracy: 0.1063
Epoch 17/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 18/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3024 - val_accuracy: 0.1063
Epoch 19/20
491/491 [==============================] - 1s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 20/20
491/491 [==============================] - 2s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3024 - val_accuracy: 0.1063

Accuracy: 10.63%
```

```
Epoch 1/20
2040/2040 [==============================] - 6s 3ms/step - loss: 2.3041 -
accuracy: 0.1087 - val_loss: 2.3027 - val_accuracy: 0.1063
Epoch 2/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3019 -
accuracy: 0.1121 - val_loss: 2.3025 - val_accuracy: 0.1063
Epoch 3/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3017 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 4/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3023 - val_accuracy: 0.1063
Epoch 5/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 6/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3014 -
accuracy: 0.1134 - val_loss: 2.3024 - val_accuracy: 0.1063
Epoch 7/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3025 - val_accuracy: 0.1063
Epoch 8/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 9/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 10/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 11/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 12/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 13/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 14/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 15/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 16/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3012 -
```

```
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 17/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 18/20
2040/2040 [==============================] - 6s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 19/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 20/20
2040/2040 [==============================] - 5s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063

Accuracy: 10.63%

Epoch 1/20
440/440 [==============================] - 2s 3ms/step - loss: 0.8906 -
accuracy: 0.7806 - val_loss: 0.3767 - val_accuracy: 0.9303
Epoch 2/20
440/440 [==============================] - 1s 3ms/step - loss: 0.3069 -
accuracy: 0.9449 - val_loss: 0.2447 - val_accuracy: 0.9529
Epoch 3/20
440/440 [==============================] - 1s 3ms/step - loss: 0.2090 -
accuracy: 0.9611 - val_loss: 0.2032 - val_accuracy: 0.9581
Epoch 4/20
440/440 [==============================] - 1s 3ms/step - loss: 0.1629 -
accuracy: 0.9702 - val_loss: 0.1820 - val_accuracy: 0.9627
Epoch 5/20
440/440 [==============================] - 1s 3ms/step - loss: 0.1355 -
accuracy: 0.9755 - val_loss: 0.1680 - val_accuracy: 0.9671
Epoch 6/20
440/440 [==============================] - 1s 3ms/step - loss: 0.1169 -
accuracy: 0.9793 - val_loss: 0.1635 - val_accuracy: 0.9651
Epoch 7/20
440/440 [==============================] - 1s 3ms/step - loss: 0.1024 -
accuracy: 0.9822 - val_loss: 0.1592 - val_accuracy: 0.9670
Epoch 8/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0919 -
accuracy: 0.9845 - val_loss: 0.1546 - val_accuracy: 0.9687
Epoch 9/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0833 -
accuracy: 0.9863 - val_loss: 0.1510 - val_accuracy: 0.9686
Epoch 10/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0756 -
accuracy: 0.9878 - val_loss: 0.1515 - val_accuracy: 0.9674
Epoch 11/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0698 -
```

```
accuracy: 0.9890 - val_loss: 0.1482 - val_accuracy: 0.9683
Epoch 12/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0646 -
accuracy: 0.9899 - val_loss: 0.1491 - val_accuracy: 0.9689
Epoch 13/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0600 -
accuracy: 0.9908 - val_loss: 0.1473 - val_accuracy: 0.9680
Epoch 14/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0562 -
accuracy: 0.9916 - val_loss: 0.1466 - val_accuracy: 0.9684
Epoch 15/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0528 -
accuracy: 0.9921 - val_loss: 0.1479 - val_accuracy: 0.9682
Epoch 16/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0497 -
accuracy: 0.9927 - val_loss: 0.1479 - val_accuracy: 0.9680
Epoch 17/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0468 -
accuracy: 0.9934 - val_loss: 0.1470 - val_accuracy: 0.9691
Epoch 18/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0444 -
accuracy: 0.9937 - val_loss: 0.1472 - val_accuracy: 0.9676
Epoch 19/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0422 -
accuracy: 0.9942 - val_loss: 0.1466 - val_accuracy: 0.9690
Epoch 20/20
440/440 [==============================] - 1s 3ms/step - loss: 0.0401 -
accuracy: 0.9946 - val_loss: 0.1466 - val_accuracy: 0.9682

Accuracy: 96.82%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.3871 -
accuracy: 0.8788 - val_loss: 0.1443 - val_accuracy: 0.9569
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1343 -
accuracy: 0.9616 - val_loss: 0.1240 - val_accuracy: 0.9646
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0975 -
accuracy: 0.9720 - val_loss: 0.1132 - val_accuracy: 0.9676
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0793 -
accuracy: 0.9773 - val_loss: 0.1014 - val_accuracy: 0.9708
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0662 -
accuracy: 0.9815 - val_loss: 0.1005 - val_accuracy: 0.9704
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0569 -
```

```
accuracy: 0.9843 - val_loss: 0.1003 - val_accuracy: 0.9719
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0503 -
accuracy: 0.9865 - val_loss: 0.1004 - val_accuracy: 0.9710
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0445 -
accuracy: 0.9877 - val_loss: 0.1029 - val_accuracy: 0.9726
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0398 -
accuracy: 0.9894 - val_loss: 0.1048 - val_accuracy: 0.9723
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0364 -
accuracy: 0.9906 - val_loss: 0.0995 - val_accuracy: 0.9727
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0326 -
accuracy: 0.9919 - val_loss: 0.1005 - val_accuracy: 0.9743
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0297 -
accuracy: 0.9925 - val_loss: 0.1019 - val_accuracy: 0.9736
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0272 -
accuracy: 0.9933 - val_loss: 0.1023 - val_accuracy: 0.9742
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0251 -
accuracy: 0.9941 - val_loss: 0.1046 - val_accuracy: 0.9741
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0230 -
accuracy: 0.9944 - val_loss: 0.1036 - val_accuracy: 0.9741
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0212 -
accuracy: 0.9952 - val_loss: 0.1068 - val_accuracy: 0.9740
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0196 -
accuracy: 0.9955 - val_loss: 0.1075 - val_accuracy: 0.9743
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0182 -
accuracy: 0.9961 - val_loss: 0.1085 - val_accuracy: 0.9740
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0168 -
accuracy: 0.9964 - val_loss: 0.1114 - val_accuracy: 0.9747
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0158 -
accuracy: 0.9968 - val_loss: 0.1109 - val_accuracy: 0.9752

Accuracy: 97.52%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 2.4075 -
```

```
accuracy: 0.0997 - val_loss: 2.3676 - val_accuracy: 0.0959
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3463 -
accuracy: 0.0997 - val_loss: 2.3342 - val_accuracy: 0.0959
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3238 -
accuracy: 0.0997 - val_loss: 2.3187 - val_accuracy: 0.0959
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3123 -
accuracy: 0.0997 - val_loss: 2.3099 - val_accuracy: 0.0959
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3055 -
accuracy: 0.0997 - val_loss: 2.3045 - val_accuracy: 0.0959
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.0997 - val_loss: 2.3007 - val_accuracy: 0.0959
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2980 -
accuracy: 0.0997 - val_loss: 2.2979 - val_accuracy: 0.0959
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2957 -
accuracy: 0.1201 - val_loss: 2.2958 - val_accuracy: 0.1958
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2939 -
accuracy: 0.1876 - val_loss: 2.2940 - val_accuracy: 0.1312
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2923 -
accuracy: 0.1154 - val_loss: 2.2925 - val_accuracy: 0.1063
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2910 -
accuracy: 0.1134 - val_loss: 2.2912 - val_accuracy: 0.1063
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2898 -
accuracy: 0.1134 - val_loss: 2.2900 - val_accuracy: 0.1063
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2887 -
accuracy: 0.1134 - val_loss: 2.2889 - val_accuracy: 0.1063
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2877 -
accuracy: 0.1134 - val_loss: 2.2878 - val_accuracy: 0.1063
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2867 -
accuracy: 0.1134 - val_loss: 2.2869 - val_accuracy: 0.1063
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2858 -
accuracy: 0.1134 - val_loss: 2.2860 - val_accuracy: 0.1063
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2849 -
```

```
accuracy: 0.1134 - val_loss: 2.2851 - val_accuracy: 0.1063
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2841 -
accuracy: 0.1134 - val_loss: 2.2842 - val_accuracy: 0.1063
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2833 -
accuracy: 0.1134 - val_loss: 2.2834 - val_accuracy: 0.1063
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 2.2825 -
accuracy: 0.1134 - val_loss: 2.2826 - val_accuracy: 0.1063

Accuracy: 10.63%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.8206 -
accuracy: 0.7836 - val_loss: 0.3707 - val_accuracy: 0.9034
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.3662 -
accuracy: 0.9026 - val_loss: 0.2990 - val_accuracy: 0.9201
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.3173 -
accuracy: 0.9149 - val_loss: 0.2699 - val_accuracy: 0.9273
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2943 -
accuracy: 0.9206 - val_loss: 0.2562 - val_accuracy: 0.9304
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2803 -
accuracy: 0.9237 - val_loss: 0.2452 - val_accuracy: 0.9346
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2705 -
accuracy: 0.9261 - val_loss: 0.2387 - val_accuracy: 0.9349
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2628 -
accuracy: 0.9285 - val_loss: 0.2323 - val_accuracy: 0.9374
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2569 -
accuracy: 0.9300 - val_loss: 0.2280 - val_accuracy: 0.9387
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2519 -
accuracy: 0.9308 - val_loss: 0.2241 - val_accuracy: 0.9396
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2477 -
accuracy: 0.9326 - val_loss: 0.2206 - val_accuracy: 0.9409
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2440 -
accuracy: 0.9330 - val_loss: 0.2178 - val_accuracy: 0.9414
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2409 -
```

```
accuracy: 0.9342 - val_loss: 0.2151 - val_accuracy: 0.9419
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2380 -
accuracy: 0.9347 - val_loss: 0.2131 - val_accuracy: 0.9420
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2356 -
accuracy: 0.9353 - val_loss: 0.2107 - val_accuracy: 0.9428
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2333 -
accuracy: 0.9362 - val_loss: 0.2091 - val_accuracy: 0.9433
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2312 -
accuracy: 0.9366 - val_loss: 0.2072 - val_accuracy: 0.9437
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2293 -
accuracy: 0.9371 - val_loss: 0.2055 - val_accuracy: 0.9447
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2275 -
accuracy: 0.9376 - val_loss: 0.2042 - val_accuracy: 0.9449
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2258 -
accuracy: 0.9380 - val_loss: 0.2029 - val_accuracy: 0.9448
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2243 -
accuracy: 0.9383 - val_loss: 0.2018 - val_accuracy: 0.9447

Accuracy: 94.47%

Epoch 1/20
981/981 [==============================] - 3s 3ms/step - loss: 0.5455 -
accuracy: 0.8440 - val_loss: 0.1761 - val_accuracy: 0.9548
Epoch 2/20
981/981 [==============================] - 3s 3ms/step - loss: 0.1467 -
accuracy: 0.9599 - val_loss: 0.1257 - val_accuracy: 0.9679
Epoch 3/20
981/981 [==============================] - 3s 3ms/step - loss: 0.1050 -
accuracy: 0.9706 - val_loss: 0.1073 - val_accuracy: 0.9712
Epoch 4/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0868 -
accuracy: 0.9753 - val_loss: 0.0996 - val_accuracy: 0.9721
Epoch 5/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0735 -
accuracy: 0.9791 - val_loss: 0.1018 - val_accuracy: 0.9717
Epoch 6/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0607 -
accuracy: 0.9825 - val_loss: 0.1048 - val_accuracy: 0.9733
Epoch 7/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0565 -
```

```
accuracy: 0.9839 - val_loss: 0.0959 - val_accuracy: 0.9736
Epoch 8/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0518 -
accuracy: 0.9849 - val_loss: 0.1104 - val_accuracy: 0.9714
Epoch 9/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0504 -
accuracy: 0.9857 - val_loss: 0.1149 - val_accuracy: 0.9686
Epoch 10/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0454 -
accuracy: 0.9862 - val_loss: 0.0956 - val_accuracy: 0.9743
Epoch 11/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0409 -
accuracy: 0.9883 - val_loss: 0.0989 - val_accuracy: 0.9739
Epoch 12/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0418 -
accuracy: 0.9872 - val_loss: 0.0990 - val_accuracy: 0.9748
Epoch 13/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0379 -
accuracy: 0.9891 - val_loss: 0.0961 - val_accuracy: 0.9758
Epoch 14/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0342 -
accuracy: 0.9899 - val_loss: 0.0940 - val_accuracy: 0.9754
Epoch 15/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0329 -
accuracy: 0.9898 - val_loss: 0.1126 - val_accuracy: 0.9732
Epoch 16/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0318 -
accuracy: 0.9904 - val_loss: 0.1250 - val_accuracy: 0.9711
Epoch 17/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0332 -
accuracy: 0.9891 - val_loss: 0.0955 - val_accuracy: 0.9779
Epoch 18/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0279 -
accuracy: 0.9915 - val_loss: 0.1075 - val_accuracy: 0.9761
Epoch 19/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0262 -
accuracy: 0.9921 - val_loss: 0.1212 - val_accuracy: 0.9736
Epoch 20/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0292 -
accuracy: 0.9910 - val_loss: 0.1140 - val_accuracy: 0.9734

Accuracy: 97.34%

Epoch 1/20
719/719 [==============================] - 3s 3ms/step - loss: 1.9209 -
accuracy: 0.3067 - val_loss: 1.4848 - val_accuracy: 0.5071
Epoch 2/20
719/719 [==============================] - 2s 3ms/step - loss: 1.3141 -
```

```
accuracy: 0.5491 - val_loss: 1.1866 - val_accuracy: 0.6497
Epoch 3/20
719/719 [==============================] - 2s 3ms/step - loss: 1.1045 -
accuracy: 0.6859 - val_loss: 1.0180 - val_accuracy: 0.7341
Epoch 4/20
719/719 [==============================] - 2s 3ms/step - loss: 0.9615 -
accuracy: 0.7729 - val_loss: 0.8895 - val_accuracy: 0.8298
Epoch 5/20
719/719 [==============================] - 2s 3ms/step - loss: 0.8420 -
accuracy: 0.8361 - val_loss: 0.7791 - val_accuracy: 0.8601
Epoch 6/20
719/719 [==============================] - 2s 3ms/step - loss: 0.7467 -
accuracy: 0.8654 - val_loss: 0.6953 - val_accuracy: 0.8787
Epoch 7/20
719/719 [==============================] - 2s 3ms/step - loss: 0.6745 -
accuracy: 0.8837 - val_loss: 0.6329 - val_accuracy: 0.8913
Epoch 8/20
719/719 [==============================] - 2s 3ms/step - loss: 0.6189 -
accuracy: 0.8931 - val_loss: 0.5842 - val_accuracy: 0.9009
Epoch 9/20
719/719 [==============================] - 2s 3ms/step - loss: 0.5747 -
accuracy: 0.9007 - val_loss: 0.5442 - val_accuracy: 0.9062
Epoch 10/20
719/719 [==============================] - 2s 3ms/step - loss: 0.5379 -
accuracy: 0.9070 - val_loss: 0.5113 - val_accuracy: 0.9107
Epoch 11/20
719/719 [==============================] - 2s 3ms/step - loss: 0.5076 -
accuracy: 0.9116 - val_loss: 0.4842 - val_accuracy: 0.9144
Epoch 12/20
719/719 [==============================] - 2s 3ms/step - loss: 0.4815 -
accuracy: 0.9147 - val_loss: 0.4611 - val_accuracy: 0.9172
Epoch 13/20
719/719 [==============================] - 2s 3ms/step - loss: 0.4595 -
accuracy: 0.9179 - val_loss: 0.4418 - val_accuracy: 0.9199
Epoch 14/20
719/719 [==============================] - 2s 3ms/step - loss: 0.4403 -
accuracy: 0.9207 - val_loss: 0.4239 - val_accuracy: 0.9237
Epoch 15/20
719/719 [==============================] - 2s 3ms/step - loss: 0.4233 -
accuracy: 0.9230 - val_loss: 0.4090 - val_accuracy: 0.9233
Epoch 16/20
719/719 [==============================] - 2s 3ms/step - loss: 0.4082 -
accuracy: 0.9254 - val_loss: 0.3959 - val_accuracy: 0.9254
Epoch 17/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3949 -
accuracy: 0.9271 - val_loss: 0.3846 - val_accuracy: 0.9278
Epoch 18/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3828 -
```

```
accuracy: 0.9287 - val_loss: 0.3733 - val_accuracy: 0.9287
Epoch 19/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3721 -
accuracy: 0.9297 - val_loss: 0.3649 - val_accuracy: 0.9299
Epoch 20/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3624 -
accuracy: 0.9314 - val_loss: 0.3553 - val_accuracy: 0.9309

Accuracy: 93.09%

Epoch 1/20
405/405 [==============================] - 2s 3ms/step - loss: 0.4643 -
accuracy: 0.8878 - val_loss: 0.1827 - val_accuracy: 0.9517
Epoch 2/20
405/405 [==============================] - 1s 3ms/step - loss: 0.1693 -
accuracy: 0.9541 - val_loss: 0.1391 - val_accuracy: 0.9628
Epoch 3/20
405/405 [==============================] - 1s 3ms/step - loss: 0.1271 -
accuracy: 0.9657 - val_loss: 0.1247 - val_accuracy: 0.9668
Epoch 4/20
405/405 [==============================] - 1s 3ms/step - loss: 0.1051 -
accuracy: 0.9719 - val_loss: 0.1133 - val_accuracy: 0.9684
Epoch 5/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0905 -
accuracy: 0.9764 - val_loss: 0.1074 - val_accuracy: 0.9701
Epoch 6/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0806 -
accuracy: 0.9793 - val_loss: 0.1040 - val_accuracy: 0.9707
Epoch 7/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0732 -
accuracy: 0.9814 - val_loss: 0.1009 - val_accuracy: 0.9716
Epoch 8/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0671 -
accuracy: 0.9832 - val_loss: 0.0986 - val_accuracy: 0.9717
Epoch 9/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0623 -
accuracy: 0.9844 - val_loss: 0.0976 - val_accuracy: 0.9713
Epoch 10/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0582 -
accuracy: 0.9856 - val_loss: 0.0952 - val_accuracy: 0.9714
Epoch 11/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0545 -
accuracy: 0.9868 - val_loss: 0.0940 - val_accuracy: 0.9719
Epoch 12/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0515 -
accuracy: 0.9874 - val_loss: 0.0931 - val_accuracy: 0.9726
Epoch 13/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0487 -
```

```
accuracy: 0.9885 - val_loss: 0.0927 - val_accuracy: 0.9717
Epoch 14/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0464 -
accuracy: 0.9893 - val_loss: 0.0924 - val_accuracy: 0.9719
Epoch 15/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0443 -
accuracy: 0.9899 - val_loss: 0.0918 - val_accuracy: 0.9722
Epoch 16/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0422 -
accuracy: 0.9906 - val_loss: 0.0918 - val_accuracy: 0.9719
Epoch 17/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0403 -
accuracy: 0.9909 - val_loss: 0.0903 - val_accuracy: 0.9722
Epoch 18/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0389 -
accuracy: 0.9913 - val_loss: 0.0908 - val_accuracy: 0.9717
Epoch 19/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0373 -
accuracy: 0.9917 - val_loss: 0.0906 - val_accuracy: 0.9727
Epoch 20/20
405/405 [==============================] - 1s 3ms/step - loss: 0.0360 -
accuracy: 0.9922 - val_loss: 0.0902 - val_accuracy: 0.9722

Accuracy: 97.22%

Epoch 1/20
690/690 [==============================] - 2s 3ms/step - loss: 0.2921 -
accuracy: 0.9174 - val_loss: 0.1359 - val_accuracy: 0.9606
Epoch 2/20
690/690 [==============================] - 2s 3ms/step - loss: 0.1176 -
accuracy: 0.9666 - val_loss: 0.0989 - val_accuracy: 0.9717
Epoch 3/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0822 -
accuracy: 0.9768 - val_loss: 0.0853 - val_accuracy: 0.9747
Epoch 4/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0637 -
accuracy: 0.9825 - val_loss: 0.0804 - val_accuracy: 0.9762
Epoch 5/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0517 -
accuracy: 0.9862 - val_loss: 0.0771 - val_accuracy: 0.9772
Epoch 6/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0434 -
accuracy: 0.9887 - val_loss: 0.0723 - val_accuracy: 0.9794
Epoch 7/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0377 -
accuracy: 0.9904 - val_loss: 0.0706 - val_accuracy: 0.9787
Epoch 8/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0326 -
```

```
accuracy: 0.9923 - val_loss: 0.0722 - val_accuracy: 0.9800
Epoch 9/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0286 -
accuracy: 0.9938 - val_loss: 0.0697 - val_accuracy: 0.9794
Epoch 10/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0254 -
accuracy: 0.9945 - val_loss: 0.0697 - val_accuracy: 0.9794
Epoch 11/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0227 -
accuracy: 0.9955 - val_loss: 0.0681 - val_accuracy: 0.9807
Epoch 12/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0206 -
accuracy: 0.9960 - val_loss: 0.0687 - val_accuracy: 0.9803
Epoch 13/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0185 -
accuracy: 0.9966 - val_loss: 0.0685 - val_accuracy: 0.9811
Epoch 14/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0169 -
accuracy: 0.9971 - val_loss: 0.0689 - val_accuracy: 0.9807
Epoch 15/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0155 -
accuracy: 0.9975 - val_loss: 0.0688 - val_accuracy: 0.9810
Epoch 16/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0141 -
accuracy: 0.9979 - val_loss: 0.0687 - val_accuracy: 0.9811
Epoch 17/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0130 -
accuracy: 0.9981 - val_loss: 0.0695 - val_accuracy: 0.9816
Epoch 18/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0120 -
accuracy: 0.9983 - val_loss: 0.0697 - val_accuracy: 0.9819
Epoch 19/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0111 -
accuracy: 0.9987 - val_loss: 0.0678 - val_accuracy: 0.9818
Epoch 20/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0102 -
accuracy: 0.9987 - val_loss: 0.0698 - val_accuracy: 0.9820

Accuracy: 98.20%

Epoch 1/20
516/516 [==============================] - 2s 3ms/step - loss: 0.5927 -
accuracy: 0.8752 - val_loss: 0.2582 - val_accuracy: 0.9411
Epoch 2/20
516/516 [==============================] - 2s 3ms/step - loss: 0.2369 -
accuracy: 0.9438 - val_loss: 0.1860 - val_accuracy: 0.9573
Epoch 3/20
516/516 [==============================] - 2s 3ms/step - loss: 0.1831 -
```

```
accuracy: 0.9561 - val_loss: 0.1572 - val_accuracy: 0.9618
Epoch 4/20
516/516 [==============================] - 2s 3ms/step - loss: 0.1564 -
accuracy: 0.9620 - val_loss: 0.1425 - val_accuracy: 0.9648
Epoch 5/20
516/516 [==============================] - 1s 3ms/step - loss: 0.1388 -
accuracy: 0.9662 - val_loss: 0.1316 - val_accuracy: 0.9670
Epoch 6/20
516/516 [==============================] - 1s 3ms/step - loss: 0.1262 -
accuracy: 0.9693 - val_loss: 0.1242 - val_accuracy: 0.9674
Epoch 7/20
516/516 [==============================] - 1s 3ms/step - loss: 0.1169 -
accuracy: 0.9718 - val_loss: 0.1186 - val_accuracy: 0.9692
Epoch 8/20
516/516 [==============================] - 1s 3ms/step - loss: 0.1093 -
accuracy: 0.9735 - val_loss: 0.1146 - val_accuracy: 0.9708
Epoch 9/20
516/516 [==============================] - 1s 3ms/step - loss: 0.1032 -
accuracy: 0.9749 - val_loss: 0.1102 - val_accuracy: 0.9704
Epoch 10/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0979 -
accuracy: 0.9762 - val_loss: 0.1077 - val_accuracy: 0.9719
Epoch 11/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0935 -
accuracy: 0.9770 - val_loss: 0.1050 - val_accuracy: 0.9721
Epoch 12/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0896 -
accuracy: 0.9780 - val_loss: 0.1028 - val_accuracy: 0.9723
Epoch 13/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0862 -
accuracy: 0.9790 - val_loss: 0.1009 - val_accuracy: 0.9724
Epoch 14/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0832 -
accuracy: 0.9798 - val_loss: 0.0992 - val_accuracy: 0.9727
Epoch 15/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0806 -
accuracy: 0.9808 - val_loss: 0.0977 - val_accuracy: 0.9738
Epoch 16/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0782 -
accuracy: 0.9813 - val_loss: 0.0964 - val_accuracy: 0.9732
Epoch 17/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0760 -
accuracy: 0.9819 - val_loss: 0.0950 - val_accuracy: 0.9740
Epoch 18/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0739 -
accuracy: 0.9824 - val_loss: 0.0943 - val_accuracy: 0.9736
Epoch 19/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0721 -
```

```
accuracy: 0.9830 - val_loss: 0.0931 - val_accuracy: 0.9738
Epoch 20/20
516/516 [==============================] - 1s 3ms/step - loss: 0.0704 -
accuracy: 0.9837 - val_loss: 0.0921 - val_accuracy: 0.9739

Accuracy: 97.39%

Epoch 1/20
587/587 [==============================] - 2s 3ms/step - loss: 1.8747 -
accuracy: 0.2983 - val_loss: 1.5748 - val_accuracy: 0.3929
Epoch 2/20
587/587 [==============================] - 2s 3ms/step - loss: 1.4231 -
accuracy: 0.4417 - val_loss: 1.3120 - val_accuracy: 0.4698
Epoch 3/20
587/587 [==============================] - 2s 3ms/step - loss: 1.2494 -
accuracy: 0.5071 - val_loss: 1.1891 - val_accuracy: 0.5464
Epoch 4/20
587/587 [==============================] - 2s 3ms/step - loss: 1.1351 -
accuracy: 0.6025 - val_loss: 1.0839 - val_accuracy: 0.6478
Epoch 5/20
587/587 [==============================] - 2s 3ms/step - loss: 1.0454 -
accuracy: 0.6705 - val_loss: 1.0066 - val_accuracy: 0.6974
Epoch 6/20
587/587 [==============================] - 2s 3ms/step - loss: 0.9761 -
accuracy: 0.7055 - val_loss: 0.9439 - val_accuracy: 0.7172
Epoch 7/20
587/587 [==============================] - 2s 3ms/step - loss: 0.9179 -
accuracy: 0.7228 - val_loss: 0.8900 - val_accuracy: 0.7356
Epoch 8/20
587/587 [==============================] - 2s 3ms/step - loss: 0.8692 -
accuracy: 0.7381 - val_loss: 0.8469 - val_accuracy: 0.7499
Epoch 9/20
587/587 [==============================] - 2s 3ms/step - loss: 0.8302 -
accuracy: 0.7494 - val_loss: 0.8120 - val_accuracy: 0.7587
Epoch 10/20
587/587 [==============================] - 2s 3ms/step - loss: 0.7980 -
accuracy: 0.7580 - val_loss: 0.7831 - val_accuracy: 0.7657
Epoch 11/20
587/587 [==============================] - 2s 3ms/step - loss: 0.7713 -
accuracy: 0.7686 - val_loss: 0.7588 - val_accuracy: 0.7710
Epoch 12/20
587/587 [==============================] - 2s 3ms/step - loss: 0.7482 -
accuracy: 0.7722 - val_loss: 0.7384 - val_accuracy: 0.7787
Epoch 13/20
587/587 [==============================] - 2s 3ms/step - loss: 0.7281 -
accuracy: 0.7805 - val_loss: 0.7203 - val_accuracy: 0.7816
Epoch 14/20
587/587 [==============================] - 2s 3ms/step - loss: 0.7103 -
```

```
accuracy: 0.7850 - val_loss: 0.7034 - val_accuracy: 0.7884
Epoch 15/20
587/587 [==============================] - 2s 3ms/step - loss: 0.6941 -
accuracy: 0.7927 - val_loss: 0.6891 - val_accuracy: 0.7934
Epoch 16/20
587/587 [==============================] - 2s 3ms/step - loss: 0.6795 -
accuracy: 0.7999 - val_loss: 0.6758 - val_accuracy: 0.7972
Epoch 17/20
587/587 [==============================] - 2s 3ms/step - loss: 0.6661 -
accuracy: 0.8061 - val_loss: 0.6635 - val_accuracy: 0.8056
Epoch 18/20
587/587 [==============================] - 2s 3ms/step - loss: 0.6538 -
accuracy: 0.8121 - val_loss: 0.6510 - val_accuracy: 0.8109
Epoch 19/20
587/587 [==============================] - 2s 3ms/step - loss: 0.6420 -
accuracy: 0.8201 - val_loss: 0.6403 - val_accuracy: 0.8177
Epoch 20/20
587/587 [==============================] - 2s 3ms/step - loss: 0.6311 -
accuracy: 0.8267 - val_loss: 0.6303 - val_accuracy: 0.8241

Accuracy: 82.41%

Epoch 1/20
1109/1109 [==============================] - 4s 3ms/step - loss: 1.0613 -
accuracy: 0.7315 - val_loss: 0.5221 - val_accuracy: 0.8868
Epoch 2/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.4867 -
accuracy: 0.8822 - val_loss: 0.3916 - val_accuracy: 0.9017
Epoch 3/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.4058 -
accuracy: 0.8953 - val_loss: 0.3463 - val_accuracy: 0.9096
Epoch 4/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.3700 -
accuracy: 0.9027 - val_loss: 0.3216 - val_accuracy: 0.9151
Epoch 5/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.3481 -
accuracy: 0.9078 - val_loss: 0.3054 - val_accuracy: 0.9183
Epoch 6/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.3328 -
accuracy: 0.9117 - val_loss: 0.2936 - val_accuracy: 0.9203
Epoch 7/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.3213 -
accuracy: 0.9143 - val_loss: 0.2849 - val_accuracy: 0.9223
Epoch 8/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.3120 -
accuracy: 0.9162 - val_loss: 0.2784 - val_accuracy: 0.9246
Epoch 9/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.3045 -
```

```
accuracy: 0.9183 - val_loss: 0.2717 - val_accuracy: 0.9270
Epoch 10/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2981 -
accuracy: 0.9197 - val_loss: 0.2665 - val_accuracy: 0.9281
Epoch 11/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2926 -
accuracy: 0.9210 - val_loss: 0.2620 - val_accuracy: 0.9301
Epoch 12/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2878 -
accuracy: 0.9222 - val_loss: 0.2582 - val_accuracy: 0.9310
Epoch 13/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2837 -
accuracy: 0.9229 - val_loss: 0.2546 - val_accuracy: 0.9319
Epoch 14/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2799 -
accuracy: 0.9239 - val_loss: 0.2517 - val_accuracy: 0.9322
Epoch 15/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2765 -
accuracy: 0.9248 - val_loss: 0.2487 - val_accuracy: 0.9333
Epoch 16/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2734 -
accuracy: 0.9253 - val_loss: 0.2461 - val_accuracy: 0.9334
Epoch 17/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2706 -
accuracy: 0.9259 - val_loss: 0.2442 - val_accuracy: 0.9348
Epoch 18/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2680 -
accuracy: 0.9266 - val_loss: 0.2417 - val_accuracy: 0.9358
Epoch 19/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2656 -
accuracy: 0.9270 - val_loss: 0.2399 - val_accuracy: 0.9361
Epoch 20/20
1109/1109 [==============================] - 3s 3ms/step - loss: 0.2634 -
accuracy: 0.9276 - val_loss: 0.2379 - val_accuracy: 0.9371

Accuracy: 93.71%

Epoch 1/20
1041/1041 [==============================] - 3s 3ms/step - loss: 1.3945 -
accuracy: 0.6428 - val_loss: 0.8987 - val_accuracy: 0.8312
Epoch 2/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.8073 -
accuracy: 0.8255 - val_loss: 0.6703 - val_accuracy: 0.8629
Epoch 3/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.6684 -
accuracy: 0.8487 - val_loss: 0.5822 - val_accuracy: 0.8763
Epoch 4/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.6032 -
```

```
accuracy: 0.8601 - val_loss: 0.5338 - val_accuracy: 0.8827
Epoch 5/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.5639 -
accuracy: 0.8667 - val_loss: 0.5024 - val_accuracy: 0.8862
Epoch 6/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.5370 -
accuracy: 0.8705 - val_loss: 0.4803 - val_accuracy: 0.8899
Epoch 7/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.5172 -
accuracy: 0.8736 - val_loss: 0.4635 - val_accuracy: 0.8926
Epoch 8/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.5019 -
accuracy: 0.8763 - val_loss: 0.4504 - val_accuracy: 0.8952
Epoch 9/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4897 -
accuracy: 0.8787 - val_loss: 0.4398 - val_accuracy: 0.8961
Epoch 10/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4796 -
accuracy: 0.8805 - val_loss: 0.4309 - val_accuracy: 0.8974
Epoch 11/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4712 -
accuracy: 0.8818 - val_loss: 0.4234 - val_accuracy: 0.8989
Epoch 12/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4639 -
accuracy: 0.8833 - val_loss: 0.4169 - val_accuracy: 0.9003
Epoch 13/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4575 -
accuracy: 0.8846 - val_loss: 0.4113 - val_accuracy: 0.9012
Epoch 14/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4519 -
accuracy: 0.8857 - val_loss: 0.4063 - val_accuracy: 0.9021
Epoch 15/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4470 -
accuracy: 0.8867 - val_loss: 0.4018 - val_accuracy: 0.9028
Epoch 16/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4425 -
accuracy: 0.8876 - val_loss: 0.3978 - val_accuracy: 0.9033
Epoch 17/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4385 -
accuracy: 0.8884 - val_loss: 0.3941 - val_accuracy: 0.9041
Epoch 18/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4348 -
accuracy: 0.8890 - val_loss: 0.3908 - val_accuracy: 0.9049
Epoch 19/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4314 -
accuracy: 0.8896 - val_loss: 0.3878 - val_accuracy: 0.9047
Epoch 20/20
1041/1041 [==============================] - 3s 3ms/step - loss: 0.4283 -
```

```
accuracy: 0.8903 - val_loss: 0.3850 - val_accuracy: 0.9046

Accuracy: 90.46%

Epoch 1/20
762/762 [==============================] - 3s 3ms/step - loss: 0.5579 -
accuracy: 0.8730 - val_loss: 0.2357 - val_accuracy: 0.9417
Epoch 2/20
762/762 [==============================] - 2s 3ms/step - loss: 0.2134 -
accuracy: 0.9441 - val_loss: 0.1709 - val_accuracy: 0.9560
Epoch 3/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1576 -
accuracy: 0.9574 - val_loss: 0.1361 - val_accuracy: 0.9646
Epoch 4/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1284 -
accuracy: 0.9657 - val_loss: 0.1236 - val_accuracy: 0.9662
Epoch 5/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1096 -
accuracy: 0.9706 - val_loss: 0.1133 - val_accuracy: 0.9699
Epoch 6/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0963 -
accuracy: 0.9747 - val_loss: 0.1054 - val_accuracy: 0.9698
Epoch 7/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0867 -
accuracy: 0.9773 - val_loss: 0.0997 - val_accuracy: 0.9731
Epoch 8/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0788 -
accuracy: 0.9797 - val_loss: 0.0963 - val_accuracy: 0.9741
Epoch 9/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0727 -
accuracy: 0.9813 - val_loss: 0.0925 - val_accuracy: 0.9741
Epoch 10/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0675 -
accuracy: 0.9827 - val_loss: 0.0894 - val_accuracy: 0.9754
Epoch 11/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0629 -
accuracy: 0.9842 - val_loss: 0.0872 - val_accuracy: 0.9747
Epoch 12/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0591 -
accuracy: 0.9852 - val_loss: 0.0863 - val_accuracy: 0.9751
Epoch 13/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0557 -
accuracy: 0.9863 - val_loss: 0.0851 - val_accuracy: 0.9753
Epoch 14/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0528 -
accuracy: 0.9870 - val_loss: 0.0827 - val_accuracy: 0.9761
Epoch 15/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0503 -
```

```
accuracy: 0.9879 - val_loss: 0.0813 - val_accuracy: 0.9769
Epoch 16/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0478 -
accuracy: 0.9887 - val_loss: 0.0810 - val_accuracy: 0.9769
Epoch 17/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0457 -
accuracy: 0.9896 - val_loss: 0.0798 - val_accuracy: 0.9771
Epoch 18/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0437 -
accuracy: 0.9903 - val_loss: 0.0793 - val_accuracy: 0.9768
Epoch 19/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0420 -
accuracy: 0.9905 - val_loss: 0.0776 - val_accuracy: 0.9776
Epoch 20/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0404 -
accuracy: 0.9910 - val_loss: 0.0768 - val_accuracy: 0.9778

Accuracy: 97.78%

Epoch 1/20
25500/25500 [==============================] - 58s 2ms/step - loss: 1.8611 -
accuracy: 0.6049 - val_loss: 1.7672 - val_accuracy: 0.6577
Epoch 2/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.7451 -
accuracy: 0.6506 - val_loss: 1.7113 - val_accuracy: 0.6747
Epoch 3/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.7044 -
accuracy: 0.6622 - val_loss: 1.6797 - val_accuracy: 0.6823
Epoch 4/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.6787 -
accuracy: 0.6682 - val_loss: 1.6577 - val_accuracy: 0.6887
Epoch 5/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.6599 -
accuracy: 0.6731 - val_loss: 1.6410 - val_accuracy: 0.6930
Epoch 6/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.6452 -
accuracy: 0.6764 - val_loss: 1.6275 - val_accuracy: 0.6967
Epoch 7/20
25500/25500 [==============================] - 58s 2ms/step - loss: 1.6331 -
accuracy: 0.6791 - val_loss: 1.6162 - val_accuracy: 0.6993
Epoch 8/20
25500/25500 [==============================] - 58s 2ms/step - loss: 1.6228 -
accuracy: 0.6818 - val_loss: 1.6064 - val_accuracy: 0.7023
Epoch 9/20
25500/25500 [==============================] - 58s 2ms/step - loss: 1.6139 -
accuracy: 0.6835 - val_loss: 1.5979 - val_accuracy: 0.7036
Epoch 10/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.6061 -
```

```
accuracy: 0.6852 - val_loss: 1.5904 - val_accuracy: 0.7052
Epoch 11/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.5991 -
accuracy: 0.6869 - val_loss: 1.5836 - val_accuracy: 0.7067
Epoch 12/20
25500/25500 [==============================] - 58s 2ms/step - loss: 1.5928 -
accuracy: 0.6882 - val_loss: 1.5774 - val_accuracy: 0.7080
Epoch 13/20
25500/25500 [==============================] - 58s 2ms/step - loss: 1.5870 -
accuracy: 0.6893 - val_loss: 1.5718 - val_accuracy: 0.7092
Epoch 14/20
25500/25500 [==============================] - 58s 2ms/step - loss: 1.5817 -
accuracy: 0.6905 - val_loss: 1.5666 - val_accuracy: 0.7106
Epoch 15/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.5768 -
accuracy: 0.6916 - val_loss: 1.5618 - val_accuracy: 0.7120
Epoch 16/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.5722 -
accuracy: 0.6926 - val_loss: 1.5573 - val_accuracy: 0.7127
Epoch 17/20
25500/25500 [==============================] - 58s 2ms/step - loss: 1.5680 -
accuracy: 0.6936 - val_loss: 1.5531 - val_accuracy: 0.7136
Epoch 18/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.5640 -
accuracy: 0.6942 - val_loss: 1.5492 - val_accuracy: 0.7141
Epoch 19/20
25500/25500 [==============================] - 57s 2ms/step - loss: 1.5603 -
accuracy: 0.6951 - val_loss: 1.5455 - val_accuracy: 0.7148
Epoch 20/20
25500/25500 [==============================] - 56s 2ms/step - loss: 1.5567 -
accuracy: 0.6958 - val_loss: 1.5420 - val_accuracy: 0.7153

Accuracy: 71.53%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.5161 -
accuracy: 0.8524 - val_loss: 0.1923 - val_accuracy: 0.9472
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1581 -
accuracy: 0.9571 - val_loss: 0.1266 - val_accuracy: 0.9662
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1067 -
accuracy: 0.9711 - val_loss: 0.1093 - val_accuracy: 0.9710
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0766 -
accuracy: 0.9785 - val_loss: 0.1091 - val_accuracy: 0.9694
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0588 -
```

```
accuracy: 0.9828 - val_loss: 0.0960 - val_accuracy: 0.9749
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0460 -
accuracy: 0.9870 - val_loss: 0.0873 - val_accuracy: 0.9777
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0323 -
accuracy: 0.9909 - val_loss: 0.0905 - val_accuracy: 0.9761
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0235 -
accuracy: 0.9930 - val_loss: 0.0996 - val_accuracy: 0.9739
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0206 -
accuracy: 0.9940 - val_loss: 0.1038 - val_accuracy: 0.9749
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0125 -
accuracy: 0.9968 - val_loss: 0.0977 - val_accuracy: 0.9759
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0118 -
accuracy: 0.9969 - val_loss: 0.1047 - val_accuracy: 0.9771
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0165 -
accuracy: 0.9945 - val_loss: 0.1254 - val_accuracy: 0.9723
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0132 -
accuracy: 0.9959 - val_loss: 0.1152 - val_accuracy: 0.9738
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0085 -
accuracy: 0.9976 - val_loss: 0.1104 - val_accuracy: 0.9766
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0085 -
accuracy: 0.9978 - val_loss: 0.1123 - val_accuracy: 0.9778
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0104 -
accuracy: 0.9968 - val_loss: 0.1221 - val_accuracy: 0.9757
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0090 -
accuracy: 0.9973 - val_loss: 0.1253 - val_accuracy: 0.9762
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0105 -
accuracy: 0.9963 - val_loss: 0.1225 - val_accuracy: 0.9779
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0065 -
accuracy: 0.9980 - val_loss: 0.1304 - val_accuracy: 0.9759
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0016 -
accuracy: 0.9996 - val_loss: 0.1286 - val_accuracy: 0.9780

Accuracy: 97.80%
```

```
Epoch 1/20
810/810 [==============================] - 3s 3ms/step - loss: 0.3195 -
accuracy: 0.9079 - val_loss: 0.1722 - val_accuracy: 0.9524
Epoch 2/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1720 -
accuracy: 0.9508 - val_loss: 0.1466 - val_accuracy: 0.9593
Epoch 3/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1480 -
accuracy: 0.9585 - val_loss: 0.1352 - val_accuracy: 0.9619
Epoch 4/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1351 -
accuracy: 0.9621 - val_loss: 0.1301 - val_accuracy: 0.9627
Epoch 5/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1268 -
accuracy: 0.9642 - val_loss: 0.1251 - val_accuracy: 0.9648
Epoch 6/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1202 -
accuracy: 0.9670 - val_loss: 0.1218 - val_accuracy: 0.9656
Epoch 7/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1154 -
accuracy: 0.9679 - val_loss: 0.1193 - val_accuracy: 0.9663
Epoch 8/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1112 -
accuracy: 0.9694 - val_loss: 0.1172 - val_accuracy: 0.9674
Epoch 9/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1078 -
accuracy: 0.9704 - val_loss: 0.1141 - val_accuracy: 0.9673
Epoch 10/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1049 -
accuracy: 0.9715 - val_loss: 0.1134 - val_accuracy: 0.9679
Epoch 11/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1025 -
accuracy: 0.9720 - val_loss: 0.1115 - val_accuracy: 0.9686
Epoch 12/20
810/810 [==============================] - 2s 3ms/step - loss: 0.1003 -
accuracy: 0.9729 - val_loss: 0.1105 - val_accuracy: 0.9687
Epoch 13/20
810/810 [==============================] - 2s 3ms/step - loss: 0.0984 -
accuracy: 0.9737 - val_loss: 0.1093 - val_accuracy: 0.9694
Epoch 14/20
810/810 [==============================] - 2s 3ms/step - loss: 0.0967 -
accuracy: 0.9741 - val_loss: 0.1082 - val_accuracy: 0.9694
Epoch 15/20
810/810 [==============================] - 2s 3ms/step - loss: 0.0951 -
accuracy: 0.9745 - val_loss: 0.1075 - val_accuracy: 0.9699
Epoch 16/20
810/810 [==============================] - 2s 3ms/step - loss: 0.0937 -
```

```
accuracy: 0.9749 - val_loss: 0.1070 - val_accuracy: 0.9699
Epoch 17/20
810/810 [==============================] - 2s 3ms/step - loss: 0.0924 -
accuracy: 0.9751 - val_loss: 0.1061 - val_accuracy: 0.9702
Epoch 18/20
810/810 [==============================] - 2s 3ms/step - loss: 0.0912 -
accuracy: 0.9756 - val_loss: 0.1052 - val_accuracy: 0.9699
Epoch 19/20
810/810 [==============================] - 2s 3ms/step - loss: 0.0900 -
accuracy: 0.9759 - val_loss: 0.1043 - val_accuracy: 0.9698
Epoch 20/20
810/810 [==============================] - 2s 3ms/step - loss: 0.0890 -
accuracy: 0.9764 - val_loss: 0.1039 - val_accuracy: 0.9706

Accuracy: 97.06%

Epoch 1/20
51000/51000 [==============================] - 114s 2ms/step - loss: 2.3040 -
accuracy: 0.1067 - val_loss: 2.3047 - val_accuracy: 0.0997
Epoch 2/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3038 -
accuracy: 0.1084 - val_loss: 2.3030 - val_accuracy: 0.1028
Epoch 3/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3037 -
accuracy: 0.1077 - val_loss: 2.3043 - val_accuracy: 0.0990
Epoch 4/20
51000/51000 [==============================] - 114s 2ms/step - loss: 2.3034 -
accuracy: 0.1080 - val_loss: 2.3057 - val_accuracy: 0.1063
Epoch 5/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3036 -
accuracy: 0.1090 - val_loss: 2.3052 - val_accuracy: 0.1028
Epoch 6/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3035 -
accuracy: 0.1077 - val_loss: 2.3032 - val_accuracy: 0.1063
Epoch 7/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3032 -
accuracy: 0.1092 - val_loss: 2.3041 - val_accuracy: 0.1063
Epoch 8/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3032 -
accuracy: 0.1083 - val_loss: 2.3036 - val_accuracy: 0.0990
Epoch 9/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3030 -
accuracy: 0.1079 - val_loss: 2.3055 - val_accuracy: 0.1063
Epoch 10/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3029 -
accuracy: 0.1089 - val_loss: 2.3032 - val_accuracy: 0.1093
Epoch 11/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3031 -
```

```
accuracy: 0.1096 - val_loss: 2.3024 - val_accuracy: 0.1063
Epoch 12/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3027 -
accuracy: 0.1100 - val_loss: 2.3026 - val_accuracy: 0.1063
Epoch 13/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3028 -
accuracy: 0.1105 - val_loss: 2.3062 - val_accuracy: 0.1063
Epoch 14/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3030 -
accuracy: 0.1096 - val_loss: 2.3038 - val_accuracy: 0.1063
Epoch 15/20
51000/51000 [==============================] - 114s 2ms/step - loss: 2.3027 -
accuracy: 0.1106 - val_loss: 2.3032 - val_accuracy: 0.1063
Epoch 16/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3028 -
accuracy: 0.1103 - val_loss: 2.3027 - val_accuracy: 0.1063
Epoch 17/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3026 -
accuracy: 0.1095 - val_loss: 2.3035 - val_accuracy: 0.1063
Epoch 18/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3028 -
accuracy: 0.1114 - val_loss: 2.3028 - val_accuracy: 0.1063
Epoch 19/20
51000/51000 [==============================] - 113s 2ms/step - loss: 2.3027 -
accuracy: 0.1092 - val_loss: 2.3030 - val_accuracy: 0.1063
Epoch 20/20
51000/51000 [==============================] - 114s 2ms/step - loss: 2.3024 -
accuracy: 0.1089 - val_loss: 2.3024 - val_accuracy: 0.1063

Accuracy: 10.63%

Epoch 1/20
600/600 [==============================] - 2s 3ms/step - loss: 0.7942 -
accuracy: 0.8329 - val_loss: 0.3986 - val_accuracy: 0.9201
Epoch 2/20
600/600 [==============================] - 1s 2ms/step - loss: 0.3626 -
accuracy: 0.9176 - val_loss: 0.2865 - val_accuracy: 0.9354
Epoch 3/20
600/600 [==============================] - 2s 3ms/step - loss: 0.2878 -
accuracy: 0.9312 - val_loss: 0.2415 - val_accuracy: 0.9436
Epoch 4/20
600/600 [==============================] - 1s 2ms/step - loss: 0.2503 -
accuracy: 0.9383 - val_loss: 0.2165 - val_accuracy: 0.9482
Epoch 5/20
600/600 [==============================] - 1s 2ms/step - loss: 0.2261 -
accuracy: 0.9430 - val_loss: 0.1998 - val_accuracy: 0.9507
Epoch 6/20
600/600 [==============================] - 1s 2ms/step - loss: 0.2088 -
```

```
accuracy: 0.9476 - val_loss: 0.1869 - val_accuracy: 0.9547
Epoch 7/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1960 -
accuracy: 0.9502 - val_loss: 0.1773 - val_accuracy: 0.9563
Epoch 8/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1857 -
accuracy: 0.9526 - val_loss: 0.1694 - val_accuracy: 0.9580
Epoch 9/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1773 -
accuracy: 0.9545 - val_loss: 0.1639 - val_accuracy: 0.9589
Epoch 10/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1703 -
accuracy: 0.9563 - val_loss: 0.1582 - val_accuracy: 0.9607
Epoch 11/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1643 -
accuracy: 0.9575 - val_loss: 0.1541 - val_accuracy: 0.9600
Epoch 12/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1590 -
accuracy: 0.9585 - val_loss: 0.1507 - val_accuracy: 0.9613
Epoch 13/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1545 -
accuracy: 0.9596 - val_loss: 0.1473 - val_accuracy: 0.9626
Epoch 14/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1505 -
accuracy: 0.9606 - val_loss: 0.1439 - val_accuracy: 0.9620
Epoch 15/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1468 -
accuracy: 0.9616 - val_loss: 0.1413 - val_accuracy: 0.9629
Epoch 16/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1435 -
accuracy: 0.9623 - val_loss: 0.1392 - val_accuracy: 0.9633
Epoch 17/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1405 -
accuracy: 0.9632 - val_loss: 0.1370 - val_accuracy: 0.9639
Epoch 18/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1378 -
accuracy: 0.9641 - val_loss: 0.1352 - val_accuracy: 0.9638
Epoch 19/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1353 -
accuracy: 0.9645 - val_loss: 0.1336 - val_accuracy: 0.9636
Epoch 20/20
600/600 [==============================] - 1s 2ms/step - loss: 0.1330 -
accuracy: 0.9650 - val_loss: 0.1321 - val_accuracy: 0.9647

Accuracy: 96.47%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.3535 -
```

```
accuracy: 0.9001 - val_loss: 0.1470 - val_accuracy: 0.9592
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1351 -
accuracy: 0.9612 - val_loss: 0.1069 - val_accuracy: 0.9700
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0941 -
accuracy: 0.9731 - val_loss: 0.0938 - val_accuracy: 0.9726
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0709 -
accuracy: 0.9803 - val_loss: 0.0867 - val_accuracy: 0.9751
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0574 -
accuracy: 0.9844 - val_loss: 0.0787 - val_accuracy: 0.9774
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0479 -
accuracy: 0.9875 - val_loss: 0.0752 - val_accuracy: 0.9788
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0404 -
accuracy: 0.9896 - val_loss: 0.0733 - val_accuracy: 0.9789
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0349 -
accuracy: 0.9920 - val_loss: 0.0724 - val_accuracy: 0.9787
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0301 -
accuracy: 0.9931 - val_loss: 0.0724 - val_accuracy: 0.9796
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0264 -
accuracy: 0.9942 - val_loss: 0.0717 - val_accuracy: 0.9790
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0236 -
accuracy: 0.9954 - val_loss: 0.0706 - val_accuracy: 0.9790
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0212 -
accuracy: 0.9959 - val_loss: 0.0690 - val_accuracy: 0.9801
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0186 -
accuracy: 0.9968 - val_loss: 0.0688 - val_accuracy: 0.9804
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0170 -
accuracy: 0.9973 - val_loss: 0.0687 - val_accuracy: 0.9807
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0152 -
accuracy: 0.9978 - val_loss: 0.0689 - val_accuracy: 0.9802
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0138 -
accuracy: 0.9979 - val_loss: 0.0691 - val_accuracy: 0.9811
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0125 -
```

```
accuracy: 0.9984 - val_loss: 0.0701 - val_accuracy: 0.9800
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0114 -
accuracy: 0.9987 - val_loss: 0.0695 - val_accuracy: 0.9811
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0105 -
accuracy: 0.9988 - val_loss: 0.0683 - val_accuracy: 0.9807
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0095 -
accuracy: 0.9990 - val_loss: 0.0689 - val_accuracy: 0.9813

Accuracy: 98.13%

Epoch 1/20
1822/1822 [==============================] - 6s 3ms/step - loss: 0.8067 -
accuracy: 0.7751 - val_loss: 0.2529 - val_accuracy: 0.9431
Epoch 2/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.2247 -
accuracy: 0.9467 - val_loss: 0.1623 - val_accuracy: 0.9602
Epoch 3/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.1470 -
accuracy: 0.9631 - val_loss: 0.1373 - val_accuracy: 0.9637
Epoch 4/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.1118 -
accuracy: 0.9714 - val_loss: 0.1257 - val_accuracy: 0.9657
Epoch 5/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0871 -
accuracy: 0.9777 - val_loss: 0.1189 - val_accuracy: 0.9693
Epoch 6/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0741 -
accuracy: 0.9810 - val_loss: 0.1087 - val_accuracy: 0.9727
Epoch 7/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0594 -
accuracy: 0.9850 - val_loss: 0.1283 - val_accuracy: 0.9683
Epoch 8/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0525 -
accuracy: 0.9866 - val_loss: 0.1290 - val_accuracy: 0.9681
Epoch 9/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0460 -
accuracy: 0.9883 - val_loss: 0.1058 - val_accuracy: 0.9734
Epoch 10/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0398 -
accuracy: 0.9895 - val_loss: 0.1277 - val_accuracy: 0.9717
Epoch 11/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0357 -
accuracy: 0.9904 - val_loss: 0.1110 - val_accuracy: 0.9751
Epoch 12/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0324 -
```

```
accuracy: 0.9915 - val_loss: 0.1335 - val_accuracy: 0.9688
Epoch 13/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0298 -
accuracy: 0.9917 - val_loss: 0.1168 - val_accuracy: 0.9740
Epoch 14/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0251 -
accuracy: 0.9933 - val_loss: 0.1259 - val_accuracy: 0.9736
Epoch 15/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0248 -
accuracy: 0.9936 - val_loss: 0.1204 - val_accuracy: 0.9747
Epoch 16/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0225 -
accuracy: 0.9938 - val_loss: 0.1419 - val_accuracy: 0.9703
Epoch 17/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0213 -
accuracy: 0.9939 - val_loss: 0.1143 - val_accuracy: 0.9758
Epoch 18/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0194 -
accuracy: 0.9947 - val_loss: 0.1494 - val_accuracy: 0.9719
Epoch 19/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0178 -
accuracy: 0.9952 - val_loss: 0.1226 - val_accuracy: 0.9752
Epoch 20/20
1822/1822 [==============================] - 5s 3ms/step - loss: 0.0170 -
accuracy: 0.9955 - val_loss: 0.1364 - val_accuracy: 0.9736

Accuracy: 97.36%

Epoch 1/20
482/482 [==============================] - 2s 3ms/step - loss: 0.6162 -
accuracy: 0.8575 - val_loss: 0.2455 - val_accuracy: 0.9359
Epoch 2/20
482/482 [==============================] - 1s 3ms/step - loss: 0.2341 -
accuracy: 0.9360 - val_loss: 0.1860 - val_accuracy: 0.9500
Epoch 3/20
482/482 [==============================] - 1s 3ms/step - loss: 0.1841 -
accuracy: 0.9490 - val_loss: 0.1600 - val_accuracy: 0.9549
Epoch 4/20
482/482 [==============================] - 1s 3ms/step - loss: 0.1578 -
accuracy: 0.9561 - val_loss: 0.1446 - val_accuracy: 0.9593
Epoch 5/20
482/482 [==============================] - 1s 3ms/step - loss: 0.1399 -
accuracy: 0.9607 - val_loss: 0.1347 - val_accuracy: 0.9617
Epoch 6/20
482/482 [==============================] - 1s 3ms/step - loss: 0.1274 -
accuracy: 0.9638 - val_loss: 0.1273 - val_accuracy: 0.9627
Epoch 7/20
482/482 [==============================] - 1s 3ms/step - loss: 0.1178 -
```

```
accuracy: 0.9670 - val_loss: 0.1236 - val_accuracy: 0.9643
Epoch 8/20
482/482 [==============================] - 1s 3ms/step - loss: 0.1103 -
accuracy: 0.9691 - val_loss: 0.1178 - val_accuracy: 0.9681
Epoch 9/20
482/482 [==============================] - 1s 3ms/step - loss: 0.1038 -
accuracy: 0.9712 - val_loss: 0.1147 - val_accuracy: 0.9686
Epoch 10/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0984 -
accuracy: 0.9729 - val_loss: 0.1128 - val_accuracy: 0.9677
Epoch 11/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0940 -
accuracy: 0.9740 - val_loss: 0.1099 - val_accuracy: 0.9696
Epoch 12/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0900 -
accuracy: 0.9750 - val_loss: 0.1095 - val_accuracy: 0.9690
Epoch 13/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0866 -
accuracy: 0.9763 - val_loss: 0.1063 - val_accuracy: 0.9698
Epoch 14/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0835 -
accuracy: 0.9773 - val_loss: 0.1057 - val_accuracy: 0.9702
Epoch 15/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0808 -
accuracy: 0.9779 - val_loss: 0.1040 - val_accuracy: 0.9702
Epoch 16/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0783 -
accuracy: 0.9786 - val_loss: 0.1024 - val_accuracy: 0.9709
Epoch 17/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0761 -
accuracy: 0.9796 - val_loss: 0.1011 - val_accuracy: 0.9712
Epoch 18/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0739 -
accuracy: 0.9801 - val_loss: 0.1012 - val_accuracy: 0.9723
Epoch 19/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0721 -
accuracy: 0.9807 - val_loss: 0.1002 - val_accuracy: 0.9721
Epoch 20/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0703 -
accuracy: 0.9812 - val_loss: 0.0992 - val_accuracy: 0.9723

Accuracy: 97.23%

Epoch 1/20
740/740 [==============================] - 3s 3ms/step - loss: 0.5168 -
accuracy: 0.8521 - val_loss: 0.1499 - val_accuracy: 0.9612
Epoch 2/20
740/740 [==============================] - 2s 3ms/step - loss: 0.1449 -
```

```
accuracy: 0.9605 - val_loss: 0.1192 - val_accuracy: 0.9689
Epoch 3/20
740/740 [==============================] - 2s 3ms/step - loss: 0.1063 -
accuracy: 0.9705 - val_loss: 0.1305 - val_accuracy: 0.9631
Epoch 4/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0884 -
accuracy: 0.9747 - val_loss: 0.1151 - val_accuracy: 0.9720
Epoch 5/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0739 -
accuracy: 0.9794 - val_loss: 0.1094 - val_accuracy: 0.9709
Epoch 6/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0694 -
accuracy: 0.9796 - val_loss: 0.1146 - val_accuracy: 0.9690
Epoch 7/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0607 -
accuracy: 0.9824 - val_loss: 0.1064 - val_accuracy: 0.9728
Epoch 8/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0550 -
accuracy: 0.9840 - val_loss: 0.1047 - val_accuracy: 0.9730
Epoch 9/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0508 -
accuracy: 0.9854 - val_loss: 0.0995 - val_accuracy: 0.9749
Epoch 10/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0466 -
accuracy: 0.9859 - val_loss: 0.1079 - val_accuracy: 0.9728
Epoch 11/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0471 -
accuracy: 0.9863 - val_loss: 0.1080 - val_accuracy: 0.9759
Epoch 12/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0444 -
accuracy: 0.9869 - val_loss: 0.1092 - val_accuracy: 0.9717
Epoch 13/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0421 -
accuracy: 0.9871 - val_loss: 0.0992 - val_accuracy: 0.9751
Epoch 14/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0376 -
accuracy: 0.9891 - val_loss: 0.1032 - val_accuracy: 0.9749
Epoch 15/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0367 -
accuracy: 0.9884 - val_loss: 0.1177 - val_accuracy: 0.9716
Epoch 16/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0391 -
accuracy: 0.9882 - val_loss: 0.1059 - val_accuracy: 0.9734
Epoch 17/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0340 -
accuracy: 0.9897 - val_loss: 0.1073 - val_accuracy: 0.9764
Epoch 18/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0346 -
```

```
accuracy: 0.9893 - val_loss: 0.1058 - val_accuracy: 0.9751
Epoch 19/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0320 -
accuracy: 0.9901 - val_loss: 0.1093 - val_accuracy: 0.9749
Epoch 20/20
740/740 [==============================] - 2s 3ms/step - loss: 0.0300 -
accuracy: 0.9907 - val_loss: 0.1281 - val_accuracy: 0.9727

Accuracy: 97.27%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.4023 -
accuracy: 0.8848 - val_loss: 0.1694 - val_accuracy: 0.9536
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1654 -
accuracy: 0.9528 - val_loss: 0.1313 - val_accuracy: 0.9652
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1315 -
accuracy: 0.9624 - val_loss: 0.1210 - val_accuracy: 0.9667
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1137 -
accuracy: 0.9678 - val_loss: 0.1128 - val_accuracy: 0.9689
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1023 -
accuracy: 0.9709 - val_loss: 0.1068 - val_accuracy: 0.9704
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0942 -
accuracy: 0.9735 - val_loss: 0.1069 - val_accuracy: 0.9712
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0883 -
accuracy: 0.9758 - val_loss: 0.1010 - val_accuracy: 0.9718
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0833 -
accuracy: 0.9772 - val_loss: 0.0997 - val_accuracy: 0.9722
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0794 -
accuracy: 0.9783 - val_loss: 0.0982 - val_accuracy: 0.9738
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0759 -
accuracy: 0.9795 - val_loss: 0.0965 - val_accuracy: 0.9733
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0730 -
accuracy: 0.9804 - val_loss: 0.0961 - val_accuracy: 0.9737
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0706 -
accuracy: 0.9812 - val_loss: 0.0943 - val_accuracy: 0.9739
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0683 -
```

```
accuracy: 0.9820 - val_loss: 0.0937 - val_accuracy: 0.9744
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0662 -
accuracy: 0.9828 - val_loss: 0.0932 - val_accuracy: 0.9744
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0644 -
accuracy: 0.9831 - val_loss: 0.0920 - val_accuracy: 0.9760
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0629 -
accuracy: 0.9834 - val_loss: 0.0913 - val_accuracy: 0.9756
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0613 -
accuracy: 0.9841 - val_loss: 0.0905 - val_accuracy: 0.9759
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0600 -
accuracy: 0.9847 - val_loss: 0.0893 - val_accuracy: 0.9764
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0586 -
accuracy: 0.9849 - val_loss: 0.0905 - val_accuracy: 0.9763
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0576 -
accuracy: 0.9851 - val_loss: 0.0894 - val_accuracy: 0.9761

Accuracy: 97.61%

Epoch 1/20
672/672 [==============================] - 2s 3ms/step - loss: 0.3528 -
accuracy: 0.9034 - val_loss: 0.2059 - val_accuracy: 0.9441
Epoch 2/20
672/672 [==============================] - 2s 3ms/step - loss: 0.2117 -
accuracy: 0.9410 - val_loss: 0.1799 - val_accuracy: 0.9514
Epoch 3/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1897 -
accuracy: 0.9474 - val_loss: 0.1678 - val_accuracy: 0.9540
Epoch 4/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1770 -
accuracy: 0.9507 - val_loss: 0.1613 - val_accuracy: 0.9556
Epoch 5/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1688 -
accuracy: 0.9534 - val_loss: 0.1569 - val_accuracy: 0.9563
Epoch 6/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1626 -
accuracy: 0.9550 - val_loss: 0.1527 - val_accuracy: 0.9584
Epoch 7/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1580 -
accuracy: 0.9560 - val_loss: 0.1489 - val_accuracy: 0.9584
Epoch 8/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1540 -
```

```
accuracy: 0.9570 - val_loss: 0.1469 - val_accuracy: 0.9601
Epoch 9/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1508 -
accuracy: 0.9580 - val_loss: 0.1443 - val_accuracy: 0.9596
Epoch 10/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1480 -
accuracy: 0.9587 - val_loss: 0.1429 - val_accuracy: 0.9608
Epoch 11/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1456 -
accuracy: 0.9595 - val_loss: 0.1413 - val_accuracy: 0.9613
Epoch 12/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1435 -
accuracy: 0.9599 - val_loss: 0.1397 - val_accuracy: 0.9617
Epoch 13/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1416 -
accuracy: 0.9605 - val_loss: 0.1384 - val_accuracy: 0.9617
Epoch 14/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1398 -
accuracy: 0.9610 - val_loss: 0.1376 - val_accuracy: 0.9620
Epoch 15/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1382 -
accuracy: 0.9620 - val_loss: 0.1364 - val_accuracy: 0.9622
Epoch 16/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1368 -
accuracy: 0.9619 - val_loss: 0.1355 - val_accuracy: 0.9623
Epoch 17/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1354 -
accuracy: 0.9623 - val_loss: 0.1344 - val_accuracy: 0.9630
Epoch 18/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1342 -
accuracy: 0.9629 - val_loss: 0.1340 - val_accuracy: 0.9628
Epoch 19/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1330 -
accuracy: 0.9634 - val_loss: 0.1332 - val_accuracy: 0.9633
Epoch 20/20
672/672 [==============================] - 2s 3ms/step - loss: 0.1320 -
accuracy: 0.9634 - val_loss: 0.1325 - val_accuracy: 0.9639

Accuracy: 96.39%

Epoch 1/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.5711 -
accuracy: 0.8337 - val_loss: 0.2996 - val_accuracy: 0.9257
Epoch 2/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.2939 -
accuracy: 0.9261 - val_loss: 0.2532 - val_accuracy: 0.9387
Epoch 3/20
51000/51000 [==============================] - 119s 2ms/step - loss: 0.2399 -
```

```
accuracy: 0.9396 - val_loss: 0.2101 - val_accuracy: 0.9529
Epoch 4/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.2127 -
accuracy: 0.9470 - val_loss: 0.2016 - val_accuracy: 0.9516
Epoch 5/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.1872 -
accuracy: 0.9534 - val_loss: 0.2150 - val_accuracy: 0.9499
Epoch 6/20
51000/51000 [==============================] - 119s 2ms/step - loss: 0.1689 -
accuracy: 0.9577 - val_loss: 0.2028 - val_accuracy: 0.9496
Epoch 7/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.1620 -
accuracy: 0.9600 - val_loss: 0.1916 - val_accuracy: 0.9554
Epoch 8/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.1490 -
accuracy: 0.9633 - val_loss: 0.1875 - val_accuracy: 0.9578
Epoch 9/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.1366 -
accuracy: 0.9664 - val_loss: 0.1789 - val_accuracy: 0.9607
Epoch 10/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.1295 -
accuracy: 0.9683 - val_loss: 0.1681 - val_accuracy: 0.9640
Epoch 11/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.1249 -
accuracy: 0.9691 - val_loss: 0.1747 - val_accuracy: 0.9618
Epoch 12/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.1206 -
accuracy: 0.9710 - val_loss: 0.1775 - val_accuracy: 0.9626
Epoch 13/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.1064 -
accuracy: 0.9732 - val_loss: 0.1735 - val_accuracy: 0.9637
Epoch 14/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.1048 -
accuracy: 0.9743 - val_loss: 0.1715 - val_accuracy: 0.9621
Epoch 15/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.0954 -
accuracy: 0.9756 - val_loss: 0.1843 - val_accuracy: 0.9630
Epoch 16/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.0930 -
accuracy: 0.9764 - val_loss: 0.1740 - val_accuracy: 0.9616
Epoch 17/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.0901 -
accuracy: 0.9769 - val_loss: 0.1774 - val_accuracy: 0.9640
Epoch 18/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.0833 -
accuracy: 0.9795 - val_loss: 0.1717 - val_accuracy: 0.9647
Epoch 19/20
51000/51000 [==============================] - 118s 2ms/step - loss: 0.0798 -
```

```
accuracy: 0.9802 - val_loss: 0.1718 - val_accuracy: 0.9640
Epoch 20/20
51000/51000 [==============================] - 120s 2ms/step - loss: 0.0742 -
accuracy: 0.9813 - val_loss: 0.1747 - val_accuracy: 0.9661

Accuracy: 96.61%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.2966 -
accuracy: 0.9101 - val_loss: 0.1347 - val_accuracy: 0.9602
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1129 -
accuracy: 0.9660 - val_loss: 0.0970 - val_accuracy: 0.9719
Epoch 3/20
399/399 [==============================] - 2s 4ms/step - loss: 0.0770 -
accuracy: 0.9767 - val_loss: 0.0967 - val_accuracy: 0.9702
Epoch 4/20
399/399 [==============================] - 2s 4ms/step - loss: 0.0561 -
accuracy: 0.9825 - val_loss: 0.0910 - val_accuracy: 0.9744
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0423 -
accuracy: 0.9870 - val_loss: 0.0822 - val_accuracy: 0.9762
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0295 -
accuracy: 0.9904 - val_loss: 0.0807 - val_accuracy: 0.9781
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0241 -
accuracy: 0.9924 - val_loss: 0.0813 - val_accuracy: 0.9780
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0182 -
accuracy: 0.9942 - val_loss: 0.1142 - val_accuracy: 0.9731
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0138 -
accuracy: 0.9954 - val_loss: 0.0853 - val_accuracy: 0.9798
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0099 -
accuracy: 0.9969 - val_loss: 0.0926 - val_accuracy: 0.9793
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0066 -
accuracy: 0.9980 - val_loss: 0.0938 - val_accuracy: 0.9788
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0075 -
accuracy: 0.9976 - val_loss: 0.1117 - val_accuracy: 0.9757
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0095 -
accuracy: 0.9969 - val_loss: 0.1041 - val_accuracy: 0.9780
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0093 -
```

```
accuracy: 0.9970 - val_loss: 0.0968 - val_accuracy: 0.9802
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0045 -
accuracy: 0.9987 - val_loss: 0.0967 - val_accuracy: 0.9807
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 8.4842e-04 -
accuracy: 0.9999 - val_loss: 0.1045 - val_accuracy: 0.9810
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0023 -
accuracy: 0.9995 - val_loss: 0.1159 - val_accuracy: 0.9777
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0012 -
accuracy: 0.9998 - val_loss: 0.1014 - val_accuracy: 0.9802
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 2.7533e-04 -
accuracy: 1.0000 - val_loss: 0.1090 - val_accuracy: 0.9803
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 1.9849e-04 -
accuracy: 1.0000 - val_loss: 0.1089 - val_accuracy: 0.9807

Accuracy: 98.07%

Epoch 1/20
709/709 [==============================] - 3s 4ms/step - loss: 0.8343 -
accuracy: 0.7414 - val_loss: 0.2917 - val_accuracy: 0.9188
Epoch 2/20
709/709 [==============================] - 2s 3ms/step - loss: 0.2589 -
accuracy: 0.9262 - val_loss: 0.2082 - val_accuracy: 0.9422
Epoch 3/20
709/709 [==============================] - 2s 3ms/step - loss: 0.1889 -
accuracy: 0.9463 - val_loss: 0.1533 - val_accuracy: 0.9577
Epoch 4/20
709/709 [==============================] - 2s 3ms/step - loss: 0.1500 -
accuracy: 0.9570 - val_loss: 0.1373 - val_accuracy: 0.9607
Epoch 5/20
709/709 [==============================] - 2s 3ms/step - loss: 0.1252 -
accuracy: 0.9639 - val_loss: 0.1277 - val_accuracy: 0.9626
Epoch 6/20
709/709 [==============================] - 2s 3ms/step - loss: 0.1057 -
accuracy: 0.9692 - val_loss: 0.1122 - val_accuracy: 0.9677
Epoch 7/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0914 -
accuracy: 0.9733 - val_loss: 0.1074 - val_accuracy: 0.9683
Epoch 8/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0784 -
accuracy: 0.9772 - val_loss: 0.1020 - val_accuracy: 0.9710
Epoch 9/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0681 -
```

```
accuracy: 0.9804 - val_loss: 0.1018 - val_accuracy: 0.9707
Epoch 10/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0601 -
accuracy: 0.9828 - val_loss: 0.0973 - val_accuracy: 0.9729
Epoch 11/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0517 -
accuracy: 0.9852 - val_loss: 0.0938 - val_accuracy: 0.9727
Epoch 12/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0453 -
accuracy: 0.9875 - val_loss: 0.0928 - val_accuracy: 0.9740
Epoch 13/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0398 -
accuracy: 0.9892 - val_loss: 0.1015 - val_accuracy: 0.9730
Epoch 14/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0344 -
accuracy: 0.9909 - val_loss: 0.0959 - val_accuracy: 0.9732
Epoch 15/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0305 -
accuracy: 0.9916 - val_loss: 0.0935 - val_accuracy: 0.9737
Epoch 16/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0259 -
accuracy: 0.9932 - val_loss: 0.1058 - val_accuracy: 0.9737
Epoch 17/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0237 -
accuracy: 0.9935 - val_loss: 0.0926 - val_accuracy: 0.9757
Epoch 18/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0208 -
accuracy: 0.9946 - val_loss: 0.0989 - val_accuracy: 0.9739
Epoch 19/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0163 -
accuracy: 0.9960 - val_loss: 0.0995 - val_accuracy: 0.9758
Epoch 20/20
709/709 [==============================] - 2s 3ms/step - loss: 0.0143 -
accuracy: 0.9965 - val_loss: 0.1142 - val_accuracy: 0.9728

Accuracy: 97.28%

Epoch 1/20
1500/1500 [==============================] - 5s 3ms/step - loss: 0.3876 -
accuracy: 0.8798 - val_loss: 0.1792 - val_accuracy: 0.9466
Epoch 2/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.1612 -
accuracy: 0.9530 - val_loss: 0.1415 - val_accuracy: 0.9581
Epoch 3/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.1298 -
accuracy: 0.9627 - val_loss: 0.1267 - val_accuracy: 0.9619
Epoch 4/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.1142 -
```

```
accuracy: 0.9671 - val_loss: 0.1234 - val_accuracy: 0.9633
Epoch 5/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.1036 -
accuracy: 0.9709 - val_loss: 0.1215 - val_accuracy: 0.9624
Epoch 6/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0961 -
accuracy: 0.9726 - val_loss: 0.1177 - val_accuracy: 0.9643
Epoch 7/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0907 -
accuracy: 0.9745 - val_loss: 0.1164 - val_accuracy: 0.9658
Epoch 8/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0865 -
accuracy: 0.9753 - val_loss: 0.1153 - val_accuracy: 0.9666
Epoch 9/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0828 -
accuracy: 0.9769 - val_loss: 0.1138 - val_accuracy: 0.9652
Epoch 10/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0800 -
accuracy: 0.9776 - val_loss: 0.1124 - val_accuracy: 0.9661
Epoch 11/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0771 -
accuracy: 0.9787 - val_loss: 0.1103 - val_accuracy: 0.9679
Epoch 12/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0749 -
accuracy: 0.9791 - val_loss: 0.1102 - val_accuracy: 0.9669
Epoch 13/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0729 -
accuracy: 0.9801 - val_loss: 0.1105 - val_accuracy: 0.9687
Epoch 14/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0708 -
accuracy: 0.9805 - val_loss: 0.1098 - val_accuracy: 0.9682
Epoch 15/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0694 -
accuracy: 0.9810 - val_loss: 0.1090 - val_accuracy: 0.9688
Epoch 16/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0678 -
accuracy: 0.9815 - val_loss: 0.1099 - val_accuracy: 0.9688
Epoch 17/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0663 -
accuracy: 0.9820 - val_loss: 0.1081 - val_accuracy: 0.9682
Epoch 18/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0652 -
accuracy: 0.9819 - val_loss: 0.1083 - val_accuracy: 0.9684
Epoch 19/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0640 -
accuracy: 0.9823 - val_loss: 0.1080 - val_accuracy: 0.9688
Epoch 20/20
1500/1500 [==============================] - 4s 3ms/step - loss: 0.0627 -
```

```
accuracy: 0.9830 - val_loss: 0.1081 - val_accuracy: 0.9687

Accuracy: 96.87%

Epoch 1/20
521/521 [==============================] - 2s 4ms/step - loss: 1.8935 -
accuracy: 0.3637 - val_loss: 1.5487 - val_accuracy: 0.4788
Epoch 2/20
521/521 [==============================] - 2s 3ms/step - loss: 1.4380 -
accuracy: 0.4895 - val_loss: 1.2778 - val_accuracy: 0.5326
Epoch 3/20
521/521 [==============================] - 2s 3ms/step - loss: 1.2438 -
accuracy: 0.5368 - val_loss: 1.1269 - val_accuracy: 0.6013
Epoch 4/20
521/521 [==============================] - 2s 3ms/step - loss: 1.1189 -
accuracy: 0.6127 - val_loss: 1.0190 - val_accuracy: 0.6787
Epoch 5/20
521/521 [==============================] - 2s 3ms/step - loss: 1.0265 -
accuracy: 0.6850 - val_loss: 0.9379 - val_accuracy: 0.7298
Epoch 6/20
521/521 [==============================] - 2s 3ms/step - loss: 0.9558 -
accuracy: 0.7251 - val_loss: 0.8744 - val_accuracy: 0.7706
Epoch 7/20
521/521 [==============================] - 2s 3ms/step - loss: 0.9001 -
accuracy: 0.7614 - val_loss: 0.8234 - val_accuracy: 0.7968
Epoch 8/20
521/521 [==============================] - 2s 3ms/step - loss: 0.8551 -
accuracy: 0.7812 - val_loss: 0.7820 - val_accuracy: 0.8143
Epoch 9/20
521/521 [==============================] - 2s 3ms/step - loss: 0.8182 -
accuracy: 0.7940 - val_loss: 0.7479 - val_accuracy: 0.8254
Epoch 10/20
521/521 [==============================] - 2s 3ms/step - loss: 0.7876 -
accuracy: 0.8041 - val_loss: 0.7194 - val_accuracy: 0.8342
Epoch 11/20
521/521 [==============================] - 2s 4ms/step - loss: 0.7620 -
accuracy: 0.8104 - val_loss: 0.6953 - val_accuracy: 0.8401
Epoch 12/20
521/521 [==============================] - 2s 3ms/step - loss: 0.7402 -
accuracy: 0.8150 - val_loss: 0.6748 - val_accuracy: 0.8452
Epoch 13/20
521/521 [==============================] - 2s 3ms/step - loss: 0.7216 -
accuracy: 0.8192 - val_loss: 0.6571 - val_accuracy: 0.8488
Epoch 14/20
521/521 [==============================] - 2s 3ms/step - loss: 0.7054 -
accuracy: 0.8220 - val_loss: 0.6418 - val_accuracy: 0.8530
Epoch 15/20
521/521 [==============================] - 2s 3ms/step - loss: 0.6912 -
```

```
accuracy: 0.8256 - val_loss: 0.6283 - val_accuracy: 0.8548
Epoch 16/20
521/521 [==============================] - 2s 3ms/step - loss: 0.6786 -
accuracy: 0.8285 - val_loss: 0.6160 - val_accuracy: 0.8568
Epoch 17/20
521/521 [==============================] - 2s 3ms/step - loss: 0.6674 -
accuracy: 0.8304 - val_loss: 0.6051 - val_accuracy: 0.8589
Epoch 18/20
521/521 [==============================] - 2s 3ms/step - loss: 0.6572 -
accuracy: 0.8321 - val_loss: 0.5955 - val_accuracy: 0.8602
Epoch 19/20
521/521 [==============================] - 2s 3ms/step - loss: 0.6481 -
accuracy: 0.8337 - val_loss: 0.5866 - val_accuracy: 0.8619
Epoch 20/20
521/521 [==============================] - 2s 3ms/step - loss: 0.6397 -
accuracy: 0.8354 - val_loss: 0.5787 - val_accuracy: 0.8632

Accuracy: 86.32%

Epoch 1/20
850/850 [==============================] - 3s 3ms/step - loss: 0.5104 -
accuracy: 0.8504 - val_loss: 0.1934 - val_accuracy: 0.9429
Epoch 2/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1832 -
accuracy: 0.9474 - val_loss: 0.1420 - val_accuracy: 0.9574
Epoch 3/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1282 -
accuracy: 0.9632 - val_loss: 0.1249 - val_accuracy: 0.9616
Epoch 4/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0967 -
accuracy: 0.9729 - val_loss: 0.1138 - val_accuracy: 0.9686
Epoch 5/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0785 -
accuracy: 0.9765 - val_loss: 0.0955 - val_accuracy: 0.9720
Epoch 6/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0622 -
accuracy: 0.9816 - val_loss: 0.0945 - val_accuracy: 0.9743
Epoch 7/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0480 -
accuracy: 0.9859 - val_loss: 0.0985 - val_accuracy: 0.9729
Epoch 8/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0394 -
accuracy: 0.9886 - val_loss: 0.1070 - val_accuracy: 0.9733
Epoch 9/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0316 -
accuracy: 0.9907 - val_loss: 0.0838 - val_accuracy: 0.9764
Epoch 10/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0239 -
```

```
accuracy: 0.9935 - val_loss: 0.0879 - val_accuracy: 0.9769
Epoch 11/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0188 -
accuracy: 0.9945 - val_loss: 0.1040 - val_accuracy: 0.9744
Epoch 12/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0178 -
accuracy: 0.9946 - val_loss: 0.0880 - val_accuracy: 0.9778
Epoch 13/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0136 -
accuracy: 0.9962 - val_loss: 0.1046 - val_accuracy: 0.9746
Epoch 14/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0127 -
accuracy: 0.9965 - val_loss: 0.0968 - val_accuracy: 0.9767
Epoch 15/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0089 -
accuracy: 0.9974 - val_loss: 0.1170 - val_accuracy: 0.9718
Epoch 16/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0129 -
accuracy: 0.9960 - val_loss: 0.1012 - val_accuracy: 0.9787
Epoch 17/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0071 -
accuracy: 0.9981 - val_loss: 0.1048 - val_accuracy: 0.9770
Epoch 18/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0083 -
accuracy: 0.9974 - val_loss: 0.1068 - val_accuracy: 0.9771
Epoch 19/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0074 -
accuracy: 0.9978 - val_loss: 0.1130 - val_accuracy: 0.9776
Epoch 20/20
850/850 [==============================] - 2s 3ms/step - loss: 0.0067 -
accuracy: 0.9979 - val_loss: 0.1129 - val_accuracy: 0.9783

Accuracy: 97.83%

Epoch 1/20
850/850 [==============================] - 3s 3ms/step - loss: 0.6446 -
accuracy: 0.8155 - val_loss: 0.3006 - val_accuracy: 0.9201
Epoch 2/20
850/850 [==============================] - 2s 3ms/step - loss: 0.2940 -
accuracy: 0.9203 - val_loss: 0.2384 - val_accuracy: 0.9357
Epoch 3/20
850/850 [==============================] - 2s 3ms/step - loss: 0.2477 -
accuracy: 0.9325 - val_loss: 0.2143 - val_accuracy: 0.9424
Epoch 4/20
850/850 [==============================] - 2s 3ms/step - loss: 0.2240 -
accuracy: 0.9383 - val_loss: 0.2014 - val_accuracy: 0.9451
Epoch 5/20
850/850 [==============================] - 2s 3ms/step - loss: 0.2089 -
```

```
accuracy: 0.9423 - val_loss: 0.1912 - val_accuracy: 0.9484
Epoch 6/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1981 -
accuracy: 0.9453 - val_loss: 0.1837 - val_accuracy: 0.9503
Epoch 7/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1897 -
accuracy: 0.9477 - val_loss: 0.1802 - val_accuracy: 0.9513
Epoch 8/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1830 -
accuracy: 0.9494 - val_loss: 0.1745 - val_accuracy: 0.9531
Epoch 9/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1775 -
accuracy: 0.9504 - val_loss: 0.1712 - val_accuracy: 0.9530
Epoch 10/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1730 -
accuracy: 0.9518 - val_loss: 0.1689 - val_accuracy: 0.9538
Epoch 11/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1689 -
accuracy: 0.9528 - val_loss: 0.1654 - val_accuracy: 0.9539
Epoch 12/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1654 -
accuracy: 0.9540 - val_loss: 0.1631 - val_accuracy: 0.9542
Epoch 13/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1622 -
accuracy: 0.9546 - val_loss: 0.1615 - val_accuracy: 0.9547
Epoch 14/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1595 -
accuracy: 0.9555 - val_loss: 0.1599 - val_accuracy: 0.9558
Epoch 15/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1569 -
accuracy: 0.9564 - val_loss: 0.1585 - val_accuracy: 0.9558
Epoch 16/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1546 -
accuracy: 0.9569 - val_loss: 0.1573 - val_accuracy: 0.9572
Epoch 17/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1525 -
accuracy: 0.9573 - val_loss: 0.1554 - val_accuracy: 0.9570
Epoch 18/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1506 -
accuracy: 0.9581 - val_loss: 0.1549 - val_accuracy: 0.9572
Epoch 19/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1487 -
accuracy: 0.9584 - val_loss: 0.1535 - val_accuracy: 0.9579
Epoch 20/20
850/850 [==============================] - 2s 3ms/step - loss: 0.1470 -
accuracy: 0.9588 - val_loss: 0.1522 - val_accuracy: 0.9584

Accuracy: 95.84%
```

```
Epoch 1/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.2873 -
accuracy: 0.9143 - val_loss: 0.1384 - val_accuracy: 0.9613
Epoch 2/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.1373 -
accuracy: 0.9611 - val_loss: 0.1238 - val_accuracy: 0.9649
Epoch 3/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.1072 -
accuracy: 0.9701 - val_loss: 0.1181 - val_accuracy: 0.9691
Epoch 4/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0854 -
accuracy: 0.9764 - val_loss: 0.1215 - val_accuracy: 0.9673
Epoch 5/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0749 -
accuracy: 0.9784 - val_loss: 0.1027 - val_accuracy: 0.9732
Epoch 6/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0679 -
accuracy: 0.9813 - val_loss: 0.1283 - val_accuracy: 0.9718
Epoch 7/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0581 -
accuracy: 0.9847 - val_loss: 0.1362 - val_accuracy: 0.9679
Epoch 8/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0529 -
accuracy: 0.9856 - val_loss: 0.1098 - val_accuracy: 0.9753
Epoch 9/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0495 -
accuracy: 0.9871 - val_loss: 0.1172 - val_accuracy: 0.9750
Epoch 10/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0458 -
accuracy: 0.9879 - val_loss: 0.1118 - val_accuracy: 0.9777
Epoch 11/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0425 -
accuracy: 0.9891 - val_loss: 0.1190 - val_accuracy: 0.9784
Epoch 12/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0381 -
accuracy: 0.9902 - val_loss: 0.1331 - val_accuracy: 0.9748
Epoch 13/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0380 -
accuracy: 0.9903 - val_loss: 0.1066 - val_accuracy: 0.9776
Epoch 14/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0366 -
accuracy: 0.9913 - val_loss: 0.1098 - val_accuracy: 0.9766
Epoch 15/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0327 -
accuracy: 0.9919 - val_loss: 0.1144 - val_accuracy: 0.9773
Epoch 16/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0294 -
```

```
accuracy: 0.9923 - val_loss: 0.1583 - val_accuracy: 0.9728
Epoch 17/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0285 -
accuracy: 0.9931 - val_loss: 0.1408 - val_accuracy: 0.9738
Epoch 18/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0256 -
accuracy: 0.9935 - val_loss: 0.1366 - val_accuracy: 0.9790
Epoch 19/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0322 -
accuracy: 0.9925 - val_loss: 0.1163 - val_accuracy: 0.9773
Epoch 20/20
2218/2218 [==============================] - 7s 3ms/step - loss: 0.0251 -
accuracy: 0.9937 - val_loss: 0.1256 - val_accuracy: 0.9780

Accuracy: 97.80%

Epoch 1/20
412/412 [==============================] - 2s 3ms/step - loss: 2.3024 -
accuracy: 0.1119 - val_loss: 2.3024 - val_accuracy: 0.1063
Epoch 2/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3022 -
accuracy: 0.1134 - val_loss: 2.3023 - val_accuracy: 0.1063
Epoch 3/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3020 -
accuracy: 0.1134 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 4/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3019 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 5/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3018 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 6/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3018 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 7/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3017 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 8/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3017 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 9/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3017 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 10/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3016 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 11/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3016 -
```

```
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 12/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3016 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 13/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 14/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 15/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 16/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 17/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 18/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 19/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3015 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 20/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3014 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063

Accuracy: 10.63%

Epoch 1/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.5866 -
accuracy: 0.8411 - val_loss: 0.2535 - val_accuracy: 0.9307
Epoch 2/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.2493 -
accuracy: 0.9311 - val_loss: 0.2034 - val_accuracy: 0.9449
Epoch 3/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.2059 -
accuracy: 0.9417 - val_loss: 0.1760 - val_accuracy: 0.9518
Epoch 4/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1811 -
accuracy: 0.9483 - val_loss: 0.1633 - val_accuracy: 0.9539
Epoch 5/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1652 -
accuracy: 0.9530 - val_loss: 0.1522 - val_accuracy: 0.9563
Epoch 6/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.1535 -
```

```
accuracy: 0.9570 - val_loss: 0.1443 - val_accuracy: 0.9606
Epoch 7/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1447 -
accuracy: 0.9595 - val_loss: 0.1396 - val_accuracy: 0.9613
Epoch 8/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1379 -
accuracy: 0.9611 - val_loss: 0.1348 - val_accuracy: 0.9627
Epoch 9/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1320 -
accuracy: 0.9634 - val_loss: 0.1324 - val_accuracy: 0.9646
Epoch 10/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1269 -
accuracy: 0.9643 - val_loss: 0.1282 - val_accuracy: 0.9652
Epoch 11/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1227 -
accuracy: 0.9655 - val_loss: 0.1268 - val_accuracy: 0.9652
Epoch 12/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1189 -
accuracy: 0.9666 - val_loss: 0.1238 - val_accuracy: 0.9652
Epoch 13/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.1158 -
accuracy: 0.9675 - val_loss: 0.1213 - val_accuracy: 0.9660
Epoch 14/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1128 -
accuracy: 0.9681 - val_loss: 0.1200 - val_accuracy: 0.9666
Epoch 15/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1102 -
accuracy: 0.9688 - val_loss: 0.1185 - val_accuracy: 0.9673
Epoch 16/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1077 -
accuracy: 0.9697 - val_loss: 0.1181 - val_accuracy: 0.9667
Epoch 17/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1056 -
accuracy: 0.9704 - val_loss: 0.1157 - val_accuracy: 0.9679
Epoch 18/20
2685/2685 [==============================] - 7s 3ms/step - loss: 0.1035 -
accuracy: 0.9715 - val_loss: 0.1150 - val_accuracy: 0.9674
Epoch 19/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.1017 -
accuracy: 0.9717 - val_loss: 0.1154 - val_accuracy: 0.9674
Epoch 20/20
2685/2685 [==============================] - 8s 3ms/step - loss: 0.0999 -
accuracy: 0.9724 - val_loss: 0.1135 - val_accuracy: 0.9683

Accuracy: 96.83%

Epoch 1/20
408/408 [==============================] - 2s 3ms/step - loss: 0.2746 -
```

```
accuracy: 0.9168 - val_loss: 0.1450 - val_accuracy: 0.9540
Epoch 2/20
408/408 [==============================] - 1s 3ms/step - loss: 0.1113 -
accuracy: 0.9667 - val_loss: 0.0974 - val_accuracy: 0.9704
Epoch 3/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0767 -
accuracy: 0.9755 - val_loss: 0.0912 - val_accuracy: 0.9740
Epoch 4/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0599 -
accuracy: 0.9810 - val_loss: 0.0774 - val_accuracy: 0.9763
Epoch 5/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0499 -
accuracy: 0.9843 - val_loss: 0.0881 - val_accuracy: 0.9759
Epoch 6/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0429 -
accuracy: 0.9859 - val_loss: 0.0955 - val_accuracy: 0.9741
Epoch 7/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0371 -
accuracy: 0.9877 - val_loss: 0.0964 - val_accuracy: 0.9739
Epoch 8/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0331 -
accuracy: 0.9889 - val_loss: 0.0895 - val_accuracy: 0.9780
Epoch 9/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0331 -
accuracy: 0.9894 - val_loss: 0.0903 - val_accuracy: 0.9779
Epoch 10/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0215 -
accuracy: 0.9933 - val_loss: 0.1158 - val_accuracy: 0.9747
Epoch 11/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0268 -
accuracy: 0.9916 - val_loss: 0.1002 - val_accuracy: 0.9772
Epoch 12/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0262 -
accuracy: 0.9916 - val_loss: 0.1017 - val_accuracy: 0.9771
Epoch 13/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0210 -
accuracy: 0.9932 - val_loss: 0.1069 - val_accuracy: 0.9767
Epoch 14/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0202 -
accuracy: 0.9935 - val_loss: 0.1307 - val_accuracy: 0.9718
Epoch 15/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0246 -
accuracy: 0.9921 - val_loss: 0.1043 - val_accuracy: 0.9768
Epoch 16/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0177 -
accuracy: 0.9946 - val_loss: 0.1061 - val_accuracy: 0.9780
Epoch 17/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0152 -
```

```
accuracy: 0.9952 - val_loss: 0.1378 - val_accuracy: 0.9767
Epoch 18/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0208 -
accuracy: 0.9935 - val_loss: 0.1262 - val_accuracy: 0.9772
Epoch 19/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0184 -
accuracy: 0.9941 - val_loss: 0.1133 - val_accuracy: 0.9779
Epoch 20/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0114 -
accuracy: 0.9962 - val_loss: 0.1164 - val_accuracy: 0.9773

Accuracy: 97.73%

Epoch 1/20
433/433 [==============================] - 2s 3ms/step - loss: 0.8872 -
accuracy: 0.8058 - val_loss: 0.3186 - val_accuracy: 0.9316
Epoch 2/20
433/433 [==============================] - 1s 3ms/step - loss: 0.2720 -
accuracy: 0.9354 - val_loss: 0.2128 - val_accuracy: 0.9494
Epoch 3/20
433/433 [==============================] - 1s 3ms/step - loss: 0.2016 -
accuracy: 0.9490 - val_loss: 0.1726 - val_accuracy: 0.9572
Epoch 4/20
433/433 [==============================] - 1s 3ms/step - loss: 0.1694 -
accuracy: 0.9569 - val_loss: 0.1557 - val_accuracy: 0.9594
Epoch 5/20
433/433 [==============================] - 1s 3ms/step - loss: 0.1497 -
accuracy: 0.9614 - val_loss: 0.1436 - val_accuracy: 0.9621
Epoch 6/20
433/433 [==============================] - 1s 3ms/step - loss: 0.1363 -
accuracy: 0.9639 - val_loss: 0.1345 - val_accuracy: 0.9648
Epoch 7/20
433/433 [==============================] - 1s 3ms/step - loss: 0.1261 -
accuracy: 0.9665 - val_loss: 0.1287 - val_accuracy: 0.9653
Epoch 8/20
433/433 [==============================] - 1s 3ms/step - loss: 0.1181 -
accuracy: 0.9685 - val_loss: 0.1241 - val_accuracy: 0.9661
Epoch 9/20
433/433 [==============================] - 1s 3ms/step - loss: 0.1116 -
accuracy: 0.9702 - val_loss: 0.1203 - val_accuracy: 0.9664
Epoch 10/20
433/433 [==============================] - 1s 3ms/step - loss: 0.1062 -
accuracy: 0.9722 - val_loss: 0.1176 - val_accuracy: 0.9678
Epoch 11/20
433/433 [==============================] - 1s 3ms/step - loss: 0.1015 -
accuracy: 0.9732 - val_loss: 0.1150 - val_accuracy: 0.9683
Epoch 12/20
433/433 [==============================] - 1s 3ms/step - loss: 0.0976 -
```

```
accuracy: 0.9744 - val_loss: 0.1125 - val_accuracy: 0.9684
Epoch 13/20
433/433 [==============================] - 1s 3ms/step - loss: 0.0938 -
accuracy: 0.9755 - val_loss: 0.1106 - val_accuracy: 0.9690
Epoch 14/20
433/433 [==============================] - 1s 3ms/step - loss: 0.0908 -
accuracy: 0.9765 - val_loss: 0.1091 - val_accuracy: 0.9687
Epoch 15/20
433/433 [==============================] - 1s 3ms/step - loss: 0.0881 -
accuracy: 0.9771 - val_loss: 0.1076 - val_accuracy: 0.9691
Epoch 16/20
433/433 [==============================] - 1s 3ms/step - loss: 0.0856 -
accuracy: 0.9780 - val_loss: 0.1061 - val_accuracy: 0.9696
Epoch 17/20
433/433 [==============================] - 1s 3ms/step - loss: 0.0832 -
accuracy: 0.9787 - val_loss: 0.1051 - val_accuracy: 0.9697
Epoch 18/20
433/433 [==============================] - 1s 3ms/step - loss: 0.0811 -
accuracy: 0.9793 - val_loss: 0.1039 - val_accuracy: 0.9697
Epoch 19/20
433/433 [==============================] - 1s 3ms/step - loss: 0.0792 -
accuracy: 0.9798 - val_loss: 0.1032 - val_accuracy: 0.9701
Epoch 20/20
433/433 [==============================] - 1s 3ms/step - loss: 0.0775 -
accuracy: 0.9803 - val_loss: 0.1023 - val_accuracy: 0.9703

Accuracy: 97.03%

Epoch 1/20
473/473 [==============================] - 2s 3ms/step - loss: 1.1795 -
accuracy: 0.5870 - val_loss: 0.5883 - val_accuracy: 0.8420
Epoch 2/20
473/473 [==============================] - 1s 3ms/step - loss: 0.4385 -
accuracy: 0.8992 - val_loss: 0.3110 - val_accuracy: 0.9357
Epoch 3/20
473/473 [==============================] - 1s 3ms/step - loss: 0.2681 -
accuracy: 0.9426 - val_loss: 0.2313 - val_accuracy: 0.9508
Epoch 4/20
473/473 [==============================] - 1s 3ms/step - loss: 0.2049 -
accuracy: 0.9533 - val_loss: 0.1974 - val_accuracy: 0.9550
Epoch 5/20
473/473 [==============================] - 1s 3ms/step - loss: 0.1705 -
accuracy: 0.9596 - val_loss: 0.1779 - val_accuracy: 0.9582
Epoch 6/20
473/473 [==============================] - 1s 3ms/step - loss: 0.1490 -
accuracy: 0.9635 - val_loss: 0.1734 - val_accuracy: 0.9591
Epoch 7/20
473/473 [==============================] - 1s 3ms/step - loss: 0.1336 -
```

```
accuracy: 0.9670 - val_loss: 0.1591 - val_accuracy: 0.9616
Epoch 8/20
473/473 [==============================] - 1s 3ms/step - loss: 0.1218 -
accuracy: 0.9698 - val_loss: 0.1542 - val_accuracy: 0.9624
Epoch 9/20
473/473 [==============================] - 1s 3ms/step - loss: 0.1126 -
accuracy: 0.9721 - val_loss: 0.1504 - val_accuracy: 0.9628
Epoch 10/20
473/473 [==============================] - 1s 3ms/step - loss: 0.1051 -
accuracy: 0.9741 - val_loss: 0.1467 - val_accuracy: 0.9644
Epoch 11/20
473/473 [==============================] - 1s 3ms/step - loss: 0.0990 -
accuracy: 0.9758 - val_loss: 0.1436 - val_accuracy: 0.9643
Epoch 12/20
473/473 [==============================] - 2s 3ms/step - loss: 0.0937 -
accuracy: 0.9771 - val_loss: 0.1417 - val_accuracy: 0.9653
Epoch 13/20
473/473 [==============================] - 1s 3ms/step - loss: 0.0891 -
accuracy: 0.9782 - val_loss: 0.1404 - val_accuracy: 0.9646
Epoch 14/20
473/473 [==============================] - 1s 3ms/step - loss: 0.0851 -
accuracy: 0.9795 - val_loss: 0.1386 - val_accuracy: 0.9656
Epoch 15/20
473/473 [==============================] - 2s 3ms/step - loss: 0.0816 -
accuracy: 0.9805 - val_loss: 0.1382 - val_accuracy: 0.9647
Epoch 16/20
473/473 [==============================] - 1s 3ms/step - loss: 0.0784 -
accuracy: 0.9813 - val_loss: 0.1368 - val_accuracy: 0.9667
Epoch 17/20
473/473 [==============================] - 1s 3ms/step - loss: 0.0755 -
accuracy: 0.9820 - val_loss: 0.1369 - val_accuracy: 0.9663
Epoch 18/20
473/473 [==============================] - 1s 3ms/step - loss: 0.0730 -
accuracy: 0.9825 - val_loss: 0.1349 - val_accuracy: 0.9661
Epoch 19/20
473/473 [==============================] - 2s 3ms/step - loss: 0.0705 -
accuracy: 0.9836 - val_loss: 0.1345 - val_accuracy: 0.9670
Epoch 20/20
473/473 [==============================] - 1s 3ms/step - loss: 0.0684 -
accuracy: 0.9838 - val_loss: 0.1348 - val_accuracy: 0.9669

Accuracy: 96.69%

Epoch 1/20
690/690 [==============================] - 3s 3ms/step - loss: 0.3284 -
accuracy: 0.8995 - val_loss: 0.1806 - val_accuracy: 0.9472
Epoch 2/20
690/690 [==============================] - 2s 3ms/step - loss: 0.1565 -
```

```
accuracy: 0.9521 - val_loss: 0.1337 - val_accuracy: 0.9608
Epoch 3/20
690/690 [==============================] - 2s 3ms/step - loss: 0.1247 -
accuracy: 0.9621 - val_loss: 0.1309 - val_accuracy: 0.9599
Epoch 4/20
690/690 [==============================] - 2s 3ms/step - loss: 0.1055 -
accuracy: 0.9686 - val_loss: 0.1224 - val_accuracy: 0.9626
Epoch 5/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0950 -
accuracy: 0.9718 - val_loss: 0.1167 - val_accuracy: 0.9661
Epoch 6/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0859 -
accuracy: 0.9747 - val_loss: 0.1142 - val_accuracy: 0.9659
Epoch 7/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0790 -
accuracy: 0.9762 - val_loss: 0.1149 - val_accuracy: 0.9652
Epoch 8/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0740 -
accuracy: 0.9776 - val_loss: 0.1126 - val_accuracy: 0.9659
Epoch 9/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0695 -
accuracy: 0.9797 - val_loss: 0.1139 - val_accuracy: 0.9671
Epoch 10/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0654 -
accuracy: 0.9809 - val_loss: 0.1174 - val_accuracy: 0.9649
Epoch 11/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0623 -
accuracy: 0.9819 - val_loss: 0.1146 - val_accuracy: 0.9667
Epoch 12/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0594 -
accuracy: 0.9825 - val_loss: 0.1152 - val_accuracy: 0.9660
Epoch 13/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0570 -
accuracy: 0.9834 - val_loss: 0.1150 - val_accuracy: 0.9669
Epoch 14/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0549 -
accuracy: 0.9842 - val_loss: 0.1168 - val_accuracy: 0.9671
Epoch 15/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0527 -
accuracy: 0.9852 - val_loss: 0.1152 - val_accuracy: 0.9668
Epoch 16/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0510 -
accuracy: 0.9855 - val_loss: 0.1166 - val_accuracy: 0.9661
Epoch 17/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0493 -
accuracy: 0.9864 - val_loss: 0.1183 - val_accuracy: 0.9660
Epoch 18/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0479 -
```

```
accuracy: 0.9868 - val_loss: 0.1186 - val_accuracy: 0.9669
Epoch 19/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0464 -
accuracy: 0.9872 - val_loss: 0.1182 - val_accuracy: 0.9663
Epoch 20/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0452 -
accuracy: 0.9876 - val_loss: 0.1203 - val_accuracy: 0.9667

Accuracy: 96.67%

Epoch 1/20
543/543 [==============================] - 2s 3ms/step - loss: 1.6309 -
accuracy: 0.4387 - val_loss: 1.1619 - val_accuracy: 0.5824
Epoch 2/20
543/543 [==============================] - 2s 3ms/step - loss: 1.0347 -
accuracy: 0.6520 - val_loss: 0.9454 - val_accuracy: 0.7296
Epoch 3/20
543/543 [==============================] - 2s 3ms/step - loss: 0.8794 -
accuracy: 0.7467 - val_loss: 0.8356 - val_accuracy: 0.7931
Epoch 4/20
543/543 [==============================] - 2s 3ms/step - loss: 0.7881 -
accuracy: 0.7916 - val_loss: 0.7599 - val_accuracy: 0.8374
Epoch 5/20
543/543 [==============================] - 2s 3ms/step - loss: 0.7170 -
accuracy: 0.8394 - val_loss: 0.6966 - val_accuracy: 0.8637
Epoch 6/20
543/543 [==============================] - 2s 3ms/step - loss: 0.6577 -
accuracy: 0.8638 - val_loss: 0.6473 - val_accuracy: 0.8608
Epoch 7/20
543/543 [==============================] - 2s 3ms/step - loss: 0.6108 -
accuracy: 0.8684 - val_loss: 0.6087 - val_accuracy: 0.8839
Epoch 8/20
543/543 [==============================] - 2s 3ms/step - loss: 0.5734 -
accuracy: 0.8846 - val_loss: 0.5778 - val_accuracy: 0.8912
Epoch 9/20
543/543 [==============================] - 2s 3ms/step - loss: 0.5422 -
accuracy: 0.9011 - val_loss: 0.5527 - val_accuracy: 0.8996
Epoch 10/20
543/543 [==============================] - 2s 3ms/step - loss: 0.5159 -
accuracy: 0.9052 - val_loss: 0.5287 - val_accuracy: 0.9323
Epoch 11/20
543/543 [==============================] - 2s 3ms/step - loss: 0.4929 -
accuracy: 0.9352 - val_loss: 0.5091 - val_accuracy: 0.9294
Epoch 12/20
543/543 [==============================] - 2s 3ms/step - loss: 0.4725 -
accuracy: 0.9378 - val_loss: 0.4915 - val_accuracy: 0.9382
Epoch 13/20
543/543 [==============================] - 2s 3ms/step - loss: 0.4544 -
```

```
accuracy: 0.9437 - val_loss: 0.4767 - val_accuracy: 0.9426
Epoch 14/20
543/543 [==============================] - 2s 3ms/step - loss: 0.4385 -
accuracy: 0.9473 - val_loss: 0.4626 - val_accuracy: 0.9426
Epoch 15/20
543/543 [==============================] - 2s 3ms/step - loss: 0.4238 -
accuracy: 0.9504 - val_loss: 0.4506 - val_accuracy: 0.9452
Epoch 16/20
543/543 [==============================] - 2s 3ms/step - loss: 0.4104 -
accuracy: 0.9528 - val_loss: 0.4381 - val_accuracy: 0.9471
Epoch 17/20
543/543 [==============================] - 2s 3ms/step - loss: 0.3981 -
accuracy: 0.9550 - val_loss: 0.4270 - val_accuracy: 0.9473
Epoch 18/20
543/543 [==============================] - 2s 3ms/step - loss: 0.3866 -
accuracy: 0.9564 - val_loss: 0.4176 - val_accuracy: 0.9479
Epoch 19/20
543/543 [==============================] - 2s 3ms/step - loss: 0.3757 -
accuracy: 0.9584 - val_loss: 0.4084 - val_accuracy: 0.9489
Epoch 20/20
543/543 [==============================] - 2s 3ms/step - loss: 0.3655 -
accuracy: 0.9595 - val_loss: 0.3995 - val_accuracy: 0.9504

Accuracy: 95.04%

Epoch 1/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.5569 -
accuracy: 0.8329 - val_loss: 0.3251 - val_accuracy: 0.9189
Epoch 2/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.3403 -
accuracy: 0.9179 - val_loss: 0.3125 - val_accuracy: 0.9183
Epoch 3/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.2910 -
accuracy: 0.9314 - val_loss: 0.4327 - val_accuracy: 0.9013
Epoch 4/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.3671 -
accuracy: 0.9166 - val_loss: 0.3451 - val_accuracy: 0.9074
Epoch 5/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.4344 -
accuracy: 0.8978 - val_loss: 0.4793 - val_accuracy: 0.8512
Epoch 6/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.3815 -
accuracy: 0.9069 - val_loss: 0.3595 - val_accuracy: 0.9220
Epoch 7/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.4360 -
accuracy: 0.8809 - val_loss: 0.7240 - val_accuracy: 0.7138
Epoch 8/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.8960 -
```

```
accuracy: 0.6945 - val_loss: 0.9101 - val_accuracy: 0.7009
Epoch 9/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.9875 -
accuracy: 0.6506 - val_loss: 0.8936 - val_accuracy: 0.6922
Epoch 10/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.8936 -
accuracy: 0.7014 - val_loss: 0.8228 - val_accuracy: 0.6901
Epoch 11/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.9300 -
accuracy: 0.6928 - val_loss: 0.9584 - val_accuracy: 0.6003
Epoch 12/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.9101 -
accuracy: 0.6917 - val_loss: 0.6488 - val_accuracy: 0.8011
Epoch 13/20
1020/1020 [==============================] - 3s 3ms/step - loss: 0.8813 -
accuracy: 0.7511 - val_loss: 1.3030 - val_accuracy: 0.5017
Epoch 14/20
1020/1020 [==============================] - 3s 3ms/step - loss: 1.4054 -
accuracy: 0.4051 - val_loss: 1.3437 - val_accuracy: 0.4162
Epoch 15/20
1020/1020 [==============================] - 3s 3ms/step - loss: 1.3987 -
accuracy: 0.3811 - val_loss: 1.6507 - val_accuracy: 0.3023
Epoch 16/20
1020/1020 [==============================] - 3s 3ms/step - loss: 1.5096 -
accuracy: 0.3465 - val_loss: 1.3053 - val_accuracy: 0.4302
Epoch 17/20
1020/1020 [==============================] - 3s 3ms/step - loss: 1.7791 -
accuracy: 0.2985 - val_loss: 1.6993 - val_accuracy: 0.2810
Epoch 18/20
1020/1020 [==============================] - 3s 3ms/step - loss: 1.7555 -
accuracy: 0.2813 - val_loss: 1.9041 - val_accuracy: 0.1971
Epoch 19/20
1020/1020 [==============================] - 3s 3ms/step - loss: 2.2965 -
accuracy: 0.1159 - val_loss: 2.3039 - val_accuracy: 0.0964
Epoch 20/20
1020/1020 [==============================] - 3s 3ms/step - loss: 2.3024 -
accuracy: 0.1095 - val_loss: 2.3018 - val_accuracy: 0.1069

Accuracy: 10.69%

Epoch 1/20
491/491 [==============================] - 2s 3ms/step - loss: 1.2841 -
accuracy: 0.5036 - val_loss: 0.6910 - val_accuracy: 0.7564
Epoch 2/20
491/491 [==============================] - 2s 3ms/step - loss: 0.5276 -
accuracy: 0.8660 - val_loss: 0.4041 - val_accuracy: 0.9328
Epoch 3/20
491/491 [==============================] - 2s 3ms/step - loss: 0.3187 -
```

```
accuracy: 0.9447 - val_loss: 0.2653 - val_accuracy: 0.9510
Epoch 4/20
491/491 [==============================] - 2s 3ms/step - loss: 0.2269 -
accuracy: 0.9578 - val_loss: 0.2228 - val_accuracy: 0.9563
Epoch 5/20
491/491 [==============================] - 2s 3ms/step - loss: 0.1845 -
accuracy: 0.9649 - val_loss: 0.2047 - val_accuracy: 0.9576
Epoch 6/20
491/491 [==============================] - 2s 3ms/step - loss: 0.1590 -
accuracy: 0.9692 - val_loss: 0.1864 - val_accuracy: 0.9600
Epoch 7/20
491/491 [==============================] - 2s 3ms/step - loss: 0.1411 -
accuracy: 0.9726 - val_loss: 0.1811 - val_accuracy: 0.9613
Epoch 8/20
491/491 [==============================] - 2s 3ms/step - loss: 0.1275 -
accuracy: 0.9754 - val_loss: 0.1730 - val_accuracy: 0.9622
Epoch 9/20
491/491 [==============================] - 2s 3ms/step - loss: 0.1161 -
accuracy: 0.9775 - val_loss: 0.1672 - val_accuracy: 0.9626
Epoch 10/20
491/491 [==============================] - 2s 3ms/step - loss: 0.1075 -
accuracy: 0.9797 - val_loss: 0.1631 - val_accuracy: 0.9646
Epoch 11/20
491/491 [==============================] - 2s 3ms/step - loss: 0.1003 -
accuracy: 0.9813 - val_loss: 0.1591 - val_accuracy: 0.9639
Epoch 12/20
491/491 [==============================] - 2s 3ms/step - loss: 0.0939 -
accuracy: 0.9826 - val_loss: 0.1587 - val_accuracy: 0.9646
Epoch 13/20
491/491 [==============================] - 2s 3ms/step - loss: 0.0886 -
accuracy: 0.9836 - val_loss: 0.1552 - val_accuracy: 0.9654
Epoch 14/20
491/491 [==============================] - 2s 3ms/step - loss: 0.0838 -
accuracy: 0.9846 - val_loss: 0.1546 - val_accuracy: 0.9654
Epoch 15/20
491/491 [==============================] - 1s 3ms/step - loss: 0.0793 -
accuracy: 0.9857 - val_loss: 0.1524 - val_accuracy: 0.9659
Epoch 16/20
491/491 [==============================] - 2s 3ms/step - loss: 0.0755 -
accuracy: 0.9866 - val_loss: 0.1510 - val_accuracy: 0.9661
Epoch 17/20
491/491 [==============================] - 2s 3ms/step - loss: 0.0723 -
accuracy: 0.9873 - val_loss: 0.1505 - val_accuracy: 0.9668
Epoch 18/20
491/491 [==============================] - 2s 3ms/step - loss: 0.0689 -
accuracy: 0.9880 - val_loss: 0.1513 - val_accuracy: 0.9670
Epoch 19/20
491/491 [==============================] - 2s 3ms/step - loss: 0.0663 -
```

```
accuracy: 0.9886 - val_loss: 0.1493 - val_accuracy: 0.9671
Epoch 20/20
491/491 [==============================] - 2s 3ms/step - loss: 0.0636 -
accuracy: 0.9892 - val_loss: 0.1485 - val_accuracy: 0.9670

Accuracy: 96.70%

Epoch 1/20
762/762 [==============================] - 3s 3ms/step - loss: 0.7388 -
accuracy: 0.7907 - val_loss: 0.2009 - val_accuracy: 0.9568
Epoch 2/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1674 -
accuracy: 0.9601 - val_loss: 0.1331 - val_accuracy: 0.9694
Epoch 3/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1012 -
accuracy: 0.9759 - val_loss: 0.1140 - val_accuracy: 0.9729
Epoch 4/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0703 -
accuracy: 0.9829 - val_loss: 0.1107 - val_accuracy: 0.9730
Epoch 5/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0496 -
accuracy: 0.9893 - val_loss: 0.1073 - val_accuracy: 0.9769
Epoch 6/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0377 -
accuracy: 0.9918 - val_loss: 0.1098 - val_accuracy: 0.9762
Epoch 7/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0279 -
accuracy: 0.9946 - val_loss: 0.1050 - val_accuracy: 0.9777
Epoch 8/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0218 -
accuracy: 0.9959 - val_loss: 0.1082 - val_accuracy: 0.9769
Epoch 9/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0174 -
accuracy: 0.9971 - val_loss: 0.1099 - val_accuracy: 0.9773
Epoch 10/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0135 -
accuracy: 0.9979 - val_loss: 0.1099 - val_accuracy: 0.9777
Epoch 11/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0112 -
accuracy: 0.9984 - val_loss: 0.1098 - val_accuracy: 0.9764
Epoch 12/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0087 -
accuracy: 0.9988 - val_loss: 0.1147 - val_accuracy: 0.9780
Epoch 13/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0071 -
accuracy: 0.9992 - val_loss: 0.1150 - val_accuracy: 0.9779
Epoch 14/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0058 -
```

```
accuracy: 0.9993 - val_loss: 0.1152 - val_accuracy: 0.9781
Epoch 15/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0048 -
accuracy: 0.9993 - val_loss: 0.1188 - val_accuracy: 0.9767
Epoch 16/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0043 -
accuracy: 0.9994 - val_loss: 0.1175 - val_accuracy: 0.9781
Epoch 17/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0034 -
accuracy: 0.9996 - val_loss: 0.1205 - val_accuracy: 0.9776
Epoch 18/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0026 -
accuracy: 0.9997 - val_loss: 0.1230 - val_accuracy: 0.9774
Epoch 19/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0022 -
accuracy: 0.9998 - val_loss: 0.1265 - val_accuracy: 0.9777
Epoch 20/20
762/762 [==============================] - 2s 3ms/step - loss: 0.0019 -
accuracy: 0.9999 - val_loss: 0.1262 - val_accuracy: 0.9777

Accuracy: 97.77%

Epoch 1/20
2040/2040 [==============================] - 6s 3ms/step - loss: 0.2955 -
accuracy: 0.9120 - val_loss: 0.1488 - val_accuracy: 0.9561
Epoch 2/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.1477 -
accuracy: 0.9571 - val_loss: 0.1479 - val_accuracy: 0.9584
Epoch 3/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.1135 -
accuracy: 0.9665 - val_loss: 0.1109 - val_accuracy: 0.9688
Epoch 4/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.1000 -
accuracy: 0.9715 - val_loss: 0.1257 - val_accuracy: 0.9661
Epoch 5/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0853 -
accuracy: 0.9753 - val_loss: 0.1074 - val_accuracy: 0.9710
Epoch 6/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0751 -
accuracy: 0.9787 - val_loss: 0.1042 - val_accuracy: 0.9713
Epoch 7/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0698 -
accuracy: 0.9798 - val_loss: 0.1213 - val_accuracy: 0.9686
Epoch 8/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0593 -
accuracy: 0.9833 - val_loss: 0.1067 - val_accuracy: 0.9742
Epoch 9/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0556 -
```

```
accuracy: 0.9844 - val_loss: 0.1180 - val_accuracy: 0.9694
Epoch 10/20
2040/2040 [==============================] - 5s 2ms/step - loss: 0.0540 -
accuracy: 0.9841 - val_loss: 0.1247 - val_accuracy: 0.9700
Epoch 11/20
2040/2040 [==============================] - 5s 2ms/step - loss: 0.0509 -
accuracy: 0.9852 - val_loss: 0.1237 - val_accuracy: 0.9751
Epoch 12/20
2040/2040 [==============================] - 5s 2ms/step - loss: 0.0472 -
accuracy: 0.9872 - val_loss: 0.1106 - val_accuracy: 0.9732
Epoch 13/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0456 -
accuracy: 0.9870 - val_loss: 0.1214 - val_accuracy: 0.9732
Epoch 14/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0397 -
accuracy: 0.9886 - val_loss: 0.1345 - val_accuracy: 0.9736
Epoch 15/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0417 -
accuracy: 0.9886 - val_loss: 0.1155 - val_accuracy: 0.9760
Epoch 16/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0377 -
accuracy: 0.9895 - val_loss: 0.1499 - val_accuracy: 0.9700
Epoch 17/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0363 -
accuracy: 0.9904 - val_loss: 0.1057 - val_accuracy: 0.9773
Epoch 18/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0362 -
accuracy: 0.9902 - val_loss: 0.1602 - val_accuracy: 0.9694
Epoch 19/20
2040/2040 [==============================] - 5s 2ms/step - loss: 0.0313 -
accuracy: 0.9917 - val_loss: 0.1518 - val_accuracy: 0.9713
Epoch 20/20
2040/2040 [==============================] - 5s 3ms/step - loss: 0.0339 -
accuracy: 0.9910 - val_loss: 0.1373 - val_accuracy: 0.9737

Accuracy: 97.37%

Epoch 1/20
750/750 [==============================] - 3s 3ms/step - loss: 0.6305 -
accuracy: 0.8429 - val_loss: 0.1774 - val_accuracy: 0.9582
Epoch 2/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1542 -
accuracy: 0.9622 - val_loss: 0.1279 - val_accuracy: 0.9668
Epoch 3/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0978 -
accuracy: 0.9764 - val_loss: 0.1071 - val_accuracy: 0.9717
Epoch 4/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0697 -
```

```
accuracy: 0.9839 - val_loss: 0.1047 - val_accuracy: 0.9728
Epoch 5/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0517 -
accuracy: 0.9888 - val_loss: 0.0960 - val_accuracy: 0.9747
Epoch 6/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0406 -
accuracy: 0.9914 - val_loss: 0.0950 - val_accuracy: 0.9750
Epoch 7/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0315 -
accuracy: 0.9938 - val_loss: 0.0939 - val_accuracy: 0.9750
Epoch 8/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0263 -
accuracy: 0.9948 - val_loss: 0.0908 - val_accuracy: 0.9750
Epoch 9/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0211 -
accuracy: 0.9960 - val_loss: 0.0948 - val_accuracy: 0.9763
Epoch 10/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0167 -
accuracy: 0.9973 - val_loss: 0.0966 - val_accuracy: 0.9764
Epoch 11/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0138 -
accuracy: 0.9979 - val_loss: 0.0931 - val_accuracy: 0.9767
Epoch 12/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0117 -
accuracy: 0.9984 - val_loss: 0.0941 - val_accuracy: 0.9778
Epoch 13/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0097 -
accuracy: 0.9987 - val_loss: 0.0973 - val_accuracy: 0.9762
Epoch 14/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0083 -
accuracy: 0.9988 - val_loss: 0.0960 - val_accuracy: 0.9773
Epoch 15/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0070 -
accuracy: 0.9991 - val_loss: 0.0943 - val_accuracy: 0.9774
Epoch 16/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0059 -
accuracy: 0.9994 - val_loss: 0.0952 - val_accuracy: 0.9780
Epoch 17/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0051 -
accuracy: 0.9995 - val_loss: 0.0983 - val_accuracy: 0.9776
Epoch 18/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0045 -
accuracy: 0.9995 - val_loss: 0.0970 - val_accuracy: 0.9781
Epoch 19/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0040 -
accuracy: 0.9996 - val_loss: 0.0998 - val_accuracy: 0.9779
Epoch 20/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0034 -
```

```
accuracy: 0.9996 - val_loss: 0.1027 - val_accuracy: 0.9768

Accuracy: 97.68%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 2.3015 -
accuracy: 0.1120 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
```

```
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3011 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063

Accuracy: 10.63%

Epoch 1/20
425/425 [==============================] - 2s 3ms/step - loss: 0.2796 -
accuracy: 0.9137 - val_loss: 0.1134 - val_accuracy: 0.9649
Epoch 2/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0938 -
accuracy: 0.9723 - val_loss: 0.0886 - val_accuracy: 0.9730
Epoch 3/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0635 -
accuracy: 0.9812 - val_loss: 0.0871 - val_accuracy: 0.9742
Epoch 4/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0467 -
accuracy: 0.9868 - val_loss: 0.0821 - val_accuracy: 0.9761
Epoch 5/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0363 -
accuracy: 0.9900 - val_loss: 0.0783 - val_accuracy: 0.9792
Epoch 6/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0288 -
accuracy: 0.9925 - val_loss: 0.0771 - val_accuracy: 0.9780
Epoch 7/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0235 -
accuracy: 0.9941 - val_loss: 0.0761 - val_accuracy: 0.9791
Epoch 8/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0198 -
accuracy: 0.9953 - val_loss: 0.0776 - val_accuracy: 0.9792
Epoch 9/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0164 -
accuracy: 0.9964 - val_loss: 0.0785 - val_accuracy: 0.9793
Epoch 10/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0140 -
```

```
accuracy: 0.9970 - val_loss: 0.0806 - val_accuracy: 0.9796
Epoch 11/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0122 -
accuracy: 0.9975 - val_loss: 0.0801 - val_accuracy: 0.9798
Epoch 12/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0102 -
accuracy: 0.9979 - val_loss: 0.0816 - val_accuracy: 0.9790
Epoch 13/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0089 -
accuracy: 0.9983 - val_loss: 0.0831 - val_accuracy: 0.9801
Epoch 14/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0076 -
accuracy: 0.9986 - val_loss: 0.0847 - val_accuracy: 0.9802
Epoch 15/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0066 -
accuracy: 0.9988 - val_loss: 0.0858 - val_accuracy: 0.9804
Epoch 16/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0057 -
accuracy: 0.9992 - val_loss: 0.0879 - val_accuracy: 0.9807
Epoch 17/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0050 -
accuracy: 0.9993 - val_loss: 0.0898 - val_accuracy: 0.9813
Epoch 18/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0044 -
accuracy: 0.9995 - val_loss: 0.0927 - val_accuracy: 0.9801
Epoch 19/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0039 -
accuracy: 0.9996 - val_loss: 0.0925 - val_accuracy: 0.9809
Epoch 20/20
425/425 [==============================] - 1s 3ms/step - loss: 0.0035 -
accuracy: 0.9997 - val_loss: 0.0943 - val_accuracy: 0.9801

Accuracy: 98.01%

Epoch 1/20
456/456 [==============================] - 2s 3ms/step - loss: 0.5014 -
accuracy: 0.8835 - val_loss: 0.2169 - val_accuracy: 0.9454
Epoch 2/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2031 -
accuracy: 0.9468 - val_loss: 0.1652 - val_accuracy: 0.9570
Epoch 3/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1605 -
accuracy: 0.9576 - val_loss: 0.1451 - val_accuracy: 0.9609
Epoch 4/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1383 -
accuracy: 0.9636 - val_loss: 0.1332 - val_accuracy: 0.9647
Epoch 5/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1236 -
```

```
accuracy: 0.9672 - val_loss: 0.1252 - val_accuracy: 0.9652
Epoch 6/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1131 -
accuracy: 0.9700 - val_loss: 0.1187 - val_accuracy: 0.9660
Epoch 7/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1050 -
accuracy: 0.9722 - val_loss: 0.1146 - val_accuracy: 0.9683
Epoch 8/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0986 -
accuracy: 0.9742 - val_loss: 0.1106 - val_accuracy: 0.9693
Epoch 9/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0931 -
accuracy: 0.9758 - val_loss: 0.1078 - val_accuracy: 0.9699
Epoch 10/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0885 -
accuracy: 0.9772 - val_loss: 0.1053 - val_accuracy: 0.9702
Epoch 11/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0846 -
accuracy: 0.9782 - val_loss: 0.1033 - val_accuracy: 0.9699
Epoch 12/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0813 -
accuracy: 0.9791 - val_loss: 0.1011 - val_accuracy: 0.9707
Epoch 13/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0782 -
accuracy: 0.9801 - val_loss: 0.1002 - val_accuracy: 0.9709
Epoch 14/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0755 -
accuracy: 0.9808 - val_loss: 0.0988 - val_accuracy: 0.9717
Epoch 15/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0732 -
accuracy: 0.9815 - val_loss: 0.0975 - val_accuracy: 0.9717
Epoch 16/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0710 -
accuracy: 0.9822 - val_loss: 0.0957 - val_accuracy: 0.9719
Epoch 17/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0690 -
accuracy: 0.9825 - val_loss: 0.0946 - val_accuracy: 0.9720
Epoch 18/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0672 -
accuracy: 0.9833 - val_loss: 0.0940 - val_accuracy: 0.9728
Epoch 19/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0656 -
accuracy: 0.9836 - val_loss: 0.0931 - val_accuracy: 0.9727
Epoch 20/20
456/456 [==============================] - 1s 3ms/step - loss: 0.0640 -
accuracy: 0.9841 - val_loss: 0.0924 - val_accuracy: 0.9724

Accuracy: 97.24%
```

```
Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.3180 -
accuracy: 0.9015 - val_loss: 0.1475 - val_accuracy: 0.9576
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1313 -
accuracy: 0.9599 - val_loss: 0.1196 - val_accuracy: 0.9653
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0998 -
accuracy: 0.9706 - val_loss: 0.1097 - val_accuracy: 0.9681
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0833 -
accuracy: 0.9746 - val_loss: 0.1028 - val_accuracy: 0.9721
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0720 -
accuracy: 0.9783 - val_loss: 0.1029 - val_accuracy: 0.9694
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0650 -
accuracy: 0.9804 - val_loss: 0.1026 - val_accuracy: 0.9696
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0589 -
accuracy: 0.9822 - val_loss: 0.0991 - val_accuracy: 0.9721
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0538 -
accuracy: 0.9841 - val_loss: 0.1008 - val_accuracy: 0.9718
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0500 -
accuracy: 0.9855 - val_loss: 0.0988 - val_accuracy: 0.9713
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0463 -
accuracy: 0.9868 - val_loss: 0.0986 - val_accuracy: 0.9717
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0436 -
accuracy: 0.9876 - val_loss: 0.0993 - val_accuracy: 0.9713
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0413 -
accuracy: 0.9884 - val_loss: 0.1000 - val_accuracy: 0.9722
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0389 -
accuracy: 0.9897 - val_loss: 0.0993 - val_accuracy: 0.9718
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0370 -
accuracy: 0.9902 - val_loss: 0.1006 - val_accuracy: 0.9728
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0354 -
accuracy: 0.9903 - val_loss: 0.1011 - val_accuracy: 0.9719
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0337 -
```

```
accuracy: 0.9918 - val_loss: 0.1028 - val_accuracy: 0.9721
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0324 -
accuracy: 0.9917 - val_loss: 0.1017 - val_accuracy: 0.9726
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0310 -
accuracy: 0.9921 - val_loss: 0.1015 - val_accuracy: 0.9731
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0299 -
accuracy: 0.9927 - val_loss: 0.1027 - val_accuracy: 0.9719
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0288 -
accuracy: 0.9934 - val_loss: 0.1031 - val_accuracy: 0.9729

Accuracy: 97.29%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 0.9367 -
accuracy: 0.7281 - val_loss: 0.3626 - val_accuracy: 0.9278
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2944 -
accuracy: 0.9361 - val_loss: 0.2265 - val_accuracy: 0.9529
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2105 -
accuracy: 0.9531 - val_loss: 0.1959 - val_accuracy: 0.9561
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1741 -
accuracy: 0.9609 - val_loss: 0.1757 - val_accuracy: 0.9590
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1521 -
accuracy: 0.9661 - val_loss: 0.1675 - val_accuracy: 0.9602
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1376 -
accuracy: 0.9691 - val_loss: 0.1587 - val_accuracy: 0.9616
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1252 -
accuracy: 0.9725 - val_loss: 0.1535 - val_accuracy: 0.9636
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1163 -
accuracy: 0.9743 - val_loss: 0.1504 - val_accuracy: 0.9646
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1088 -
accuracy: 0.9764 - val_loss: 0.1479 - val_accuracy: 0.9638
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1029 -
accuracy: 0.9775 - val_loss: 0.1463 - val_accuracy: 0.9638
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0973 -
```

```
accuracy: 0.9789 - val_loss: 0.1441 - val_accuracy: 0.9641
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0930 -
accuracy: 0.9807 - val_loss: 0.1427 - val_accuracy: 0.9647
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0891 -
accuracy: 0.9814 - val_loss: 0.1417 - val_accuracy: 0.9643
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0853 -
accuracy: 0.9824 - val_loss: 0.1394 - val_accuracy: 0.9654
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0823 -
accuracy: 0.9829 - val_loss: 0.1391 - val_accuracy: 0.9654
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0793 -
accuracy: 0.9840 - val_loss: 0.1385 - val_accuracy: 0.9656
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0767 -
accuracy: 0.9846 - val_loss: 0.1382 - val_accuracy: 0.9657
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0742 -
accuracy: 0.9854 - val_loss: 0.1380 - val_accuracy: 0.9660
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0721 -
accuracy: 0.9858 - val_loss: 0.1374 - val_accuracy: 0.9654
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0700 -
accuracy: 0.9861 - val_loss: 0.1364 - val_accuracy: 0.9662

Accuracy: 96.62%

Epoch 1/20
464/464 [==============================] - 2s 3ms/step - loss: 0.5507 -
accuracy: 0.8454 - val_loss: 0.1659 - val_accuracy: 0.9551
Epoch 2/20
464/464 [==============================] - 1s 3ms/step - loss: 0.1418 -
accuracy: 0.9604 - val_loss: 0.1174 - val_accuracy: 0.9667
Epoch 3/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0943 -
accuracy: 0.9732 - val_loss: 0.1041 - val_accuracy: 0.9707
Epoch 4/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0666 -
accuracy: 0.9812 - val_loss: 0.0918 - val_accuracy: 0.9751
Epoch 5/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0518 -
accuracy: 0.9850 - val_loss: 0.0933 - val_accuracy: 0.9741
Epoch 6/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0379 -
```

```
accuracy: 0.9888 - val_loss: 0.0906 - val_accuracy: 0.9742
Epoch 7/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0302 -
accuracy: 0.9911 - val_loss: 0.0888 - val_accuracy: 0.9774
Epoch 8/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0213 -
accuracy: 0.9939 - val_loss: 0.0874 - val_accuracy: 0.9778
Epoch 9/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0156 -
accuracy: 0.9958 - val_loss: 0.0941 - val_accuracy: 0.9761
Epoch 10/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0149 -
accuracy: 0.9957 - val_loss: 0.1078 - val_accuracy: 0.9768
Epoch 11/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0124 -
accuracy: 0.9966 - val_loss: 0.1010 - val_accuracy: 0.9753
Epoch 12/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0111 -
accuracy: 0.9965 - val_loss: 0.1018 - val_accuracy: 0.9772
Epoch 13/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0089 -
accuracy: 0.9975 - val_loss: 0.0984 - val_accuracy: 0.9779
Epoch 14/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0079 -
accuracy: 0.9977 - val_loss: 0.0975 - val_accuracy: 0.9794
Epoch 15/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0099 -
accuracy: 0.9967 - val_loss: 0.1068 - val_accuracy: 0.9783
Epoch 16/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0102 -
accuracy: 0.9967 - val_loss: 0.1121 - val_accuracy: 0.9768
Epoch 17/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0072 -
accuracy: 0.9978 - val_loss: 0.1152 - val_accuracy: 0.9777
Epoch 18/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0036 -
accuracy: 0.9991 - val_loss: 0.1092 - val_accuracy: 0.9800
Epoch 19/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0083 -
accuracy: 0.9975 - val_loss: 0.1335 - val_accuracy: 0.9739
Epoch 20/20
464/464 [==============================] - 1s 3ms/step - loss: 0.0092 -
accuracy: 0.9971 - val_loss: 0.1156 - val_accuracy: 0.9776

Accuracy: 97.76%

Epoch 1/20
415/415 [==============================] - 2s 3ms/step - loss: 0.3093 -
```

```
accuracy: 0.9113 - val_loss: 0.1367 - val_accuracy: 0.9626
Epoch 2/20
415/415 [==============================] - 1s 3ms/step - loss: 0.1153 -
accuracy: 0.9672 - val_loss: 0.0969 - val_accuracy: 0.9713
Epoch 3/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0766 -
accuracy: 0.9780 - val_loss: 0.0836 - val_accuracy: 0.9757
Epoch 4/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0555 -
accuracy: 0.9847 - val_loss: 0.0749 - val_accuracy: 0.9774
Epoch 5/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0423 -
accuracy: 0.9882 - val_loss: 0.0718 - val_accuracy: 0.9796
Epoch 6/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0331 -
accuracy: 0.9917 - val_loss: 0.0751 - val_accuracy: 0.9777
Epoch 7/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0261 -
accuracy: 0.9938 - val_loss: 0.0695 - val_accuracy: 0.9798
Epoch 8/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0212 -
accuracy: 0.9955 - val_loss: 0.0697 - val_accuracy: 0.9792
Epoch 9/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0176 -
accuracy: 0.9968 - val_loss: 0.0682 - val_accuracy: 0.9801
Epoch 10/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0147 -
accuracy: 0.9974 - val_loss: 0.0682 - val_accuracy: 0.9808
Epoch 11/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0125 -
accuracy: 0.9981 - val_loss: 0.0671 - val_accuracy: 0.9814
Epoch 12/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0105 -
accuracy: 0.9985 - val_loss: 0.0695 - val_accuracy: 0.9808
Epoch 13/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0089 -
accuracy: 0.9991 - val_loss: 0.0684 - val_accuracy: 0.9814
Epoch 14/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0076 -
accuracy: 0.9992 - val_loss: 0.0683 - val_accuracy: 0.9811
Epoch 15/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0064 -
accuracy: 0.9995 - val_loss: 0.0684 - val_accuracy: 0.9809
Epoch 16/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0057 -
accuracy: 0.9995 - val_loss: 0.0694 - val_accuracy: 0.9813
Epoch 17/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0049 -
```

```
accuracy: 0.9997 - val_loss: 0.0732 - val_accuracy: 0.9809
Epoch 18/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0043 -
accuracy: 0.9998 - val_loss: 0.0709 - val_accuracy: 0.9821
Epoch 19/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0037 -
accuracy: 0.9999 - val_loss: 0.0715 - val_accuracy: 0.9813
Epoch 20/20
415/415 [==============================] - 1s 3ms/step - loss: 0.0032 -
accuracy: 0.9999 - val_loss: 0.0724 - val_accuracy: 0.9814

Accuracy: 98.14%

Epoch 1/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.8774 -
accuracy: 0.7687 - val_loss: 0.5317 - val_accuracy: 0.8811
Epoch 2/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.5161 -
accuracy: 0.8744 - val_loss: 0.4324 - val_accuracy: 0.8982
Epoch 3/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.4505 -
accuracy: 0.8869 - val_loss: 0.3935 - val_accuracy: 0.9042
Epoch 4/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.4188 -
accuracy: 0.8938 - val_loss: 0.3708 - val_accuracy: 0.9059
Epoch 5/20
3400/3400 [==============================] - 8s 2ms/step - loss: 0.3989 -
accuracy: 0.8977 - val_loss: 0.3555 - val_accuracy: 0.9094
Epoch 6/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.3848 -
accuracy: 0.9006 - val_loss: 0.3444 - val_accuracy: 0.9124
Epoch 7/20
3400/3400 [==============================] - 8s 2ms/step - loss: 0.3741 -
accuracy: 0.9031 - val_loss: 0.3359 - val_accuracy: 0.9139
Epoch 8/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.3656 -
accuracy: 0.9046 - val_loss: 0.3290 - val_accuracy: 0.9157
Epoch 9/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.3587 -
accuracy: 0.9058 - val_loss: 0.3232 - val_accuracy: 0.9170
Epoch 10/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.3528 -
accuracy: 0.9073 - val_loss: 0.3181 - val_accuracy: 0.9181
Epoch 11/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.3478 -
accuracy: 0.9086 - val_loss: 0.3141 - val_accuracy: 0.9182
Epoch 12/20
3400/3400 [==============================] - 9s 2ms/step - loss: 0.3434 -
```

```
accuracy: 0.9094 - val_loss: 0.3105 - val_accuracy: 0.9206
Epoch 13/20
3400/3400 [==============================] - 8s 2ms/step - loss: 0.3396 -
accuracy: 0.9103 - val_loss: 0.3072 - val_accuracy: 0.9209
Epoch 14/20
3400/3400 [==============================] - 8s 2ms/step - loss: 0.3361 -
accuracy: 0.9111 - val_loss: 0.3041 - val_accuracy: 0.9214
Epoch 15/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.3330 -
accuracy: 0.9117 - val_loss: 0.3014 - val_accuracy: 0.9218
Epoch 16/20
3400/3400 [==============================] - 8s 2ms/step - loss: 0.3301 -
accuracy: 0.9123 - val_loss: 0.2992 - val_accuracy: 0.9221
Epoch 17/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.3276 -
accuracy: 0.9126 - val_loss: 0.2968 - val_accuracy: 0.9226
Epoch 18/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.3252 -
accuracy: 0.9135 - val_loss: 0.2947 - val_accuracy: 0.9228
Epoch 19/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.3230 -
accuracy: 0.9142 - val_loss: 0.2929 - val_accuracy: 0.9233
Epoch 20/20
3400/3400 [==============================] - 9s 3ms/step - loss: 0.3210 -
accuracy: 0.9143 - val_loss: 0.2910 - val_accuracy: 0.9242

Accuracy: 92.42%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.5953 -
accuracy: 0.8566 - val_loss: 0.2302 - val_accuracy: 0.9422
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2110 -
accuracy: 0.9441 - val_loss: 0.1590 - val_accuracy: 0.9600
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1526 -
accuracy: 0.9591 - val_loss: 0.1369 - val_accuracy: 0.9629
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1239 -
accuracy: 0.9668 - val_loss: 0.1154 - val_accuracy: 0.9697
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1042 -
accuracy: 0.9726 - val_loss: 0.1053 - val_accuracy: 0.9713
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0909 -
accuracy: 0.9762 - val_loss: 0.0988 - val_accuracy: 0.9719
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0812 -
```

```
accuracy: 0.9789 - val_loss: 0.0941 - val_accuracy: 0.9731
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0732 -
accuracy: 0.9814 - val_loss: 0.0897 - val_accuracy: 0.9743
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0669 -
accuracy: 0.9828 - val_loss: 0.0880 - val_accuracy: 0.9741
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0615 -
accuracy: 0.9848 - val_loss: 0.0840 - val_accuracy: 0.9756
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0570 -
accuracy: 0.9860 - val_loss: 0.0826 - val_accuracy: 0.9754
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0530 -
accuracy: 0.9872 - val_loss: 0.0806 - val_accuracy: 0.9754
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0496 -
accuracy: 0.9882 - val_loss: 0.0793 - val_accuracy: 0.9758
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0466 -
accuracy: 0.9890 - val_loss: 0.0778 - val_accuracy: 0.9761
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0439 -
accuracy: 0.9897 - val_loss: 0.0773 - val_accuracy: 0.9764
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0415 -
accuracy: 0.9907 - val_loss: 0.0752 - val_accuracy: 0.9770
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0393 -
accuracy: 0.9912 - val_loss: 0.0751 - val_accuracy: 0.9776
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0373 -
accuracy: 0.9918 - val_loss: 0.0737 - val_accuracy: 0.9774
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0355 -
accuracy: 0.9925 - val_loss: 0.0735 - val_accuracy: 0.9778
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0337 -
accuracy: 0.9928 - val_loss: 0.0720 - val_accuracy: 0.9773

Accuracy: 97.73%

Epoch 1/20
574/574 [==============================] - 2s 3ms/step - loss: 0.4008 -
accuracy: 0.8796 - val_loss: 0.1763 - val_accuracy: 0.9511
Epoch 2/20
574/574 [==============================] - 2s 3ms/step - loss: 0.1397 -
```

```
accuracy: 0.9593 - val_loss: 0.1377 - val_accuracy: 0.9604
Epoch 3/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0914 -
accuracy: 0.9738 - val_loss: 0.1010 - val_accuracy: 0.9710
Epoch 4/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0648 -
accuracy: 0.9810 - val_loss: 0.0949 - val_accuracy: 0.9722
Epoch 5/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0496 -
accuracy: 0.9858 - val_loss: 0.0944 - val_accuracy: 0.9753
Epoch 6/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0370 -
accuracy: 0.9891 - val_loss: 0.0857 - val_accuracy: 0.9773
Epoch 7/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0276 -
accuracy: 0.9917 - val_loss: 0.0946 - val_accuracy: 0.9733
Epoch 8/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0201 -
accuracy: 0.9945 - val_loss: 0.0927 - val_accuracy: 0.9769
Epoch 9/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0187 -
accuracy: 0.9943 - val_loss: 0.1201 - val_accuracy: 0.9710
Epoch 10/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0181 -
accuracy: 0.9943 - val_loss: 0.0961 - val_accuracy: 0.9774
Epoch 11/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0115 -
accuracy: 0.9968 - val_loss: 0.0985 - val_accuracy: 0.9773
Epoch 12/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0128 -
accuracy: 0.9958 - val_loss: 0.1204 - val_accuracy: 0.9743
Epoch 13/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0127 -
accuracy: 0.9957 - val_loss: 0.1045 - val_accuracy: 0.9773
Epoch 14/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0059 -
accuracy: 0.9985 - val_loss: 0.1159 - val_accuracy: 0.9768
Epoch 15/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0073 -
accuracy: 0.9980 - val_loss: 0.1440 - val_accuracy: 0.9732
Epoch 16/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0119 -
accuracy: 0.9960 - val_loss: 0.1114 - val_accuracy: 0.9784
Epoch 17/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0065 -
accuracy: 0.9979 - val_loss: 0.1208 - val_accuracy: 0.9777
Epoch 18/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0057 -
```

```
accuracy: 0.9981 - val_loss: 0.1227 - val_accuracy: 0.9772
Epoch 19/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0073 -
accuracy: 0.9978 - val_loss: 0.1284 - val_accuracy: 0.9767
Epoch 20/20
574/574 [==============================] - 2s 3ms/step - loss: 0.0079 -
accuracy: 0.9975 - val_loss: 0.1190 - val_accuracy: 0.9772

Accuracy: 97.72%

Epoch 1/20
580/580 [==============================] - 2s 3ms/step - loss: 0.4262 -
accuracy: 0.8847 - val_loss: 0.2036 - val_accuracy: 0.9448
Epoch 2/20
580/580 [==============================] - 2s 3ms/step - loss: 0.1884 -
accuracy: 0.9468 - val_loss: 0.1555 - val_accuracy: 0.9572
Epoch 3/20
580/580 [==============================] - 2s 3ms/step - loss: 0.1501 -
accuracy: 0.9587 - val_loss: 0.1364 - val_accuracy: 0.9616
Epoch 4/20
580/580 [==============================] - 2s 3ms/step - loss: 0.1286 -
accuracy: 0.9648 - val_loss: 0.1276 - val_accuracy: 0.9637
Epoch 5/20
580/580 [==============================] - 2s 3ms/step - loss: 0.1153 -
accuracy: 0.9688 - val_loss: 0.1183 - val_accuracy: 0.9671
Epoch 6/20
580/580 [==============================] - 2s 3ms/step - loss: 0.1056 -
accuracy: 0.9712 - val_loss: 0.1129 - val_accuracy: 0.9670
Epoch 7/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0978 -
accuracy: 0.9735 - val_loss: 0.1103 - val_accuracy: 0.9684
Epoch 8/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0919 -
accuracy: 0.9754 - val_loss: 0.1067 - val_accuracy: 0.9696
Epoch 9/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0868 -
accuracy: 0.9772 - val_loss: 0.1038 - val_accuracy: 0.9706
Epoch 10/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0826 -
accuracy: 0.9781 - val_loss: 0.1003 - val_accuracy: 0.9702
Epoch 11/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0789 -
accuracy: 0.9791 - val_loss: 0.1012 - val_accuracy: 0.9708
Epoch 12/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0755 -
accuracy: 0.9801 - val_loss: 0.0983 - val_accuracy: 0.9711
Epoch 13/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0729 -
```

```
accuracy: 0.9806 - val_loss: 0.0970 - val_accuracy: 0.9710
Epoch 14/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0700 -
accuracy: 0.9819 - val_loss: 0.0959 - val_accuracy: 0.9728
Epoch 15/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0680 -
accuracy: 0.9827 - val_loss: 0.0942 - val_accuracy: 0.9721
Epoch 16/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0659 -
accuracy: 0.9833 - val_loss: 0.0938 - val_accuracy: 0.9726
Epoch 17/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0641 -
accuracy: 0.9832 - val_loss: 0.0924 - val_accuracy: 0.9730
Epoch 18/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0624 -
accuracy: 0.9840 - val_loss: 0.0927 - val_accuracy: 0.9723
Epoch 19/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0609 -
accuracy: 0.9847 - val_loss: 0.0911 - val_accuracy: 0.9731
Epoch 20/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0594 -
accuracy: 0.9851 - val_loss: 0.0911 - val_accuracy: 0.9736

Accuracy: 97.36%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 0.4835 -
accuracy: 0.8559 - val_loss: 0.1723 - val_accuracy: 0.9519
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1480 -
accuracy: 0.9586 - val_loss: 0.1183 - val_accuracy: 0.9669
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0922 -
accuracy: 0.9731 - val_loss: 0.1129 - val_accuracy: 0.9683
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0646 -
accuracy: 0.9814 - val_loss: 0.0972 - val_accuracy: 0.9740
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0472 -
accuracy: 0.9868 - val_loss: 0.0905 - val_accuracy: 0.9762
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0337 -
accuracy: 0.9908 - val_loss: 0.0908 - val_accuracy: 0.9762
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0241 -
accuracy: 0.9941 - val_loss: 0.0892 - val_accuracy: 0.9778
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0180 -
```

```
accuracy: 0.9957 - val_loss: 0.0930 - val_accuracy: 0.9773
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0134 -
accuracy: 0.9969 - val_loss: 0.0948 - val_accuracy: 0.9764
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0099 -
accuracy: 0.9980 - val_loss: 0.0973 - val_accuracy: 0.9780
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0075 -
accuracy: 0.9987 - val_loss: 0.0978 - val_accuracy: 0.9778
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0054 -
accuracy: 0.9993 - val_loss: 0.0984 - val_accuracy: 0.9786
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0038 -
accuracy: 0.9996 - val_loss: 0.1030 - val_accuracy: 0.9794
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0030 -
accuracy: 0.9998 - val_loss: 0.1024 - val_accuracy: 0.9788
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0023 -
accuracy: 0.9998 - val_loss: 0.1100 - val_accuracy: 0.9786
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0018 -
accuracy: 0.9999 - val_loss: 0.1104 - val_accuracy: 0.9786
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0014 -
accuracy: 0.9999 - val_loss: 0.1149 - val_accuracy: 0.9780
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0012 -
accuracy: 0.9999 - val_loss: 0.1154 - val_accuracy: 0.9794
Epoch 19/20
399/399 [==============================] - 1s 4ms/step - loss: 8.3570e-04 -
accuracy: 1.0000 - val_loss: 0.1180 - val_accuracy: 0.9781
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 7.2685e-04 -
accuracy: 1.0000 - val_loss: 0.1235 - val_accuracy: 0.9786

Accuracy: 97.86%

Epoch 1/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.3702 -
accuracy: 0.8856 - val_loss: 0.2017 - val_accuracy: 0.9431
Epoch 2/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.2099 -
accuracy: 0.9388 - val_loss: 0.1766 - val_accuracy: 0.9497
Epoch 3/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1816 -
```

```
accuracy: 0.9470 - val_loss: 0.1626 - val_accuracy: 0.9540
Epoch 4/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1648 -
accuracy: 0.9515 - val_loss: 0.1640 - val_accuracy: 0.9519
Epoch 5/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1546 -
accuracy: 0.9542 - val_loss: 0.1509 - val_accuracy: 0.9562
Epoch 6/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1474 -
accuracy: 0.9571 - val_loss: 0.1490 - val_accuracy: 0.9562
Epoch 7/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1419 -
accuracy: 0.9588 - val_loss: 0.1515 - val_accuracy: 0.9548
Epoch 8/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1369 -
accuracy: 0.9601 - val_loss: 0.1432 - val_accuracy: 0.9587
Epoch 9/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1328 -
accuracy: 0.9616 - val_loss: 0.1458 - val_accuracy: 0.9577
Epoch 10/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1297 -
accuracy: 0.9619 - val_loss: 0.1464 - val_accuracy: 0.9569
Epoch 11/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1264 -
accuracy: 0.9633 - val_loss: 0.1436 - val_accuracy: 0.9590
Epoch 12/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1238 -
accuracy: 0.9632 - val_loss: 0.1426 - val_accuracy: 0.9583
Epoch 13/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1219 -
accuracy: 0.9647 - val_loss: 0.1417 - val_accuracy: 0.9588
Epoch 14/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1196 -
accuracy: 0.9652 - val_loss: 0.1398 - val_accuracy: 0.9607
Epoch 15/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1177 -
accuracy: 0.9655 - val_loss: 0.1413 - val_accuracy: 0.9596
Epoch 16/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1163 -
accuracy: 0.9657 - val_loss: 0.1387 - val_accuracy: 0.9603
Epoch 17/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1148 -
accuracy: 0.9667 - val_loss: 0.1386 - val_accuracy: 0.9606
Epoch 18/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1135 -
accuracy: 0.9675 - val_loss: 0.1388 - val_accuracy: 0.9600
Epoch 19/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1118 -
```

```
accuracy: 0.9674 - val_loss: 0.1368 - val_accuracy: 0.9600
Epoch 20/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1112 -
accuracy: 0.9673 - val_loss: 0.1383 - val_accuracy: 0.9600

Accuracy: 96.00%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 0.3248 -
accuracy: 0.9012 - val_loss: 0.1394 - val_accuracy: 0.9596
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1244 -
accuracy: 0.9626 - val_loss: 0.1091 - val_accuracy: 0.9681
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0879 -
accuracy: 0.9739 - val_loss: 0.1050 - val_accuracy: 0.9697
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0697 -
accuracy: 0.9797 - val_loss: 0.0966 - val_accuracy: 0.9708
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0591 -
accuracy: 0.9832 - val_loss: 0.0938 - val_accuracy: 0.9731
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0502 -
accuracy: 0.9859 - val_loss: 0.0894 - val_accuracy: 0.9740
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0438 -
accuracy: 0.9884 - val_loss: 0.0872 - val_accuracy: 0.9761
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0387 -
accuracy: 0.9897 - val_loss: 0.0886 - val_accuracy: 0.9757
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0346 -
accuracy: 0.9910 - val_loss: 0.0879 - val_accuracy: 0.9761
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0309 -
accuracy: 0.9919 - val_loss: 0.0901 - val_accuracy: 0.9752
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0285 -
accuracy: 0.9928 - val_loss: 0.0890 - val_accuracy: 0.9752
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0256 -
accuracy: 0.9938 - val_loss: 0.0925 - val_accuracy: 0.9760
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0232 -
accuracy: 0.9944 - val_loss: 0.0913 - val_accuracy: 0.9760
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0214 -
```

```
accuracy: 0.9949 - val_loss: 0.0920 - val_accuracy: 0.9767
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0199 -
accuracy: 0.9957 - val_loss: 0.0919 - val_accuracy: 0.9769
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0181 -
accuracy: 0.9962 - val_loss: 0.0939 - val_accuracy: 0.9757
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0169 -
accuracy: 0.9964 - val_loss: 0.0952 - val_accuracy: 0.9757
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0156 -
accuracy: 0.9968 - val_loss: 0.0964 - val_accuracy: 0.9759
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0145 -
accuracy: 0.9972 - val_loss: 0.0973 - val_accuracy: 0.9764
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0135 -
accuracy: 0.9975 - val_loss: 0.0978 - val_accuracy: 0.9767

Accuracy: 97.67%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.3685 -
accuracy: 0.8941 - val_loss: 0.1547 - val_accuracy: 0.9560
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1291 -
accuracy: 0.9632 - val_loss: 0.1068 - val_accuracy: 0.9709
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0821 -
accuracy: 0.9764 - val_loss: 0.0865 - val_accuracy: 0.9731
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0572 -
accuracy: 0.9831 - val_loss: 0.0789 - val_accuracy: 0.9759
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0413 -
accuracy: 0.9880 - val_loss: 0.0778 - val_accuracy: 0.9768
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0325 -
accuracy: 0.9897 - val_loss: 0.0766 - val_accuracy: 0.9780
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0206 -
accuracy: 0.9940 - val_loss: 0.0796 - val_accuracy: 0.9774
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0171 -
accuracy: 0.9951 - val_loss: 0.0746 - val_accuracy: 0.9786
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0135 -
```

```
accuracy: 0.9959 - val_loss: 0.0810 - val_accuracy: 0.9782
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0111 -
accuracy: 0.9967 - val_loss: 0.1055 - val_accuracy: 0.9749
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0081 -
accuracy: 0.9978 - val_loss: 0.0916 - val_accuracy: 0.9772
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0089 -
accuracy: 0.9974 - val_loss: 0.1061 - val_accuracy: 0.9756
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0139 -
accuracy: 0.9955 - val_loss: 0.0914 - val_accuracy: 0.9800
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0069 -
accuracy: 0.9981 - val_loss: 0.0995 - val_accuracy: 0.9787
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0085 -
accuracy: 0.9974 - val_loss: 0.1005 - val_accuracy: 0.9779
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0078 -
accuracy: 0.9974 - val_loss: 0.0951 - val_accuracy: 0.9802
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0039 -
accuracy: 0.9989 - val_loss: 0.0910 - val_accuracy: 0.9797
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0108 -
accuracy: 0.9964 - val_loss: 0.1106 - val_accuracy: 0.9772
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0072 -
accuracy: 0.9974 - val_loss: 0.1080 - val_accuracy: 0.9781
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0071 -
accuracy: 0.9974 - val_loss: 0.1113 - val_accuracy: 0.9788

Accuracy: 97.88%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.5159 -
accuracy: 0.8751 - val_loss: 0.1568 - val_accuracy: 0.9588
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1297 -
accuracy: 0.9670 - val_loss: 0.1102 - val_accuracy: 0.9711
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0854 -
accuracy: 0.9790 - val_loss: 0.1004 - val_accuracy: 0.9723
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0639 -
```

```
accuracy: 0.9845 - val_loss: 0.0925 - val_accuracy: 0.9747
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0502 -
accuracy: 0.9886 - val_loss: 0.0870 - val_accuracy: 0.9754
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0409 -
accuracy: 0.9913 - val_loss: 0.0855 - val_accuracy: 0.9769
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0346 -
accuracy: 0.9929 - val_loss: 0.0832 - val_accuracy: 0.9772
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0294 -
accuracy: 0.9944 - val_loss: 0.0821 - val_accuracy: 0.9780
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0254 -
accuracy: 0.9954 - val_loss: 0.0820 - val_accuracy: 0.9778
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0221 -
accuracy: 0.9963 - val_loss: 0.0804 - val_accuracy: 0.9780
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0195 -
accuracy: 0.9968 - val_loss: 0.0812 - val_accuracy: 0.9773
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0174 -
accuracy: 0.9973 - val_loss: 0.0826 - val_accuracy: 0.9769
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0155 -
accuracy: 0.9978 - val_loss: 0.0806 - val_accuracy: 0.9777
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0139 -
accuracy: 0.9981 - val_loss: 0.0816 - val_accuracy: 0.9777
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0125 -
accuracy: 0.9984 - val_loss: 0.0806 - val_accuracy: 0.9786
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0112 -
accuracy: 0.9986 - val_loss: 0.0827 - val_accuracy: 0.9771
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0102 -
accuracy: 0.9988 - val_loss: 0.0809 - val_accuracy: 0.9778
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0092 -
accuracy: 0.9989 - val_loss: 0.0825 - val_accuracy: 0.9781
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0083 -
accuracy: 0.9990 - val_loss: 0.0824 - val_accuracy: 0.9783
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0076 -
```

```
accuracy: 0.9992 - val_loss: 0.0822 - val_accuracy: 0.9788

Accuracy: 97.88%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.3578 -
accuracy: 0.8965 - val_loss: 0.1527 - val_accuracy: 0.9546
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1242 -
accuracy: 0.9645 - val_loss: 0.0993 - val_accuracy: 0.9710
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0803 -
accuracy: 0.9766 - val_loss: 0.0880 - val_accuracy: 0.9731
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0595 -
accuracy: 0.9822 - val_loss: 0.0750 - val_accuracy: 0.9770
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0428 -
accuracy: 0.9875 - val_loss: 0.0845 - val_accuracy: 0.9747
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0342 -
accuracy: 0.9897 - val_loss: 0.0809 - val_accuracy: 0.9763
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0234 -
accuracy: 0.9929 - val_loss: 0.0761 - val_accuracy: 0.9780
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0202 -
accuracy: 0.9937 - val_loss: 0.0819 - val_accuracy: 0.9771
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0170 -
accuracy: 0.9953 - val_loss: 0.0754 - val_accuracy: 0.9799
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0136 -
accuracy: 0.9958 - val_loss: 0.0748 - val_accuracy: 0.9812
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0083 -
accuracy: 0.9977 - val_loss: 0.0888 - val_accuracy: 0.9794
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0079 -
accuracy: 0.9976 - val_loss: 0.0834 - val_accuracy: 0.9799
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0113 -
accuracy: 0.9965 - val_loss: 0.0956 - val_accuracy: 0.9777
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0101 -
accuracy: 0.9968 - val_loss: 0.1044 - val_accuracy: 0.9768
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0078 -
```

```
accuracy: 0.9975 - val_loss: 0.0848 - val_accuracy: 0.9811
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0077 -
accuracy: 0.9978 - val_loss: 0.0940 - val_accuracy: 0.9803
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0060 -
accuracy: 0.9982 - val_loss: 0.0887 - val_accuracy: 0.9822
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0046 -
accuracy: 0.9985 - val_loss: 0.1023 - val_accuracy: 0.9788
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0076 -
accuracy: 0.9976 - val_loss: 0.1024 - val_accuracy: 0.9794
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0076 -
accuracy: 0.9974 - val_loss: 0.0991 - val_accuracy: 0.9813

Accuracy: 98.13%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.3268 -
accuracy: 0.9066 - val_loss: 0.1286 - val_accuracy: 0.9622
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1169 -
accuracy: 0.9657 - val_loss: 0.1007 - val_accuracy: 0.9704
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0761 -
accuracy: 0.9773 - val_loss: 0.0916 - val_accuracy: 0.9707
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0543 -
accuracy: 0.9839 - val_loss: 0.0839 - val_accuracy: 0.9751
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0388 -
accuracy: 0.9882 - val_loss: 0.0799 - val_accuracy: 0.9758
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0279 -
accuracy: 0.9919 - val_loss: 0.0857 - val_accuracy: 0.9763
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0230 -
accuracy: 0.9926 - val_loss: 0.0788 - val_accuracy: 0.9783
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0174 -
accuracy: 0.9950 - val_loss: 0.0868 - val_accuracy: 0.9748
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0125 -
accuracy: 0.9964 - val_loss: 0.0796 - val_accuracy: 0.9794
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0120 -
```

```
accuracy: 0.9966 - val_loss: 0.0861 - val_accuracy: 0.9774
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0071 -
accuracy: 0.9981 - val_loss: 0.0960 - val_accuracy: 0.9779
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0145 -
accuracy: 0.9954 - val_loss: 0.0949 - val_accuracy: 0.9756
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0106 -
accuracy: 0.9965 - val_loss: 0.1018 - val_accuracy: 0.9762
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0068 -
accuracy: 0.9978 - val_loss: 0.1022 - val_accuracy: 0.9784
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0064 -
accuracy: 0.9983 - val_loss: 0.0889 - val_accuracy: 0.9810
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0082 -
accuracy: 0.9972 - val_loss: 0.1042 - val_accuracy: 0.9769
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0097 -
accuracy: 0.9969 - val_loss: 0.0905 - val_accuracy: 0.9809
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0056 -
accuracy: 0.9984 - val_loss: 0.0895 - val_accuracy: 0.9797
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0084 -
accuracy: 0.9974 - val_loss: 0.1035 - val_accuracy: 0.9777
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0057 -
accuracy: 0.9983 - val_loss: 0.0968 - val_accuracy: 0.9797

Accuracy: 97.97%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.3406 -
accuracy: 0.9008 - val_loss: 0.1425 - val_accuracy: 0.9592
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1262 -
accuracy: 0.9623 - val_loss: 0.1111 - val_accuracy: 0.9677
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0810 -
accuracy: 0.9760 - val_loss: 0.0857 - val_accuracy: 0.9749
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0570 -
accuracy: 0.9831 - val_loss: 0.0986 - val_accuracy: 0.9698
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0408 -
```

```
accuracy: 0.9878 - val_loss: 0.0785 - val_accuracy: 0.9760
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0301 -
accuracy: 0.9914 - val_loss: 0.0820 - val_accuracy: 0.9756
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0244 -
accuracy: 0.9925 - val_loss: 0.0911 - val_accuracy: 0.9746
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0180 -
accuracy: 0.9945 - val_loss: 0.0767 - val_accuracy: 0.9791
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0162 -
accuracy: 0.9950 - val_loss: 0.0954 - val_accuracy: 0.9750
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0121 -
accuracy: 0.9963 - val_loss: 0.0792 - val_accuracy: 0.9798
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0086 -
accuracy: 0.9974 - val_loss: 0.0848 - val_accuracy: 0.9797
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0104 -
accuracy: 0.9967 - val_loss: 0.0944 - val_accuracy: 0.9768
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0150 -
accuracy: 0.9952 - val_loss: 0.0919 - val_accuracy: 0.9773
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0100 -
accuracy: 0.9969 - val_loss: 0.0885 - val_accuracy: 0.9803
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0049 -
accuracy: 0.9986 - val_loss: 0.0950 - val_accuracy: 0.9807
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0022 -
accuracy: 0.9996 - val_loss: 0.0958 - val_accuracy: 0.9807
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0077 -
accuracy: 0.9975 - val_loss: 0.1146 - val_accuracy: 0.9754
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0129 -
accuracy: 0.9959 - val_loss: 0.1124 - val_accuracy: 0.9767
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0100 -
accuracy: 0.9967 - val_loss: 0.0944 - val_accuracy: 0.9814
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0051 -
accuracy: 0.9984 - val_loss: 0.1047 - val_accuracy: 0.9798

Accuracy: 97.98%
```

```
Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.4364 -
accuracy: 0.8740 - val_loss: 0.1473 - val_accuracy: 0.9587
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1270 -
accuracy: 0.9629 - val_loss: 0.1000 - val_accuracy: 0.9721
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0834 -
accuracy: 0.9750 - val_loss: 0.0936 - val_accuracy: 0.9704
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0593 -
accuracy: 0.9822 - val_loss: 0.0895 - val_accuracy: 0.9767
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0456 -
accuracy: 0.9864 - val_loss: 0.0786 - val_accuracy: 0.9767
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0299 -
accuracy: 0.9914 - val_loss: 0.0813 - val_accuracy: 0.9782
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0223 -
accuracy: 0.9934 - val_loss: 0.0849 - val_accuracy: 0.9780
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0187 -
accuracy: 0.9944 - val_loss: 0.0790 - val_accuracy: 0.9792
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0172 -
accuracy: 0.9948 - val_loss: 0.0962 - val_accuracy: 0.9758
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0136 -
accuracy: 0.9956 - val_loss: 0.0927 - val_accuracy: 0.9767
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0108 -
accuracy: 0.9965 - val_loss: 0.0916 - val_accuracy: 0.9774
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0059 -
accuracy: 0.9985 - val_loss: 0.0865 - val_accuracy: 0.9808
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0043 -
accuracy: 0.9990 - val_loss: 0.0855 - val_accuracy: 0.9802
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0127 -
accuracy: 0.9956 - val_loss: 0.0937 - val_accuracy: 0.9793
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0117 -
accuracy: 0.9963 - val_loss: 0.0999 - val_accuracy: 0.9787
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0043 -
```

```
accuracy: 0.9990 - val_loss: 0.0910 - val_accuracy: 0.9804
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0018 -
accuracy: 0.9997 - val_loss: 0.1052 - val_accuracy: 0.9790
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0084 -
accuracy: 0.9973 - val_loss: 0.1052 - val_accuracy: 0.9793
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0101 -
accuracy: 0.9964 - val_loss: 0.1062 - val_accuracy: 0.9797
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0061 -
accuracy: 0.9981 - val_loss: 0.1191 - val_accuracy: 0.9792

Accuracy: 97.92%

Epoch 1/20
399/399 [==============================] - 2s 3ms/step - loss: 0.3447 -
accuracy: 0.8973 - val_loss: 0.1491 - val_accuracy: 0.9586
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1270 -
accuracy: 0.9627 - val_loss: 0.1151 - val_accuracy: 0.9651
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0832 -
accuracy: 0.9752 - val_loss: 0.0905 - val_accuracy: 0.9739
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0584 -
accuracy: 0.9826 - val_loss: 0.0876 - val_accuracy: 0.9749
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0410 -
accuracy: 0.9877 - val_loss: 0.0787 - val_accuracy: 0.9793
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0323 -
accuracy: 0.9901 - val_loss: 0.0837 - val_accuracy: 0.9770
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0228 -
accuracy: 0.9933 - val_loss: 0.0780 - val_accuracy: 0.9779
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0192 -
accuracy: 0.9939 - val_loss: 0.0788 - val_accuracy: 0.9790
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0162 -
accuracy: 0.9949 - val_loss: 0.0868 - val_accuracy: 0.9784
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0153 -
accuracy: 0.9951 - val_loss: 0.0850 - val_accuracy: 0.9784
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0089 -
```

```
accuracy: 0.9975 - val_loss: 0.0814 - val_accuracy: 0.9798
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0065 -
accuracy: 0.9983 - val_loss: 0.0863 - val_accuracy: 0.9790
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0054 -
accuracy: 0.9985 - val_loss: 0.0908 - val_accuracy: 0.9800
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0150 -
accuracy: 0.9949 - val_loss: 0.1070 - val_accuracy: 0.9777
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0108 -
accuracy: 0.9967 - val_loss: 0.0979 - val_accuracy: 0.9807
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0089 -
accuracy: 0.9972 - val_loss: 0.0935 - val_accuracy: 0.9792
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0057 -
accuracy: 0.9981 - val_loss: 0.1052 - val_accuracy: 0.9798
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0034 -
accuracy: 0.9990 - val_loss: 0.0884 - val_accuracy: 0.9829
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 7.2097e-04 -
accuracy: 0.9999 - val_loss: 0.0906 - val_accuracy: 0.9824
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0082 -
accuracy: 0.9975 - val_loss: 0.1371 - val_accuracy: 0.9717

Accuracy: 97.17%

Epoch 1/20
477/477 [==============================] - 2s 4ms/step - loss: 2.1254 -
accuracy: 0.1781 - val_loss: 1.8454 - val_accuracy: 0.2123
Epoch 2/20
477/477 [==============================] - 2s 3ms/step - loss: 1.7576 -
accuracy: 0.2737 - val_loss: 1.6786 - val_accuracy: 0.2976
Epoch 3/20
477/477 [==============================] - 2s 3ms/step - loss: 1.6424 -
accuracy: 0.3122 - val_loss: 1.5890 - val_accuracy: 0.3108
Epoch 4/20
477/477 [==============================] - 2s 3ms/step - loss: 1.5720 -
accuracy: 0.3301 - val_loss: 1.5312 - val_accuracy: 0.3326
Epoch 5/20
477/477 [==============================] - 2s 3ms/step - loss: 1.5255 -
accuracy: 0.3451 - val_loss: 1.4910 - val_accuracy: 0.3657
Epoch 6/20
477/477 [==============================] - 2s 3ms/step - loss: 1.4914 -
```

```
accuracy: 0.3668 - val_loss: 1.4606 - val_accuracy: 0.3813
Epoch 7/20
477/477 [==============================] - 2s 3ms/step - loss: 1.4646 -
accuracy: 0.3833 - val_loss: 1.4368 - val_accuracy: 0.3926
Epoch 8/20
477/477 [==============================] - 2s 3ms/step - loss: 1.4426 -
accuracy: 0.3958 - val_loss: 1.4168 - val_accuracy: 0.4017
Epoch 9/20
477/477 [==============================] - 2s 3ms/step - loss: 1.4243 -
accuracy: 0.4026 - val_loss: 1.3992 - val_accuracy: 0.4059
Epoch 10/20
477/477 [==============================] - 2s 3ms/step - loss: 1.4085 -
accuracy: 0.4096 - val_loss: 1.3843 - val_accuracy: 0.4106
Epoch 11/20
477/477 [==============================] - 2s 3ms/step - loss: 1.3946 -
accuracy: 0.4155 - val_loss: 1.3710 - val_accuracy: 0.4166
Epoch 12/20
477/477 [==============================] - 2s 3ms/step - loss: 1.3823 -
accuracy: 0.4203 - val_loss: 1.3595 - val_accuracy: 0.4217
Epoch 13/20
477/477 [==============================] - 2s 3ms/step - loss: 1.3713 -
accuracy: 0.4255 - val_loss: 1.3490 - val_accuracy: 0.4243
Epoch 14/20
477/477 [==============================] - 2s 3ms/step - loss: 1.3613 -
accuracy: 0.4282 - val_loss: 1.3394 - val_accuracy: 0.4280
Epoch 15/20
477/477 [==============================] - 2s 3ms/step - loss: 1.3521 -
accuracy: 0.4326 - val_loss: 1.3307 - val_accuracy: 0.4304
Epoch 16/20
477/477 [==============================] - 2s 4ms/step - loss: 1.3436 -
accuracy: 0.4354 - val_loss: 1.3224 - val_accuracy: 0.4329
Epoch 17/20
477/477 [==============================] - 2s 3ms/step - loss: 1.3358 -
accuracy: 0.4376 - val_loss: 1.3149 - val_accuracy: 0.4354
Epoch 18/20
477/477 [==============================] - 2s 3ms/step - loss: 1.3286 -
accuracy: 0.4406 - val_loss: 1.3078 - val_accuracy: 0.4378
Epoch 19/20
477/477 [==============================] - 2s 3ms/step - loss: 1.3217 -
accuracy: 0.4427 - val_loss: 1.3021 - val_accuracy: 0.4394
Epoch 20/20
477/477 [==============================] - 2s 3ms/step - loss: 1.3154 -
accuracy: 0.4439 - val_loss: 1.2952 - val_accuracy: 0.4429

Accuracy: 44.29%

Epoch 1/20
543/543 [==============================] - 3s 4ms/step - loss: 2.0518 -
```

```
accuracy: 0.1943 - val_loss: 1.7342 - val_accuracy: 0.2844
Epoch 2/20
543/543 [==============================] - 2s 3ms/step - loss: 1.5927 -
accuracy: 0.3673 - val_loss: 1.4458 - val_accuracy: 0.4133
Epoch 3/20
543/543 [==============================] - 2s 3ms/step - loss: 1.3846 -
accuracy: 0.4294 - val_loss: 1.3202 - val_accuracy: 0.4561
Epoch 4/20
543/543 [==============================] - 2s 3ms/step - loss: 1.2702 -
accuracy: 0.5103 - val_loss: 1.2204 - val_accuracy: 0.5380
Epoch 5/20
543/543 [==============================] - 2s 3ms/step - loss: 1.1653 -
accuracy: 0.5473 - val_loss: 1.1280 - val_accuracy: 0.5759
Epoch 6/20
543/543 [==============================] - 2s 3ms/step - loss: 1.0787 -
accuracy: 0.5669 - val_loss: 1.0615 - val_accuracy: 0.5671
Epoch 7/20
543/543 [==============================] - 2s 3ms/step - loss: 1.0124 -
accuracy: 0.5723 - val_loss: 1.0086 - val_accuracy: 0.5683
Epoch 8/20
543/543 [==============================] - 2s 3ms/step - loss: 0.9594 -
accuracy: 0.5767 - val_loss: 0.9746 - val_accuracy: 0.5753
Epoch 9/20
543/543 [==============================] - 2s 3ms/step - loss: 0.9176 -
accuracy: 0.5824 - val_loss: 0.9439 - val_accuracy: 0.5749
Epoch 10/20
543/543 [==============================] - 2s 3ms/step - loss: 0.8851 -
accuracy: 0.5850 - val_loss: 0.9181 - val_accuracy: 0.5771
Epoch 11/20
543/543 [==============================] - 2s 3ms/step - loss: 0.8601 -
accuracy: 0.5873 - val_loss: 0.9005 - val_accuracy: 0.5758
Epoch 12/20
543/543 [==============================] - 2s 3ms/step - loss: 0.8384 -
accuracy: 0.5896 - val_loss: 0.8875 - val_accuracy: 0.5814
Epoch 13/20
543/543 [==============================] - 2s 3ms/step - loss: 0.8212 -
accuracy: 0.5914 - val_loss: 0.8789 - val_accuracy: 0.5764
Epoch 14/20
543/543 [==============================] - 2s 3ms/step - loss: 0.8062 -
accuracy: 0.5936 - val_loss: 0.8700 - val_accuracy: 0.5811
Epoch 15/20
543/543 [==============================] - 2s 3ms/step - loss: 0.7945 -
accuracy: 0.5946 - val_loss: 0.8665 - val_accuracy: 0.5774
Epoch 16/20
543/543 [==============================] - 2s 3ms/step - loss: 0.7841 -
accuracy: 0.5967 - val_loss: 0.8586 - val_accuracy: 0.5800
Epoch 17/20
543/543 [==============================] - 2s 3ms/step - loss: 0.7759 -
```

```
accuracy: 0.5981 - val_loss: 0.8533 - val_accuracy: 0.5806
Epoch 18/20
543/543 [==============================] - 2s 3ms/step - loss: 0.7686 -
accuracy: 0.5989 - val_loss: 0.8557 - val_accuracy: 0.5803
Epoch 19/20
543/543 [==============================] - 2s 3ms/step - loss: 0.7625 -
accuracy: 0.6018 - val_loss: 0.8519 - val_accuracy: 0.5846
Epoch 20/20
543/543 [==============================] - 2s 3ms/step - loss: 0.7570 -
accuracy: 0.5988 - val_loss: 0.8497 - val_accuracy: 0.5697

Accuracy: 56.97%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 1.2747 -
accuracy: 0.7104 - val_loss: 0.6819 - val_accuracy: 0.9201
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.4866 -
accuracy: 0.9404 - val_loss: 0.3414 - val_accuracy: 0.9577
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2836 -
accuracy: 0.9624 - val_loss: 0.2385 - val_accuracy: 0.9662
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2051 -
accuracy: 0.9709 - val_loss: 0.1967 - val_accuracy: 0.9682
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1635 -
accuracy: 0.9765 - val_loss: 0.1729 - val_accuracy: 0.9690
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1363 -
accuracy: 0.9803 - val_loss: 0.1551 - val_accuracy: 0.9697
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1179 -
accuracy: 0.9829 - val_loss: 0.1444 - val_accuracy: 0.9718
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1042 -
accuracy: 0.9851 - val_loss: 0.1363 - val_accuracy: 0.9712
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0931 -
accuracy: 0.9864 - val_loss: 0.1297 - val_accuracy: 0.9734
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0842 -
accuracy: 0.9880 - val_loss: 0.1260 - val_accuracy: 0.9738
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0769 -
accuracy: 0.9891 - val_loss: 0.1224 - val_accuracy: 0.9736
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0708 -
```

```
accuracy: 0.9901 - val_loss: 0.1195 - val_accuracy: 0.9734
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0655 -
accuracy: 0.9908 - val_loss: 0.1174 - val_accuracy: 0.9739
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0609 -
accuracy: 0.9917 - val_loss: 0.1160 - val_accuracy: 0.9744
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0568 -
accuracy: 0.9925 - val_loss: 0.1133 - val_accuracy: 0.9740
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0533 -
accuracy: 0.9929 - val_loss: 0.1133 - val_accuracy: 0.9740
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0501 -
accuracy: 0.9936 - val_loss: 0.1114 - val_accuracy: 0.9746
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0473 -
accuracy: 0.9940 - val_loss: 0.1097 - val_accuracy: 0.9748
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0449 -
accuracy: 0.9945 - val_loss: 0.1101 - val_accuracy: 0.9742
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0424 -
accuracy: 0.9949 - val_loss: 0.1087 - val_accuracy: 0.9748

Accuracy: 97.48%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 0.7310 -
accuracy: 0.7611 - val_loss: 0.3306 - val_accuracy: 0.9112
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2912 -
accuracy: 0.9232 - val_loss: 0.2431 - val_accuracy: 0.9372
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2103 -
accuracy: 0.9449 - val_loss: 0.1964 - val_accuracy: 0.9473
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1682 -
accuracy: 0.9556 - val_loss: 0.1849 - val_accuracy: 0.9511
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1431 -
accuracy: 0.9625 - val_loss: 0.1673 - val_accuracy: 0.9544
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1266 -
accuracy: 0.9667 - val_loss: 0.1595 - val_accuracy: 0.9578
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1127 -
```

```
accuracy: 0.9703 - val_loss: 0.1538 - val_accuracy: 0.9601
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1026 -
accuracy: 0.9731 - val_loss: 0.1505 - val_accuracy: 0.9607
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0934 -
accuracy: 0.9762 - val_loss: 0.1487 - val_accuracy: 0.9620
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0868 -
accuracy: 0.9778 - val_loss: 0.1454 - val_accuracy: 0.9620
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0804 -
accuracy: 0.9802 - val_loss: 0.1446 - val_accuracy: 0.9626
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0751 -
accuracy: 0.9813 - val_loss: 0.1417 - val_accuracy: 0.9633
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0701 -
accuracy: 0.9832 - val_loss: 0.1419 - val_accuracy: 0.9639
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0660 -
accuracy: 0.9839 - val_loss: 0.1419 - val_accuracy: 0.9636
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0622 -
accuracy: 0.9853 - val_loss: 0.1423 - val_accuracy: 0.9628
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0592 -
accuracy: 0.9862 - val_loss: 0.1397 - val_accuracy: 0.9647
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0559 -
accuracy: 0.9870 - val_loss: 0.1401 - val_accuracy: 0.9642
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0532 -
accuracy: 0.9879 - val_loss: 0.1410 - val_accuracy: 0.9640
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0509 -
accuracy: 0.9886 - val_loss: 0.1408 - val_accuracy: 0.9634
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0484 -
accuracy: 0.9893 - val_loss: 0.1394 - val_accuracy: 0.9653

Accuracy: 96.53%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 1.4207 -
accuracy: 0.4755 - val_loss: 0.7709 - val_accuracy: 0.8111
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.5462 -
```

```
accuracy: 0.8984 - val_loss: 0.3755 - val_accuracy: 0.9409
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.3156 -
accuracy: 0.9471 - val_loss: 0.2647 - val_accuracy: 0.9526
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2297 -
accuracy: 0.9579 - val_loss: 0.2190 - val_accuracy: 0.9544
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1854 -
accuracy: 0.9645 - val_loss: 0.1965 - val_accuracy: 0.9570
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1581 -
accuracy: 0.9685 - val_loss: 0.1802 - val_accuracy: 0.9597
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1396 -
accuracy: 0.9722 - val_loss: 0.1666 - val_accuracy: 0.9624
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1264 -
accuracy: 0.9747 - val_loss: 0.1593 - val_accuracy: 0.9626
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1154 -
accuracy: 0.9760 - val_loss: 0.1559 - val_accuracy: 0.9633
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1067 -
accuracy: 0.9782 - val_loss: 0.1516 - val_accuracy: 0.9638
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0998 -
accuracy: 0.9795 - val_loss: 0.1494 - val_accuracy: 0.9641
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0935 -
accuracy: 0.9812 - val_loss: 0.1477 - val_accuracy: 0.9647
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0884 -
accuracy: 0.9824 - val_loss: 0.1450 - val_accuracy: 0.9646
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0839 -
accuracy: 0.9835 - val_loss: 0.1423 - val_accuracy: 0.9659
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0797 -
accuracy: 0.9843 - val_loss: 0.1417 - val_accuracy: 0.9652
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0761 -
accuracy: 0.9855 - val_loss: 0.1412 - val_accuracy: 0.9652
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0729 -
accuracy: 0.9860 - val_loss: 0.1390 - val_accuracy: 0.9659
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0699 -
```

```
accuracy: 0.9866 - val_loss: 0.1373 - val_accuracy: 0.9663
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0672 -
accuracy: 0.9876 - val_loss: 0.1377 - val_accuracy: 0.9661
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0647 -
accuracy: 0.9880 - val_loss: 0.1369 - val_accuracy: 0.9668

Accuracy: 96.68%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 0.8051 -
accuracy: 0.8316 - val_loss: 0.3054 - val_accuracy: 0.9409
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2661 -
accuracy: 0.9414 - val_loss: 0.2073 - val_accuracy: 0.9558
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1991 -
accuracy: 0.9547 - val_loss: 0.1741 - val_accuracy: 0.9603
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1673 -
accuracy: 0.9612 - val_loss: 0.1579 - val_accuracy: 0.9637
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1479 -
accuracy: 0.9654 - val_loss: 0.1464 - val_accuracy: 0.9642
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1336 -
accuracy: 0.9689 - val_loss: 0.1369 - val_accuracy: 0.9666
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1232 -
accuracy: 0.9713 - val_loss: 0.1316 - val_accuracy: 0.9678
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1146 -
accuracy: 0.9735 - val_loss: 0.1256 - val_accuracy: 0.9691
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1079 -
accuracy: 0.9746 - val_loss: 0.1228 - val_accuracy: 0.9681
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1022 -
accuracy: 0.9765 - val_loss: 0.1195 - val_accuracy: 0.9703
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0972 -
accuracy: 0.9776 - val_loss: 0.1162 - val_accuracy: 0.9700
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0933 -
accuracy: 0.9786 - val_loss: 0.1149 - val_accuracy: 0.9697
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0896 -
```

```
accuracy: 0.9792 - val_loss: 0.1127 - val_accuracy: 0.9703
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0863 -
accuracy: 0.9800 - val_loss: 0.1101 - val_accuracy: 0.9716
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0834 -
accuracy: 0.9810 - val_loss: 0.1094 - val_accuracy: 0.9711
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0808 -
accuracy: 0.9817 - val_loss: 0.1086 - val_accuracy: 0.9726
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0784 -
accuracy: 0.9818 - val_loss: 0.1064 - val_accuracy: 0.9726
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0762 -
accuracy: 0.9826 - val_loss: 0.1051 - val_accuracy: 0.9716
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0744 -
accuracy: 0.9830 - val_loss: 0.1045 - val_accuracy: 0.9718
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0723 -
accuracy: 0.9835 - val_loss: 0.1035 - val_accuracy: 0.9723

Accuracy: 97.23%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 1.3835 -
accuracy: 0.5150 - val_loss: 0.7928 - val_accuracy: 0.8604
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.5900 -
accuracy: 0.8937 - val_loss: 0.4268 - val_accuracy: 0.9276
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.3704 -
accuracy: 0.9350 - val_loss: 0.3248 - val_accuracy: 0.9418
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2828 -
accuracy: 0.9483 - val_loss: 0.2732 - val_accuracy: 0.9497
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2324 -
accuracy: 0.9567 - val_loss: 0.2498 - val_accuracy: 0.9504
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.2006 -
accuracy: 0.9625 - val_loss: 0.2301 - val_accuracy: 0.9540
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1761 -
accuracy: 0.9674 - val_loss: 0.2165 - val_accuracy: 0.9570
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1583 -
```

```
accuracy: 0.9702 - val_loss: 0.2061 - val_accuracy: 0.9573
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1437 -
accuracy: 0.9740 - val_loss: 0.2004 - val_accuracy: 0.9577
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1317 -
accuracy: 0.9754 - val_loss: 0.1923 - val_accuracy: 0.9572
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1224 -
accuracy: 0.9773 - val_loss: 0.1901 - val_accuracy: 0.9584
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1138 -
accuracy: 0.9794 - val_loss: 0.1866 - val_accuracy: 0.9591
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1067 -
accuracy: 0.9808 - val_loss: 0.1858 - val_accuracy: 0.9597
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.1008 -
accuracy: 0.9817 - val_loss: 0.1804 - val_accuracy: 0.9606
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0951 -
accuracy: 0.9832 - val_loss: 0.1788 - val_accuracy: 0.9606
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0908 -
accuracy: 0.9841 - val_loss: 0.1777 - val_accuracy: 0.9612
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0866 -
accuracy: 0.9851 - val_loss: 0.1763 - val_accuracy: 0.9612
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0828 -
accuracy: 0.9860 - val_loss: 0.1765 - val_accuracy: 0.9610
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0795 -
accuracy: 0.9866 - val_loss: 0.1749 - val_accuracy: 0.9617
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0763 -
accuracy: 0.9873 - val_loss: 0.1748 - val_accuracy: 0.9621

Accuracy: 96.21%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 0.2719 -
accuracy: 0.9179 - val_loss: 0.1123 - val_accuracy: 0.9688
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0952 -
accuracy: 0.9723 - val_loss: 0.0934 - val_accuracy: 0.9734
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0642 -
```

```
accuracy: 0.9816 - val_loss: 0.0813 - val_accuracy: 0.9754
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0470 -
accuracy: 0.9874 - val_loss: 0.0777 - val_accuracy: 0.9766
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0369 -
accuracy: 0.9900 - val_loss: 0.0824 - val_accuracy: 0.9770
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0295 -
accuracy: 0.9922 - val_loss: 0.0762 - val_accuracy: 0.9789
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0240 -
accuracy: 0.9942 - val_loss: 0.0780 - val_accuracy: 0.9781
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0202 -
accuracy: 0.9955 - val_loss: 0.0790 - val_accuracy: 0.9791
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0172 -
accuracy: 0.9962 - val_loss: 0.0795 - val_accuracy: 0.9792
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0147 -
accuracy: 0.9971 - val_loss: 0.0788 - val_accuracy: 0.9794
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0126 -
accuracy: 0.9976 - val_loss: 0.0798 - val_accuracy: 0.9798
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0110 -
accuracy: 0.9980 - val_loss: 0.0808 - val_accuracy: 0.9802
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0097 -
accuracy: 0.9984 - val_loss: 0.0811 - val_accuracy: 0.9802
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0084 -
accuracy: 0.9989 - val_loss: 0.0822 - val_accuracy: 0.9799
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0074 -
accuracy: 0.9991 - val_loss: 0.0849 - val_accuracy: 0.9802
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0067 -
accuracy: 0.9991 - val_loss: 0.0846 - val_accuracy: 0.9797
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0058 -
accuracy: 0.9993 - val_loss: 0.0856 - val_accuracy: 0.9807
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0052 -
accuracy: 0.9994 - val_loss: 0.0871 - val_accuracy: 0.9799
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0047 -
```

```
accuracy: 0.9995 - val_loss: 0.0888 - val_accuracy: 0.9803
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 0.0042 -
accuracy: 0.9996 - val_loss: 0.0897 - val_accuracy: 0.9802

Accuracy: 98.02%

Epoch 1/20
699/699 [==============================] - 3s 3ms/step - loss: 0.4786 -
accuracy: 0.8639 - val_loss: 0.2185 - val_accuracy: 0.9418
Epoch 2/20
699/699 [==============================] - 2s 3ms/step - loss: 0.2186 -
accuracy: 0.9421 - val_loss: 0.1783 - val_accuracy: 0.9521
Epoch 3/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1843 -
accuracy: 0.9505 - val_loss: 0.1611 - val_accuracy: 0.9563
Epoch 4/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1667 -
accuracy: 0.9547 - val_loss: 0.1512 - val_accuracy: 0.9592
Epoch 5/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1549 -
accuracy: 0.9582 - val_loss: 0.1446 - val_accuracy: 0.9600
Epoch 6/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1467 -
accuracy: 0.9601 - val_loss: 0.1403 - val_accuracy: 0.9608
Epoch 7/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1403 -
accuracy: 0.9618 - val_loss: 0.1354 - val_accuracy: 0.9630
Epoch 8/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1351 -
accuracy: 0.9627 - val_loss: 0.1318 - val_accuracy: 0.9630
Epoch 9/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1307 -
accuracy: 0.9644 - val_loss: 0.1296 - val_accuracy: 0.9628
Epoch 10/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1271 -
accuracy: 0.9652 - val_loss: 0.1270 - val_accuracy: 0.9637
Epoch 11/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1240 -
accuracy: 0.9660 - val_loss: 0.1251 - val_accuracy: 0.9640
Epoch 12/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1213 -
accuracy: 0.9666 - val_loss: 0.1239 - val_accuracy: 0.9643
Epoch 13/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1188 -
accuracy: 0.9676 - val_loss: 0.1225 - val_accuracy: 0.9652
Epoch 14/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1166 -
```

```
accuracy: 0.9680 - val_loss: 0.1208 - val_accuracy: 0.9657
Epoch 15/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1147 -
accuracy: 0.9688 - val_loss: 0.1199 - val_accuracy: 0.9658
Epoch 16/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1129 -
accuracy: 0.9691 - val_loss: 0.1188 - val_accuracy: 0.9660
Epoch 17/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1113 -
accuracy: 0.9696 - val_loss: 0.1177 - val_accuracy: 0.9664
Epoch 18/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1098 -
accuracy: 0.9700 - val_loss: 0.1170 - val_accuracy: 0.9661
Epoch 19/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1084 -
accuracy: 0.9707 - val_loss: 0.1161 - val_accuracy: 0.9664
Epoch 20/20
699/699 [==============================] - 2s 3ms/step - loss: 0.1071 -
accuracy: 0.9711 - val_loss: 0.1153 - val_accuracy: 0.9664

Accuracy: 96.64%

Epoch 1/20
422/422 [==============================] - 2s 4ms/step - loss: 1.8023 -
accuracy: 0.3919 - val_loss: 1.2810 - val_accuracy: 0.5769
Epoch 2/20
422/422 [==============================] - 1s 3ms/step - loss: 1.1432 -
accuracy: 0.6194 - val_loss: 1.0232 - val_accuracy: 0.6641
Epoch 3/20
422/422 [==============================] - 1s 3ms/step - loss: 0.9759 -
accuracy: 0.6661 - val_loss: 0.9151 - val_accuracy: 0.6742
Epoch 4/20
422/422 [==============================] - 1s 3ms/step - loss: 0.8898 -
accuracy: 0.6973 - val_loss: 0.8505 - val_accuracy: 0.7217
Epoch 5/20
422/422 [==============================] - 1s 3ms/step - loss: 0.8324 -
accuracy: 0.7328 - val_loss: 0.7995 - val_accuracy: 0.7652
Epoch 6/20
422/422 [==============================] - 1s 3ms/step - loss: 0.7867 -
accuracy: 0.7584 - val_loss: 0.7577 - val_accuracy: 0.7851
Epoch 7/20
422/422 [==============================] - 1s 3ms/step - loss: 0.7467 -
accuracy: 0.7928 - val_loss: 0.7198 - val_accuracy: 0.7946
Epoch 8/20
422/422 [==============================] - 1s 3ms/step - loss: 0.7112 -
accuracy: 0.8011 - val_loss: 0.6859 - val_accuracy: 0.8270
Epoch 9/20
422/422 [==============================] - 1s 3ms/step - loss: 0.6789 -
```

```
accuracy: 0.8223 - val_loss: 0.6548 - val_accuracy: 0.8478
Epoch 10/20
422/422 [==============================] - 1s 3ms/step - loss: 0.6498 -
accuracy: 0.8392 - val_loss: 0.6265 - val_accuracy: 0.8529
Epoch 11/20
422/422 [==============================] - 1s 3ms/step - loss: 0.6232 -
accuracy: 0.8503 - val_loss: 0.6009 - val_accuracy: 0.8637
Epoch 12/20
422/422 [==============================] - 1s 3ms/step - loss: 0.5991 -
accuracy: 0.8616 - val_loss: 0.5781 - val_accuracy: 0.8707
Epoch 13/20
422/422 [==============================] - 1s 3ms/step - loss: 0.5776 -
accuracy: 0.8682 - val_loss: 0.5581 - val_accuracy: 0.8789
Epoch 14/20
422/422 [==============================] - 1s 3ms/step - loss: 0.5585 -
accuracy: 0.8761 - val_loss: 0.5402 - val_accuracy: 0.8837
Epoch 15/20
422/422 [==============================] - 1s 3ms/step - loss: 0.5414 -
accuracy: 0.8813 - val_loss: 0.5244 - val_accuracy: 0.8894
Epoch 16/20
422/422 [==============================] - 1s 3ms/step - loss: 0.5260 -
accuracy: 0.8864 - val_loss: 0.5102 - val_accuracy: 0.8950
Epoch 17/20
422/422 [==============================] - 1s 3ms/step - loss: 0.5120 -
accuracy: 0.8914 - val_loss: 0.4972 - val_accuracy: 0.8984
Epoch 18/20
422/422 [==============================] - 1s 3ms/step - loss: 0.4993 -
accuracy: 0.8952 - val_loss: 0.4857 - val_accuracy: 0.9028
Epoch 19/20
422/422 [==============================] - 1s 3ms/step - loss: 0.4878 -
accuracy: 0.8979 - val_loss: 0.4748 - val_accuracy: 0.9051
Epoch 20/20
422/422 [==============================] - 1s 3ms/step - loss: 0.4770 -
accuracy: 0.9022 - val_loss: 0.4653 - val_accuracy: 0.9059

Accuracy: 90.59%

Epoch 1/20
399/399 [==============================] - 2s 4ms/step - loss: 2.3061 -
accuracy: 0.1066 - val_loss: 2.3039 - val_accuracy: 0.1002
Epoch 2/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3020 -
accuracy: 0.1105 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 3/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3017 -
accuracy: 0.1134 - val_loss: 2.3029 - val_accuracy: 0.1063
Epoch 4/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3015 -
```

```
accuracy: 0.1134 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 5/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3015 -
accuracy: 0.1131 - val_loss: 2.3018 - val_accuracy: 0.1063
Epoch 6/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 7/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063
Epoch 8/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3014 -
accuracy: 0.1134 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 9/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 10/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3022 - val_accuracy: 0.1063
Epoch 11/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3013 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 12/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3024 - val_accuracy: 0.1063
Epoch 13/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3023 - val_accuracy: 0.1063
Epoch 14/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 15/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 16/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 17/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 18/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 19/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
accuracy: 0.1134 - val_loss: 2.3019 - val_accuracy: 0.1063
Epoch 20/20
399/399 [==============================] - 1s 3ms/step - loss: 2.3012 -
```

```
accuracy: 0.1134 - val_loss: 2.3020 - val_accuracy: 0.1063

Accuracy: 10.63%

Epoch 1/20
1275/1275 [==============================] - 4s 3ms/step - loss: 1.5065 -
accuracy: 0.3512 - val_loss: 0.9237 - val_accuracy: 0.5861
Epoch 2/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.5109 -
accuracy: 0.8547 - val_loss: 0.2379 - val_accuracy: 0.9483
Epoch 3/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.1841 -
accuracy: 0.9602 - val_loss: 0.1515 - val_accuracy: 0.9663
Epoch 4/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.1229 -
accuracy: 0.9721 - val_loss: 0.1437 - val_accuracy: 0.9666
Epoch 5/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0915 -
accuracy: 0.9786 - val_loss: 0.1257 - val_accuracy: 0.9712
Epoch 6/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0716 -
accuracy: 0.9829 - val_loss: 0.1197 - val_accuracy: 0.9719
Epoch 7/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0597 -
accuracy: 0.9850 - val_loss: 0.1221 - val_accuracy: 0.9733
Epoch 8/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0507 -
accuracy: 0.9872 - val_loss: 0.1208 - val_accuracy: 0.9722
Epoch 9/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0435 -
accuracy: 0.9891 - val_loss: 0.1113 - val_accuracy: 0.9746
Epoch 10/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0387 -
accuracy: 0.9907 - val_loss: 0.1266 - val_accuracy: 0.9720
Epoch 11/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0339 -
accuracy: 0.9914 - val_loss: 0.1126 - val_accuracy: 0.9747
Epoch 12/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0295 -
accuracy: 0.9923 - val_loss: 0.1175 - val_accuracy: 0.9738
Epoch 13/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0281 -
accuracy: 0.9925 - val_loss: 0.1224 - val_accuracy: 0.9748
Epoch 14/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0243 -
accuracy: 0.9931 - val_loss: 0.1201 - val_accuracy: 0.9764
Epoch 15/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0217 -
```

```
accuracy: 0.9942 - val_loss: 0.1212 - val_accuracy: 0.9756
Epoch 16/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0195 -
accuracy: 0.9950 - val_loss: 0.1267 - val_accuracy: 0.9742
Epoch 17/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0195 -
accuracy: 0.9950 - val_loss: 0.1108 - val_accuracy: 0.9752
Epoch 18/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0183 -
accuracy: 0.9950 - val_loss: 0.1381 - val_accuracy: 0.9746
Epoch 19/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0160 -
accuracy: 0.9955 - val_loss: 0.1265 - val_accuracy: 0.9757
Epoch 20/20
1275/1275 [==============================] - 4s 3ms/step - loss: 0.0166 -
accuracy: 0.9954 - val_loss: 0.1310 - val_accuracy: 0.9751

Accuracy: 97.51%

Epoch 1/20
1063/1063 [==============================] - 4s 3ms/step - loss: 0.6227 -
accuracy: 0.8130 - val_loss: 0.2990 - val_accuracy: 0.9270
Epoch 2/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.2469 -
accuracy: 0.9405 - val_loss: 0.2120 - val_accuracy: 0.9489
Epoch 3/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.1878 -
accuracy: 0.9548 - val_loss: 0.1932 - val_accuracy: 0.9518
Epoch 4/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.1569 -
accuracy: 0.9633 - val_loss: 0.1829 - val_accuracy: 0.9540
Epoch 5/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.1363 -
accuracy: 0.9675 - val_loss: 0.1762 - val_accuracy: 0.9566
Epoch 6/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.1209 -
accuracy: 0.9717 - val_loss: 0.1700 - val_accuracy: 0.9579
Epoch 7/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.1097 -
accuracy: 0.9738 - val_loss: 0.1688 - val_accuracy: 0.9588
Epoch 8/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.1001 -
accuracy: 0.9769 - val_loss: 0.1674 - val_accuracy: 0.9590
Epoch 9/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0930 -
accuracy: 0.9788 - val_loss: 0.1638 - val_accuracy: 0.9602
Epoch 10/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0867 -
```

```
accuracy: 0.9806 - val_loss: 0.1644 - val_accuracy: 0.9612
Epoch 11/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0812 -
accuracy: 0.9822 - val_loss: 0.1638 - val_accuracy: 0.9609
Epoch 12/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0770 -
accuracy: 0.9834 - val_loss: 0.1639 - val_accuracy: 0.9600
Epoch 13/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0734 -
accuracy: 0.9841 - val_loss: 0.1652 - val_accuracy: 0.9606
Epoch 14/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0695 -
accuracy: 0.9851 - val_loss: 0.1652 - val_accuracy: 0.9610
Epoch 15/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0668 -
accuracy: 0.9859 - val_loss: 0.1653 - val_accuracy: 0.9613
Epoch 16/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0642 -
accuracy: 0.9866 - val_loss: 0.1637 - val_accuracy: 0.9618
Epoch 17/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0618 -
accuracy: 0.9870 - val_loss: 0.1660 - val_accuracy: 0.9608
Epoch 18/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0596 -
accuracy: 0.9876 - val_loss: 0.1678 - val_accuracy: 0.9620
Epoch 19/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0579 -
accuracy: 0.9881 - val_loss: 0.1691 - val_accuracy: 0.9611
Epoch 20/20
1063/1063 [==============================] - 3s 3ms/step - loss: 0.0559 -
accuracy: 0.9885 - val_loss: 0.1730 - val_accuracy: 0.9613

Accuracy: 96.13%

Epoch 1/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.5167 -
accuracy: 0.8471 - val_loss: 0.2134 - val_accuracy: 0.9491
Epoch 2/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.2033 -
accuracy: 0.9497 - val_loss: 0.1821 - val_accuracy: 0.9559
Epoch 3/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.1498 -
accuracy: 0.9619 - val_loss: 0.1869 - val_accuracy: 0.9503
Epoch 4/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.1208 -
accuracy: 0.9693 - val_loss: 0.1203 - val_accuracy: 0.9693
Epoch 5/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.1011 -
```

```
accuracy: 0.9743 - val_loss: 0.1145 - val_accuracy: 0.9709
Epoch 6/20
51000/51000 [==============================] - 138s 3ms/step - loss: 0.0868 -
accuracy: 0.9777 - val_loss: 0.1152 - val_accuracy: 0.9716
Epoch 7/20
51000/51000 [==============================] - 138s 3ms/step - loss: 0.0743 -
accuracy: 0.9808 - val_loss: 0.1042 - val_accuracy: 0.9759
Epoch 8/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0629 -
accuracy: 0.9845 - val_loss: 0.1061 - val_accuracy: 0.9762
Epoch 9/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0577 -
accuracy: 0.9853 - val_loss: 0.1152 - val_accuracy: 0.9749
Epoch 10/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0504 -
accuracy: 0.9870 - val_loss: 0.1010 - val_accuracy: 0.9758
Epoch 11/20
51000/51000 [==============================] - 138s 3ms/step - loss: 0.0441 -
accuracy: 0.9885 - val_loss: 0.1408 - val_accuracy: 0.9756
Epoch 12/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0420 -
accuracy: 0.9896 - val_loss: 0.1115 - val_accuracy: 0.9769
Epoch 13/20
51000/51000 [==============================] - 138s 3ms/step - loss: 0.0348 -
accuracy: 0.9912 - val_loss: 0.1217 - val_accuracy: 0.9792
Epoch 14/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0321 -
accuracy: 0.9924 - val_loss: 0.1331 - val_accuracy: 0.9764
Epoch 15/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0267 -
accuracy: 0.9934 - val_loss: 0.1459 - val_accuracy: 0.9769
Epoch 16/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0251 -
accuracy: 0.9935 - val_loss: 0.1343 - val_accuracy: 0.9773
Epoch 17/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0216 -
accuracy: 0.9948 - val_loss: 0.1691 - val_accuracy: 0.9778
Epoch 18/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0190 -
accuracy: 0.9957 - val_loss: 0.1630 - val_accuracy: 0.9749
Epoch 19/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0178 -
accuracy: 0.9959 - val_loss: 0.1564 - val_accuracy: 0.9776
Epoch 20/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0165 -
accuracy: 0.9959 - val_loss: 0.1566 - val_accuracy: 0.9764

Accuracy: 97.64%
```

```
Epoch 1/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.4781 -
accuracy: 0.8598 - val_loss: 0.1774 - val_accuracy: 0.9576
Epoch 2/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.1783 -
accuracy: 0.9561 - val_loss: 0.1476 - val_accuracy: 0.9660
Epoch 3/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.1309 -
accuracy: 0.9675 - val_loss: 0.1285 - val_accuracy: 0.9691
Epoch 4/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.1063 -
accuracy: 0.9737 - val_loss: 0.1155 - val_accuracy: 0.9702
Epoch 5/20
51000/51000 [==============================] - 141s 3ms/step - loss: 0.0890 -
accuracy: 0.9777 - val_loss: 0.1303 - val_accuracy: 0.9679
Epoch 6/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0740 -
accuracy: 0.9811 - val_loss: 0.1105 - val_accuracy: 0.9743
Epoch 7/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0618 -
accuracy: 0.9840 - val_loss: 0.1152 - val_accuracy: 0.9747
Epoch 8/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0542 -
accuracy: 0.9870 - val_loss: 0.1161 - val_accuracy: 0.9761
Epoch 9/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0485 -
accuracy: 0.9885 - val_loss: 0.1202 - val_accuracy: 0.9757
Epoch 10/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0425 -
accuracy: 0.9894 - val_loss: 0.1073 - val_accuracy: 0.9752
Epoch 11/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0363 -
accuracy: 0.9909 - val_loss: 0.1261 - val_accuracy: 0.9751
Epoch 12/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0323 -
accuracy: 0.9925 - val_loss: 0.1439 - val_accuracy: 0.9782
Epoch 13/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0304 -
accuracy: 0.9927 - val_loss: 0.1399 - val_accuracy: 0.9768
Epoch 14/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0264 -
accuracy: 0.9936 - val_loss: 0.1420 - val_accuracy: 0.9793
Epoch 15/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0227 -
accuracy: 0.9948 - val_loss: 0.1526 - val_accuracy: 0.9786
Epoch 16/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0208 -
```

```
accuracy: 0.9950 - val_loss: 0.1416 - val_accuracy: 0.9767
Epoch 17/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0192 -
accuracy: 0.9957 - val_loss: 0.1557 - val_accuracy: 0.9776
Epoch 18/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0186 -
accuracy: 0.9961 - val_loss: 0.1198 - val_accuracy: 0.9782
Epoch 19/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0139 -
accuracy: 0.9970 - val_loss: 0.1808 - val_accuracy: 0.9802
Epoch 20/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0133 -
accuracy: 0.9970 - val_loss: 0.2132 - val_accuracy: 0.9773

Accuracy: 97.73%

Epoch 1/20
51000/51000 [==============================] - 141s 3ms/step - loss: 0.5422 -
accuracy: 0.8325 - val_loss: 0.2164 - val_accuracy: 0.9477
Epoch 2/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.1948 -
accuracy: 0.9503 - val_loss: 0.2094 - val_accuracy: 0.9491
Epoch 3/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.1415 -
accuracy: 0.9644 - val_loss: 0.1660 - val_accuracy: 0.9626
Epoch 4/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.1140 -
accuracy: 0.9713 - val_loss: 0.1226 - val_accuracy: 0.9689
Epoch 5/20
51000/51000 [==============================] - 141s 3ms/step - loss: 0.0919 -
accuracy: 0.9770 - val_loss: 0.1248 - val_accuracy: 0.9693
Epoch 6/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0772 -
accuracy: 0.9809 - val_loss: 0.1323 - val_accuracy: 0.9719
Epoch 7/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0649 -
accuracy: 0.9831 - val_loss: 0.1247 - val_accuracy: 0.9709
Epoch 8/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0591 -
accuracy: 0.9853 - val_loss: 0.1020 - val_accuracy: 0.9749
Epoch 9/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0492 -
accuracy: 0.9880 - val_loss: 0.1287 - val_accuracy: 0.9724
Epoch 10/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0454 -
accuracy: 0.9889 - val_loss: 0.1244 - val_accuracy: 0.9767
Epoch 11/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0381 -
```

```
accuracy: 0.9904 - val_loss: 0.1141 - val_accuracy: 0.9766
Epoch 12/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0347 -
accuracy: 0.9916 - val_loss: 0.1119 - val_accuracy: 0.9780
Epoch 13/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0287 -
accuracy: 0.9930 - val_loss: 0.1393 - val_accuracy: 0.9769
Epoch 14/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0259 -
accuracy: 0.9940 - val_loss: 0.1491 - val_accuracy: 0.9777
Epoch 15/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0236 -
accuracy: 0.9942 - val_loss: 0.1566 - val_accuracy: 0.9770
Epoch 16/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0197 -
accuracy: 0.9954 - val_loss: 0.1331 - val_accuracy: 0.9788
Epoch 17/20
51000/51000 [==============================] - 140s 3ms/step - loss: 0.0186 -
accuracy: 0.9958 - val_loss: 0.1360 - val_accuracy: 0.9793
Epoch 18/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0168 -
accuracy: 0.9964 - val_loss: 0.1536 - val_accuracy: 0.9781
Epoch 19/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0172 -
accuracy: 0.9964 - val_loss: 0.1592 - val_accuracy: 0.9783
Epoch 20/20
51000/51000 [==============================] - 139s 3ms/step - loss: 0.0127 -
accuracy: 0.9972 - val_loss: 0.1645 - val_accuracy: 0.9771

Accuracy: 97.71%
```

### 1.3 Find best accuracy

[ ]:
```
print("best accuracy was " + str(round(gp_result.fun *-100,2))+"%.")
```

```
best accuracy was 98.2%.
```

#### 1.3.1 The best function

[ ]:
```
gp_result.x
```

[ ]:
```
[0.0014480753787065842, 1, 447, 13, 'relu', 74, 0.0015325746259423636]
```

[ ]:
```
gp_result.func_vals
```

[ ]:
```
array([-0.98011112, -0.97355556, -0.96777779, -0.97155553, -0.972     ,
       -0.97677779, -0.96244442, -0.38766667, -0.91533333, -0.94711113,
       -0.96888888, -0.10644444, -0.84244442, -0.92211109, -0.10633333,
       -0.30700001, -0.95033336, -0.10633333, -0.10633333, -0.9682222 ,
       -0.97522223, -0.10633333, -0.94466668, -0.97344446, -0.93088889,
       -0.97222221, -0.98199999, -0.97388887, -0.8241111 , -0.93711114,
       -0.90455556, -0.97777778, -0.71533334, -0.97799999, -0.97055554,
       -0.10633333, -0.96466666, -0.98133332, -0.97355556, -0.97233331,
       -0.97266668, -0.97611111, -0.96388888, -0.96611112, -0.98066664,
       -0.97277778, -0.96866667, -0.86322224, -0.97833335, -0.95844442,
       -0.97799999, -0.10633333, -0.9683333 , -0.97733331, -0.97033334,
       -0.9668889 , -0.96666664, -0.95044446, -0.10688889, -0.96700001,
       -0.97766668, -0.97366667, -0.97677779, -0.10633333, -0.98011112,
       -0.97244442, -0.97288889, -0.96622223, -0.97755557, -0.98144442,
       -0.92422223, -0.97733331, -0.9772222 , -0.97355556, -0.97855556,
       -0.95999998, -0.97666669, -0.97877777, -0.97877777, -0.98133332,
       -0.97966665, -0.97977775, -0.97922224, -0.97166669, -0.44288889,
       -0.56966668, -0.97477776, -0.96533334, -0.9667778 , -0.97233331,
       -0.96211112, -0.98022223, -0.96644443, -0.90588892, -0.10633333,
       -0.97511113, -0.96133333, -0.97644442, -0.97733331, -0.9771111 ])
```

### 1.3.2 All the models and paremeters

[ ]:
```
df_temp = pd.concat([pd.DataFrame(gp_result.x_iters, columns = ["learning␣
↪rate","hidden layers","input layer nodes","hidden layer nodes",
                                                "activation function","batch␣
↪size","adam learning rate decay"]),
                                    (pd.Series(gp_result.func_vals*-100,␣
↪name="accuracy"))], axis=1)
```

[ ]:
```
df_temp.head()
```

[ ]:

| | learning rate | hidden layers | input layer nodes | hidden layer nodes | activation function | batch size | adam learning rate decay | accuracy |
|---|---|---|---|---|---|---|---|---|
| 0 | 0.001000 | 1 | 512 | 13 | relu | 64 | 0.001000 | 98.011112 |
| 1 | 0.005828 | 2 | 254 | 16 | sigmoid | 9 | 0.002643 | 97.355556 |
| 2 | 0.013022 | 3 | 285 | 16 | sigmoid | 90 | 0.009880 | 96.777779 |
| 3 | 0.004085 | 3 | 473 | 15 | sigmoid | 67 | 0.001773 | 97.155553 |
| 4 | 0.002228 | 4 | 219 | 20 | sigmoid | 53 | 0.000720 | 97.200000 |

[ ]:
```
df_temp = df_temp.sort_values(by=['accuracy'], ascending=False)
```

[ ]:
```
df_temp
```

[ ]:
```
    learning rate  hidden layers  input layer nodes  hidden layer nodes  \
26       0.001448              1                447                  13
69       0.001088              1                512                  28
79       0.001267              1                512                  12
37       0.001200              1                512                  11
44       0.002269              2                193                  27
..            …            …                …                   …
51       0.000100              2                181                   1
14       0.072794              2                472                  23
35       0.003725              1                512                   1
21       0.000100              5                512                  17
17       0.100000              5                189                   1

   activation function  batch size  adam learning rate decay   accuracy
26                relu          74                  0.001533  98.199999
69                relu         123                  0.001037  98.144442
79                relu         128                  0.000001  98.133332
37                relu         128                  0.001242  98.133332
44                relu         128                  0.000215  98.066664
..                 …         …                    …         …
51                relu         124                  0.001292  10.633333
14             sigmoid           6                  0.000608  10.633333
35                relu           1                  0.000001  10.633333
21             sigmoid         128                  0.002175  10.633333
17                relu         104                  0.004735  10.633333

[100 rows x 8 columns]
```

[ ]:
```
df_temp.to_csv("DF_TEMP.csv")
```

[ ]:
```
gp_result.x
```

[ ]:
```
[0.0014480753787065842, 1, 447, 13, 'relu', 74, 0.0015325746259423636]
```

[ ]:
```
gp_model = create_model(gp_result.x[0],gp_result.x[1],gp_result.x[2],gp_result.
 ↪x[3],gp_result.x[4],gp_result.x[6])
gp_model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense (Dense)               (None, 447)               350895

 layer_dense_1 (Dense)       (None, 13)                5824
```

```
 dense_1 (Dense)             (None, 10)                140

=================================================================
Total params: 356,859
Trainable params: 356,859
Non-trainable params: 0
_________________________________________________________________
```

[ ]:
```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_layer (Dense)         (None, 16)                12560

 hidden_layer (Dense)        (None, 16)                272

 output_layer (Dense)        (None, 10)                170

=================================================================
Total params: 13,002
Trainable params: 13,002
Non-trainable params: 0
_________________________________________________________________
```

### 1.3.3 Retrain the best model architecture

[ ]:
```
gp_model.fit(X_train, y_train, batch_size=gp_result.x[5], epochs =20,␣
↪validation_split=0.15)
gp_model.evaluate(X_train,y_train)
```

```
Epoch 1/20
690/690 [==============================] - 2s 3ms/step - loss: 0.3144 -
accuracy: 0.9065 - val_loss: 0.1365 - val_accuracy: 0.9627
Epoch 2/20
690/690 [==============================] - 2s 3ms/step - loss: 0.1145 -
accuracy: 0.9670 - val_loss: 0.1013 - val_accuracy: 0.9711
Epoch 3/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0791 -
accuracy: 0.9775 - val_loss: 0.0873 - val_accuracy: 0.9734
Epoch 4/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0603 -
accuracy: 0.9830 - val_loss: 0.0858 - val_accuracy: 0.9759
Epoch 5/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0484 -
accuracy: 0.9868 - val_loss: 0.0802 - val_accuracy: 0.9753
```

```
Epoch 6/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0403 -
accuracy: 0.9896 - val_loss: 0.0770 - val_accuracy: 0.9781
Epoch 7/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0343 -
accuracy: 0.9916 - val_loss: 0.0758 - val_accuracy: 0.9786
Epoch 8/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0297 -
accuracy: 0.9930 - val_loss: 0.0766 - val_accuracy: 0.9798
Epoch 9/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0257 -
accuracy: 0.9946 - val_loss: 0.0733 - val_accuracy: 0.9784
Epoch 10/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0226 -
accuracy: 0.9955 - val_loss: 0.0733 - val_accuracy: 0.9789
Epoch 11/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0200 -
accuracy: 0.9961 - val_loss: 0.0733 - val_accuracy: 0.9792
Epoch 12/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0179 -
accuracy: 0.9968 - val_loss: 0.0734 - val_accuracy: 0.9797
Epoch 13/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0160 -
accuracy: 0.9974 - val_loss: 0.0755 - val_accuracy: 0.9792
Epoch 14/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0144 -
accuracy: 0.9979 - val_loss: 0.0739 - val_accuracy: 0.9801
Epoch 15/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0131 -
accuracy: 0.9982 - val_loss: 0.0744 - val_accuracy: 0.9796
Epoch 16/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0118 -
accuracy: 0.9984 - val_loss: 0.0741 - val_accuracy: 0.9794
Epoch 17/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0107 -
accuracy: 0.9987 - val_loss: 0.0735 - val_accuracy: 0.9791
Epoch 18/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0098 -
accuracy: 0.9989 - val_loss: 0.0733 - val_accuracy: 0.9796
Epoch 19/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0090 -
accuracy: 0.9991 - val_loss: 0.0737 - val_accuracy: 0.9797
Epoch 20/20
690/690 [==============================] - 2s 3ms/step - loss: 0.0082 -
accuracy: 0.9993 - val_loss: 0.0746 - val_accuracy: 0.9798
1875/1875 [==============================] - 4s 2ms/step - loss: 0.0174 -
accuracy: 0.9966
```

[ ]: [0.01735677570104599, 0.996566653251648]

[ ]:
```
gp_model.evaluate(X_test,y_test)
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.0722 -
accuracy: 0.9792
```

[ ]: [0.07222875207662582, 0.979200005531311]

### 1.4 Random search

[ ]:
```
import random
```

[ ]:
```
dim_learning_rate = Real(low=1e-4, high=1e-1, prior='log-uniform',
                         name='learning_rate')
dim_num_dense_layers = Integer(low=1, high=5, name='num_dense_layers')
dim_num_input_nodes = Integer(low=1, high=512, name='num_input_nodes')
dim_num_dense_nodes = Integer(low=1, high=28, name='num_dense_nodes')
dim_activation = Categorical(categories=['relu', 'sigmoid'],
                             name='activation')
dim_batch_size = Integer(low=1, high=128, name='batch_size')
dim_adam_decay = Real(low=1e-6,high=1e-2,name="adam_decay")

dimensions = [dim_learning_rate,
              dim_num_dense_layers,
              dim_num_input_nodes,
              dim_num_dense_nodes,
              dim_activation,
              dim_batch_size,
              dim_adam_decay
             ]

param_grid = {
              'dim_learning_rate' : list(np.logspace(np.log(0.005), np.log(0.
 ↪2), base = np.exp(1), num = 1000)),
              'dim_num_dense_layers' : list(range(1, 5)),
              'dim_num_input_nodes' : list(range(2, 512, 2)),
              'dim_num_dense_nodes' : list(range(1, 28)),
              'dim_activation' : ['relu', 'sigmoid'],
              'dim_batch_size' : list(range(1, 128))
}
```

[ ]:
```
random.seed(50)

# Iterate through the specified number of evaluations
for i in range(5):
```

```
    # Randomly sample parameters for gbm
    params = [random.sample(value, 1)[0] for key, value in param_grid.items()]

    print(params)
```

```
[0.03275177220475209, 3, 188, 21, 'relu', 89]
[0.029863672437724486, 3, 44, 18, 'sigmoid', 29]
[0.06437322298735856, 1, 478, 5, 'sigmoid', 106]
[0.007233298202346897, 3, 164, 8, 'relu', 9]
[0.19706765150537875, 3, 506, 20, 'sigmoid', 82]
```

[ ]:
```
def create_model(learning_rate, num_dense_layers,num_input_nodes,
                 num_dense_nodes, activation):
    #start the model making process and create our first layer
    model = Sequential()
    model.add(Dense(num_input_nodes, input_shape= input_shape,␣
 ↪activation=activation
                    ))
    #create a loop making a new dense layer for the amount passed to this model.
    #naming the layers helps avoid tensorflow error deep in the stack trace.
    for i in range(num_dense_layers):
        name = 'layer_dense_{0}'.format(i+1)
        model.add(Dense(num_dense_nodes,
                  activation=activation,
                         name=name
                  ))
    #add our classification layer.
    model.add(Dense(10,activation='softmax'))

    #setup our optimizer and compile
    adam = Adam(learning_rate=learning_rate)
    model.compile(optimizer=adam, loss='categorical_crossentropy',
                  metrics=['accuracy'])
    return model
```

[ ]:
```
def fitness(learning_rate, num_dense_layers, num_input_nodes,
            num_dense_nodes,activation, batch_size):

    model = create_model(learning_rate=learning_rate,
                         num_dense_layers=num_dense_layers,
                         num_input_nodes=num_input_nodes,
                         num_dense_nodes=num_dense_nodes,
                         activation=activation
                        )
```

```
    #named blackbox becuase it represents the structure
    blackbox = model.fit(x=X_train,
                         y=y_train,
                         epochs=20,
                         batch_size=batch_size,
                         validation_split=0.15,
                         )
    #return the validation accuracy for the last epoch.
    accuracy = blackbox.history['val_accuracy'][-1]

    # Print the classification accuracy.
    print()
    print("Accuracy: {0:.2%}".format(accuracy))
    print()


    # Delete the Keras model with these hyper-parameters from memory.
    del model

    # Clear the Keras session, otherwise it will keep adding new
    # models to the same TensorFlow graph each time we create
    # a model with a different set of hyper-parameters.
    K.clear_session()
    ops.reset_default_graph()

    return [learning_rate, num_dense_layers, num_input_nodes,
            num_dense_nodes,activation, batch_size, accuracy]
```

[ ]:
```
random.seed(50)

results = []
best_results = [0, 0, 0, 0, 0, 0, 0]

# Iterate through the specified number of evaluations
for i in range(100):

    print("Iteration: ", i+1)

    # Randomly sample parameters for gbm
    params = [random.sample(value, 1)[0] for key, value in param_grid.items()]

    result = fitness(params[0], params[1], params[2], params[3], params[4],␣
 ↪params[5])
    results.append(result)
    if(best_results[6] < result[6]):
      best_results = result
```

```
Iteration:  1
Epoch 1/20
574/574 [==============================] - 2s 3ms/step - loss: 0.5546 -
accuracy: 0.8364 - val_loss: 0.3162 - val_accuracy: 0.9173
Epoch 2/20
574/574 [==============================] - 2s 3ms/step - loss: 0.3405 -
accuracy: 0.9109 - val_loss: 0.2545 - val_accuracy: 0.9386
Epoch 3/20
574/574 [==============================] - 2s 3ms/step - loss: 0.3086 -
accuracy: 0.9233 - val_loss: 0.2725 - val_accuracy: 0.9332
Epoch 4/20
574/574 [==============================] - 2s 3ms/step - loss: 0.3029 -
accuracy: 0.9276 - val_loss: 0.4105 - val_accuracy: 0.9211
Epoch 5/20
574/574 [==============================] - 2s 3ms/step - loss: 0.3523 -
accuracy: 0.9163 - val_loss: 0.2989 - val_accuracy: 0.9270
Epoch 6/20
574/574 [==============================] - 2s 3ms/step - loss: 0.3614 -
accuracy: 0.9100 - val_loss: 0.2753 - val_accuracy: 0.9256
Epoch 7/20
574/574 [==============================] - 2s 3ms/step - loss: 0.2821 -
accuracy: 0.9315 - val_loss: 0.3138 - val_accuracy: 0.9210
Epoch 8/20
574/574 [==============================] - 2s 3ms/step - loss: 0.3570 -
accuracy: 0.9154 - val_loss: 0.3113 - val_accuracy: 0.9329
Epoch 9/20
574/574 [==============================] - 2s 3ms/step - loss: 0.3825 -
accuracy: 0.8981 - val_loss: 0.5039 - val_accuracy: 0.8344
Epoch 10/20
574/574 [==============================] - 2s 3ms/step - loss: 0.6190 -
accuracy: 0.7979 - val_loss: 0.5365 - val_accuracy: 0.8202
Epoch 11/20
574/574 [==============================] - 2s 3ms/step - loss: 0.5697 -
accuracy: 0.8107 - val_loss: 0.4669 - val_accuracy: 0.8306
Epoch 12/20
574/574 [==============================] - 2s 3ms/step - loss: 0.4987 -
accuracy: 0.8344 - val_loss: 0.4445 - val_accuracy: 0.8454
Epoch 13/20
574/574 [==============================] - 2s 3ms/step - loss: 0.4759 -
accuracy: 0.8346 - val_loss: 0.5751 - val_accuracy: 0.8168
Epoch 14/20
574/574 [==============================] - 2s 3ms/step - loss: 0.6898 -
accuracy: 0.7465 - val_loss: 0.5738 - val_accuracy: 0.7804
Epoch 15/20
574/574 [==============================] - 2s 3ms/step - loss: 0.8432 -
accuracy: 0.7205 - val_loss: 0.6989 - val_accuracy: 0.7691
Epoch 16/20
574/574 [==============================] - 2s 3ms/step - loss: 0.8413 -
```

```
accuracy: 0.7233 - val_loss: 0.9536 - val_accuracy: 0.6372
Epoch 17/20
574/574 [==============================] - 2s 3ms/step - loss: 0.8663 -
accuracy: 0.6844 - val_loss: 0.6939 - val_accuracy: 0.7280
Epoch 18/20
574/574 [==============================] - 2s 3ms/step - loss: 0.9667 -
accuracy: 0.6453 - val_loss: 1.0889 - val_accuracy: 0.5908
Epoch 19/20
574/574 [==============================] - 2s 3ms/step - loss: 1.1224 -
accuracy: 0.5575 - val_loss: 1.0462 - val_accuracy: 0.5819
Epoch 20/20
574/574 [==============================] - 2s 3ms/step - loss: 1.0002 -
accuracy: 0.6540 - val_loss: 0.7888 - val_accuracy: 0.7278

Accuracy: 72.78%

Iteration:  2
Epoch 1/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.5940 -
accuracy: 0.8170 - val_loss: 0.3265 - val_accuracy: 0.9100
Epoch 2/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.3537 -
accuracy: 0.9013 - val_loss: 0.3110 - val_accuracy: 0.9097
Epoch 3/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.3339 -
accuracy: 0.9070 - val_loss: 0.2837 - val_accuracy: 0.9201
Epoch 4/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.3085 -
accuracy: 0.9132 - val_loss: 0.3006 - val_accuracy: 0.9132
Epoch 5/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2994 -
accuracy: 0.9184 - val_loss: 0.3159 - val_accuracy: 0.9103
Epoch 6/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2835 -
accuracy: 0.9216 - val_loss: 0.2446 - val_accuracy: 0.9318
Epoch 7/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2743 -
accuracy: 0.9254 - val_loss: 0.2542 - val_accuracy: 0.9309
Epoch 8/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2646 -
accuracy: 0.9267 - val_loss: 0.2242 - val_accuracy: 0.9397
Epoch 9/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2649 -
accuracy: 0.9281 - val_loss: 0.2339 - val_accuracy: 0.9350
Epoch 10/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2671 -
accuracy: 0.9258 - val_loss: 0.2563 - val_accuracy: 0.9278
Epoch 11/20
```

```
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2660 -
accuracy: 0.9286 - val_loss: 0.2337 - val_accuracy: 0.9408
Epoch 12/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2565 -
accuracy: 0.9306 - val_loss: 0.2377 - val_accuracy: 0.9341
Epoch 13/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2559 -
accuracy: 0.9295 - val_loss: 0.2374 - val_accuracy: 0.9354
Epoch 14/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2587 -
accuracy: 0.9299 - val_loss: 0.2297 - val_accuracy: 0.9391
Epoch 15/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2470 -
accuracy: 0.9332 - val_loss: 0.2291 - val_accuracy: 0.9404
Epoch 16/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2430 -
accuracy: 0.9340 - val_loss: 0.2132 - val_accuracy: 0.9437
Epoch 17/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2488 -
accuracy: 0.9319 - val_loss: 0.2680 - val_accuracy: 0.9302
Epoch 18/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2474 -
accuracy: 0.9317 - val_loss: 0.2354 - val_accuracy: 0.9372
Epoch 19/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2437 -
accuracy: 0.9326 - val_loss: 0.2425 - val_accuracy: 0.9332
Epoch 20/20
1759/1759 [==============================] - 5s 3ms/step - loss: 0.2368 -
accuracy: 0.9343 - val_loss: 0.2319 - val_accuracy: 0.9396

Accuracy: 93.96%

Iteration:  3
Epoch 1/20
482/482 [==============================] - 2s 3ms/step - loss: 2.3096 -
accuracy: 0.1036 - val_loss: 2.3097 - val_accuracy: 0.0959
Epoch 2/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3102 -
accuracy: 0.1031 - val_loss: 2.3082 - val_accuracy: 0.1063
Epoch 3/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3100 -
accuracy: 0.1064 - val_loss: 2.3171 - val_accuracy: 0.1063
Epoch 4/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3098 -
accuracy: 0.1041 - val_loss: 2.3085 - val_accuracy: 0.1093
Epoch 5/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3094 -
accuracy: 0.1061 - val_loss: 2.3165 - val_accuracy: 0.1093
```

```
Epoch 6/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3091 -
accuracy: 0.1053 - val_loss: 2.3109 - val_accuracy: 0.1063
Epoch 7/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3103 -
accuracy: 0.1031 - val_loss: 2.3113 - val_accuracy: 0.0990
Epoch 8/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3104 -
accuracy: 0.1042 - val_loss: 2.3098 - val_accuracy: 0.0959
Epoch 9/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3094 -
accuracy: 0.1046 - val_loss: 2.3055 - val_accuracy: 0.0959
Epoch 10/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3098 -
accuracy: 0.1043 - val_loss: 2.3043 - val_accuracy: 0.1063
Epoch 11/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3109 -
accuracy: 0.1006 - val_loss: 2.3123 - val_accuracy: 0.1028
Epoch 12/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3098 -
accuracy: 0.1039 - val_loss: 2.3067 - val_accuracy: 0.1028
Epoch 13/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3097 -
accuracy: 0.1051 - val_loss: 2.3133 - val_accuracy: 0.1063
Epoch 14/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3093 -
accuracy: 0.1043 - val_loss: 2.3101 - val_accuracy: 0.0990
Epoch 15/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3106 -
accuracy: 0.1022 - val_loss: 2.3070 - val_accuracy: 0.0959
Epoch 16/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3097 -
accuracy: 0.1073 - val_loss: 2.3063 - val_accuracy: 0.1028
Epoch 17/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3106 -
accuracy: 0.1030 - val_loss: 2.3159 - val_accuracy: 0.0959
Epoch 18/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3091 -
accuracy: 0.1041 - val_loss: 2.3088 - val_accuracy: 0.1063
Epoch 19/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3099 -
accuracy: 0.1041 - val_loss: 2.3066 - val_accuracy: 0.1028
Epoch 20/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3097 -
accuracy: 0.1044 - val_loss: 2.3060 - val_accuracy: 0.0959

Accuracy: 9.59%
```

```
Iteration:  4
Epoch 1/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.4933 -
accuracy: 0.8521 - val_loss: 0.3210 - val_accuracy: 0.9146
Epoch 2/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.2353 -
accuracy: 0.9414 - val_loss: 0.1891 - val_accuracy: 0.9531
Epoch 3/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.2055 -
accuracy: 0.9492 - val_loss: 0.1831 - val_accuracy: 0.9578
Epoch 4/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1925 -
accuracy: 0.9521 - val_loss: 0.2057 - val_accuracy: 0.9536
Epoch 5/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1722 -
accuracy: 0.9570 - val_loss: 0.2053 - val_accuracy: 0.9509
Epoch 6/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1636 -
accuracy: 0.9603 - val_loss: 0.1812 - val_accuracy: 0.9558
Epoch 7/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1542 -
accuracy: 0.9626 - val_loss: 0.3506 - val_accuracy: 0.9379
Epoch 8/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1496 -
accuracy: 0.9642 - val_loss: 0.1929 - val_accuracy: 0.9594
Epoch 9/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1499 -
accuracy: 0.9638 - val_loss: 0.2016 - val_accuracy: 0.9604
Epoch 10/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1513 -
accuracy: 0.9643 - val_loss: 0.1654 - val_accuracy: 0.9631
Epoch 11/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1431 -
accuracy: 0.9660 - val_loss: 0.1919 - val_accuracy: 0.9582
Epoch 12/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1330 -
accuracy: 0.9678 - val_loss: 0.2106 - val_accuracy: 0.9559
Epoch 13/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1240 -
accuracy: 0.9711 - val_loss: 0.1668 - val_accuracy: 0.9653
Epoch 14/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1305 -
accuracy: 0.9685 - val_loss: 0.2596 - val_accuracy: 0.9444
Epoch 15/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1299 -
accuracy: 0.9691 - val_loss: 0.1872 - val_accuracy: 0.9597
Epoch 16/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1259 -
```

```
accuracy: 0.9696 - val_loss: 0.1857 - val_accuracy: 0.9639
Epoch 17/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1437 -
accuracy: 0.9664 - val_loss: 0.3007 - val_accuracy: 0.9623
Epoch 18/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1581 -
accuracy: 0.9643 - val_loss: 0.2421 - val_accuracy: 0.9529
Epoch 19/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1438 -
accuracy: 0.9653 - val_loss: 0.2116 - val_accuracy: 0.9554
Epoch 20/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.1440 -
accuracy: 0.9666 - val_loss: 0.1954 - val_accuracy: 0.9637

Accuracy: 96.37%

Iteration:  5
Epoch 1/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3165 -
accuracy: 0.1049 - val_loss: 2.3212 - val_accuracy: 0.0959
Epoch 2/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3156 -
accuracy: 0.1042 - val_loss: 2.3213 - val_accuracy: 0.0959
Epoch 3/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3150 -
accuracy: 0.1049 - val_loss: 2.3253 - val_accuracy: 0.1028
Epoch 4/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3153 -
accuracy: 0.1039 - val_loss: 2.3293 - val_accuracy: 0.1002
Epoch 5/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3159 -
accuracy: 0.1065 - val_loss: 2.3289 - val_accuracy: 0.0993
Epoch 6/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3159 -
accuracy: 0.1033 - val_loss: 2.3102 - val_accuracy: 0.1063
Epoch 7/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3155 -
accuracy: 0.1023 - val_loss: 2.3148 - val_accuracy: 0.1063
Epoch 8/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3154 -
accuracy: 0.1034 - val_loss: 2.3109 - val_accuracy: 0.0997
Epoch 9/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3155 -
accuracy: 0.1030 - val_loss: 2.3160 - val_accuracy: 0.1063
Epoch 10/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3164 -
accuracy: 0.1003 - val_loss: 2.3329 - val_accuracy: 0.0916
Epoch 11/20
```

```
622/622 [==============================] - 2s 3ms/step - loss: 2.3163 -
accuracy: 0.1048 - val_loss: 2.3164 - val_accuracy: 0.1063
Epoch 12/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3160 -
accuracy: 0.1011 - val_loss: 2.3204 - val_accuracy: 0.1063
Epoch 13/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3158 -
accuracy: 0.1044 - val_loss: 2.3097 - val_accuracy: 0.1093
Epoch 14/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3140 -
accuracy: 0.1042 - val_loss: 2.3301 - val_accuracy: 0.1063
Epoch 15/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3168 -
accuracy: 0.1030 - val_loss: 2.3161 - val_accuracy: 0.1093
Epoch 16/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3158 -
accuracy: 0.1012 - val_loss: 2.3314 - val_accuracy: 0.0990
Epoch 17/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3158 -
accuracy: 0.1004 - val_loss: 2.3081 - val_accuracy: 0.1093
Epoch 18/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3167 -
accuracy: 0.1034 - val_loss: 2.3176 - val_accuracy: 0.0959
Epoch 19/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3166 -
accuracy: 0.1020 - val_loss: 2.3055 - val_accuracy: 0.0997
Epoch 20/20
622/622 [==============================] - 2s 3ms/step - loss: 2.3165 -
accuracy: 0.1038 - val_loss: 2.3146 - val_accuracy: 0.0959

Accuracy: 9.59%

Iteration:  6
Epoch 1/20
500/500 [==============================] - 2s 3ms/step - loss: 0.4260 -
accuracy: 0.8904 - val_loss: 0.1302 - val_accuracy: 0.9657
Epoch 2/20
500/500 [==============================] - 1s 2ms/step - loss: 0.1210 -
accuracy: 0.9649 - val_loss: 0.1003 - val_accuracy: 0.9710
Epoch 3/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0783 -
accuracy: 0.9772 - val_loss: 0.0993 - val_accuracy: 0.9710
Epoch 4/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0544 -
accuracy: 0.9835 - val_loss: 0.0893 - val_accuracy: 0.9722
Epoch 5/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0412 -
accuracy: 0.9874 - val_loss: 0.0931 - val_accuracy: 0.9743
```

```
Epoch 6/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0343 -
accuracy: 0.9893 - val_loss: 0.0957 - val_accuracy: 0.9719
Epoch 7/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0316 -
accuracy: 0.9897 - val_loss: 0.0847 - val_accuracy: 0.9752
Epoch 8/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0262 -
accuracy: 0.9917 - val_loss: 0.0807 - val_accuracy: 0.9774
Epoch 9/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0239 -
accuracy: 0.9923 - val_loss: 0.0919 - val_accuracy: 0.9763
Epoch 10/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0270 -
accuracy: 0.9912 - val_loss: 0.0804 - val_accuracy: 0.9778
Epoch 11/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0222 -
accuracy: 0.9927 - val_loss: 0.0947 - val_accuracy: 0.9756
Epoch 12/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0210 -
accuracy: 0.9930 - val_loss: 0.0895 - val_accuracy: 0.9783
Epoch 13/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0211 -
accuracy: 0.9932 - val_loss: 0.0936 - val_accuracy: 0.9752
Epoch 14/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0191 -
accuracy: 0.9937 - val_loss: 0.1023 - val_accuracy: 0.9740
Epoch 15/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0122 -
accuracy: 0.9963 - val_loss: 0.0888 - val_accuracy: 0.9783
Epoch 16/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0166 -
accuracy: 0.9947 - val_loss: 0.0910 - val_accuracy: 0.9766
Epoch 17/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0199 -
accuracy: 0.9933 - val_loss: 0.0961 - val_accuracy: 0.9767
Epoch 18/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0165 -
accuracy: 0.9947 - val_loss: 0.1069 - val_accuracy: 0.9778
Epoch 19/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0148 -
accuracy: 0.9952 - val_loss: 0.0912 - val_accuracy: 0.9783
Epoch 20/20
500/500 [==============================] - 1s 2ms/step - loss: 0.0121 -
accuracy: 0.9958 - val_loss: 0.0983 - val_accuracy: 0.9759

Accuracy: 97.59%
```

```
Iteration:  7
Epoch 1/20
1458/1458 [==============================] - 5s 3ms/step - loss: 1.5811 -
accuracy: 0.3424 - val_loss: 1.4632 - val_accuracy: 0.3716
Epoch 2/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.4996 -
accuracy: 0.3665 - val_loss: 1.4667 - val_accuracy: 0.3839
Epoch 3/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.4634 -
accuracy: 0.3833 - val_loss: 1.3405 - val_accuracy: 0.4600
Epoch 4/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.3951 -
accuracy: 0.4355 - val_loss: 1.3351 - val_accuracy: 0.4344
Epoch 5/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.4994 -
accuracy: 0.3782 - val_loss: 1.5387 - val_accuracy: 0.3660
Epoch 6/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.4575 -
accuracy: 0.4136 - val_loss: 1.3039 - val_accuracy: 0.4684
Epoch 7/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.4503 -
accuracy: 0.4134 - val_loss: 1.5326 - val_accuracy: 0.3790
Epoch 8/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.4371 -
accuracy: 0.4238 - val_loss: 1.3241 - val_accuracy: 0.4474
Epoch 9/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.3876 -
accuracy: 0.4443 - val_loss: 1.3376 - val_accuracy: 0.4459
Epoch 10/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.5132 -
accuracy: 0.3943 - val_loss: 1.4133 - val_accuracy: 0.4274
Epoch 11/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.5056 -
accuracy: 0.3886 - val_loss: 1.4614 - val_accuracy: 0.3907
Epoch 12/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.5418 -
accuracy: 0.3701 - val_loss: 1.5344 - val_accuracy: 0.3390
Epoch 13/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.6531 -
accuracy: 0.3297 - val_loss: 1.7852 - val_accuracy: 0.2946
Epoch 14/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.6005 -
accuracy: 0.3748 - val_loss: 1.5597 - val_accuracy: 0.3769
Epoch 15/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.6393 -
accuracy: 0.3494 - val_loss: 1.5043 - val_accuracy: 0.3772
Epoch 16/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.6243 -
```

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accuracy: 0.3405 - val_loss: 1.5290 - val_accuracy: 0.3638
Epoch 17/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.4548 -
accuracy: 0.4129 - val_loss: 1.3850 - val_accuracy: 0.4419
Epoch 18/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.4451 -
accuracy: 0.4170 - val_loss: 1.3997 - val_accuracy: 0.4173
Epoch 19/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.4198 -
accuracy: 0.4311 - val_loss: 1.3918 - val_accuracy: 0.4392
Epoch 20/20
1458/1458 [==============================] - 4s 3ms/step - loss: 1.3736 -
accuracy: 0.4475 - val_loss: 1.3204 - val_accuracy: 0.4239

Accuracy: 42.39%

Iteration:  8
Epoch 1/20
436/436 [==============================] - 2s 3ms/step - loss: 2.3077 -
accuracy: 0.1063 - val_loss: 2.3101 - val_accuracy: 0.1063
Epoch 2/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3071 -
accuracy: 0.1059 - val_loss: 2.3072 - val_accuracy: 0.1002
Epoch 3/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3081 -
accuracy: 0.1042 - val_loss: 2.3047 - val_accuracy: 0.1063
Epoch 4/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3069 -
accuracy: 0.1080 - val_loss: 2.3073 - val_accuracy: 0.1028
Epoch 5/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3071 -
accuracy: 0.1060 - val_loss: 2.3097 - val_accuracy: 0.0959
Epoch 6/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3074 -
accuracy: 0.1059 - val_loss: 2.3028 - val_accuracy: 0.1063
Epoch 7/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3068 -
accuracy: 0.1046 - val_loss: 2.3071 - val_accuracy: 0.0959
Epoch 8/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3073 -
accuracy: 0.1053 - val_loss: 2.3076 - val_accuracy: 0.1063
Epoch 9/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3067 -
accuracy: 0.1073 - val_loss: 2.3076 - val_accuracy: 0.1063
Epoch 10/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3074 -
accuracy: 0.1039 - val_loss: 2.3053 - val_accuracy: 0.1002
Epoch 11/20
```

```
436/436 [==============================] - 1s 3ms/step - loss: 2.3084 -
accuracy: 0.1052 - val_loss: 2.3046 - val_accuracy: 0.0959
Epoch 12/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3069 -
accuracy: 0.1045 - val_loss: 2.3073 - val_accuracy: 0.0990
Epoch 13/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3082 -
accuracy: 0.1030 - val_loss: 2.3079 - val_accuracy: 0.0997
Epoch 14/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3086 -
accuracy: 0.1019 - val_loss: 2.3113 - val_accuracy: 0.0997
Epoch 15/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3080 -
accuracy: 0.1038 - val_loss: 2.3102 - val_accuracy: 0.0959
Epoch 16/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3077 -
accuracy: 0.1040 - val_loss: 2.3095 - val_accuracy: 0.0959
Epoch 17/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3082 -
accuracy: 0.1051 - val_loss: 2.3104 - val_accuracy: 0.0959
Epoch 18/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3074 -
accuracy: 0.1066 - val_loss: 2.3087 - val_accuracy: 0.1063
Epoch 19/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3078 -
accuracy: 0.1057 - val_loss: 2.3095 - val_accuracy: 0.0993
Epoch 20/20
436/436 [==============================] - 1s 3ms/step - loss: 2.3074 -
accuracy: 0.1031 - val_loss: 2.3129 - val_accuracy: 0.0990

Accuracy: 9.90%

Iteration:  9
Epoch 1/20
3000/3000 [==============================] - 8s 2ms/step - loss: 2.3070 -
accuracy: 0.1062 - val_loss: 2.3059 - val_accuracy: 0.1093
Epoch 2/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3061 -
accuracy: 0.1063 - val_loss: 2.3036 - val_accuracy: 0.1093
Epoch 3/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3058 -
accuracy: 0.1048 - val_loss: 2.3051 - val_accuracy: 0.0959
Epoch 4/20
3000/3000 [==============================] - 8s 3ms/step - loss: 2.3052 -
accuracy: 0.1076 - val_loss: 2.3081 - val_accuracy: 0.0959
Epoch 5/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3060 -
accuracy: 0.1059 - val_loss: 2.3072 - val_accuracy: 0.1063
```

```
Epoch 6/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3057 -
accuracy: 0.1056 - val_loss: 2.3073 - val_accuracy: 0.0997
Epoch 7/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3058 -
accuracy: 0.1067 - val_loss: 2.3072 - val_accuracy: 0.1028
Epoch 8/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3058 -
accuracy: 0.1063 - val_loss: 2.3067 - val_accuracy: 0.1028
Epoch 9/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3062 -
accuracy: 0.1075 - val_loss: 2.3066 - val_accuracy: 0.0993
Epoch 10/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3057 -
accuracy: 0.1070 - val_loss: 2.3059 - val_accuracy: 0.0990
Epoch 11/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3058 -
accuracy: 0.1058 - val_loss: 2.3063 - val_accuracy: 0.0997
Epoch 12/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3058 -
accuracy: 0.1049 - val_loss: 2.3121 - val_accuracy: 0.1028
Epoch 13/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3058 -
accuracy: 0.1065 - val_loss: 2.3084 - val_accuracy: 0.1063
Epoch 14/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3058 -
accuracy: 0.1046 - val_loss: 2.3085 - val_accuracy: 0.1063
Epoch 15/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3062 -
accuracy: 0.1046 - val_loss: 2.3124 - val_accuracy: 0.1063
Epoch 16/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3056 -
accuracy: 0.1064 - val_loss: 2.3120 - val_accuracy: 0.1063
Epoch 17/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3057 -
accuracy: 0.1047 - val_loss: 2.3074 - val_accuracy: 0.0959
Epoch 18/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3061 -
accuracy: 0.1044 - val_loss: 2.3096 - val_accuracy: 0.0997
Epoch 19/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3058 -
accuracy: 0.1050 - val_loss: 2.3070 - val_accuracy: 0.1063
Epoch 20/20
3000/3000 [==============================] - 7s 2ms/step - loss: 2.3059 -
accuracy: 0.1046 - val_loss: 2.3044 - val_accuracy: 0.1063

Accuracy: 10.63%
```

```
Iteration:  10
Epoch 1/20
963/963 [==============================] - 3s 3ms/step - loss: 0.3537 -
accuracy: 0.8934 - val_loss: 0.1618 - val_accuracy: 0.9584
Epoch 2/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1818 -
accuracy: 0.9512 - val_loss: 0.1578 - val_accuracy: 0.9620
Epoch 3/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1552 -
accuracy: 0.9593 - val_loss: 0.1645 - val_accuracy: 0.9601
Epoch 4/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1490 -
accuracy: 0.9610 - val_loss: 0.1479 - val_accuracy: 0.9647
Epoch 5/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1327 -
accuracy: 0.9663 - val_loss: 0.1426 - val_accuracy: 0.9622
Epoch 6/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1293 -
accuracy: 0.9669 - val_loss: 0.1626 - val_accuracy: 0.9627
Epoch 7/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1281 -
accuracy: 0.9682 - val_loss: 0.1643 - val_accuracy: 0.9658
Epoch 8/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1281 -
accuracy: 0.9692 - val_loss: 0.1275 - val_accuracy: 0.9676
Epoch 9/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1139 -
accuracy: 0.9720 - val_loss: 0.1446 - val_accuracy: 0.9672
Epoch 10/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1125 -
accuracy: 0.9738 - val_loss: 0.1726 - val_accuracy: 0.9633
Epoch 11/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1015 -
accuracy: 0.9748 - val_loss: 0.1836 - val_accuracy: 0.9617
Epoch 12/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1011 -
accuracy: 0.9760 - val_loss: 0.1540 - val_accuracy: 0.9706
Epoch 13/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1030 -
accuracy: 0.9757 - val_loss: 0.1731 - val_accuracy: 0.9668
Epoch 14/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0925 -
accuracy: 0.9776 - val_loss: 0.1753 - val_accuracy: 0.9643
Epoch 15/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1010 -
accuracy: 0.9776 - val_loss: 0.1694 - val_accuracy: 0.9690
Epoch 16/20
963/963 [==============================] - 3s 3ms/step - loss: 0.1008 -
```

```
accuracy: 0.9766 - val_loss: 0.1577 - val_accuracy: 0.9711
Epoch 17/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0984 -
accuracy: 0.9777 - val_loss: 0.2014 - val_accuracy: 0.9654
Epoch 18/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0948 -
accuracy: 0.9785 - val_loss: 0.1834 - val_accuracy: 0.9676
Epoch 19/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0996 -
accuracy: 0.9784 - val_loss: 0.2028 - val_accuracy: 0.9680
Epoch 20/20
963/963 [==============================] - 3s 3ms/step - loss: 0.0871 -
accuracy: 0.9811 - val_loss: 0.1881 - val_accuracy: 0.9660

Accuracy: 96.60%

Iteration:  11
Epoch 1/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3422 -
accuracy: 0.1031 - val_loss: 2.3384 - val_accuracy: 0.0993
Epoch 2/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3428 -
accuracy: 0.1016 - val_loss: 2.3518 - val_accuracy: 0.1028
Epoch 3/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3414 -
accuracy: 0.1025 - val_loss: 2.3493 - val_accuracy: 0.0997
Epoch 4/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3402 -
accuracy: 0.1014 - val_loss: 2.3151 - val_accuracy: 0.0997
Epoch 5/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3394 -
accuracy: 0.1011 - val_loss: 2.3201 - val_accuracy: 0.1093
Epoch 6/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3409 -
accuracy: 0.1027 - val_loss: 2.3296 - val_accuracy: 0.0959
Epoch 7/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3425 -
accuracy: 0.1044 - val_loss: 2.3492 - val_accuracy: 0.0959
Epoch 8/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3402 -
accuracy: 0.1020 - val_loss: 2.3299 - val_accuracy: 0.0993
Epoch 9/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3425 -
accuracy: 0.1001 - val_loss: 2.3654 - val_accuracy: 0.0990
Epoch 10/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3426 -
accuracy: 0.1005 - val_loss: 2.3154 - val_accuracy: 0.0997
Epoch 11/20
```

```
928/928 [==============================] - 2s 3ms/step - loss: 2.3403 -
accuracy: 0.1028 - val_loss: 2.3144 - val_accuracy: 0.0990
Epoch 12/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3402 -
accuracy: 0.1016 - val_loss: 2.3401 - val_accuracy: 0.1063
Epoch 13/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3404 -
accuracy: 0.1048 - val_loss: 2.3343 - val_accuracy: 0.0997
Epoch 14/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3389 -
accuracy: 0.1011 - val_loss: 2.3306 - val_accuracy: 0.1063
Epoch 15/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3397 -
accuracy: 0.1044 - val_loss: 2.3500 - val_accuracy: 0.1063
Epoch 16/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3453 -
accuracy: 0.1025 - val_loss: 2.3614 - val_accuracy: 0.0993
Epoch 17/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3402 -
accuracy: 0.1033 - val_loss: 2.3932 - val_accuracy: 0.0959
Epoch 18/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3398 -
accuracy: 0.1027 - val_loss: 2.3322 - val_accuracy: 0.1093
Epoch 19/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3445 -
accuracy: 0.1011 - val_loss: 2.3285 - val_accuracy: 0.1063
Epoch 20/20
928/928 [==============================] - 2s 3ms/step - loss: 2.3411 -
accuracy: 0.1019 - val_loss: 2.3539 - val_accuracy: 0.0959

Accuracy: 9.59%

Iteration:  12
Epoch 1/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3322 -
accuracy: 0.1023 - val_loss: 2.3425 - val_accuracy: 0.1063
Epoch 2/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3313 -
accuracy: 0.1044 - val_loss: 2.3533 - val_accuracy: 0.1093
Epoch 3/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3316 -
accuracy: 0.1035 - val_loss: 2.3351 - val_accuracy: 0.0959
Epoch 4/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3324 -
accuracy: 0.1038 - val_loss: 2.3256 - val_accuracy: 0.1063
Epoch 5/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3314 -
accuracy: 0.1015 - val_loss: 2.3423 - val_accuracy: 0.0990
```

```
Epoch 6/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3318 -
accuracy: 0.1023 - val_loss: 2.3387 - val_accuracy: 0.0959
Epoch 7/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3314 -
accuracy: 0.1003 - val_loss: 2.3192 - val_accuracy: 0.0993
Epoch 8/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3332 -
accuracy: 0.1010 - val_loss: 2.3411 - val_accuracy: 0.0997
Epoch 9/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3316 -
accuracy: 0.1028 - val_loss: 2.3166 - val_accuracy: 0.0916
Epoch 10/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3302 -
accuracy: 0.1029 - val_loss: 2.3325 - val_accuracy: 0.1063
Epoch 11/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3304 -
accuracy: 0.1025 - val_loss: 2.3283 - val_accuracy: 0.1002
Epoch 12/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3317 -
accuracy: 0.1025 - val_loss: 2.3676 - val_accuracy: 0.0997
Epoch 13/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3312 -
accuracy: 0.1042 - val_loss: 2.3166 - val_accuracy: 0.0993
Epoch 14/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3307 -
accuracy: 0.1017 - val_loss: 2.3128 - val_accuracy: 0.1093
Epoch 15/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3316 -
accuracy: 0.1000 - val_loss: 2.3243 - val_accuracy: 0.0997
Epoch 16/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3317 -
accuracy: 0.1008 - val_loss: 2.3352 - val_accuracy: 0.0993
Epoch 17/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3308 -
accuracy: 0.1027 - val_loss: 2.3535 - val_accuracy: 0.0959
Epoch 18/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3311 -
accuracy: 0.1009 - val_loss: 2.3228 - val_accuracy: 0.0993
Epoch 19/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3304 -
accuracy: 0.1040 - val_loss: 2.3441 - val_accuracy: 0.0993
Epoch 20/20
4250/4250 [==============================] - 10s 2ms/step - loss: 2.3310 -
accuracy: 0.1003 - val_loss: 2.3306 - val_accuracy: 0.1093

Accuracy: 10.93%
```

```
Iteration:  13
Epoch 1/20
51000/51000 [==============================] - 121s 2ms/step - loss: 2.3973 -
accuracy: 0.1019 - val_loss: 2.4318 - val_accuracy: 0.1093
Epoch 2/20
51000/51000 [==============================] - 130s 3ms/step - loss: 2.3963 -
accuracy: 0.1018 - val_loss: 2.3816 - val_accuracy: 0.0993
Epoch 3/20
51000/51000 [==============================] - 120s 2ms/step - loss: 2.3975 -
accuracy: 0.1020 - val_loss: 2.3454 - val_accuracy: 0.0990
Epoch 4/20
51000/51000 [==============================] - 120s 2ms/step - loss: 2.3969 -
accuracy: 0.1013 - val_loss: 2.3651 - val_accuracy: 0.1063
Epoch 5/20
51000/51000 [==============================] - 121s 2ms/step - loss: 2.3958 -
accuracy: 0.1027 - val_loss: 2.3562 - val_accuracy: 0.1002
Epoch 6/20
51000/51000 [==============================] - 120s 2ms/step - loss: 2.3961 -
accuracy: 0.1017 - val_loss: 2.4019 - val_accuracy: 0.0959
Epoch 7/20
51000/51000 [==============================] - 121s 2ms/step - loss: 2.3958 -
accuracy: 0.0988 - val_loss: 2.3810 - val_accuracy: 0.0990
Epoch 8/20
51000/51000 [==============================] - 119s 2ms/step - loss: 2.3977 -
accuracy: 0.0999 - val_loss: 2.4033 - val_accuracy: 0.0916
Epoch 9/20
51000/51000 [==============================] - 118s 2ms/step - loss: 2.3989 -
accuracy: 0.1022 - val_loss: 2.3387 - val_accuracy: 0.1093
Epoch 10/20
51000/51000 [==============================] - 120s 2ms/step - loss: 2.3973 -
accuracy: 0.1002 - val_loss: 2.4430 - val_accuracy: 0.1002
Epoch 11/20
51000/51000 [==============================] - 118s 2ms/step - loss: 2.3984 -
accuracy: 0.0998 - val_loss: 2.3459 - val_accuracy: 0.1063
Epoch 12/20
51000/51000 [==============================] - 118s 2ms/step - loss: 2.3956 -
accuracy: 0.1001 - val_loss: 2.4475 - val_accuracy: 0.0959
Epoch 13/20
51000/51000 [==============================] - 118s 2ms/step - loss: 2.3976 -
accuracy: 0.0992 - val_loss: 2.3599 - val_accuracy: 0.0959
Epoch 14/20
51000/51000 [==============================] - 118s 2ms/step - loss: 2.3980 -
accuracy: 0.1017 - val_loss: 2.3752 - val_accuracy: 0.1002
Epoch 15/20
51000/51000 [==============================] - 118s 2ms/step - loss: 2.3978 -
accuracy: 0.1033 - val_loss: 2.4017 - val_accuracy: 0.0959
Epoch 16/20
51000/51000 [==============================] - 118s 2ms/step - loss: 2.3967 -
```

```
accuracy: 0.1017 - val_loss: 2.3488 - val_accuracy: 0.1093
Epoch 17/20
51000/51000 [==============================] - 120s 2ms/step - loss: 2.3957 -
accuracy: 0.1025 - val_loss: 2.4186 - val_accuracy: 0.1063
Epoch 18/20
51000/51000 [==============================] - 120s 2ms/step - loss: 2.3978 -
accuracy: 0.1014 - val_loss: 2.3679 - val_accuracy: 0.1028
Epoch 19/20
51000/51000 [==============================] - 119s 2ms/step - loss: 2.3961 -
accuracy: 0.1004 - val_loss: 2.4621 - val_accuracy: 0.0959
Epoch 20/20
51000/51000 [==============================] - 120s 2ms/step - loss: 2.3968 -
accuracy: 0.1014 - val_loss: 2.5224 - val_accuracy: 0.1002

Accuracy: 10.02%

Iteration:  14
Epoch 1/20
837/837 [==============================] - 3s 3ms/step - loss: 1.8454 -
accuracy: 0.2062 - val_loss: 1.7477 - val_accuracy: 0.2231
Epoch 2/20
837/837 [==============================] - 2s 3ms/step - loss: 1.7396 -
accuracy: 0.2198 - val_loss: 1.7058 - val_accuracy: 0.2218
Epoch 3/20
837/837 [==============================] - 2s 3ms/step - loss: 1.5750 -
accuracy: 0.3026 - val_loss: 1.0971 - val_accuracy: 0.4997
Epoch 4/20
837/837 [==============================] - 2s 3ms/step - loss: 1.0500 -
accuracy: 0.5434 - val_loss: 0.9913 - val_accuracy: 0.5661
Epoch 5/20
837/837 [==============================] - 2s 3ms/step - loss: 0.6967 -
accuracy: 0.7525 - val_loss: 0.4607 - val_accuracy: 0.9034
Epoch 6/20
837/837 [==============================] - 2s 3ms/step - loss: 0.4302 -
accuracy: 0.9007 - val_loss: 0.3658 - val_accuracy: 0.9276
Epoch 7/20
837/837 [==============================] - 2s 3ms/step - loss: 0.3724 -
accuracy: 0.9168 - val_loss: 0.3411 - val_accuracy: 0.9300
Epoch 8/20
837/837 [==============================] - 2s 3ms/step - loss: 0.3510 -
accuracy: 0.9212 - val_loss: 0.3825 - val_accuracy: 0.9121
Epoch 9/20
837/837 [==============================] - 2s 3ms/step - loss: 0.3257 -
accuracy: 0.9251 - val_loss: 0.3717 - val_accuracy: 0.9258
Epoch 10/20
837/837 [==============================] - 2s 3ms/step - loss: 0.3236 -
accuracy: 0.9256 - val_loss: 0.3055 - val_accuracy: 0.9351
Epoch 11/20
```

```
837/837 [==============================] - 2s 3ms/step - loss: 0.3002 -
accuracy: 0.9337 - val_loss: 0.3208 - val_accuracy: 0.9337
Epoch 12/20
837/837 [==============================] - 2s 3ms/step - loss: 0.2996 -
accuracy: 0.9340 - val_loss: 0.8699 - val_accuracy: 0.6767
Epoch 13/20
837/837 [==============================] - 2s 3ms/step - loss: 0.3094 -
accuracy: 0.9314 - val_loss: 0.3299 - val_accuracy: 0.9338
Epoch 14/20
837/837 [==============================] - 2s 3ms/step - loss: 0.2745 -
accuracy: 0.9401 - val_loss: 0.2806 - val_accuracy: 0.9451
Epoch 15/20
837/837 [==============================] - 2s 3ms/step - loss: 0.2660 -
accuracy: 0.9418 - val_loss: 0.2798 - val_accuracy: 0.9452
Epoch 16/20
837/837 [==============================] - 2s 3ms/step - loss: 0.2608 -
accuracy: 0.9430 - val_loss: 0.3136 - val_accuracy: 0.9357
Epoch 17/20
837/837 [==============================] - 2s 3ms/step - loss: 0.2721 -
accuracy: 0.9402 - val_loss: 0.2965 - val_accuracy: 0.9470
Epoch 18/20
837/837 [==============================] - 2s 3ms/step - loss: 0.2664 -
accuracy: 0.9434 - val_loss: 0.2814 - val_accuracy: 0.9462
Epoch 19/20
837/837 [==============================] - 2s 3ms/step - loss: 0.2526 -
accuracy: 0.9462 - val_loss: 0.4033 - val_accuracy: 0.9031
Epoch 20/20
837/837 [==============================] - 2s 3ms/step - loss: 0.2408 -
accuracy: 0.9475 - val_loss: 0.2649 - val_accuracy: 0.9447

Accuracy: 94.47%

Iteration:  15
Epoch 1/20
473/473 [==============================] - 2s 3ms/step - loss: 2.5397 -
accuracy: 0.1057 - val_loss: 2.3094 - val_accuracy: 0.1063
Epoch 2/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3080 -
accuracy: 0.1054 - val_loss: 2.3062 - val_accuracy: 0.0959
Epoch 3/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3077 -
accuracy: 0.1045 - val_loss: 2.3064 - val_accuracy: 0.0990
Epoch 4/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3078 -
accuracy: 0.1022 - val_loss: 2.3080 - val_accuracy: 0.1002
Epoch 5/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3078 -
accuracy: 0.1030 - val_loss: 2.3111 - val_accuracy: 0.1063
```

```
Epoch 6/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3075 -
accuracy: 0.1058 - val_loss: 2.3112 - val_accuracy: 0.0916
Epoch 7/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3079 -
accuracy: 0.1056 - val_loss: 2.3131 - val_accuracy: 0.1028
Epoch 8/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3072 -
accuracy: 0.1043 - val_loss: 2.3078 - val_accuracy: 0.0990
Epoch 9/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3080 -
accuracy: 0.1049 - val_loss: 2.3082 - val_accuracy: 0.1028
Epoch 10/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3082 -
accuracy: 0.1035 - val_loss: 2.3088 - val_accuracy: 0.0993
Epoch 11/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3079 -
accuracy: 0.1062 - val_loss: 2.3076 - val_accuracy: 0.1093
Epoch 12/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3084 -
accuracy: 0.1043 - val_loss: 2.3086 - val_accuracy: 0.1063
Epoch 13/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3079 -
accuracy: 0.1058 - val_loss: 2.3046 - val_accuracy: 0.1028
Epoch 14/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3080 -
accuracy: 0.1045 - val_loss: 2.3093 - val_accuracy: 0.0959
Epoch 15/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3077 -
accuracy: 0.1045 - val_loss: 2.3121 - val_accuracy: 0.0997
Epoch 16/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3091 -
accuracy: 0.1036 - val_loss: 2.3059 - val_accuracy: 0.0997
Epoch 17/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3084 -
accuracy: 0.1057 - val_loss: 2.3044 - val_accuracy: 0.1063
Epoch 18/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3085 -
accuracy: 0.1046 - val_loss: 2.3124 - val_accuracy: 0.1028
Epoch 19/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3077 -
accuracy: 0.1043 - val_loss: 2.3046 - val_accuracy: 0.1063
Epoch 20/20
473/473 [==============================] - 1s 3ms/step - loss: 2.3077 -
accuracy: 0.1064 - val_loss: 2.3080 - val_accuracy: 0.1028

Accuracy: 10.28%
```

```
Iteration:  16
Epoch 1/20
1160/1160 [==============================] - 4s 3ms/step - loss: 0.3036 -
accuracy: 0.9102 - val_loss: 0.1966 - val_accuracy: 0.9378
Epoch 2/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.1710 -
accuracy: 0.9532 - val_loss: 0.1590 - val_accuracy: 0.9564
Epoch 3/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.1358 -
accuracy: 0.9629 - val_loss: 0.1665 - val_accuracy: 0.9578
Epoch 4/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.1211 -
accuracy: 0.9686 - val_loss: 0.1524 - val_accuracy: 0.9631
Epoch 5/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.1113 -
accuracy: 0.9707 - val_loss: 0.1255 - val_accuracy: 0.9667
Epoch 6/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.1007 -
accuracy: 0.9733 - val_loss: 0.1588 - val_accuracy: 0.9663
Epoch 7/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0923 -
accuracy: 0.9760 - val_loss: 0.1018 - val_accuracy: 0.9748
Epoch 8/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0882 -
accuracy: 0.9774 - val_loss: 0.1202 - val_accuracy: 0.9727
Epoch 9/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0788 -
accuracy: 0.9805 - val_loss: 0.1298 - val_accuracy: 0.9694
Epoch 10/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0852 -
accuracy: 0.9787 - val_loss: 0.1405 - val_accuracy: 0.9686
Epoch 11/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0699 -
accuracy: 0.9832 - val_loss: 0.1256 - val_accuracy: 0.9741
Epoch 12/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0672 -
accuracy: 0.9845 - val_loss: 0.1280 - val_accuracy: 0.9730
Epoch 13/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0766 -
accuracy: 0.9821 - val_loss: 0.1312 - val_accuracy: 0.9734
Epoch 14/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0628 -
accuracy: 0.9855 - val_loss: 0.1426 - val_accuracy: 0.9711
Epoch 15/20
1160/1160 [==============================] - 4s 3ms/step - loss: 0.0614 -
accuracy: 0.9854 - val_loss: 0.1447 - val_accuracy: 0.9711
Epoch 16/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0542 -
```

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accuracy: 0.9873 - val_loss: 0.1295 - val_accuracy: 0.9746
Epoch 17/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0563 -
accuracy: 0.9872 - val_loss: 0.1232 - val_accuracy: 0.9761
Epoch 18/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0590 -
accuracy: 0.9874 - val_loss: 0.1687 - val_accuracy: 0.9744
Epoch 19/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0648 -
accuracy: 0.9855 - val_loss: 0.1214 - val_accuracy: 0.9778
Epoch 20/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.0495 -
accuracy: 0.9886 - val_loss: 0.1169 - val_accuracy: 0.9787

Accuracy: 97.87%

Iteration:  17
Epoch 1/20
580/580 [==============================] - 2s 3ms/step - loss: 1.0943 -
accuracy: 0.5725 - val_loss: 0.7467 - val_accuracy: 0.7031
Epoch 2/20
580/580 [==============================] - 2s 3ms/step - loss: 0.5899 -
accuracy: 0.8165 - val_loss: 0.3962 - val_accuracy: 0.9254
Epoch 3/20
580/580 [==============================] - 2s 3ms/step - loss: 0.3312 -
accuracy: 0.9320 - val_loss: 0.3183 - val_accuracy: 0.9386
Epoch 4/20
580/580 [==============================] - 2s 3ms/step - loss: 0.2438 -
accuracy: 0.9464 - val_loss: 0.2768 - val_accuracy: 0.9460
Epoch 5/20
580/580 [==============================] - 2s 3ms/step - loss: 0.1959 -
accuracy: 0.9545 - val_loss: 0.2812 - val_accuracy: 0.9502
Epoch 6/20
580/580 [==============================] - 2s 3ms/step - loss: 0.1633 -
accuracy: 0.9603 - val_loss: 0.2553 - val_accuracy: 0.9523
Epoch 7/20
580/580 [==============================] - 2s 3ms/step - loss: 0.1340 -
accuracy: 0.9674 - val_loss: 0.2701 - val_accuracy: 0.9528
Epoch 8/20
580/580 [==============================] - 2s 3ms/step - loss: 0.1239 -
accuracy: 0.9694 - val_loss: 0.2898 - val_accuracy: 0.9542
Epoch 9/20
580/580 [==============================] - 2s 3ms/step - loss: 0.1110 -
accuracy: 0.9718 - val_loss: 0.2881 - val_accuracy: 0.9534
Epoch 10/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0983 -
accuracy: 0.9752 - val_loss: 0.2919 - val_accuracy: 0.9487
Epoch 11/20
```

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580/580 [==============================] - 2s 3ms/step - loss: 0.0881 -
accuracy: 0.9782 - val_loss: 0.2650 - val_accuracy: 0.9587
Epoch 12/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0786 -
accuracy: 0.9802 - val_loss: 0.3112 - val_accuracy: 0.9588
Epoch 13/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0694 -
accuracy: 0.9828 - val_loss: 0.3345 - val_accuracy: 0.9571
Epoch 14/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0736 -
accuracy: 0.9821 - val_loss: 0.3005 - val_accuracy: 0.9567
Epoch 15/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0713 -
accuracy: 0.9819 - val_loss: 0.3655 - val_accuracy: 0.9551
Epoch 16/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0623 -
accuracy: 0.9840 - val_loss: 0.3869 - val_accuracy: 0.9524
Epoch 17/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0612 -
accuracy: 0.9848 - val_loss: 0.3649 - val_accuracy: 0.9558
Epoch 18/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0531 -
accuracy: 0.9868 - val_loss: 0.3384 - val_accuracy: 0.9607
Epoch 19/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0416 -
accuracy: 0.9887 - val_loss: 0.3644 - val_accuracy: 0.9600
Epoch 20/20
580/580 [==============================] - 2s 3ms/step - loss: 0.0417 -
accuracy: 0.9893 - val_loss: 0.3530 - val_accuracy: 0.9612

Accuracy: 96.12%

Iteration:  18
Epoch 1/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3152 -
accuracy: 0.1046 - val_loss: 2.3161 - val_accuracy: 0.0959
Epoch 2/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3133 -
accuracy: 0.1035 - val_loss: 2.3161 - val_accuracy: 0.1063
Epoch 3/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3142 -
accuracy: 0.1036 - val_loss: 2.3191 - val_accuracy: 0.0959
Epoch 4/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3132 -
accuracy: 0.1042 - val_loss: 2.3116 - val_accuracy: 0.1002
Epoch 5/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3147 -
accuracy: 0.1030 - val_loss: 2.3224 - val_accuracy: 0.1093
```

```
Epoch 6/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3133 -
accuracy: 0.1042 - val_loss: 2.3103 - val_accuracy: 0.0993
Epoch 7/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3155 -
accuracy: 0.1037 - val_loss: 2.3246 - val_accuracy: 0.0997
Epoch 8/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3142 -
accuracy: 0.1030 - val_loss: 2.3116 - val_accuracy: 0.1063
Epoch 9/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3144 -
accuracy: 0.1016 - val_loss: 2.3301 - val_accuracy: 0.1002
Epoch 10/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3146 -
accuracy: 0.1027 - val_loss: 2.3228 - val_accuracy: 0.1002
Epoch 11/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3149 -
accuracy: 0.1024 - val_loss: 2.3230 - val_accuracy: 0.1063
Epoch 12/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3141 -
accuracy: 0.1030 - val_loss: 2.3303 - val_accuracy: 0.0959
Epoch 13/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3139 -
accuracy: 0.1029 - val_loss: 2.3106 - val_accuracy: 0.1002
Epoch 14/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3139 -
accuracy: 0.1042 - val_loss: 2.3142 - val_accuracy: 0.0997
Epoch 15/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3149 -
accuracy: 0.1037 - val_loss: 2.3096 - val_accuracy: 0.0959
Epoch 16/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3140 -
accuracy: 0.1028 - val_loss: 2.3314 - val_accuracy: 0.0990
Epoch 17/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3153 -
accuracy: 0.1051 - val_loss: 2.3310 - val_accuracy: 0.0997
Epoch 18/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3150 -
accuracy: 0.1022 - val_loss: 2.3206 - val_accuracy: 0.0990
Epoch 19/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3146 -
accuracy: 0.1023 - val_loss: 2.3212 - val_accuracy: 0.0959
Epoch 20/20
690/690 [==============================] - 2s 3ms/step - loss: 2.3147 -
accuracy: 0.1059 - val_loss: 2.3061 - val_accuracy: 0.1093

Accuracy: 10.93%
```

```
Iteration:  19
Epoch 1/20
3188/3188 [==============================] - 10s 3ms/step - loss: 1.5654 -
accuracy: 0.3346 - val_loss: 1.5145 - val_accuracy: 0.3822
Epoch 2/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.3990 -
accuracy: 0.3816 - val_loss: 1.3207 - val_accuracy: 0.3821
Epoch 3/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.3824 -
accuracy: 0.3806 - val_loss: 1.8536 - val_accuracy: 0.2902
Epoch 4/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.3988 -
accuracy: 0.3822 - val_loss: 1.3458 - val_accuracy: 0.3801
Epoch 5/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.3817 -
accuracy: 0.3881 - val_loss: 1.4313 - val_accuracy: 0.3801
Epoch 6/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.4303 -
accuracy: 0.3871 - val_loss: 1.5401 - val_accuracy: 0.3593
Epoch 7/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5004 -
accuracy: 0.3734 - val_loss: 1.4444 - val_accuracy: 0.3666
Epoch 8/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5142 -
accuracy: 0.3630 - val_loss: 1.5093 - val_accuracy: 0.3603
Epoch 9/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5230 -
accuracy: 0.3594 - val_loss: 1.4268 - val_accuracy: 0.3776
Epoch 10/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5198 -
accuracy: 0.3498 - val_loss: 1.4542 - val_accuracy: 0.3653
Epoch 11/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.6034 -
accuracy: 0.3068 - val_loss: 1.6279 - val_accuracy: 0.2920
Epoch 12/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.6096 -
accuracy: 0.2890 - val_loss: 1.6044 - val_accuracy: 0.2882
Epoch 13/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5973 -
accuracy: 0.2902 - val_loss: 1.5934 - val_accuracy: 0.2863
Epoch 14/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5914 -
accuracy: 0.2913 - val_loss: 1.5612 - val_accuracy: 0.2961
Epoch 15/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5965 -
accuracy: 0.2927 - val_loss: 1.6476 - val_accuracy: 0.2718
Epoch 16/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5954 -
```

```
accuracy: 0.2910 - val_loss: 1.6496 - val_accuracy: 0.2958
Epoch 17/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5842 -
accuracy: 0.2887 - val_loss: 1.5876 - val_accuracy: 0.2972
Epoch 18/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.6045 -
accuracy: 0.2881 - val_loss: 1.5713 - val_accuracy: 0.2798
Epoch 19/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5762 -
accuracy: 0.2883 - val_loss: 1.5949 - val_accuracy: 0.2964
Epoch 20/20
3188/3188 [==============================] - 9s 3ms/step - loss: 1.5967 -
accuracy: 0.2919 - val_loss: 1.5641 - val_accuracy: 0.2918

Accuracy: 29.18%

Iteration:  20
Epoch 1/20
5667/5667 [==============================] - 15s 3ms/step - loss: 1.8300 -
accuracy: 0.2658 - val_loss: 1.6191 - val_accuracy: 0.2937
Epoch 2/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.6201 -
accuracy: 0.3598 - val_loss: 1.4195 - val_accuracy: 0.4472
Epoch 3/20
5667/5667 [==============================] - 14s 2ms/step - loss: 1.3100 -
accuracy: 0.4998 - val_loss: 1.1801 - val_accuracy: 0.5466
Epoch 4/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.1727 -
accuracy: 0.5498 - val_loss: 1.0701 - val_accuracy: 0.5614
Epoch 5/20
5667/5667 [==============================] - 14s 3ms/step - loss: 1.0946 -
accuracy: 0.5897 - val_loss: 0.9899 - val_accuracy: 0.6519
Epoch 6/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.9870 -
accuracy: 0.6446 - val_loss: 0.8902 - val_accuracy: 0.6958
Epoch 7/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.8374 -
accuracy: 0.7193 - val_loss: 0.6628 - val_accuracy: 0.7654
Epoch 8/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.7089 -
accuracy: 0.7729 - val_loss: 0.6519 - val_accuracy: 0.8259
Epoch 9/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.6619 -
accuracy: 0.7991 - val_loss: 0.6176 - val_accuracy: 0.8197
Epoch 10/20
5667/5667 [==============================] - 14s 3ms/step - loss: 0.6355 -
accuracy: 0.8038 - val_loss: 0.6445 - val_accuracy: 0.7872
Epoch 11/20
```

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5667/5667 [==============================] - 14s 2ms/step - loss: 0.6457 -
accuracy: 0.8030 - val_loss: 0.6727 - val_accuracy: 0.8269
Epoch 12/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.6229 -
accuracy: 0.8112 - val_loss: 0.6201 - val_accuracy: 0.8272
Epoch 13/20
5667/5667 [==============================] - 14s 3ms/step - loss: 0.5132 -
accuracy: 0.8906 - val_loss: 0.9224 - val_accuracy: 0.8137
Epoch 14/20
5667/5667 [==============================] - 15s 3ms/step - loss: 0.5043 -
accuracy: 0.9011 - val_loss: 0.5457 - val_accuracy: 0.9177
Epoch 15/20
5667/5667 [==============================] - 14s 3ms/step - loss: 0.4855 -
accuracy: 0.9046 - val_loss: 0.6127 - val_accuracy: 0.8856
Epoch 16/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.5020 -
accuracy: 0.8927 - val_loss: 0.9152 - val_accuracy: 0.8021
Epoch 17/20
5667/5667 [==============================] - 14s 2ms/step - loss: 0.4834 -
accuracy: 0.9036 - val_loss: 0.6421 - val_accuracy: 0.9000
Epoch 18/20
5667/5667 [==============================] - 14s 3ms/step - loss: 0.5059 -
accuracy: 0.8998 - val_loss: 0.5839 - val_accuracy: 0.8944
Epoch 19/20
5667/5667 [==============================] - 14s 3ms/step - loss: 0.4872 -
accuracy: 0.9019 - val_loss: 0.6275 - val_accuracy: 0.9187
Epoch 20/20
5667/5667 [==============================] - 14s 3ms/step - loss: 0.4721 -
accuracy: 0.9053 - val_loss: 0.4658 - val_accuracy: 0.9003

Accuracy: 90.03%

Iteration:  21
Epoch 1/20
729/729 [==============================] - 2s 3ms/step - loss: 0.3836 -
accuracy: 0.8952 - val_loss: 0.3024 - val_accuracy: 0.9128
Epoch 2/20
729/729 [==============================] - 2s 3ms/step - loss: 0.2291 -
accuracy: 0.9346 - val_loss: 0.1813 - val_accuracy: 0.9521
Epoch 3/20
729/729 [==============================] - 2s 3ms/step - loss: 0.2051 -
accuracy: 0.9406 - val_loss: 0.1994 - val_accuracy: 0.9403
Epoch 4/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1950 -
accuracy: 0.9437 - val_loss: 0.1680 - val_accuracy: 0.9549
Epoch 5/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1891 -
accuracy: 0.9463 - val_loss: 0.1789 - val_accuracy: 0.9514
```

```
Epoch 6/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1809 -
accuracy: 0.9494 - val_loss: 0.2014 - val_accuracy: 0.9430
Epoch 7/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1762 -
accuracy: 0.9509 - val_loss: 0.1660 - val_accuracy: 0.9562
Epoch 8/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1782 -
accuracy: 0.9495 - val_loss: 0.1792 - val_accuracy: 0.9534
Epoch 9/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1706 -
accuracy: 0.9522 - val_loss: 0.1851 - val_accuracy: 0.9521
Epoch 10/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1670 -
accuracy: 0.9529 - val_loss: 0.1862 - val_accuracy: 0.9460
Epoch 11/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1576 -
accuracy: 0.9557 - val_loss: 0.1673 - val_accuracy: 0.9529
Epoch 12/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1653 -
accuracy: 0.9531 - val_loss: 0.1989 - val_accuracy: 0.9466
Epoch 13/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1604 -
accuracy: 0.9547 - val_loss: 0.1707 - val_accuracy: 0.9542
Epoch 14/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1526 -
accuracy: 0.9566 - val_loss: 0.1551 - val_accuracy: 0.9572
Epoch 15/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1528 -
accuracy: 0.9582 - val_loss: 0.1563 - val_accuracy: 0.9582
Epoch 16/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1519 -
accuracy: 0.9572 - val_loss: 0.1797 - val_accuracy: 0.9481
Epoch 17/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1552 -
accuracy: 0.9571 - val_loss: 0.1880 - val_accuracy: 0.9488
Epoch 18/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1515 -
accuracy: 0.9582 - val_loss: 0.1721 - val_accuracy: 0.9529
Epoch 19/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1464 -
accuracy: 0.9588 - val_loss: 0.1575 - val_accuracy: 0.9583
Epoch 20/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1377 -
accuracy: 0.9618 - val_loss: 0.1578 - val_accuracy: 0.9590

Accuracy: 95.90%
```

```
Iteration:  22
Epoch 1/20
911/911 [==============================] - 3s 3ms/step - loss: 1.6492 -
accuracy: 0.3276 - val_loss: 1.4311 - val_accuracy: 0.3839
Epoch 2/20
911/911 [==============================] - 3s 3ms/step - loss: 1.4603 -
accuracy: 0.4036 - val_loss: 1.5309 - val_accuracy: 0.4010
Epoch 3/20
911/911 [==============================] - 3s 3ms/step - loss: 1.3920 -
accuracy: 0.4399 - val_loss: 1.2989 - val_accuracy: 0.4886
Epoch 4/20
911/911 [==============================] - 3s 3ms/step - loss: 1.3803 -
accuracy: 0.4440 - val_loss: 1.3149 - val_accuracy: 0.4766
Epoch 5/20
911/911 [==============================] - 3s 3ms/step - loss: 1.3534 -
accuracy: 0.4574 - val_loss: 1.2890 - val_accuracy: 0.5184
Epoch 6/20
911/911 [==============================] - 3s 3ms/step - loss: 1.3391 -
accuracy: 0.4830 - val_loss: 1.2835 - val_accuracy: 0.4903
Epoch 7/20
911/911 [==============================] - 3s 3ms/step - loss: 1.3428 -
accuracy: 0.4529 - val_loss: 1.3375 - val_accuracy: 0.4427
Epoch 8/20
911/911 [==============================] - 3s 3ms/step - loss: 1.5539 -
accuracy: 0.3829 - val_loss: 1.5906 - val_accuracy: 0.3623
Epoch 9/20
911/911 [==============================] - 3s 3ms/step - loss: 1.5264 -
accuracy: 0.3829 - val_loss: 1.7023 - val_accuracy: 0.2961
Epoch 10/20
911/911 [==============================] - 3s 3ms/step - loss: 1.3573 -
accuracy: 0.4625 - val_loss: 1.2461 - val_accuracy: 0.5009
Epoch 11/20
911/911 [==============================] - 3s 3ms/step - loss: 1.3513 -
accuracy: 0.4822 - val_loss: 1.2074 - val_accuracy: 0.5362
Epoch 12/20
911/911 [==============================] - 3s 3ms/step - loss: 1.2938 -
accuracy: 0.4986 - val_loss: 1.2328 - val_accuracy: 0.5208
Epoch 13/20
911/911 [==============================] - 3s 3ms/step - loss: 1.2761 -
accuracy: 0.5065 - val_loss: 1.2075 - val_accuracy: 0.5467
Epoch 14/20
911/911 [==============================] - 3s 3ms/step - loss: 1.2941 -
accuracy: 0.4936 - val_loss: 1.3853 - val_accuracy: 0.4017
Epoch 15/20
911/911 [==============================] - 3s 3ms/step - loss: 1.2958 -
accuracy: 0.4947 - val_loss: 1.2938 - val_accuracy: 0.5252
Epoch 16/20
911/911 [==============================] - 3s 3ms/step - loss: 1.2889 -
```

```
accuracy: 0.5044 - val_loss: 1.2050 - val_accuracy: 0.5257
Epoch 17/20
911/911 [==============================] - 3s 3ms/step - loss: 1.2541 -
accuracy: 0.5071 - val_loss: 1.2059 - val_accuracy: 0.4966
Epoch 18/20
911/911 [==============================] - 3s 3ms/step - loss: 1.2964 -
accuracy: 0.4859 - val_loss: 1.5007 - val_accuracy: 0.3862
Epoch 19/20
911/911 [==============================] - 3s 3ms/step - loss: 1.4954 -
accuracy: 0.3918 - val_loss: 1.6998 - val_accuracy: 0.3229
Epoch 20/20
911/911 [==============================] - 3s 3ms/step - loss: 1.5072 -
accuracy: 0.3780 - val_loss: 1.3328 - val_accuracy: 0.4352

Accuracy: 43.52%

Iteration:  23
Epoch 1/20
2429/2429 [==============================] - 7s 3ms/step - loss: 0.9967 -
accuracy: 0.6255 - val_loss: 0.5859 - val_accuracy: 0.8052
Epoch 2/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.5151 -
accuracy: 0.8174 - val_loss: 0.4712 - val_accuracy: 0.8338
Epoch 3/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.3672 -
accuracy: 0.9087 - val_loss: 0.3711 - val_accuracy: 0.9216
Epoch 4/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.3043 -
accuracy: 0.9305 - val_loss: 0.3677 - val_accuracy: 0.9297
Epoch 5/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.2702 -
accuracy: 0.9364 - val_loss: 0.3130 - val_accuracy: 0.9433
Epoch 6/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.2479 -
accuracy: 0.9433 - val_loss: 0.3005 - val_accuracy: 0.9448
Epoch 7/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.2321 -
accuracy: 0.9473 - val_loss: 0.3308 - val_accuracy: 0.9430
Epoch 8/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.2243 -
accuracy: 0.9504 - val_loss: 0.3473 - val_accuracy: 0.9444
Epoch 9/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.2062 -
accuracy: 0.9530 - val_loss: 0.2797 - val_accuracy: 0.9519
Epoch 10/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.1939 -
accuracy: 0.9557 - val_loss: 0.3743 - val_accuracy: 0.9377
Epoch 11/20
```

```
2429/2429 [==============================] - 6s 3ms/step - loss: 0.1859 -
accuracy: 0.9588 - val_loss: 0.3559 - val_accuracy: 0.9469
Epoch 12/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.1835 -
accuracy: 0.9602 - val_loss: 0.3607 - val_accuracy: 0.9437
Epoch 13/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.1727 -
accuracy: 0.9618 - val_loss: 0.2959 - val_accuracy: 0.9487
Epoch 14/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.1735 -
accuracy: 0.9625 - val_loss: 0.2759 - val_accuracy: 0.9587
Epoch 15/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.1666 -
accuracy: 0.9630 - val_loss: 0.3215 - val_accuracy: 0.9497
Epoch 16/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.1505 -
accuracy: 0.9665 - val_loss: 0.3329 - val_accuracy: 0.9537
Epoch 17/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.1483 -
accuracy: 0.9669 - val_loss: 0.3637 - val_accuracy: 0.9521
Epoch 18/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.1520 -
accuracy: 0.9672 - val_loss: 0.3329 - val_accuracy: 0.9557
Epoch 19/20
2429/2429 [==============================] - 6s 3ms/step - loss: 0.1461 -
accuracy: 0.9685 - val_loss: 0.3314 - val_accuracy: 0.9533
Epoch 20/20
2429/2429 [==============================] - 7s 3ms/step - loss: 0.1333 -
accuracy: 0.9701 - val_loss: 0.3911 - val_accuracy: 0.9537

Accuracy: 95.37%

Iteration:  24
Epoch 1/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.5056 -
accuracy: 0.8493 - val_loss: 0.1812 - val_accuracy: 0.9504
Epoch 2/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.1695 -
accuracy: 0.9550 - val_loss: 0.1686 - val_accuracy: 0.9544
Epoch 3/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.1298 -
accuracy: 0.9643 - val_loss: 0.1320 - val_accuracy: 0.9680
Epoch 4/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.1110 -
accuracy: 0.9699 - val_loss: 0.1609 - val_accuracy: 0.9614
Epoch 5/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0962 -
accuracy: 0.9734 - val_loss: 0.1386 - val_accuracy: 0.9677
```

```
Epoch 6/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0911 -
accuracy: 0.9749 - val_loss: 0.1656 - val_accuracy: 0.9638
Epoch 7/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0792 -
accuracy: 0.9777 - val_loss: 0.1612 - val_accuracy: 0.9671
Epoch 8/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0736 -
accuracy: 0.9797 - val_loss: 0.1569 - val_accuracy: 0.9698
Epoch 9/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0708 -
accuracy: 0.9807 - val_loss: 0.1443 - val_accuracy: 0.9689
Epoch 10/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0607 -
accuracy: 0.9835 - val_loss: 0.1756 - val_accuracy: 0.9687
Epoch 11/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0635 -
accuracy: 0.9837 - val_loss: 0.1689 - val_accuracy: 0.9716
Epoch 12/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0567 -
accuracy: 0.9847 - val_loss: 0.1510 - val_accuracy: 0.9703
Epoch 13/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0576 -
accuracy: 0.9846 - val_loss: 0.1896 - val_accuracy: 0.9718
Epoch 14/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0552 -
accuracy: 0.9861 - val_loss: 0.1767 - val_accuracy: 0.9718
Epoch 15/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0483 -
accuracy: 0.9879 - val_loss: 0.2088 - val_accuracy: 0.9719
Epoch 16/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0475 -
accuracy: 0.9881 - val_loss: 0.1997 - val_accuracy: 0.9719
Epoch 17/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0482 -
accuracy: 0.9876 - val_loss: 0.2054 - val_accuracy: 0.9702
Epoch 18/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0544 -
accuracy: 0.9875 - val_loss: 0.2039 - val_accuracy: 0.9712
Epoch 19/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0424 -
accuracy: 0.9896 - val_loss: 0.1899 - val_accuracy: 0.9736
Epoch 20/20
1275/1275 [==============================] - 3s 2ms/step - loss: 0.0451 -
accuracy: 0.9894 - val_loss: 0.2380 - val_accuracy: 0.9741

Accuracy: 97.41%
```

```
Iteration:  25
Epoch 1/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.5928 -
accuracy: 0.3340 - val_loss: 1.5297 - val_accuracy: 0.3310
Epoch 2/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.6211 -
accuracy: 0.3139 - val_loss: 1.6321 - val_accuracy: 0.3271
Epoch 3/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.6645 -
accuracy: 0.3443 - val_loss: 1.5829 - val_accuracy: 0.3563
Epoch 4/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.7098 -
accuracy: 0.2702 - val_loss: 1.6590 - val_accuracy: 0.2741
Epoch 5/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.7426 -
accuracy: 0.2634 - val_loss: 1.7026 - val_accuracy: 0.2758
Epoch 6/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.6835 -
accuracy: 0.2750 - val_loss: 1.7001 - val_accuracy: 0.2847
Epoch 7/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.6956 -
accuracy: 0.2742 - val_loss: 1.6377 - val_accuracy: 0.2707
Epoch 8/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.6970 -
accuracy: 0.2764 - val_loss: 1.6484 - val_accuracy: 0.2730
Epoch 9/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.7028 -
accuracy: 0.2713 - val_loss: 1.6631 - val_accuracy: 0.2800
Epoch 10/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.8095 -
accuracy: 0.2721 - val_loss: 1.8059 - val_accuracy: 0.2779
Epoch 11/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.8273 -
accuracy: 0.2679 - val_loss: 1.7343 - val_accuracy: 0.2848
Epoch 12/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.7955 -
accuracy: 0.2750 - val_loss: 1.7782 - val_accuracy: 0.2768
Epoch 13/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.7698 -
accuracy: 0.2767 - val_loss: 1.7114 - val_accuracy: 0.2672
Epoch 14/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.8464 -
accuracy: 0.2644 - val_loss: 1.8115 - val_accuracy: 0.2834
Epoch 15/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.8294 -
accuracy: 0.2666 - val_loss: 1.8141 - val_accuracy: 0.2764
Epoch 16/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.7610 -
```

```
accuracy: 0.2753 - val_loss: 1.7246 - val_accuracy: 0.2711
Epoch 17/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.7601 -
accuracy: 0.2645 - val_loss: 1.6945 - val_accuracy: 0.2741
Epoch 18/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.7831 -
accuracy: 0.2710 - val_loss: 1.7526 - val_accuracy: 0.2829
Epoch 19/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.7716 -
accuracy: 0.2704 - val_loss: 1.7445 - val_accuracy: 0.2736
Epoch 20/20
1646/1646 [==============================] - 5s 3ms/step - loss: 1.7527 -
accuracy: 0.2707 - val_loss: 1.7008 - val_accuracy: 0.2833

Accuracy: 28.33%

Iteration:  26
Epoch 1/20
2550/2550 [==============================] - 7s 3ms/step - loss: 1.9331 -
accuracy: 0.2630 - val_loss: 2.3108 - val_accuracy: 0.0959
Epoch 2/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3088 -
accuracy: 0.1051 - val_loss: 2.3044 - val_accuracy: 0.1093
Epoch 3/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3083 -
accuracy: 0.1046 - val_loss: 2.3070 - val_accuracy: 0.1063
Epoch 4/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3088 -
accuracy: 0.1045 - val_loss: 2.3092 - val_accuracy: 0.1063
Epoch 5/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3087 -
accuracy: 0.1042 - val_loss: 2.3102 - val_accuracy: 0.0959
Epoch 6/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3082 -
accuracy: 0.1060 - val_loss: 2.3114 - val_accuracy: 0.0993
Epoch 7/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3084 -
accuracy: 0.1036 - val_loss: 2.3085 - val_accuracy: 0.0993
Epoch 8/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3083 -
accuracy: 0.1041 - val_loss: 2.3172 - val_accuracy: 0.1002
Epoch 9/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3088 -
accuracy: 0.1044 - val_loss: 2.3060 - val_accuracy: 0.1063
Epoch 10/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3081 -
accuracy: 0.1030 - val_loss: 2.3075 - val_accuracy: 0.0990
Epoch 11/20
```

```
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3082 -
accuracy: 0.1042 - val_loss: 2.3055 - val_accuracy: 0.1028
Epoch 12/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3084 -
accuracy: 0.1045 - val_loss: 2.3131 - val_accuracy: 0.1063
Epoch 13/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3081 -
accuracy: 0.1073 - val_loss: 2.3083 - val_accuracy: 0.0990
Epoch 14/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3084 -
accuracy: 0.1038 - val_loss: 2.3059 - val_accuracy: 0.1063
Epoch 15/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3083 -
accuracy: 0.1050 - val_loss: 2.3077 - val_accuracy: 0.1093
Epoch 16/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3090 -
accuracy: 0.1030 - val_loss: 2.3084 - val_accuracy: 0.1093
Epoch 17/20
2550/2550 [==============================] - 6s 3ms/step - loss: 2.3087 -
accuracy: 0.1033 - val_loss: 2.3039 - val_accuracy: 0.0959
Epoch 18/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3086 -
accuracy: 0.1032 - val_loss: 2.3125 - val_accuracy: 0.1028
Epoch 19/20
2550/2550 [==============================] - 6s 3ms/step - loss: 2.3086 -
accuracy: 0.1042 - val_loss: 2.3134 - val_accuracy: 0.1093
Epoch 20/20
2550/2550 [==============================] - 6s 2ms/step - loss: 2.3081 -
accuracy: 0.1048 - val_loss: 2.3096 - val_accuracy: 0.0997

Accuracy: 9.97%

Iteration:  27
Epoch 1/20
1759/1759 [==============================] - 6s 3ms/step - loss: 2.3060 -
accuracy: 0.1058 - val_loss: 2.3054 - val_accuracy: 0.1063
Epoch 2/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3057 -
accuracy: 0.1075 - val_loss: 2.3070 - val_accuracy: 0.0997
Epoch 3/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3053 -
accuracy: 0.1049 - val_loss: 2.3098 - val_accuracy: 0.1063
Epoch 4/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3051 -
accuracy: 0.1054 - val_loss: 2.3044 - val_accuracy: 0.1063
Epoch 5/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3056 -
accuracy: 0.1074 - val_loss: 2.3043 - val_accuracy: 0.1063
```

```
Epoch 6/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3052 -
accuracy: 0.1071 - val_loss: 2.3061 - val_accuracy: 0.0993
Epoch 7/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3056 -
accuracy: 0.1033 - val_loss: 2.3078 - val_accuracy: 0.1063
Epoch 8/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3055 -
accuracy: 0.1061 - val_loss: 2.3078 - val_accuracy: 0.1063
Epoch 9/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3055 -
accuracy: 0.1060 - val_loss: 2.3048 - val_accuracy: 0.0916
Epoch 10/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3055 -
accuracy: 0.1075 - val_loss: 2.3106 - val_accuracy: 0.1063
Epoch 11/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3058 -
accuracy: 0.1062 - val_loss: 2.3053 - val_accuracy: 0.1028
Epoch 12/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3053 -
accuracy: 0.1081 - val_loss: 2.3029 - val_accuracy: 0.1093
Epoch 13/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3056 -
accuracy: 0.1065 - val_loss: 2.3070 - val_accuracy: 0.0959
Epoch 14/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3058 -
accuracy: 0.1073 - val_loss: 2.3079 - val_accuracy: 0.0993
Epoch 15/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3061 -
accuracy: 0.1046 - val_loss: 2.3096 - val_accuracy: 0.1063
Epoch 16/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3059 -
accuracy: 0.1044 - val_loss: 2.3035 - val_accuracy: 0.1063
Epoch 17/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3056 -
accuracy: 0.1044 - val_loss: 2.3085 - val_accuracy: 0.1063
Epoch 18/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3056 -
accuracy: 0.1073 - val_loss: 2.3047 - val_accuracy: 0.1063
Epoch 19/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3056 -
accuracy: 0.1064 - val_loss: 2.3046 - val_accuracy: 0.1093
Epoch 20/20
1759/1759 [==============================] - 5s 3ms/step - loss: 2.3052 -
accuracy: 0.1065 - val_loss: 2.3130 - val_accuracy: 0.1002

Accuracy: 10.02%
```

```
Iteration:  28
Epoch 1/20
482/482 [==============================] - 2s 3ms/step - loss: 2.3554 -
accuracy: 0.1042 - val_loss: 2.3349 - val_accuracy: 0.1063
Epoch 2/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3488 -
accuracy: 0.1011 - val_loss: 2.3254 - val_accuracy: 0.0997
Epoch 3/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3506 -
accuracy: 0.1025 - val_loss: 2.3702 - val_accuracy: 0.1063
Epoch 4/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3471 -
accuracy: 0.1025 - val_loss: 2.3452 - val_accuracy: 0.0959
Epoch 5/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3487 -
accuracy: 0.0992 - val_loss: 2.3380 - val_accuracy: 0.0959
Epoch 6/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3512 -
accuracy: 0.1018 - val_loss: 2.3135 - val_accuracy: 0.0959
Epoch 7/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3487 -
accuracy: 0.1019 - val_loss: 2.3744 - val_accuracy: 0.1028
Epoch 8/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3515 -
accuracy: 0.1036 - val_loss: 2.3641 - val_accuracy: 0.1063
Epoch 9/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3486 -
accuracy: 0.1025 - val_loss: 2.3821 - val_accuracy: 0.0997
Epoch 10/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3480 -
accuracy: 0.1029 - val_loss: 2.3896 - val_accuracy: 0.1093
Epoch 11/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3537 -
accuracy: 0.1017 - val_loss: 2.3315 - val_accuracy: 0.1093
Epoch 12/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3482 -
accuracy: 0.1038 - val_loss: 2.3380 - val_accuracy: 0.1093
Epoch 13/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3492 -
accuracy: 0.1012 - val_loss: 2.3484 - val_accuracy: 0.0959
Epoch 14/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3488 -
accuracy: 0.1024 - val_loss: 2.3262 - val_accuracy: 0.1093
Epoch 15/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3476 -
accuracy: 0.1018 - val_loss: 2.3219 - val_accuracy: 0.0990
Epoch 16/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3471 -
```

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accuracy: 0.0994 - val_loss: 2.3610 - val_accuracy: 0.0997
Epoch 17/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3474 -
accuracy: 0.1028 - val_loss: 2.3519 - val_accuracy: 0.0916
Epoch 18/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3518 -
accuracy: 0.1004 - val_loss: 2.3459 - val_accuracy: 0.0916
Epoch 19/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3475 -
accuracy: 0.1010 - val_loss: 2.3754 - val_accuracy: 0.1002
Epoch 20/20
482/482 [==============================] - 1s 3ms/step - loss: 2.3502 -
accuracy: 0.1015 - val_loss: 2.3107 - val_accuracy: 0.1093

Accuracy: 10.93%

Iteration:  29
Epoch 1/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3191 -
accuracy: 0.1024 - val_loss: 2.3422 - val_accuracy: 0.0990
Epoch 2/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3183 -
accuracy: 0.1022 - val_loss: 2.3189 - val_accuracy: 0.1002
Epoch 3/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3197 -
accuracy: 0.1023 - val_loss: 2.3116 - val_accuracy: 0.1063
Epoch 4/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3186 -
accuracy: 0.1038 - val_loss: 2.3169 - val_accuracy: 0.0997
Epoch 5/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3190 -
accuracy: 0.1037 - val_loss: 2.3213 - val_accuracy: 0.1063
Epoch 6/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3189 -
accuracy: 0.1035 - val_loss: 2.3237 - val_accuracy: 0.1063
Epoch 7/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3197 -
accuracy: 0.1045 - val_loss: 2.3185 - val_accuracy: 0.0997
Epoch 8/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3184 -
accuracy: 0.1035 - val_loss: 2.3190 - val_accuracy: 0.1063
Epoch 9/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3192 -
accuracy: 0.1017 - val_loss: 2.3133 - val_accuracy: 0.0959
Epoch 10/20
8500/8500 [==============================] - 21s 3ms/step - loss: 2.3194 -
accuracy: 0.1019 - val_loss: 2.3166 - val_accuracy: 0.1002
Epoch 11/20
```

```
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3192 -
accuracy: 0.1018 - val_loss: 2.3193 - val_accuracy: 0.1063
Epoch 12/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3193 -
accuracy: 0.1005 - val_loss: 2.3111 - val_accuracy: 0.0959
Epoch 13/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3199 -
accuracy: 0.1049 - val_loss: 2.3153 - val_accuracy: 0.0959
Epoch 14/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3188 -
accuracy: 0.1042 - val_loss: 2.3241 - val_accuracy: 0.0993
Epoch 15/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3185 -
accuracy: 0.1049 - val_loss: 2.3204 - val_accuracy: 0.1028
Epoch 16/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3179 -
accuracy: 0.1039 - val_loss: 2.3380 - val_accuracy: 0.1093
Epoch 17/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3201 -
accuracy: 0.0999 - val_loss: 2.3118 - val_accuracy: 0.0959
Epoch 18/20
8500/8500 [==============================] - 20s 2ms/step - loss: 2.3183 -
accuracy: 0.1051 - val_loss: 2.3136 - val_accuracy: 0.1063
Epoch 19/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3182 -
accuracy: 0.1032 - val_loss: 2.3168 - val_accuracy: 0.1093
Epoch 20/20
8500/8500 [==============================] - 21s 2ms/step - loss: 2.3188 -
accuracy: 0.1022 - val_loss: 2.3196 - val_accuracy: 0.1093

Accuracy: 10.93%

Iteration:  30
Epoch 1/20
1244/1244 [==============================] - 5s 3ms/step - loss: 1.2966 -
accuracy: 0.4724 - val_loss: 0.7269 - val_accuracy: 0.7639
Epoch 2/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.6098 -
accuracy: 0.8053 - val_loss: 0.4247 - val_accuracy: 0.8969
Epoch 3/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.3984 -
accuracy: 0.8998 - val_loss: 0.3249 - val_accuracy: 0.9269
Epoch 4/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.2946 -
accuracy: 0.9279 - val_loss: 0.2960 - val_accuracy: 0.9330
Epoch 5/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.2692 -
accuracy: 0.9367 - val_loss: 0.2877 - val_accuracy: 0.9318
```

```
Epoch 6/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.2308 -
accuracy: 0.9450 - val_loss: 0.2582 - val_accuracy: 0.9477
Epoch 7/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.2111 -
accuracy: 0.9494 - val_loss: 0.2342 - val_accuracy: 0.9461
Epoch 8/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1912 -
accuracy: 0.9538 - val_loss: 0.2267 - val_accuracy: 0.9531
Epoch 9/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1897 -
accuracy: 0.9551 - val_loss: 0.2599 - val_accuracy: 0.9436
Epoch 10/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1796 -
accuracy: 0.9574 - val_loss: 0.2224 - val_accuracy: 0.9536
Epoch 11/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1654 -
accuracy: 0.9598 - val_loss: 0.2776 - val_accuracy: 0.9476
Epoch 12/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1543 -
accuracy: 0.9641 - val_loss: 0.2440 - val_accuracy: 0.9527
Epoch 13/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1492 -
accuracy: 0.9652 - val_loss: 0.2132 - val_accuracy: 0.9560
Epoch 14/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1395 -
accuracy: 0.9679 - val_loss: 0.2265 - val_accuracy: 0.9562
Epoch 15/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1325 -
accuracy: 0.9692 - val_loss: 0.2077 - val_accuracy: 0.9592
Epoch 16/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1359 -
accuracy: 0.9683 - val_loss: 0.2194 - val_accuracy: 0.9621
Epoch 17/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1301 -
accuracy: 0.9697 - val_loss: 0.2128 - val_accuracy: 0.9592
Epoch 18/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1216 -
accuracy: 0.9712 - val_loss: 0.2825 - val_accuracy: 0.9524
Epoch 19/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1165 -
accuracy: 0.9728 - val_loss: 0.2465 - val_accuracy: 0.9599
Epoch 20/20
1244/1244 [==============================] - 4s 3ms/step - loss: 0.1176 -
accuracy: 0.9727 - val_loss: 0.2224 - val_accuracy: 0.9560

Accuracy: 95.60%
```

```
Iteration:  31
Epoch 1/20
773/773 [==============================] - 3s 3ms/step - loss: 2.3135 -
accuracy: 0.1062 - val_loss: 2.3168 - val_accuracy: 0.0990
Epoch 2/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3121 -
accuracy: 0.1030 - val_loss: 2.3088 - val_accuracy: 0.1093
Epoch 3/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3123 -
accuracy: 0.1015 - val_loss: 2.3070 - val_accuracy: 0.1063
Epoch 4/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3121 -
accuracy: 0.1039 - val_loss: 2.3167 - val_accuracy: 0.1063
Epoch 5/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3120 -
accuracy: 0.1044 - val_loss: 2.3218 - val_accuracy: 0.1028
Epoch 6/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3121 -
accuracy: 0.1031 - val_loss: 2.3106 - val_accuracy: 0.1028
Epoch 7/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3116 -
accuracy: 0.1015 - val_loss: 2.3166 - val_accuracy: 0.0997
Epoch 8/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3104 -
accuracy: 0.1071 - val_loss: 2.3100 - val_accuracy: 0.0959
Epoch 9/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3115 -
accuracy: 0.1048 - val_loss: 2.3207 - val_accuracy: 0.1063
Epoch 10/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3117 -
accuracy: 0.1049 - val_loss: 2.3108 - val_accuracy: 0.1063
Epoch 11/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3111 -
accuracy: 0.1029 - val_loss: 2.3151 - val_accuracy: 0.1093
Epoch 12/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3120 -
accuracy: 0.1048 - val_loss: 2.3097 - val_accuracy: 0.0959
Epoch 13/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3129 -
accuracy: 0.1023 - val_loss: 2.3081 - val_accuracy: 0.1063
Epoch 14/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3119 -
accuracy: 0.1045 - val_loss: 2.3136 - val_accuracy: 0.1028
Epoch 15/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3133 -
accuracy: 0.1020 - val_loss: 2.3128 - val_accuracy: 0.0993
Epoch 16/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3118 -
```

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accuracy: 0.1055 - val_loss: 2.3080 - val_accuracy: 0.0997
Epoch 17/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3114 -
accuracy: 0.1051 - val_loss: 2.3215 - val_accuracy: 0.1063
Epoch 18/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3120 -
accuracy: 0.1037 - val_loss: 2.3063 - val_accuracy: 0.1093
Epoch 19/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3113 -
accuracy: 0.1027 - val_loss: 2.3033 - val_accuracy: 0.1063
Epoch 20/20
773/773 [==============================] - 2s 3ms/step - loss: 2.3117 -
accuracy: 0.1052 - val_loss: 2.3130 - val_accuracy: 0.0959

Accuracy: 9.59%

Iteration:  32
Epoch 1/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3180 -
accuracy: 0.1026 - val_loss: 2.3204 - val_accuracy: 0.0916
Epoch 2/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3159 -
accuracy: 0.1032 - val_loss: 2.3144 - val_accuracy: 0.1093
Epoch 3/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3151 -
accuracy: 0.1019 - val_loss: 2.3119 - val_accuracy: 0.1063
Epoch 4/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3157 -
accuracy: 0.1011 - val_loss: 2.3176 - val_accuracy: 0.1063
Epoch 5/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3155 -
accuracy: 0.1039 - val_loss: 2.3166 - val_accuracy: 0.0959
Epoch 6/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3158 -
accuracy: 0.1038 - val_loss: 2.3161 - val_accuracy: 0.1063
Epoch 7/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3158 -
accuracy: 0.1034 - val_loss: 2.3193 - val_accuracy: 0.0990
Epoch 8/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3157 -
accuracy: 0.1046 - val_loss: 2.3132 - val_accuracy: 0.1063
Epoch 9/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3160 -
accuracy: 0.1029 - val_loss: 2.3146 - val_accuracy: 0.1063
Epoch 10/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3154 -
accuracy: 0.1048 - val_loss: 2.3190 - val_accuracy: 0.0959
Epoch 11/20
```

```
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3156 -
accuracy: 0.1023 - val_loss: 2.3161 - val_accuracy: 0.0959
Epoch 12/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3162 -
accuracy: 0.1041 - val_loss: 2.3163 - val_accuracy: 0.1002
Epoch 13/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3153 -
accuracy: 0.1020 - val_loss: 2.3096 - val_accuracy: 0.0997
Epoch 14/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3162 -
accuracy: 0.1015 - val_loss: 2.3117 - val_accuracy: 0.0959
Epoch 15/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3155 -
accuracy: 0.1045 - val_loss: 2.3214 - val_accuracy: 0.0990
Epoch 16/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3161 -
accuracy: 0.1030 - val_loss: 2.3104 - val_accuracy: 0.1063
Epoch 17/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3153 -
accuracy: 0.1035 - val_loss: 2.3204 - val_accuracy: 0.0959
Epoch 18/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3161 -
accuracy: 0.1039 - val_loss: 2.3097 - val_accuracy: 0.1063
Epoch 19/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3159 -
accuracy: 0.1029 - val_loss: 2.3074 - val_accuracy: 0.1063
Epoch 20/20
12750/12750 [==============================] - 28s 2ms/step - loss: 2.3158 -
accuracy: 0.1028 - val_loss: 2.3181 - val_accuracy: 0.0959

Accuracy: 9.59%

Iteration:  33
Epoch 1/20
1546/1546 [==============================] - 5s 3ms/step - loss: 0.6981 -
accuracy: 0.7832 - val_loss: 0.2323 - val_accuracy: 0.9453
Epoch 2/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.2078 -
accuracy: 0.9455 - val_loss: 0.1818 - val_accuracy: 0.9522
Epoch 3/20
1546/1546 [==============================] - 5s 3ms/step - loss: 0.1572 -
accuracy: 0.9580 - val_loss: 0.1323 - val_accuracy: 0.9624
Epoch 4/20
1546/1546 [==============================] - 5s 3ms/step - loss: 0.1257 -
accuracy: 0.9661 - val_loss: 0.1329 - val_accuracy: 0.9636
Epoch 5/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.1202 -
accuracy: 0.9671 - val_loss: 0.1402 - val_accuracy: 0.9621
```

```
Epoch 6/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.1092 -
accuracy: 0.9695 - val_loss: 0.1401 - val_accuracy: 0.9640
Epoch 7/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0974 -
accuracy: 0.9722 - val_loss: 0.1411 - val_accuracy: 0.9634
Epoch 8/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0907 -
accuracy: 0.9746 - val_loss: 0.1238 - val_accuracy: 0.9686
Epoch 9/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0853 -
accuracy: 0.9759 - val_loss: 0.1324 - val_accuracy: 0.9650
Epoch 10/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0874 -
accuracy: 0.9758 - val_loss: 0.1176 - val_accuracy: 0.9696
Epoch 11/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0824 -
accuracy: 0.9763 - val_loss: 0.1366 - val_accuracy: 0.9652
Epoch 12/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0756 -
accuracy: 0.9795 - val_loss: 0.1162 - val_accuracy: 0.9689
Epoch 13/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0755 -
accuracy: 0.9791 - val_loss: 0.1127 - val_accuracy: 0.9718
Epoch 14/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0738 -
accuracy: 0.9789 - val_loss: 0.1100 - val_accuracy: 0.9717
Epoch 15/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0712 -
accuracy: 0.9800 - val_loss: 0.1214 - val_accuracy: 0.9678
Epoch 16/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0716 -
accuracy: 0.9796 - val_loss: 0.1039 - val_accuracy: 0.9738
Epoch 17/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0611 -
accuracy: 0.9824 - val_loss: 0.1129 - val_accuracy: 0.9717
Epoch 18/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0660 -
accuracy: 0.9806 - val_loss: 0.1272 - val_accuracy: 0.9682
Epoch 19/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0616 -
accuracy: 0.9827 - val_loss: 0.1221 - val_accuracy: 0.9700
Epoch 20/20
1546/1546 [==============================] - 4s 3ms/step - loss: 0.0609 -
accuracy: 0.9827 - val_loss: 0.1206 - val_accuracy: 0.9683

Accuracy: 96.83%
```

```
Iteration:  34
Epoch 1/20
477/477 [==============================] - 2s 3ms/step - loss: 0.5838 -
accuracy: 0.8395 - val_loss: 0.2117 - val_accuracy: 0.9460
Epoch 2/20
477/477 [==============================] - 1s 3ms/step - loss: 0.2024 -
accuracy: 0.9461 - val_loss: 0.1663 - val_accuracy: 0.9566
Epoch 3/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1655 -
accuracy: 0.9557 - val_loss: 0.1596 - val_accuracy: 0.9591
Epoch 4/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1433 -
accuracy: 0.9604 - val_loss: 0.1588 - val_accuracy: 0.9578
Epoch 5/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1324 -
accuracy: 0.9639 - val_loss: 0.1415 - val_accuracy: 0.9657
Epoch 6/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1178 -
accuracy: 0.9686 - val_loss: 0.1632 - val_accuracy: 0.9559
Epoch 7/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1235 -
accuracy: 0.9673 - val_loss: 0.1453 - val_accuracy: 0.9652
Epoch 8/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1185 -
accuracy: 0.9667 - val_loss: 0.1564 - val_accuracy: 0.9608
Epoch 9/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1139 -
accuracy: 0.9677 - val_loss: 0.1293 - val_accuracy: 0.9683
Epoch 10/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1082 -
accuracy: 0.9694 - val_loss: 0.1557 - val_accuracy: 0.9613
Epoch 11/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1077 -
accuracy: 0.9698 - val_loss: 0.1417 - val_accuracy: 0.9661
Epoch 12/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1018 -
accuracy: 0.9713 - val_loss: 0.1539 - val_accuracy: 0.9589
Epoch 13/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1062 -
accuracy: 0.9707 - val_loss: 0.1516 - val_accuracy: 0.9603
Epoch 14/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1005 -
accuracy: 0.9719 - val_loss: 0.1386 - val_accuracy: 0.9659
Epoch 15/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0953 -
accuracy: 0.9738 - val_loss: 0.1315 - val_accuracy: 0.9693
Epoch 16/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0970 -
```

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accuracy: 0.9734 - val_loss: 0.1346 - val_accuracy: 0.9667
Epoch 17/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0966 -
accuracy: 0.9736 - val_loss: 0.1292 - val_accuracy: 0.9682
Epoch 18/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0939 -
accuracy: 0.9745 - val_loss: 0.1461 - val_accuracy: 0.9643
Epoch 19/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0889 -
accuracy: 0.9752 - val_loss: 0.1380 - val_accuracy: 0.9668
Epoch 20/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0902 -
accuracy: 0.9746 - val_loss: 0.1393 - val_accuracy: 0.9667

Accuracy: 96.67%

Iteration:  35
Epoch 1/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.5895 -
accuracy: 0.7990 - val_loss: 0.3912 - val_accuracy: 0.8946
Epoch 2/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.4016 -
accuracy: 0.9000 - val_loss: 0.3041 - val_accuracy: 0.9293
Epoch 3/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.3475 -
accuracy: 0.9181 - val_loss: 0.3663 - val_accuracy: 0.9032
Epoch 4/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.3400 -
accuracy: 0.9191 - val_loss: 0.3002 - val_accuracy: 0.9272
Epoch 5/20
7286/7286 [==============================] - 19s 3ms/step - loss: 0.3163 -
accuracy: 0.9280 - val_loss: 0.2879 - val_accuracy: 0.9426
Epoch 6/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.3311 -
accuracy: 0.9245 - val_loss: 0.3822 - val_accuracy: 0.9109
Epoch 7/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.3036 -
accuracy: 0.9345 - val_loss: 0.2546 - val_accuracy: 0.9480
Epoch 8/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.3199 -
accuracy: 0.9284 - val_loss: 0.2965 - val_accuracy: 0.9398
Epoch 9/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.2957 -
accuracy: 0.9352 - val_loss: 0.2648 - val_accuracy: 0.9424
Epoch 10/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.2777 -
accuracy: 0.9404 - val_loss: 0.2994 - val_accuracy: 0.9411
Epoch 11/20
```

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7286/7286 [==============================] - 20s 3ms/step - loss: 0.3396 -
accuracy: 0.8995 - val_loss: 0.4433 - val_accuracy: 0.8466
Epoch 12/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.3609 -
accuracy: 0.8965 - val_loss: 0.2781 - val_accuracy: 0.9386
Epoch 13/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.2823 -
accuracy: 0.9373 - val_loss: 0.3433 - val_accuracy: 0.9383
Epoch 14/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.2664 -
accuracy: 0.9431 - val_loss: 0.2597 - val_accuracy: 0.9476
Epoch 15/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.2763 -
accuracy: 0.9402 - val_loss: 0.3231 - val_accuracy: 0.9339
Epoch 16/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.2840 -
accuracy: 0.9366 - val_loss: 0.2703 - val_accuracy: 0.9441
Epoch 17/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.2785 -
accuracy: 0.9437 - val_loss: 0.2702 - val_accuracy: 0.9450
Epoch 18/20
7286/7286 [==============================] - 19s 3ms/step - loss: 0.3134 -
accuracy: 0.9284 - val_loss: 0.3250 - val_accuracy: 0.9380
Epoch 19/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.2828 -
accuracy: 0.9420 - val_loss: 0.3422 - val_accuracy: 0.9361
Epoch 20/20
7286/7286 [==============================] - 20s 3ms/step - loss: 0.2748 -
accuracy: 0.9422 - val_loss: 0.3018 - val_accuracy: 0.9400

Accuracy: 94.00%

Iteration:  36
Epoch 1/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3157 -
accuracy: 0.1030 - val_loss: 2.3099 - val_accuracy: 0.0990
Epoch 2/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3121 -
accuracy: 0.1040 - val_loss: 2.3305 - val_accuracy: 0.0993
Epoch 3/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3124 -
accuracy: 0.1031 - val_loss: 2.3109 - val_accuracy: 0.0997
Epoch 4/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3130 -
accuracy: 0.1025 - val_loss: 2.3188 - val_accuracy: 0.0993
Epoch 5/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3126 -
accuracy: 0.1058 - val_loss: 2.3162 - val_accuracy: 0.1028
```

```
Epoch 6/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3134 -
accuracy: 0.1014 - val_loss: 2.3060 - val_accuracy: 0.0959
Epoch 7/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3131 -
accuracy: 0.1034 - val_loss: 2.3138 - val_accuracy: 0.1063
Epoch 8/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3132 -
accuracy: 0.1031 - val_loss: 2.3164 - val_accuracy: 0.1028
Epoch 9/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3131 -
accuracy: 0.1021 - val_loss: 2.3066 - val_accuracy: 0.1093
Epoch 10/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3132 -
accuracy: 0.1017 - val_loss: 2.3166 - val_accuracy: 0.1002
Epoch 11/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3128 -
accuracy: 0.1032 - val_loss: 2.3213 - val_accuracy: 0.0990
Epoch 12/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3133 -
accuracy: 0.1031 - val_loss: 2.3202 - val_accuracy: 0.1063
Epoch 13/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3117 -
accuracy: 0.1058 - val_loss: 2.3049 - val_accuracy: 0.1063
Epoch 14/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3121 -
accuracy: 0.1033 - val_loss: 2.3155 - val_accuracy: 0.0959
Epoch 15/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3135 -
accuracy: 0.1030 - val_loss: 2.3102 - val_accuracy: 0.0959
Epoch 16/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3133 -
accuracy: 0.1034 - val_loss: 2.3180 - val_accuracy: 0.1063
Epoch 17/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3138 -
accuracy: 0.1045 - val_loss: 2.3082 - val_accuracy: 0.1063
Epoch 18/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3122 -
accuracy: 0.1027 - val_loss: 2.3181 - val_accuracy: 0.0997
Epoch 19/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3124 -
accuracy: 0.1045 - val_loss: 2.3267 - val_accuracy: 0.0993
Epoch 20/20
567/567 [==============================] - 2s 3ms/step - loss: 2.3144 -
accuracy: 0.1031 - val_loss: 2.3126 - val_accuracy: 0.0959

Accuracy: 9.59%
```

```
Iteration:  37
Epoch 1/20
709/709 [==============================] - 3s 3ms/step - loss: 1.9885 -
accuracy: 0.1873 - val_loss: 1.8002 - val_accuracy: 0.2019
Epoch 2/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7951 -
accuracy: 0.2085 - val_loss: 1.7573 - val_accuracy: 0.2051
Epoch 3/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7723 -
accuracy: 0.2108 - val_loss: 1.7430 - val_accuracy: 0.2142
Epoch 4/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7530 -
accuracy: 0.2122 - val_loss: 1.7494 - val_accuracy: 0.2100
Epoch 5/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7435 -
accuracy: 0.2123 - val_loss: 1.7264 - val_accuracy: 0.2109
Epoch 6/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7292 -
accuracy: 0.2138 - val_loss: 1.7384 - val_accuracy: 0.2068
Epoch 7/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7274 -
accuracy: 0.2151 - val_loss: 1.7241 - val_accuracy: 0.2118
Epoch 8/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7214 -
accuracy: 0.2188 - val_loss: 1.7191 - val_accuracy: 0.2138
Epoch 9/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7158 -
accuracy: 0.2145 - val_loss: 1.7170 - val_accuracy: 0.2071
Epoch 10/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7144 -
accuracy: 0.2152 - val_loss: 1.7286 - val_accuracy: 0.2087
Epoch 11/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7071 -
accuracy: 0.2118 - val_loss: 1.7060 - val_accuracy: 0.2077
Epoch 12/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7092 -
accuracy: 0.2165 - val_loss: 1.7170 - val_accuracy: 0.2144
Epoch 13/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7033 -
accuracy: 0.2158 - val_loss: 1.7047 - val_accuracy: 0.2071
Epoch 14/20
709/709 [==============================] - 2s 3ms/step - loss: 1.7013 -
accuracy: 0.2213 - val_loss: 1.7195 - val_accuracy: 0.2214
Epoch 15/20
709/709 [==============================] - 2s 3ms/step - loss: 1.6997 -
accuracy: 0.2235 - val_loss: 1.6876 - val_accuracy: 0.2489
Epoch 16/20
709/709 [==============================] - 2s 3ms/step - loss: 1.6898 -
```

```
accuracy: 0.2420 - val_loss: 1.6848 - val_accuracy: 0.2476
Epoch 17/20
709/709 [==============================] - 2s 3ms/step - loss: 1.6501 -
accuracy: 0.2745 - val_loss: 1.6149 - val_accuracy: 0.3096
Epoch 18/20
709/709 [==============================] - 2s 3ms/step - loss: 1.6092 -
accuracy: 0.3029 - val_loss: 1.5872 - val_accuracy: 0.3336
Epoch 19/20
709/709 [==============================] - 2s 3ms/step - loss: 1.5833 -
accuracy: 0.3254 - val_loss: 1.6029 - val_accuracy: 0.3332
Epoch 20/20
709/709 [==============================] - 2s 3ms/step - loss: 1.5331 -
accuracy: 0.3415 - val_loss: 1.5756 - val_accuracy: 0.3253

Accuracy: 32.53%

Iteration:  38
Epoch 1/20
412/412 [==============================] - 2s 3ms/step - loss: 2.3368 -
accuracy: 0.1034 - val_loss: 2.3609 - val_accuracy: 0.0959
Epoch 2/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3379 -
accuracy: 0.1004 - val_loss: 2.3181 - val_accuracy: 0.1028
Epoch 3/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3321 -
accuracy: 0.1035 - val_loss: 2.3433 - val_accuracy: 0.0993
Epoch 4/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3323 -
accuracy: 0.1035 - val_loss: 2.3294 - val_accuracy: 0.0993
Epoch 5/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3367 -
accuracy: 0.1022 - val_loss: 2.3328 - val_accuracy: 0.0993
Epoch 6/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3371 -
accuracy: 0.1028 - val_loss: 2.3390 - val_accuracy: 0.0990
Epoch 7/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3328 -
accuracy: 0.1019 - val_loss: 2.3606 - val_accuracy: 0.0959
Epoch 8/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3354 -
accuracy: 0.1012 - val_loss: 2.3221 - val_accuracy: 0.0990
Epoch 9/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3338 -
accuracy: 0.1019 - val_loss: 2.3208 - val_accuracy: 0.1002
Epoch 10/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3368 -
accuracy: 0.1029 - val_loss: 2.3497 - val_accuracy: 0.0993
Epoch 11/20
```

```
412/412 [==============================] - 1s 3ms/step - loss: 2.3375 -
accuracy: 0.1009 - val_loss: 2.3835 - val_accuracy: 0.1063
Epoch 12/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3361 -
accuracy: 0.1014 - val_loss: 2.3859 - val_accuracy: 0.0959
Epoch 13/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3351 -
accuracy: 0.1025 - val_loss: 2.3173 - val_accuracy: 0.0993
Epoch 14/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3365 -
accuracy: 0.1003 - val_loss: 2.3653 - val_accuracy: 0.0916
Epoch 15/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3350 -
accuracy: 0.1009 - val_loss: 2.3258 - val_accuracy: 0.1093
Epoch 16/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3348 -
accuracy: 0.1017 - val_loss: 2.3196 - val_accuracy: 0.1093
Epoch 17/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3339 -
accuracy: 0.1007 - val_loss: 2.3238 - val_accuracy: 0.1063
Epoch 18/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3353 -
accuracy: 0.1020 - val_loss: 2.3120 - val_accuracy: 0.0959
Epoch 19/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3317 -
accuracy: 0.1045 - val_loss: 2.3118 - val_accuracy: 0.1063
Epoch 20/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3328 -
accuracy: 0.1001 - val_loss: 2.3228 - val_accuracy: 0.0997

Accuracy: 9.97%

Iteration:  39
Epoch 1/20
750/750 [==============================] - 3s 3ms/step - loss: 0.3613 -
accuracy: 0.8934 - val_loss: 0.1667 - val_accuracy: 0.9536
Epoch 2/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1878 -
accuracy: 0.9509 - val_loss: 0.1479 - val_accuracy: 0.9612
Epoch 3/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1620 -
accuracy: 0.9586 - val_loss: 0.1479 - val_accuracy: 0.9619
Epoch 4/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1436 -
accuracy: 0.9629 - val_loss: 0.1446 - val_accuracy: 0.9636
Epoch 5/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1210 -
accuracy: 0.9699 - val_loss: 0.1505 - val_accuracy: 0.9668
```

```
Epoch 6/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1248 -
accuracy: 0.9690 - val_loss: 0.1735 - val_accuracy: 0.9661
Epoch 7/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1213 -
accuracy: 0.9698 - val_loss: 0.1405 - val_accuracy: 0.9660
Epoch 8/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1080 -
accuracy: 0.9733 - val_loss: 0.1519 - val_accuracy: 0.9623
Epoch 9/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1031 -
accuracy: 0.9753 - val_loss: 0.1509 - val_accuracy: 0.9697
Epoch 10/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0908 -
accuracy: 0.9781 - val_loss: 0.1565 - val_accuracy: 0.9706
Epoch 11/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0921 -
accuracy: 0.9778 - val_loss: 0.1468 - val_accuracy: 0.9656
Epoch 12/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0838 -
accuracy: 0.9802 - val_loss: 0.1739 - val_accuracy: 0.9583
Epoch 13/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0920 -
accuracy: 0.9781 - val_loss: 0.1369 - val_accuracy: 0.9701
Epoch 14/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0897 -
accuracy: 0.9799 - val_loss: 0.1526 - val_accuracy: 0.9632
Epoch 15/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1113 -
accuracy: 0.9738 - val_loss: 0.1469 - val_accuracy: 0.9660
Epoch 16/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0830 -
accuracy: 0.9809 - val_loss: 0.1339 - val_accuracy: 0.9714
Epoch 17/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0883 -
accuracy: 0.9797 - val_loss: 0.1392 - val_accuracy: 0.9690
Epoch 18/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0896 -
accuracy: 0.9792 - val_loss: 0.1974 - val_accuracy: 0.9581
Epoch 19/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0979 -
accuracy: 0.9776 - val_loss: 0.1662 - val_accuracy: 0.9674
Epoch 20/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1133 -
accuracy: 0.9734 - val_loss: 0.1332 - val_accuracy: 0.9702

Accuracy: 97.02%
```

```
Iteration:  40
Epoch 1/20
425/425 [==============================] - 2s 3ms/step - loss: 0.8135 -
accuracy: 0.7143 - val_loss: 0.3617 - val_accuracy: 0.8988
Epoch 2/20
425/425 [==============================] - 1s 3ms/step - loss: 0.3607 -
accuracy: 0.9054 - val_loss: 0.2866 - val_accuracy: 0.9251
Epoch 3/20
425/425 [==============================] - 1s 3ms/step - loss: 0.2920 -
accuracy: 0.9238 - val_loss: 0.2426 - val_accuracy: 0.9372
Epoch 4/20
425/425 [==============================] - 1s 3ms/step - loss: 0.2598 -
accuracy: 0.9323 - val_loss: 0.2227 - val_accuracy: 0.9429
Epoch 5/20
425/425 [==============================] - 1s 3ms/step - loss: 0.2364 -
accuracy: 0.9388 - val_loss: 0.2295 - val_accuracy: 0.9428
Epoch 6/20
425/425 [==============================] - 1s 3ms/step - loss: 0.2160 -
accuracy: 0.9450 - val_loss: 0.2314 - val_accuracy: 0.9431
Epoch 7/20
425/425 [==============================] - 1s 3ms/step - loss: 0.2047 -
accuracy: 0.9473 - val_loss: 0.2080 - val_accuracy: 0.9520
Epoch 8/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1954 -
accuracy: 0.9484 - val_loss: 0.2311 - val_accuracy: 0.9442
Epoch 9/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1897 -
accuracy: 0.9518 - val_loss: 0.2092 - val_accuracy: 0.9512
Epoch 10/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1816 -
accuracy: 0.9533 - val_loss: 0.2152 - val_accuracy: 0.9512
Epoch 11/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1766 -
accuracy: 0.9555 - val_loss: 0.2163 - val_accuracy: 0.9493
Epoch 12/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1806 -
accuracy: 0.9537 - val_loss: 0.2299 - val_accuracy: 0.9451
Epoch 13/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1786 -
accuracy: 0.9553 - val_loss: 0.2047 - val_accuracy: 0.9524
Epoch 14/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1739 -
accuracy: 0.9566 - val_loss: 0.1951 - val_accuracy: 0.9523
Epoch 15/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1827 -
accuracy: 0.9545 - val_loss: 0.2010 - val_accuracy: 0.9546
Epoch 16/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1654 -
```

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accuracy: 0.9597 - val_loss: 0.2097 - val_accuracy: 0.9559
Epoch 17/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1496 -
accuracy: 0.9622 - val_loss: 0.2064 - val_accuracy: 0.9524
Epoch 18/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1473 -
accuracy: 0.9631 - val_loss: 0.1864 - val_accuracy: 0.9574
Epoch 19/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1363 -
accuracy: 0.9659 - val_loss: 0.2055 - val_accuracy: 0.9512
Epoch 20/20
425/425 [==============================] - 1s 3ms/step - loss: 0.1664 -
accuracy: 0.9570 - val_loss: 0.2157 - val_accuracy: 0.9514

Accuracy: 95.14%

Iteration:  41
Epoch 1/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3298 -
accuracy: 0.1060 - val_loss: 2.3088 - val_accuracy: 0.1063
Epoch 2/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3132 -
accuracy: 0.1010 - val_loss: 2.3177 - val_accuracy: 0.1063
Epoch 3/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3127 -
accuracy: 0.1056 - val_loss: 2.3137 - val_accuracy: 0.1063
Epoch 4/20
1700/1700 [==============================] - 4s 2ms/step - loss: 2.3137 -
accuracy: 0.1035 - val_loss: 2.3118 - val_accuracy: 0.0993
Epoch 5/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3136 -
accuracy: 0.1039 - val_loss: 2.3139 - val_accuracy: 0.1028
Epoch 6/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3137 -
accuracy: 0.1042 - val_loss: 2.3103 - val_accuracy: 0.1063
Epoch 7/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3137 -
accuracy: 0.1004 - val_loss: 2.3160 - val_accuracy: 0.0959
Epoch 8/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3129 -
accuracy: 0.1065 - val_loss: 2.3286 - val_accuracy: 0.1063
Epoch 9/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3130 -
accuracy: 0.1036 - val_loss: 2.3074 - val_accuracy: 0.1028
Epoch 10/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3139 -
accuracy: 0.1038 - val_loss: 2.3174 - val_accuracy: 0.1063
Epoch 11/20
```

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1700/1700 [==============================] - 4s 3ms/step - loss: 2.3138 -
accuracy: 0.1036 - val_loss: 2.3119 - val_accuracy: 0.1002
Epoch 12/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3137 -
accuracy: 0.1037 - val_loss: 2.3170 - val_accuracy: 0.1063
Epoch 13/20
1700/1700 [==============================] - 4s 2ms/step - loss: 2.3132 -
accuracy: 0.1027 - val_loss: 2.3175 - val_accuracy: 0.0959
Epoch 14/20
1700/1700 [==============================] - 4s 2ms/step - loss: 2.3139 -
accuracy: 0.1027 - val_loss: 2.3133 - val_accuracy: 0.0993
Epoch 15/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3130 -
accuracy: 0.1050 - val_loss: 2.3086 - val_accuracy: 0.1028
Epoch 16/20
1700/1700 [==============================] - 4s 2ms/step - loss: 2.3130 -
accuracy: 0.1046 - val_loss: 2.3088 - val_accuracy: 0.1093
Epoch 17/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3135 -
accuracy: 0.1020 - val_loss: 2.3154 - val_accuracy: 0.0990
Epoch 18/20
1700/1700 [==============================] - 4s 2ms/step - loss: 2.3142 -
accuracy: 0.1032 - val_loss: 2.3170 - val_accuracy: 0.0990
Epoch 19/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3132 -
accuracy: 0.1029 - val_loss: 2.3156 - val_accuracy: 0.0993
Epoch 20/20
1700/1700 [==============================] - 4s 3ms/step - loss: 2.3130 -
accuracy: 0.1024 - val_loss: 2.3069 - val_accuracy: 0.0993

Accuracy: 9.93%

Iteration:  42
Epoch 1/20
622/622 [==============================] - 2s 3ms/step - loss: 0.8174 -
accuracy: 0.7239 - val_loss: 0.2633 - val_accuracy: 0.9372
Epoch 2/20
622/622 [==============================] - 2s 3ms/step - loss: 0.2565 -
accuracy: 0.9375 - val_loss: 0.2227 - val_accuracy: 0.9450
Epoch 3/20
622/622 [==============================] - 2s 3ms/step - loss: 0.1914 -
accuracy: 0.9515 - val_loss: 0.1597 - val_accuracy: 0.9602
Epoch 4/20
622/622 [==============================] - 2s 3ms/step - loss: 0.1535 -
accuracy: 0.9608 - val_loss: 0.1499 - val_accuracy: 0.9616
Epoch 5/20
622/622 [==============================] - 2s 3ms/step - loss: 0.1297 -
accuracy: 0.9655 - val_loss: 0.1310 - val_accuracy: 0.9658
```

```
Epoch 6/20
622/622 [==============================] - 2s 3ms/step - loss: 0.1096 -
accuracy: 0.9704 - val_loss: 0.1361 - val_accuracy: 0.9656
Epoch 7/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0969 -
accuracy: 0.9738 - val_loss: 0.1212 - val_accuracy: 0.9710
Epoch 8/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0880 -
accuracy: 0.9763 - val_loss: 0.1270 - val_accuracy: 0.9681
Epoch 9/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0848 -
accuracy: 0.9754 - val_loss: 0.1355 - val_accuracy: 0.9660
Epoch 10/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0820 -
accuracy: 0.9777 - val_loss: 0.1235 - val_accuracy: 0.9690
Epoch 11/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0751 -
accuracy: 0.9790 - val_loss: 0.1231 - val_accuracy: 0.9693
Epoch 12/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0686 -
accuracy: 0.9804 - val_loss: 0.1307 - val_accuracy: 0.9699
Epoch 13/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0680 -
accuracy: 0.9806 - val_loss: 0.1369 - val_accuracy: 0.9676
Epoch 14/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0667 -
accuracy: 0.9811 - val_loss: 0.1236 - val_accuracy: 0.9684
Epoch 15/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0622 -
accuracy: 0.9821 - val_loss: 0.1308 - val_accuracy: 0.9710
Epoch 16/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0625 -
accuracy: 0.9815 - val_loss: 0.1125 - val_accuracy: 0.9713
Epoch 17/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0553 -
accuracy: 0.9843 - val_loss: 0.1154 - val_accuracy: 0.9720
Epoch 18/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0598 -
accuracy: 0.9823 - val_loss: 0.1417 - val_accuracy: 0.9653
Epoch 19/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0539 -
accuracy: 0.9848 - val_loss: 0.1187 - val_accuracy: 0.9704
Epoch 20/20
622/622 [==============================] - 2s 3ms/step - loss: 0.0539 -
accuracy: 0.9841 - val_loss: 0.1395 - val_accuracy: 0.9681

Accuracy: 96.81%
```

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Iteration:  43
Epoch 1/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3634 -
accuracy: 0.1007 - val_loss: 2.3586 - val_accuracy: 0.1002
Epoch 2/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3636 -
accuracy: 0.1001 - val_loss: 2.4557 - val_accuracy: 0.0959
Epoch 3/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3622 -
accuracy: 0.1032 - val_loss: 2.3550 - val_accuracy: 0.0959
Epoch 4/20
12750/12750 [==============================] - 30s 2ms/step - loss: 2.3641 -
accuracy: 0.1014 - val_loss: 2.3320 - val_accuracy: 0.1063
Epoch 5/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3623 -
accuracy: 0.1031 - val_loss: 2.3317 - val_accuracy: 0.0997
Epoch 6/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3624 -
accuracy: 0.1034 - val_loss: 2.3301 - val_accuracy: 0.1063
Epoch 7/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3642 -
accuracy: 0.1010 - val_loss: 2.3305 - val_accuracy: 0.1093
Epoch 8/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3642 -
accuracy: 0.0993 - val_loss: 2.3825 - val_accuracy: 0.0916
Epoch 9/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3635 -
accuracy: 0.1031 - val_loss: 2.3491 - val_accuracy: 0.1063
Epoch 10/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3622 -
accuracy: 0.0988 - val_loss: 2.3907 - val_accuracy: 0.1063
Epoch 11/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3630 -
accuracy: 0.1018 - val_loss: 2.3580 - val_accuracy: 0.1002
Epoch 12/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3644 -
accuracy: 0.1021 - val_loss: 2.3539 - val_accuracy: 0.1028
Epoch 13/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3639 -
accuracy: 0.0998 - val_loss: 2.3445 - val_accuracy: 0.0990
Epoch 14/20
12750/12750 [==============================] - 30s 2ms/step - loss: 2.3640 -
accuracy: 0.0990 - val_loss: 2.3877 - val_accuracy: 0.0959
Epoch 15/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3632 -
accuracy: 0.1002 - val_loss: 2.3308 - val_accuracy: 0.0959
Epoch 16/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3642 -
```

```
accuracy: 0.1022 - val_loss: 2.3893 - val_accuracy: 0.0916
Epoch 17/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3644 -
accuracy: 0.1016 - val_loss: 2.3616 - val_accuracy: 0.0993
Epoch 18/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3616 -
accuracy: 0.1023 - val_loss: 2.3885 - val_accuracy: 0.1028
Epoch 19/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3636 -
accuracy: 0.1001 - val_loss: 2.3609 - val_accuracy: 0.0990
Epoch 20/20
12750/12750 [==============================] - 29s 2ms/step - loss: 2.3636 -
accuracy: 0.1003 - val_loss: 2.3371 - val_accuracy: 0.1063

Accuracy: 10.63%

Iteration:  44
Epoch 1/20
561/561 [==============================] - 2s 3ms/step - loss: 0.5969 -
accuracy: 0.7943 - val_loss: 0.2186 - val_accuracy: 0.9400
Epoch 2/20
561/561 [==============================] - 2s 3ms/step - loss: 0.1680 -
accuracy: 0.9536 - val_loss: 0.1465 - val_accuracy: 0.9603
Epoch 3/20
561/561 [==============================] - 2s 3ms/step - loss: 0.1297 -
accuracy: 0.9638 - val_loss: 0.1619 - val_accuracy: 0.9601
Epoch 4/20
561/561 [==============================] - 2s 3ms/step - loss: 0.1128 -
accuracy: 0.9673 - val_loss: 0.1643 - val_accuracy: 0.9552
Epoch 5/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0978 -
accuracy: 0.9721 - val_loss: 0.1472 - val_accuracy: 0.9671
Epoch 6/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0895 -
accuracy: 0.9749 - val_loss: 0.1275 - val_accuracy: 0.9694
Epoch 7/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0806 -
accuracy: 0.9765 - val_loss: 0.1400 - val_accuracy: 0.9674
Epoch 8/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0714 -
accuracy: 0.9795 - val_loss: 0.1551 - val_accuracy: 0.9646
Epoch 9/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0694 -
accuracy: 0.9802 - val_loss: 0.1562 - val_accuracy: 0.9683
Epoch 10/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0658 -
accuracy: 0.9807 - val_loss: 0.1548 - val_accuracy: 0.9700
Epoch 11/20
```

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561/561 [==============================] - 2s 3ms/step - loss: 0.0629 -
accuracy: 0.9820 - val_loss: 0.1478 - val_accuracy: 0.9688
Epoch 12/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0642 -
accuracy: 0.9823 - val_loss: 0.1742 - val_accuracy: 0.9642
Epoch 13/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0546 -
accuracy: 0.9847 - val_loss: 0.1676 - val_accuracy: 0.9719
Epoch 14/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0518 -
accuracy: 0.9850 - val_loss: 0.2024 - val_accuracy: 0.9688
Epoch 15/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0562 -
accuracy: 0.9842 - val_loss: 0.1524 - val_accuracy: 0.9738
Epoch 16/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0467 -
accuracy: 0.9871 - val_loss: 0.1697 - val_accuracy: 0.9683
Epoch 17/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0460 -
accuracy: 0.9869 - val_loss: 0.1981 - val_accuracy: 0.9668
Epoch 18/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0516 -
accuracy: 0.9856 - val_loss: 0.1859 - val_accuracy: 0.9680
Epoch 19/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0426 -
accuracy: 0.9886 - val_loss: 0.2065 - val_accuracy: 0.9664
Epoch 20/20
561/561 [==============================] - 2s 3ms/step - loss: 0.0408 -
accuracy: 0.9884 - val_loss: 0.2271 - val_accuracy: 0.9653

Accuracy: 96.53%

Iteration:  45
Epoch 1/20
412/412 [==============================] - 2s 4ms/step - loss: 2.3099 -
accuracy: 0.1045 - val_loss: 2.3143 - val_accuracy: 0.1093
Epoch 2/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3082 -
accuracy: 0.1039 - val_loss: 2.3080 - val_accuracy: 0.1063
Epoch 3/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3073 -
accuracy: 0.1048 - val_loss: 2.3107 - val_accuracy: 0.1063
Epoch 4/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3083 -
accuracy: 0.1066 - val_loss: 2.3079 - val_accuracy: 0.0990
Epoch 5/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3080 -
accuracy: 0.1051 - val_loss: 2.3117 - val_accuracy: 0.0959
```

```
Epoch 6/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3086 -
accuracy: 0.1039 - val_loss: 2.3065 - val_accuracy: 0.1028
Epoch 7/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3084 -
accuracy: 0.1044 - val_loss: 2.3088 - val_accuracy: 0.1093
Epoch 8/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3077 -
accuracy: 0.1037 - val_loss: 2.3059 - val_accuracy: 0.0959
Epoch 9/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3077 -
accuracy: 0.1062 - val_loss: 2.3107 - val_accuracy: 0.1063
Epoch 10/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3081 -
accuracy: 0.1053 - val_loss: 2.3059 - val_accuracy: 0.1093
Epoch 11/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3080 -
accuracy: 0.1046 - val_loss: 2.3102 - val_accuracy: 0.1028
Epoch 12/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3076 -
accuracy: 0.1042 - val_loss: 2.3147 - val_accuracy: 0.0959
Epoch 13/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3079 -
accuracy: 0.1041 - val_loss: 2.3045 - val_accuracy: 0.1063
Epoch 14/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3082 -
accuracy: 0.1043 - val_loss: 2.3102 - val_accuracy: 0.1063
Epoch 15/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3084 -
accuracy: 0.1024 - val_loss: 2.3062 - val_accuracy: 0.0997
Epoch 16/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3082 -
accuracy: 0.1056 - val_loss: 2.3048 - val_accuracy: 0.0997
Epoch 17/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3069 -
accuracy: 0.1059 - val_loss: 2.3081 - val_accuracy: 0.1063
Epoch 18/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3086 -
accuracy: 0.1051 - val_loss: 2.3134 - val_accuracy: 0.0959
Epoch 19/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3087 -
accuracy: 0.1047 - val_loss: 2.3066 - val_accuracy: 0.1028
Epoch 20/20
412/412 [==============================] - 1s 3ms/step - loss: 2.3081 -
accuracy: 0.1030 - val_loss: 2.3061 - val_accuracy: 0.1093

Accuracy: 10.93%
```

```
Iteration:  46
Epoch 1/20
638/638 [==============================] - 2s 3ms/step - loss: 0.3710 -
accuracy: 0.8974 - val_loss: 0.1552 - val_accuracy: 0.9547
Epoch 2/20
638/638 [==============================] - 2s 3ms/step - loss: 0.1410 -
accuracy: 0.9590 - val_loss: 0.1271 - val_accuracy: 0.9611
Epoch 3/20
638/638 [==============================] - 2s 3ms/step - loss: 0.1110 -
accuracy: 0.9672 - val_loss: 0.1237 - val_accuracy: 0.9659
Epoch 4/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0959 -
accuracy: 0.9715 - val_loss: 0.1353 - val_accuracy: 0.9628
Epoch 5/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0844 -
accuracy: 0.9758 - val_loss: 0.1015 - val_accuracy: 0.9722
Epoch 6/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0741 -
accuracy: 0.9778 - val_loss: 0.1036 - val_accuracy: 0.9724
Epoch 7/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0688 -
accuracy: 0.9791 - val_loss: 0.1213 - val_accuracy: 0.9674
Epoch 8/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0663 -
accuracy: 0.9802 - val_loss: 0.1058 - val_accuracy: 0.9724
Epoch 9/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0627 -
accuracy: 0.9810 - val_loss: 0.1150 - val_accuracy: 0.9709
Epoch 10/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0610 -
accuracy: 0.9809 - val_loss: 0.1070 - val_accuracy: 0.9710
Epoch 11/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0541 -
accuracy: 0.9830 - val_loss: 0.1090 - val_accuracy: 0.9691
Epoch 12/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0514 -
accuracy: 0.9836 - val_loss: 0.1082 - val_accuracy: 0.9699
Epoch 13/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0494 -
accuracy: 0.9845 - val_loss: 0.1152 - val_accuracy: 0.9737
Epoch 14/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0490 -
accuracy: 0.9847 - val_loss: 0.1030 - val_accuracy: 0.9743
Epoch 15/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0464 -
accuracy: 0.9857 - val_loss: 0.1185 - val_accuracy: 0.9703
Epoch 16/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0457 -
```

```
accuracy: 0.9855 - val_loss: 0.1143 - val_accuracy: 0.9750
Epoch 17/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0399 -
accuracy: 0.9874 - val_loss: 0.1181 - val_accuracy: 0.9717
Epoch 18/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0422 -
accuracy: 0.9871 - val_loss: 0.1164 - val_accuracy: 0.9707
Epoch 19/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0471 -
accuracy: 0.9847 - val_loss: 0.1059 - val_accuracy: 0.9727
Epoch 20/20
638/638 [==============================] - 2s 3ms/step - loss: 0.0393 -
accuracy: 0.9881 - val_loss: 0.1015 - val_accuracy: 0.9750

Accuracy: 97.50%

Iteration:  47
Epoch 1/20
981/981 [==============================] - 3s 3ms/step - loss: 1.1331 -
accuracy: 0.6086 - val_loss: 0.7189 - val_accuracy: 0.7407
Epoch 2/20
981/981 [==============================] - 3s 3ms/step - loss: 0.5898 -
accuracy: 0.7721 - val_loss: 0.5180 - val_accuracy: 0.7813
Epoch 3/20
981/981 [==============================] - 3s 3ms/step - loss: 0.4716 -
accuracy: 0.8027 - val_loss: 0.4216 - val_accuracy: 0.8574
Epoch 4/20
981/981 [==============================] - 3s 3ms/step - loss: 0.3624 -
accuracy: 0.8670 - val_loss: 0.3411 - val_accuracy: 0.8779
Epoch 5/20
981/981 [==============================] - 3s 3ms/step - loss: 0.3037 -
accuracy: 0.8823 - val_loss: 0.3098 - val_accuracy: 0.8730
Epoch 6/20
981/981 [==============================] - 3s 3ms/step - loss: 0.2680 -
accuracy: 0.8889 - val_loss: 0.3226 - val_accuracy: 0.8782
Epoch 7/20
981/981 [==============================] - 3s 3ms/step - loss: 0.2475 -
accuracy: 0.8937 - val_loss: 0.2834 - val_accuracy: 0.8887
Epoch 8/20
981/981 [==============================] - 3s 3ms/step - loss: 0.2311 -
accuracy: 0.9005 - val_loss: 0.2855 - val_accuracy: 0.9041
Epoch 9/20
981/981 [==============================] - 3s 3ms/step - loss: 0.2169 -
accuracy: 0.9132 - val_loss: 0.2707 - val_accuracy: 0.9158
Epoch 10/20
981/981 [==============================] - 3s 3ms/step - loss: 0.1956 -
accuracy: 0.9409 - val_loss: 0.2410 - val_accuracy: 0.9471
Epoch 11/20
```

```
981/981 [==============================] - 3s 3ms/step - loss: 0.1563 -
accuracy: 0.9664 - val_loss: 0.2045 - val_accuracy: 0.9584
Epoch 12/20
981/981 [==============================] - 3s 3ms/step - loss: 0.1155 -
accuracy: 0.9759 - val_loss: 0.1904 - val_accuracy: 0.9610
Epoch 13/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0909 -
accuracy: 0.9808 - val_loss: 0.1810 - val_accuracy: 0.9638
Epoch 14/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0824 -
accuracy: 0.9813 - val_loss: 0.1928 - val_accuracy: 0.9596
Epoch 15/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0742 -
accuracy: 0.9821 - val_loss: 0.1741 - val_accuracy: 0.9648
Epoch 16/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0611 -
accuracy: 0.9861 - val_loss: 0.1680 - val_accuracy: 0.9649
Epoch 17/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0600 -
accuracy: 0.9855 - val_loss: 0.1794 - val_accuracy: 0.9653
Epoch 18/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0547 -
accuracy: 0.9873 - val_loss: 0.1728 - val_accuracy: 0.9688
Epoch 19/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0546 -
accuracy: 0.9862 - val_loss: 0.1829 - val_accuracy: 0.9628
Epoch 20/20
981/981 [==============================] - 3s 3ms/step - loss: 0.0491 -
accuracy: 0.9880 - val_loss: 0.1777 - val_accuracy: 0.9686

Accuracy: 96.86%

Iteration:  48
Epoch 1/20
663/663 [==============================] - 2s 3ms/step - loss: 0.5377 -
accuracy: 0.8358 - val_loss: 0.3604 - val_accuracy: 0.8927
Epoch 2/20
663/663 [==============================] - 2s 3ms/step - loss: 0.3674 -
accuracy: 0.8916 - val_loss: 0.2860 - val_accuracy: 0.9177
Epoch 3/20
663/663 [==============================] - 2s 3ms/step - loss: 0.3263 -
accuracy: 0.9059 - val_loss: 0.2869 - val_accuracy: 0.9149
Epoch 4/20
663/663 [==============================] - 2s 3ms/step - loss: 0.3016 -
accuracy: 0.9125 - val_loss: 0.2879 - val_accuracy: 0.9214
Epoch 5/20
663/663 [==============================] - 2s 3ms/step - loss: 0.3045 -
accuracy: 0.9128 - val_loss: 0.2903 - val_accuracy: 0.9226
```

```
Epoch 6/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2870 -
accuracy: 0.9185 - val_loss: 0.2711 - val_accuracy: 0.9218
Epoch 7/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2787 -
accuracy: 0.9219 - val_loss: 0.2487 - val_accuracy: 0.9304
Epoch 8/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2762 -
accuracy: 0.9216 - val_loss: 0.2913 - val_accuracy: 0.9203
Epoch 9/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2668 -
accuracy: 0.9245 - val_loss: 0.2582 - val_accuracy: 0.9260
Epoch 10/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2690 -
accuracy: 0.9244 - val_loss: 0.2436 - val_accuracy: 0.9342
Epoch 11/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2691 -
accuracy: 0.9245 - val_loss: 0.2413 - val_accuracy: 0.9328
Epoch 12/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2649 -
accuracy: 0.9269 - val_loss: 0.2508 - val_accuracy: 0.9332
Epoch 13/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2634 -
accuracy: 0.9260 - val_loss: 0.2427 - val_accuracy: 0.9353
Epoch 14/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2514 -
accuracy: 0.9299 - val_loss: 0.2259 - val_accuracy: 0.9383
Epoch 15/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2467 -
accuracy: 0.9306 - val_loss: 0.2409 - val_accuracy: 0.9317
Epoch 16/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2574 -
accuracy: 0.9274 - val_loss: 0.2673 - val_accuracy: 0.9223
Epoch 17/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2506 -
accuracy: 0.9290 - val_loss: 0.2413 - val_accuracy: 0.9337
Epoch 18/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2509 -
accuracy: 0.9288 - val_loss: 0.2548 - val_accuracy: 0.9300
Epoch 19/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2367 -
accuracy: 0.9332 - val_loss: 0.2323 - val_accuracy: 0.9397
Epoch 20/20
663/663 [==============================] - 2s 3ms/step - loss: 0.2385 -
accuracy: 0.9328 - val_loss: 0.2347 - val_accuracy: 0.9360

Accuracy: 93.60%
```

```
Iteration:  49
Epoch 1/20
850/850 [==============================] - 3s 3ms/step - loss: 2.3039 -
accuracy: 0.1093 - val_loss: 2.3051 - val_accuracy: 0.1063
Epoch 2/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3026 -
accuracy: 0.1082 - val_loss: 2.3026 - val_accuracy: 0.0997
Epoch 3/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3027 -
accuracy: 0.1109 - val_loss: 2.3023 - val_accuracy: 0.1063
Epoch 4/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3027 -
accuracy: 0.1092 - val_loss: 2.3046 - val_accuracy: 0.1063
Epoch 5/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3029 -
accuracy: 0.1110 - val_loss: 2.3030 - val_accuracy: 0.1063
Epoch 6/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3027 -
accuracy: 0.1093 - val_loss: 2.3027 - val_accuracy: 0.1063
Epoch 7/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3026 -
accuracy: 0.1107 - val_loss: 2.3044 - val_accuracy: 0.0959
Epoch 8/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3027 -
accuracy: 0.1088 - val_loss: 2.3023 - val_accuracy: 0.0997
Epoch 9/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3025 -
accuracy: 0.1104 - val_loss: 2.3035 - val_accuracy: 0.1063
Epoch 10/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3026 -
accuracy: 0.1095 - val_loss: 2.3036 - val_accuracy: 0.1063
Epoch 11/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3029 -
accuracy: 0.1090 - val_loss: 2.3033 - val_accuracy: 0.1063
Epoch 12/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3024 -
accuracy: 0.1111 - val_loss: 2.3048 - val_accuracy: 0.1063
Epoch 13/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3028 -
accuracy: 0.1086 - val_loss: 2.3050 - val_accuracy: 0.1063
Epoch 14/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3026 -
accuracy: 0.1098 - val_loss: 2.3037 - val_accuracy: 0.1063
Epoch 15/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3027 -
accuracy: 0.1112 - val_loss: 2.3038 - val_accuracy: 0.1028
Epoch 16/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3026 -
```

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accuracy: 0.1103 - val_loss: 2.3038 - val_accuracy: 0.1063
Epoch 17/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3026 -
accuracy: 0.1114 - val_loss: 2.3028 - val_accuracy: 0.1063
Epoch 18/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3026 -
accuracy: 0.1106 - val_loss: 2.3021 - val_accuracy: 0.1063
Epoch 19/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3027 -
accuracy: 0.1104 - val_loss: 2.3023 - val_accuracy: 0.1063
Epoch 20/20
850/850 [==============================] - 2s 3ms/step - loss: 2.3027 -
accuracy: 0.1091 - val_loss: 2.3025 - val_accuracy: 0.1093

Accuracy: 10.93%

Iteration:  50
Epoch 1/20
500/500 [==============================] - 2s 3ms/step - loss: 0.3467 -
accuracy: 0.8961 - val_loss: 0.1568 - val_accuracy: 0.9572
Epoch 2/20
500/500 [==============================] - 1s 3ms/step - loss: 0.1671 -
accuracy: 0.9547 - val_loss: 0.1440 - val_accuracy: 0.9641
Epoch 3/20
500/500 [==============================] - 1s 3ms/step - loss: 0.1354 -
accuracy: 0.9650 - val_loss: 0.1268 - val_accuracy: 0.9672
Epoch 4/20
500/500 [==============================] - 1s 3ms/step - loss: 0.1155 -
accuracy: 0.9700 - val_loss: 0.1389 - val_accuracy: 0.9666
Epoch 5/20
500/500 [==============================] - 1s 3ms/step - loss: 0.1040 -
accuracy: 0.9735 - val_loss: 0.1421 - val_accuracy: 0.9694
Epoch 6/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0952 -
accuracy: 0.9759 - val_loss: 0.1339 - val_accuracy: 0.9714
Epoch 7/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0846 -
accuracy: 0.9786 - val_loss: 0.1269 - val_accuracy: 0.9729
Epoch 8/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0800 -
accuracy: 0.9801 - val_loss: 0.1377 - val_accuracy: 0.9682
Epoch 9/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0804 -
accuracy: 0.9815 - val_loss: 0.1259 - val_accuracy: 0.9717
Epoch 10/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0938 -
accuracy: 0.9781 - val_loss: 0.1340 - val_accuracy: 0.9717
Epoch 11/20
```

```
500/500 [==============================] - 1s 3ms/step - loss: 0.0852 -
accuracy: 0.9804 - val_loss: 0.1257 - val_accuracy: 0.9728
Epoch 12/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0718 -
accuracy: 0.9827 - val_loss: 0.1398 - val_accuracy: 0.9718
Epoch 13/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0725 -
accuracy: 0.9836 - val_loss: 0.1484 - val_accuracy: 0.9693
Epoch 14/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0813 -
accuracy: 0.9809 - val_loss: 0.1343 - val_accuracy: 0.9682
Epoch 15/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0950 -
accuracy: 0.9771 - val_loss: 0.1500 - val_accuracy: 0.9687
Epoch 16/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0920 -
accuracy: 0.9775 - val_loss: 0.1528 - val_accuracy: 0.9716
Epoch 17/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0693 -
accuracy: 0.9834 - val_loss: 0.1503 - val_accuracy: 0.9681
Epoch 18/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0731 -
accuracy: 0.9828 - val_loss: 0.1380 - val_accuracy: 0.9676
Epoch 19/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0805 -
accuracy: 0.9813 - val_loss: 0.1500 - val_accuracy: 0.9724
Epoch 20/20
500/500 [==============================] - 1s 3ms/step - loss: 0.0724 -
accuracy: 0.9835 - val_loss: 0.1613 - val_accuracy: 0.9623

Accuracy: 96.23%

Iteration:  51
Epoch 1/20
740/740 [==============================] - 2s 3ms/step - loss: 2.4951 -
accuracy: 0.1126 - val_loss: 2.3063 - val_accuracy: 0.0997
Epoch 2/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3076 -
accuracy: 0.1046 - val_loss: 2.3157 - val_accuracy: 0.0959
Epoch 3/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3085 -
accuracy: 0.1043 - val_loss: 2.3138 - val_accuracy: 0.1063
Epoch 4/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3086 -
accuracy: 0.1053 - val_loss: 2.3046 - val_accuracy: 0.1063
Epoch 5/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3088 -
accuracy: 0.1050 - val_loss: 2.3057 - val_accuracy: 0.0997
```

```
Epoch 6/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3085 -
accuracy: 0.1045 - val_loss: 2.3068 - val_accuracy: 0.1063
Epoch 7/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3079 -
accuracy: 0.1037 - val_loss: 2.3094 - val_accuracy: 0.1002
Epoch 8/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3079 -
accuracy: 0.1050 - val_loss: 2.3048 - val_accuracy: 0.1093
Epoch 9/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3084 -
accuracy: 0.1039 - val_loss: 2.3083 - val_accuracy: 0.1063
Epoch 10/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3093 -
accuracy: 0.1036 - val_loss: 2.3060 - val_accuracy: 0.1093
Epoch 11/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3076 -
accuracy: 0.1059 - val_loss: 2.3134 - val_accuracy: 0.0959
Epoch 12/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3082 -
accuracy: 0.1061 - val_loss: 2.3068 - val_accuracy: 0.1063
Epoch 13/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3087 -
accuracy: 0.1054 - val_loss: 2.3088 - val_accuracy: 0.0959
Epoch 14/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3082 -
accuracy: 0.1048 - val_loss: 2.3109 - val_accuracy: 0.0997
Epoch 15/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3089 -
accuracy: 0.1056 - val_loss: 2.3078 - val_accuracy: 0.0993
Epoch 16/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3079 -
accuracy: 0.1039 - val_loss: 2.3093 - val_accuracy: 0.0993
Epoch 17/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3083 -
accuracy: 0.1024 - val_loss: 2.3132 - val_accuracy: 0.0959
Epoch 18/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3090 -
accuracy: 0.1037 - val_loss: 2.3043 - val_accuracy: 0.1093
Epoch 19/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3091 -
accuracy: 0.1038 - val_loss: 2.3055 - val_accuracy: 0.1028
Epoch 20/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3081 -
accuracy: 0.1053 - val_loss: 2.3181 - val_accuracy: 0.1063

Accuracy: 10.63%
```

```
Iteration:  52
Epoch 1/20
750/750 [==============================] - 3s 3ms/step - loss: 0.8740 -
accuracy: 0.7182 - val_loss: 0.2791 - val_accuracy: 0.9379
Epoch 2/20
750/750 [==============================] - 2s 3ms/step - loss: 0.2564 -
accuracy: 0.9397 - val_loss: 0.2014 - val_accuracy: 0.9504
Epoch 3/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1712 -
accuracy: 0.9573 - val_loss: 0.1498 - val_accuracy: 0.9623
Epoch 4/20
750/750 [==============================] - 2s 3ms/step - loss: 0.1214 -
accuracy: 0.9685 - val_loss: 0.1399 - val_accuracy: 0.9658
Epoch 5/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0944 -
accuracy: 0.9752 - val_loss: 0.1238 - val_accuracy: 0.9682
Epoch 6/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0809 -
accuracy: 0.9780 - val_loss: 0.1180 - val_accuracy: 0.9707
Epoch 7/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0707 -
accuracy: 0.9802 - val_loss: 0.1226 - val_accuracy: 0.9691
Epoch 8/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0628 -
accuracy: 0.9830 - val_loss: 0.1284 - val_accuracy: 0.9692
Epoch 9/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0549 -
accuracy: 0.9846 - val_loss: 0.1200 - val_accuracy: 0.9713
Epoch 10/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0521 -
accuracy: 0.9850 - val_loss: 0.1174 - val_accuracy: 0.9712
Epoch 11/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0454 -
accuracy: 0.9873 - val_loss: 0.1296 - val_accuracy: 0.9696
Epoch 12/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0413 -
accuracy: 0.9886 - val_loss: 0.1211 - val_accuracy: 0.9711
Epoch 13/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0396 -
accuracy: 0.9890 - val_loss: 0.1225 - val_accuracy: 0.9720
Epoch 14/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0371 -
accuracy: 0.9897 - val_loss: 0.1274 - val_accuracy: 0.9708
Epoch 15/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0339 -
accuracy: 0.9900 - val_loss: 0.1310 - val_accuracy: 0.9706
Epoch 16/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0331 -
```

```
accuracy: 0.9902 - val_loss: 0.1148 - val_accuracy: 0.9734
Epoch 17/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0295 -
accuracy: 0.9915 - val_loss: 0.1248 - val_accuracy: 0.9716
Epoch 18/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0319 -
accuracy: 0.9907 - val_loss: 0.1261 - val_accuracy: 0.9719
Epoch 19/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0325 -
accuracy: 0.9906 - val_loss: 0.1354 - val_accuracy: 0.9708
Epoch 20/20
750/750 [==============================] - 2s 3ms/step - loss: 0.0266 -
accuracy: 0.9926 - val_loss: 0.1252 - val_accuracy: 0.9729

Accuracy: 97.29%

Iteration:  53
Epoch 1/20
750/750 [==============================] - 3s 3ms/step - loss: 2.3078 -
accuracy: 0.1034 - val_loss: 2.3045 - val_accuracy: 0.1063
Epoch 2/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3068 -
accuracy: 0.1047 - val_loss: 2.3062 - val_accuracy: 0.0959
Epoch 3/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3068 -
accuracy: 0.1035 - val_loss: 2.3093 - val_accuracy: 0.0990
Epoch 4/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3065 -
accuracy: 0.1041 - val_loss: 2.3084 - val_accuracy: 0.1028
Epoch 5/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3069 -
accuracy: 0.1039 - val_loss: 2.3105 - val_accuracy: 0.0959
Epoch 6/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3074 -
accuracy: 0.1038 - val_loss: 2.3089 - val_accuracy: 0.1002
Epoch 7/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3071 -
accuracy: 0.1031 - val_loss: 2.3089 - val_accuracy: 0.1028
Epoch 8/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3065 -
accuracy: 0.1045 - val_loss: 2.3101 - val_accuracy: 0.1028
Epoch 9/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3066 -
accuracy: 0.1061 - val_loss: 2.3054 - val_accuracy: 0.1063
Epoch 10/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3065 -
accuracy: 0.1063 - val_loss: 2.3049 - val_accuracy: 0.1093
Epoch 11/20
```

```
750/750 [==============================] - 2s 3ms/step - loss: 2.3061 -
accuracy: 0.1037 - val_loss: 2.3080 - val_accuracy: 0.0997
Epoch 12/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3064 -
accuracy: 0.1065 - val_loss: 2.3112 - val_accuracy: 0.1063
Epoch 13/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3066 -
accuracy: 0.1036 - val_loss: 2.3074 - val_accuracy: 0.1093
Epoch 14/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3074 -
accuracy: 0.1039 - val_loss: 2.3071 - val_accuracy: 0.1063
Epoch 15/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3064 -
accuracy: 0.1048 - val_loss: 2.3175 - val_accuracy: 0.1063
Epoch 16/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3063 -
accuracy: 0.1070 - val_loss: 2.3124 - val_accuracy: 0.0997
Epoch 17/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3059 -
accuracy: 0.1082 - val_loss: 2.3073 - val_accuracy: 0.1063
Epoch 18/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3060 -
accuracy: 0.1063 - val_loss: 2.3078 - val_accuracy: 0.1063
Epoch 19/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3067 -
accuracy: 0.1057 - val_loss: 2.3144 - val_accuracy: 0.1063
Epoch 20/20
750/750 [==============================] - 2s 3ms/step - loss: 2.3067 -
accuracy: 0.1057 - val_loss: 2.3039 - val_accuracy: 0.0993

Accuracy: 9.93%

Iteration:  54
Epoch 1/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.4304 -
accuracy: 0.8687 - val_loss: 0.2646 - val_accuracy: 0.9209
Epoch 2/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2813 -
accuracy: 0.9155 - val_loss: 0.2252 - val_accuracy: 0.9334
Epoch 3/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2586 -
accuracy: 0.9242 - val_loss: 0.2263 - val_accuracy: 0.9329
Epoch 4/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2464 -
accuracy: 0.9280 - val_loss: 0.2522 - val_accuracy: 0.9258
Epoch 5/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2328 -
accuracy: 0.9304 - val_loss: 0.2326 - val_accuracy: 0.9341
```

```
Epoch 6/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2277 -
accuracy: 0.9333 - val_loss: 0.2385 - val_accuracy: 0.9367
Epoch 7/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2277 -
accuracy: 0.9339 - val_loss: 0.2542 - val_accuracy: 0.9239
Epoch 8/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2185 -
accuracy: 0.9379 - val_loss: 0.2111 - val_accuracy: 0.9426
Epoch 9/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2145 -
accuracy: 0.9377 - val_loss: 0.2145 - val_accuracy: 0.9414
Epoch 10/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2120 -
accuracy: 0.9394 - val_loss: 0.2094 - val_accuracy: 0.9417
Epoch 11/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2087 -
accuracy: 0.9392 - val_loss: 0.2299 - val_accuracy: 0.9352
Epoch 12/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2052 -
accuracy: 0.9407 - val_loss: 0.2555 - val_accuracy: 0.9291
Epoch 13/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2024 -
accuracy: 0.9418 - val_loss: 0.2308 - val_accuracy: 0.9392
Epoch 14/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2047 -
accuracy: 0.9423 - val_loss: 0.2126 - val_accuracy: 0.9454
Epoch 15/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2009 -
accuracy: 0.9424 - val_loss: 0.2046 - val_accuracy: 0.9423
Epoch 16/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1966 -
accuracy: 0.9447 - val_loss: 0.2114 - val_accuracy: 0.9422
Epoch 17/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1968 -
accuracy: 0.9437 - val_loss: 0.2383 - val_accuracy: 0.9366
Epoch 18/20
1000/1000 [==============================] - 3s 2ms/step - loss: 0.1970 -
accuracy: 0.9443 - val_loss: 0.2395 - val_accuracy: 0.9393
Epoch 19/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1923 -
accuracy: 0.9456 - val_loss: 0.2216 - val_accuracy: 0.9414
Epoch 20/20
1000/1000 [==============================] - 3s 2ms/step - loss: 0.1962 -
accuracy: 0.9449 - val_loss: 0.2284 - val_accuracy: 0.9423

Accuracy: 94.23%
```

```
Iteration:  55
Epoch 1/20
1160/1160 [==============================] - 4s 3ms/step - loss: 0.7059 -
accuracy: 0.7508 - val_loss: 0.2801 - val_accuracy: 0.9216
Epoch 2/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.3183 -
accuracy: 0.9137 - val_loss: 0.2896 - val_accuracy: 0.9249
Epoch 3/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2871 -
accuracy: 0.9225 - val_loss: 0.2656 - val_accuracy: 0.9289
Epoch 4/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2738 -
accuracy: 0.9262 - val_loss: 0.2135 - val_accuracy: 0.9437
Epoch 5/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2441 -
accuracy: 0.9343 - val_loss: 0.2375 - val_accuracy: 0.9367
Epoch 6/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2374 -
accuracy: 0.9350 - val_loss: 0.2160 - val_accuracy: 0.9396
Epoch 7/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2301 -
accuracy: 0.9376 - val_loss: 0.2135 - val_accuracy: 0.9446
Epoch 8/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2318 -
accuracy: 0.9367 - val_loss: 0.2625 - val_accuracy: 0.9310
Epoch 9/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2163 -
accuracy: 0.9404 - val_loss: 0.2037 - val_accuracy: 0.9466
Epoch 10/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2181 -
accuracy: 0.9397 - val_loss: 0.1953 - val_accuracy: 0.9461
Epoch 11/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2179 -
accuracy: 0.9412 - val_loss: 0.2094 - val_accuracy: 0.9428
Epoch 12/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2137 -
accuracy: 0.9413 - val_loss: 0.1927 - val_accuracy: 0.9471
Epoch 13/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2168 -
accuracy: 0.9408 - val_loss: 0.2051 - val_accuracy: 0.9441
Epoch 14/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2150 -
accuracy: 0.9402 - val_loss: 0.2112 - val_accuracy: 0.9434
Epoch 15/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2059 -
accuracy: 0.9433 - val_loss: 0.1982 - val_accuracy: 0.9473
Epoch 16/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2020 -
```

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accuracy: 0.9439 - val_loss: 0.2094 - val_accuracy: 0.9443
Epoch 17/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2063 -
accuracy: 0.9432 - val_loss: 0.1979 - val_accuracy: 0.9451
Epoch 18/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2011 -
accuracy: 0.9458 - val_loss: 0.1789 - val_accuracy: 0.9534
Epoch 19/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.1983 -
accuracy: 0.9470 - val_loss: 0.1889 - val_accuracy: 0.9510
Epoch 20/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.1950 -
accuracy: 0.9475 - val_loss: 0.2065 - val_accuracy: 0.9444

Accuracy: 94.44%

Iteration:  56
Epoch 1/20
460/460 [==============================] - 2s 4ms/step - loss: 0.3969 -
accuracy: 0.8809 - val_loss: 0.2110 - val_accuracy: 0.9390
Epoch 2/20
460/460 [==============================] - 1s 3ms/step - loss: 0.1882 -
accuracy: 0.9470 - val_loss: 0.1435 - val_accuracy: 0.9617
Epoch 3/20
460/460 [==============================] - 1s 3ms/step - loss: 0.1527 -
accuracy: 0.9580 - val_loss: 0.1682 - val_accuracy: 0.9526
Epoch 4/20
460/460 [==============================] - 1s 3ms/step - loss: 0.1330 -
accuracy: 0.9650 - val_loss: 0.1335 - val_accuracy: 0.9654
Epoch 5/20
460/460 [==============================] - 1s 3ms/step - loss: 0.1209 -
accuracy: 0.9682 - val_loss: 0.1427 - val_accuracy: 0.9648
Epoch 6/20
460/460 [==============================] - 1s 3ms/step - loss: 0.1119 -
accuracy: 0.9695 - val_loss: 0.1559 - val_accuracy: 0.9628
Epoch 7/20
460/460 [==============================] - 1s 3ms/step - loss: 0.1220 -
accuracy: 0.9682 - val_loss: 0.1461 - val_accuracy: 0.9659
Epoch 8/20
460/460 [==============================] - 1s 3ms/step - loss: 0.1056 -
accuracy: 0.9735 - val_loss: 0.1254 - val_accuracy: 0.9694
Epoch 9/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0904 -
accuracy: 0.9760 - val_loss: 0.1574 - val_accuracy: 0.9657
Epoch 10/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0994 -
accuracy: 0.9749 - val_loss: 0.1512 - val_accuracy: 0.9679
Epoch 11/20
```

```
460/460 [==============================] - 1s 3ms/step - loss: 0.0927 -
accuracy: 0.9766 - val_loss: 0.1444 - val_accuracy: 0.9700
Epoch 12/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0902 -
accuracy: 0.9775 - val_loss: 0.1459 - val_accuracy: 0.9694
Epoch 13/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0893 -
accuracy: 0.9781 - val_loss: 0.1397 - val_accuracy: 0.9711
Epoch 14/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0789 -
accuracy: 0.9806 - val_loss: 0.1427 - val_accuracy: 0.9692
Epoch 15/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0901 -
accuracy: 0.9785 - val_loss: 0.1412 - val_accuracy: 0.9688
Epoch 16/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0773 -
accuracy: 0.9811 - val_loss: 0.1504 - val_accuracy: 0.9687
Epoch 17/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0940 -
accuracy: 0.9775 - val_loss: 0.1413 - val_accuracy: 0.9718
Epoch 18/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0737 -
accuracy: 0.9823 - val_loss: 0.1362 - val_accuracy: 0.9712
Epoch 19/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0710 -
accuracy: 0.9826 - val_loss: 0.1709 - val_accuracy: 0.9670
Epoch 20/20
460/460 [==============================] - 1s 3ms/step - loss: 0.0738 -
accuracy: 0.9828 - val_loss: 0.1546 - val_accuracy: 0.9701

Accuracy: 97.01%

Iteration:  57
Epoch 1/20
729/729 [==============================] - 2s 3ms/step - loss: 0.3057 -
accuracy: 0.9197 - val_loss: 0.1167 - val_accuracy: 0.9676
Epoch 2/20
729/729 [==============================] - 2s 3ms/step - loss: 0.1074 -
accuracy: 0.9680 - val_loss: 0.1055 - val_accuracy: 0.9703
Epoch 3/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0756 -
accuracy: 0.9766 - val_loss: 0.0933 - val_accuracy: 0.9728
Epoch 4/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0554 -
accuracy: 0.9836 - val_loss: 0.0906 - val_accuracy: 0.9728
Epoch 5/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0486 -
accuracy: 0.9847 - val_loss: 0.0977 - val_accuracy: 0.9730
```

```
Epoch 6/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0380 -
accuracy: 0.9886 - val_loss: 0.0882 - val_accuracy: 0.9759
Epoch 7/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0401 -
accuracy: 0.9870 - val_loss: 0.0962 - val_accuracy: 0.9729
Epoch 8/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0325 -
accuracy: 0.9895 - val_loss: 0.0942 - val_accuracy: 0.9750
Epoch 9/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0328 -
accuracy: 0.9893 - val_loss: 0.0892 - val_accuracy: 0.9777
Epoch 10/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0315 -
accuracy: 0.9902 - val_loss: 0.0973 - val_accuracy: 0.9739
Epoch 11/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0279 -
accuracy: 0.9908 - val_loss: 0.1052 - val_accuracy: 0.9738
Epoch 12/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0257 -
accuracy: 0.9918 - val_loss: 0.1085 - val_accuracy: 0.9734
Epoch 13/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0256 -
accuracy: 0.9916 - val_loss: 0.1057 - val_accuracy: 0.9737
Epoch 14/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0254 -
accuracy: 0.9914 - val_loss: 0.1034 - val_accuracy: 0.9750
Epoch 15/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0261 -
accuracy: 0.9913 - val_loss: 0.0964 - val_accuracy: 0.9767
Epoch 16/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0278 -
accuracy: 0.9907 - val_loss: 0.1097 - val_accuracy: 0.9750
Epoch 17/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0249 -
accuracy: 0.9918 - val_loss: 0.0970 - val_accuracy: 0.9769
Epoch 18/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0212 -
accuracy: 0.9930 - val_loss: 0.1002 - val_accuracy: 0.9761
Epoch 19/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0203 -
accuracy: 0.9933 - val_loss: 0.1196 - val_accuracy: 0.9737
Epoch 20/20
729/729 [==============================] - 2s 3ms/step - loss: 0.0214 -
accuracy: 0.9932 - val_loss: 0.1014 - val_accuracy: 0.9759

Accuracy: 97.59%
```

```
Iteration:  58
Epoch 1/20
928/928 [==============================] - 3s 3ms/step - loss: 2.7588 -
accuracy: 0.1028 - val_loss: 2.3114 - val_accuracy: 0.1093
Epoch 2/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3153 -
accuracy: 0.1053 - val_loss: 2.3148 - val_accuracy: 0.1002
Epoch 3/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3148 -
accuracy: 0.1028 - val_loss: 2.3225 - val_accuracy: 0.0916
Epoch 4/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3156 -
accuracy: 0.1008 - val_loss: 2.3166 - val_accuracy: 0.0997
Epoch 5/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3149 -
accuracy: 0.1014 - val_loss: 2.3280 - val_accuracy: 0.0990
Epoch 6/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3157 -
accuracy: 0.1004 - val_loss: 2.3156 - val_accuracy: 0.1063
Epoch 7/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3153 -
accuracy: 0.1010 - val_loss: 2.3184 - val_accuracy: 0.0997
Epoch 8/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3149 -
accuracy: 0.1017 - val_loss: 2.3135 - val_accuracy: 0.1063
Epoch 9/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3157 -
accuracy: 0.1025 - val_loss: 2.3293 - val_accuracy: 0.0916
Epoch 10/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3143 -
accuracy: 0.1024 - val_loss: 2.3111 - val_accuracy: 0.0993
Epoch 11/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3136 -
accuracy: 0.1034 - val_loss: 2.3150 - val_accuracy: 0.1093
Epoch 12/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3135 -
accuracy: 0.1037 - val_loss: 2.3105 - val_accuracy: 0.0959
Epoch 13/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3153 -
accuracy: 0.1027 - val_loss: 2.3200 - val_accuracy: 0.1063
Epoch 14/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3154 -
accuracy: 0.1029 - val_loss: 2.3110 - val_accuracy: 0.0959
Epoch 15/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3147 -
accuracy: 0.1014 - val_loss: 2.3179 - val_accuracy: 0.1002
Epoch 16/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3155 -
```

```
accuracy: 0.1035 - val_loss: 2.3200 - val_accuracy: 0.0997
Epoch 17/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3141 -
accuracy: 0.1032 - val_loss: 2.3120 - val_accuracy: 0.0959
Epoch 18/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3154 -
accuracy: 0.1028 - val_loss: 2.3088 - val_accuracy: 0.1093
Epoch 19/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3155 -
accuracy: 0.1037 - val_loss: 2.3150 - val_accuracy: 0.1002
Epoch 20/20
928/928 [==============================] - 3s 3ms/step - loss: 2.3146 -
accuracy: 0.1020 - val_loss: 2.3123 - val_accuracy: 0.0959

Accuracy: 9.59%

Iteration:  59
Epoch 1/20
477/477 [==============================] - 2s 3ms/step - loss: 0.4935 -
accuracy: 0.8622 - val_loss: 0.1601 - val_accuracy: 0.9584
Epoch 2/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1426 -
accuracy: 0.9605 - val_loss: 0.1405 - val_accuracy: 0.9618
Epoch 3/20
477/477 [==============================] - 1s 3ms/step - loss: 0.1041 -
accuracy: 0.9698 - val_loss: 0.1159 - val_accuracy: 0.9677
Epoch 4/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0869 -
accuracy: 0.9751 - val_loss: 0.1249 - val_accuracy: 0.9663
Epoch 5/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0810 -
accuracy: 0.9765 - val_loss: 0.1095 - val_accuracy: 0.9677
Epoch 6/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0752 -
accuracy: 0.9781 - val_loss: 0.1071 - val_accuracy: 0.9687
Epoch 7/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0654 -
accuracy: 0.9804 - val_loss: 0.1037 - val_accuracy: 0.9731
Epoch 8/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0581 -
accuracy: 0.9830 - val_loss: 0.0966 - val_accuracy: 0.9737
Epoch 9/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0556 -
accuracy: 0.9830 - val_loss: 0.1031 - val_accuracy: 0.9707
Epoch 10/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0545 -
accuracy: 0.9836 - val_loss: 0.1026 - val_accuracy: 0.9708
Epoch 11/20
```

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477/477 [==============================] - 1s 3ms/step - loss: 0.0531 -
accuracy: 0.9839 - val_loss: 0.1060 - val_accuracy: 0.9722
Epoch 12/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0548 -
accuracy: 0.9836 - val_loss: 0.1091 - val_accuracy: 0.9713
Epoch 13/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0454 -
accuracy: 0.9859 - val_loss: 0.1109 - val_accuracy: 0.9711
Epoch 14/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0451 -
accuracy: 0.9862 - val_loss: 0.1080 - val_accuracy: 0.9737
Epoch 15/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0459 -
accuracy: 0.9863 - val_loss: 0.1143 - val_accuracy: 0.9738
Epoch 16/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0400 -
accuracy: 0.9876 - val_loss: 0.1075 - val_accuracy: 0.9734
Epoch 17/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0431 -
accuracy: 0.9865 - val_loss: 0.1052 - val_accuracy: 0.9732
Epoch 18/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0398 -
accuracy: 0.9878 - val_loss: 0.1110 - val_accuracy: 0.9722
Epoch 19/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0423 -
accuracy: 0.9870 - val_loss: 0.1225 - val_accuracy: 0.9697
Epoch 20/20
477/477 [==============================] - 1s 3ms/step - loss: 0.0380 -
accuracy: 0.9883 - val_loss: 0.1085 - val_accuracy: 0.9728

Accuracy: 97.28%

Iteration:  60
Epoch 1/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.4224 -
accuracy: 0.1041 - val_loss: 2.3210 - val_accuracy: 0.0959
Epoch 2/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3126 -
accuracy: 0.1041 - val_loss: 2.3190 - val_accuracy: 0.0997
Epoch 3/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3125 -
accuracy: 0.1039 - val_loss: 2.3219 - val_accuracy: 0.1028
Epoch 4/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3121 -
accuracy: 0.1037 - val_loss: 2.3187 - val_accuracy: 0.0959
Epoch 5/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3136 -
accuracy: 0.1032 - val_loss: 2.3119 - val_accuracy: 0.0959
```

```
Epoch 6/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3130 -
accuracy: 0.1045 - val_loss: 2.3113 - val_accuracy: 0.0959
Epoch 7/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3133 -
accuracy: 0.1031 - val_loss: 2.3098 - val_accuracy: 0.1093
Epoch 8/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3130 -
accuracy: 0.1023 - val_loss: 2.3232 - val_accuracy: 0.1063
Epoch 9/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3134 -
accuracy: 0.1037 - val_loss: 2.3132 - val_accuracy: 0.0916
Epoch 10/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3125 -
accuracy: 0.1045 - val_loss: 2.3244 - val_accuracy: 0.0959
Epoch 11/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3123 -
accuracy: 0.1047 - val_loss: 2.3121 - val_accuracy: 0.1063
Epoch 12/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3131 -
accuracy: 0.1046 - val_loss: 2.3132 - val_accuracy: 0.1028
Epoch 13/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3135 -
accuracy: 0.1027 - val_loss: 2.3121 - val_accuracy: 0.1063
Epoch 14/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3138 -
accuracy: 0.1028 - val_loss: 2.3112 - val_accuracy: 0.1028
Epoch 15/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3121 -
accuracy: 0.1025 - val_loss: 2.3139 - val_accuracy: 0.1028
Epoch 16/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3124 -
accuracy: 0.1021 - val_loss: 2.3110 - val_accuracy: 0.0959
Epoch 17/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3133 -
accuracy: 0.1019 - val_loss: 2.3124 - val_accuracy: 0.0997
Epoch 18/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3130 -
accuracy: 0.1023 - val_loss: 2.3112 - val_accuracy: 0.1063
Epoch 19/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3134 -
accuracy: 0.1055 - val_loss: 2.3134 - val_accuracy: 0.1063
Epoch 20/20
1187/1187 [==============================] - 4s 3ms/step - loss: 2.3123 -
accuracy: 0.1039 - val_loss: 2.3193 - val_accuracy: 0.0959

Accuracy: 9.59%
```

```
Iteration:  61
Epoch 1/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3112 -
accuracy: 0.1026 - val_loss: 2.3125 - val_accuracy: 0.1002
Epoch 2/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3106 -
accuracy: 0.1045 - val_loss: 2.3113 - val_accuracy: 0.0959
Epoch 3/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3105 -
accuracy: 0.1031 - val_loss: 2.3185 - val_accuracy: 0.0959
Epoch 4/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3112 -
accuracy: 0.1018 - val_loss: 2.3045 - val_accuracy: 0.0993
Epoch 5/20
51000/51000 [==============================] - 124s 2ms/step - loss: 2.3107 -
accuracy: 0.1040 - val_loss: 2.3102 - val_accuracy: 0.0959
Epoch 6/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3100 -
accuracy: 0.1031 - val_loss: 2.3191 - val_accuracy: 0.1063
Epoch 7/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3108 -
accuracy: 0.1044 - val_loss: 2.3080 - val_accuracy: 0.1093
Epoch 8/20
51000/51000 [==============================] - 124s 2ms/step - loss: 2.3110 -
accuracy: 0.1037 - val_loss: 2.3091 - val_accuracy: 0.1063
Epoch 9/20
51000/51000 [==============================] - 124s 2ms/step - loss: 2.3108 -
accuracy: 0.1031 - val_loss: 2.3084 - val_accuracy: 0.0990
Epoch 10/20
51000/51000 [==============================] - 124s 2ms/step - loss: 2.3109 -
accuracy: 0.1038 - val_loss: 2.3035 - val_accuracy: 0.0997
Epoch 11/20
51000/51000 [==============================] - 124s 2ms/step - loss: 2.3102 -
accuracy: 0.1039 - val_loss: 2.3084 - val_accuracy: 0.0997
Epoch 12/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3104 -
accuracy: 0.1028 - val_loss: 2.3114 - val_accuracy: 0.1063
Epoch 13/20
51000/51000 [==============================] - 124s 2ms/step - loss: 2.3105 -
accuracy: 0.1011 - val_loss: 2.3128 - val_accuracy: 0.1063
Epoch 14/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3104 -
accuracy: 0.1028 - val_loss: 2.3136 - val_accuracy: 0.0959
Epoch 15/20
51000/51000 [==============================] - 124s 2ms/step - loss: 2.3112 -
accuracy: 0.1011 - val_loss: 2.3200 - val_accuracy: 0.1063
Epoch 16/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3100 -
```

```
accuracy: 0.1054 - val_loss: 2.3195 - val_accuracy: 0.0916
Epoch 17/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3105 -
accuracy: 0.1041 - val_loss: 2.3233 - val_accuracy: 0.1063
Epoch 18/20
51000/51000 [==============================] - 123s 2ms/step - loss: 2.3105 -
accuracy: 0.1058 - val_loss: 2.3083 - val_accuracy: 0.1063
Epoch 19/20
51000/51000 [==============================] - 124s 2ms/step - loss: 2.3110 -
accuracy: 0.1017 - val_loss: 2.3067 - val_accuracy: 0.1093
Epoch 20/20
51000/51000 [==============================] - 124s 2ms/step - loss: 2.3104 -
accuracy: 0.1047 - val_loss: 2.3097 - val_accuracy: 0.0959

Accuracy: 9.59%

Iteration:  62
Epoch 1/20
543/543 [==============================] - 2s 3ms/step - loss: 1.6313 -
accuracy: 0.3063 - val_loss: 1.3623 - val_accuracy: 0.3890
Epoch 2/20
543/543 [==============================] - 2s 3ms/step - loss: 1.2770 -
accuracy: 0.4525 - val_loss: 1.1785 - val_accuracy: 0.5198
Epoch 3/20
543/543 [==============================] - 2s 3ms/step - loss: 1.1219 -
accuracy: 0.5288 - val_loss: 1.1985 - val_accuracy: 0.5153
Epoch 4/20
543/543 [==============================] - 2s 3ms/step - loss: 1.1094 -
accuracy: 0.5377 - val_loss: 1.0379 - val_accuracy: 0.5464
Epoch 5/20
543/543 [==============================] - 2s 3ms/step - loss: 1.0700 -
accuracy: 0.5466 - val_loss: 1.0820 - val_accuracy: 0.5818
Epoch 6/20
543/543 [==============================] - 2s 3ms/step - loss: 1.0247 -
accuracy: 0.5873 - val_loss: 0.8974 - val_accuracy: 0.6216
Epoch 7/20
543/543 [==============================] - 2s 3ms/step - loss: 0.9521 -
accuracy: 0.6181 - val_loss: 0.9021 - val_accuracy: 0.6470
Epoch 8/20
543/543 [==============================] - 2s 3ms/step - loss: 1.0308 -
accuracy: 0.5844 - val_loss: 1.0278 - val_accuracy: 0.5911
Epoch 9/20
543/543 [==============================] - 2s 3ms/step - loss: 0.9351 -
accuracy: 0.6219 - val_loss: 0.8332 - val_accuracy: 0.6598
Epoch 10/20
543/543 [==============================] - 2s 3ms/step - loss: 0.9100 -
accuracy: 0.6373 - val_loss: 0.8506 - val_accuracy: 0.6482
Epoch 11/20
```

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543/543 [==============================] - 2s 3ms/step - loss: 0.9934 -
accuracy: 0.6028 - val_loss: 0.8293 - val_accuracy: 0.6312
Epoch 12/20
543/543 [==============================] - 2s 3ms/step - loss: 1.0734 -
accuracy: 0.5737 - val_loss: 0.9854 - val_accuracy: 0.5438
Epoch 13/20
543/543 [==============================] - 2s 3ms/step - loss: 0.9469 -
accuracy: 0.6077 - val_loss: 0.8470 - val_accuracy: 0.6250
Epoch 14/20
543/543 [==============================] - 2s 3ms/step - loss: 0.9091 -
accuracy: 0.6359 - val_loss: 0.9774 - val_accuracy: 0.6490
Epoch 15/20
543/543 [==============================] - 2s 3ms/step - loss: 0.9975 -
accuracy: 0.6187 - val_loss: 0.8325 - val_accuracy: 0.6927
Epoch 16/20
543/543 [==============================] - 2s 3ms/step - loss: 1.1234 -
accuracy: 0.5572 - val_loss: 1.0172 - val_accuracy: 0.6008
Epoch 17/20
543/543 [==============================] - 2s 3ms/step - loss: 0.9972 -
accuracy: 0.6034 - val_loss: 0.9057 - val_accuracy: 0.6248
Epoch 18/20
543/543 [==============================] - 2s 3ms/step - loss: 0.9345 -
accuracy: 0.6246 - val_loss: 0.8546 - val_accuracy: 0.6346
Epoch 19/20
543/543 [==============================] - 2s 3ms/step - loss: 0.8702 -
accuracy: 0.6500 - val_loss: 0.8170 - val_accuracy: 0.6723
Epoch 20/20
543/543 [==============================] - 2s 3ms/step - loss: 0.8857 -
accuracy: 0.6826 - val_loss: 1.1540 - val_accuracy: 0.5570

Accuracy: 55.70%

Iteration:  63
Epoch 1/20
880/880 [==============================] - 4s 3ms/step - loss: 2.2862 -
accuracy: 0.1107 - val_loss: 2.3097 - val_accuracy: 0.1063
Epoch 2/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3065 -
accuracy: 0.1025 - val_loss: 2.3061 - val_accuracy: 0.1093
Epoch 3/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3073 -
accuracy: 0.1068 - val_loss: 2.3064 - val_accuracy: 0.0959
Epoch 4/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3076 -
accuracy: 0.1039 - val_loss: 2.3115 - val_accuracy: 0.1028
Epoch 5/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3070 -
accuracy: 0.1050 - val_loss: 2.3082 - val_accuracy: 0.1063
```

```
Epoch 6/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3070 -
accuracy: 0.1045 - val_loss: 2.3135 - val_accuracy: 0.1063
Epoch 7/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3067 -
accuracy: 0.1052 - val_loss: 2.3050 - val_accuracy: 0.1063
Epoch 8/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3073 -
accuracy: 0.1041 - val_loss: 2.3042 - val_accuracy: 0.1093
Epoch 9/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3070 -
accuracy: 0.1061 - val_loss: 2.3057 - val_accuracy: 0.0997
Epoch 10/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3074 -
accuracy: 0.1040 - val_loss: 2.3086 - val_accuracy: 0.1063
Epoch 11/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3080 -
accuracy: 0.1035 - val_loss: 2.3070 - val_accuracy: 0.1002
Epoch 12/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3072 -
accuracy: 0.1058 - val_loss: 2.3065 - val_accuracy: 0.1093
Epoch 13/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3068 -
accuracy: 0.1072 - val_loss: 2.3083 - val_accuracy: 0.0959
Epoch 14/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3071 -
accuracy: 0.1059 - val_loss: 2.3096 - val_accuracy: 0.0916
Epoch 15/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3075 -
accuracy: 0.1065 - val_loss: 2.3072 - val_accuracy: 0.0959
Epoch 16/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3071 -
accuracy: 0.1059 - val_loss: 2.3120 - val_accuracy: 0.1063
Epoch 17/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3066 -
accuracy: 0.1047 - val_loss: 2.3065 - val_accuracy: 0.1028
Epoch 18/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3069 -
accuracy: 0.1049 - val_loss: 2.3074 - val_accuracy: 0.1028
Epoch 19/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3075 -
accuracy: 0.1025 - val_loss: 2.3069 - val_accuracy: 0.1063
Epoch 20/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3069 -
accuracy: 0.1067 - val_loss: 2.3076 - val_accuracy: 0.1093

Accuracy: 10.93%
```

```
Iteration:  64
Epoch 1/20
408/408 [==============================] - 2s 3ms/step - loss: 0.4797 -
accuracy: 0.8491 - val_loss: 0.1839 - val_accuracy: 0.9471
Epoch 2/20
408/408 [==============================] - 1s 3ms/step - loss: 0.1945 -
accuracy: 0.9468 - val_loss: 0.1430 - val_accuracy: 0.9611
Epoch 3/20
408/408 [==============================] - 1s 3ms/step - loss: 0.1554 -
accuracy: 0.9573 - val_loss: 0.1451 - val_accuracy: 0.9604
Epoch 4/20
408/408 [==============================] - 1s 3ms/step - loss: 0.1303 -
accuracy: 0.9655 - val_loss: 0.1656 - val_accuracy: 0.9584
Epoch 5/20
408/408 [==============================] - 1s 3ms/step - loss: 0.1278 -
accuracy: 0.9666 - val_loss: 0.1443 - val_accuracy: 0.9607
Epoch 6/20
408/408 [==============================] - 1s 3ms/step - loss: 0.1121 -
accuracy: 0.9702 - val_loss: 0.1282 - val_accuracy: 0.9701
Epoch 7/20
408/408 [==============================] - 1s 3ms/step - loss: 0.1064 -
accuracy: 0.9725 - val_loss: 0.1430 - val_accuracy: 0.9681
Epoch 8/20
408/408 [==============================] - 1s 3ms/step - loss: 0.1088 -
accuracy: 0.9723 - val_loss: 0.1440 - val_accuracy: 0.9663
Epoch 9/20
408/408 [==============================] - 1s 3ms/step - loss: 0.1004 -
accuracy: 0.9751 - val_loss: 0.1412 - val_accuracy: 0.9692
Epoch 10/20
408/408 [==============================] - 1s 3ms/step - loss: 0.1015 -
accuracy: 0.9747 - val_loss: 0.1242 - val_accuracy: 0.9699
Epoch 11/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0910 -
accuracy: 0.9778 - val_loss: 0.1748 - val_accuracy: 0.9643
Epoch 12/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0910 -
accuracy: 0.9777 - val_loss: 0.1513 - val_accuracy: 0.9688
Epoch 13/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0925 -
accuracy: 0.9772 - val_loss: 0.1552 - val_accuracy: 0.9687
Epoch 14/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0913 -
accuracy: 0.9782 - val_loss: 0.1630 - val_accuracy: 0.9658
Epoch 15/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0887 -
accuracy: 0.9783 - val_loss: 0.1330 - val_accuracy: 0.9708
Epoch 16/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0742 -
```

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accuracy: 0.9822 - val_loss: 0.1413 - val_accuracy: 0.9706
Epoch 17/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0928 -
accuracy: 0.9780 - val_loss: 0.1736 - val_accuracy: 0.9641
Epoch 18/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0806 -
accuracy: 0.9815 - val_loss: 0.1633 - val_accuracy: 0.9656
Epoch 19/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0972 -
accuracy: 0.9775 - val_loss: 0.1710 - val_accuracy: 0.9632
Epoch 20/20
408/408 [==============================] - 1s 3ms/step - loss: 0.0971 -
accuracy: 0.9770 - val_loss: 0.1453 - val_accuracy: 0.9711

Accuracy: 97.11%

Iteration:  65
Epoch 1/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3120 -
accuracy: 0.1034 - val_loss: 2.3049 - val_accuracy: 0.1063
Epoch 2/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3107 -
accuracy: 0.1029 - val_loss: 2.3078 - val_accuracy: 0.1063
Epoch 3/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3110 -
accuracy: 0.1034 - val_loss: 2.3076 - val_accuracy: 0.0959
Epoch 4/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3108 -
accuracy: 0.1026 - val_loss: 2.3061 - val_accuracy: 0.1093
Epoch 5/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3099 -
accuracy: 0.1069 - val_loss: 2.3074 - val_accuracy: 0.0959
Epoch 6/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3096 -
accuracy: 0.1059 - val_loss: 2.3105 - val_accuracy: 0.1063
Epoch 7/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3103 -
accuracy: 0.1037 - val_loss: 2.3050 - val_accuracy: 0.1028
Epoch 8/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3103 -
accuracy: 0.1056 - val_loss: 2.3057 - val_accuracy: 0.1002
Epoch 9/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3103 -
accuracy: 0.1060 - val_loss: 2.3055 - val_accuracy: 0.1002
Epoch 10/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3112 -
accuracy: 0.1019 - val_loss: 2.3301 - val_accuracy: 0.1063
Epoch 11/20
```

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516/516 [==============================] - 2s 3ms/step - loss: 2.3110 -
accuracy: 0.1037 - val_loss: 2.3223 - val_accuracy: 0.0916
Epoch 12/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3094 -
accuracy: 0.1068 - val_loss: 2.3087 - val_accuracy: 0.1063
Epoch 13/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3087 -
accuracy: 0.1046 - val_loss: 2.3073 - val_accuracy: 0.1063
Epoch 14/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3101 -
accuracy: 0.1046 - val_loss: 2.3097 - val_accuracy: 0.0959
Epoch 15/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3099 -
accuracy: 0.1053 - val_loss: 2.3109 - val_accuracy: 0.0916
Epoch 16/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3096 -
accuracy: 0.1054 - val_loss: 2.3143 - val_accuracy: 0.1063
Epoch 17/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3098 -
accuracy: 0.1058 - val_loss: 2.3049 - val_accuracy: 0.1063
Epoch 18/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3105 -
accuracy: 0.1038 - val_loss: 2.3056 - val_accuracy: 0.1028
Epoch 19/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3101 -
accuracy: 0.1009 - val_loss: 2.3048 - val_accuracy: 0.0990
Epoch 20/20
516/516 [==============================] - 2s 3ms/step - loss: 2.3103 -
accuracy: 0.1032 - val_loss: 2.3099 - val_accuracy: 0.1093

Accuracy: 10.93%

Iteration:  66
Epoch 1/20
608/608 [==============================] - 2s 3ms/step - loss: 1.4315 -
accuracy: 0.4524 - val_loss: 0.8735 - val_accuracy: 0.7244
Epoch 2/20
608/608 [==============================] - 2s 3ms/step - loss: 0.8110 -
accuracy: 0.7558 - val_loss: 0.6565 - val_accuracy: 0.8289
Epoch 3/20
608/608 [==============================] - 2s 3ms/step - loss: 0.6853 -
accuracy: 0.8187 - val_loss: 0.6110 - val_accuracy: 0.8458
Epoch 4/20
608/608 [==============================] - 2s 3ms/step - loss: 0.6017 -
accuracy: 0.8495 - val_loss: 0.5834 - val_accuracy: 0.8514
Epoch 5/20
608/608 [==============================] - 2s 3ms/step - loss: 0.5835 -
accuracy: 0.8537 - val_loss: 0.5283 - val_accuracy: 0.8814
```

```
Epoch 6/20
608/608 [==============================] - 2s 3ms/step - loss: 0.5542 -
accuracy: 0.8662 - val_loss: 0.4494 - val_accuracy: 0.9006
Epoch 7/20
608/608 [==============================] - 2s 3ms/step - loss: 0.5269 -
accuracy: 0.8724 - val_loss: 0.4687 - val_accuracy: 0.8908
Epoch 8/20
608/608 [==============================] - 2s 3ms/step - loss: 0.5100 -
accuracy: 0.8761 - val_loss: 0.4649 - val_accuracy: 0.8947
Epoch 9/20
608/608 [==============================] - 2s 3ms/step - loss: 0.4993 -
accuracy: 0.8761 - val_loss: 0.4455 - val_accuracy: 0.8927
Epoch 10/20
608/608 [==============================] - 2s 3ms/step - loss: 0.5082 -
accuracy: 0.8750 - val_loss: 0.4494 - val_accuracy: 0.8928
Epoch 11/20
608/608 [==============================] - 2s 3ms/step - loss: 0.5015 -
accuracy: 0.8806 - val_loss: 0.4477 - val_accuracy: 0.8967
Epoch 12/20
608/608 [==============================] - 2s 3ms/step - loss: 0.4880 -
accuracy: 0.8852 - val_loss: 0.4126 - val_accuracy: 0.9061
Epoch 13/20
608/608 [==============================] - 2s 3ms/step - loss: 0.4986 -
accuracy: 0.8796 - val_loss: 0.5362 - val_accuracy: 0.8740
Epoch 14/20
608/608 [==============================] - 2s 3ms/step - loss: 0.5116 -
accuracy: 0.8772 - val_loss: 0.4662 - val_accuracy: 0.8931
Epoch 15/20
608/608 [==============================] - 2s 3ms/step - loss: 0.4429 -
accuracy: 0.8953 - val_loss: 0.4402 - val_accuracy: 0.9039
Epoch 16/20
608/608 [==============================] - 2s 3ms/step - loss: 0.4646 -
accuracy: 0.8882 - val_loss: 0.4111 - val_accuracy: 0.9038
Epoch 17/20
608/608 [==============================] - 2s 3ms/step - loss: 0.4428 -
accuracy: 0.8994 - val_loss: 0.3646 - val_accuracy: 0.9193
Epoch 18/20
608/608 [==============================] - 2s 3ms/step - loss: 0.4521 -
accuracy: 0.8934 - val_loss: 0.5173 - val_accuracy: 0.8861
Epoch 19/20
608/608 [==============================] - 2s 3ms/step - loss: 0.4250 -
accuracy: 0.9037 - val_loss: 0.3834 - val_accuracy: 0.9132
Epoch 20/20
608/608 [==============================] - 2s 3ms/step - loss: 0.4044 -
accuracy: 0.9082 - val_loss: 0.3446 - val_accuracy: 0.9267

Accuracy: 92.67%
```

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Iteration:  67
Epoch 1/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.3771 -
accuracy: 0.8943 - val_loss: 0.1783 - val_accuracy: 0.9524
Epoch 2/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.2149 -
accuracy: 0.9449 - val_loss: 0.1510 - val_accuracy: 0.9620
Epoch 3/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1852 -
accuracy: 0.9536 - val_loss: 0.1530 - val_accuracy: 0.9611
Epoch 4/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1637 -
accuracy: 0.9607 - val_loss: 0.1403 - val_accuracy: 0.9646
Epoch 5/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1414 -
accuracy: 0.9653 - val_loss: 0.1938 - val_accuracy: 0.9584
Epoch 6/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1345 -
accuracy: 0.9679 - val_loss: 0.1453 - val_accuracy: 0.9653
Epoch 7/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1259 -
accuracy: 0.9704 - val_loss: 0.1550 - val_accuracy: 0.9661
Epoch 8/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1280 -
accuracy: 0.9691 - val_loss: 0.1404 - val_accuracy: 0.9696
Epoch 9/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1199 -
accuracy: 0.9718 - val_loss: 0.1445 - val_accuracy: 0.9664
Epoch 10/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1134 -
accuracy: 0.9735 - val_loss: 0.1579 - val_accuracy: 0.9671
Epoch 11/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1066 -
accuracy: 0.9750 - val_loss: 0.1378 - val_accuracy: 0.9671
Epoch 12/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1032 -
accuracy: 0.9758 - val_loss: 0.1685 - val_accuracy: 0.9696
Epoch 13/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1003 -
accuracy: 0.9767 - val_loss: 0.1254 - val_accuracy: 0.9736
Epoch 14/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.0936 -
accuracy: 0.9785 - val_loss: 0.1336 - val_accuracy: 0.9716
Epoch 15/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1092 -
accuracy: 0.9740 - val_loss: 0.1247 - val_accuracy: 0.9711
Epoch 16/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.0976 -
```

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accuracy: 0.9764 - val_loss: 0.1637 - val_accuracy: 0.9674
Epoch 17/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1005 -
accuracy: 0.9755 - val_loss: 0.1794 - val_accuracy: 0.9627
Epoch 18/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.0937 -
accuracy: 0.9765 - val_loss: 0.1239 - val_accuracy: 0.9729
Epoch 19/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.1047 -
accuracy: 0.9749 - val_loss: 0.1758 - val_accuracy: 0.9662
Epoch 20/20
3924/3924 [==============================] - 12s 3ms/step - loss: 0.0956 -
accuracy: 0.9774 - val_loss: 0.1810 - val_accuracy: 0.9664

Accuracy: 96.64%

Iteration:  68
Epoch 1/20
6375/6375 [==============================] - 17s 3ms/step - loss: 0.4854 -
accuracy: 0.8575 - val_loss: 0.1821 - val_accuracy: 0.9521
Epoch 2/20
6375/6375 [==============================] - 16s 3ms/step - loss: 0.2060 -
accuracy: 0.9435 - val_loss: 0.1779 - val_accuracy: 0.9523
Epoch 3/20
6375/6375 [==============================] - 16s 3ms/step - loss: 0.1731 -
accuracy: 0.9502 - val_loss: 0.1687 - val_accuracy: 0.9573
Epoch 4/20
6375/6375 [==============================] - 17s 3ms/step - loss: 0.1584 -
accuracy: 0.9558 - val_loss: 0.1569 - val_accuracy: 0.9590
Epoch 5/20
6375/6375 [==============================] - 17s 3ms/step - loss: 0.1414 -
accuracy: 0.9607 - val_loss: 0.1417 - val_accuracy: 0.9604
Epoch 6/20
6375/6375 [==============================] - 17s 3ms/step - loss: 0.1315 -
accuracy: 0.9627 - val_loss: 0.1397 - val_accuracy: 0.9658
Epoch 7/20
6375/6375 [==============================] - 16s 3ms/step - loss: 0.1264 -
accuracy: 0.9636 - val_loss: 0.1260 - val_accuracy: 0.9667
Epoch 8/20
6375/6375 [==============================] - 17s 3ms/step - loss: 0.1227 -
accuracy: 0.9653 - val_loss: 0.1325 - val_accuracy: 0.9643
Epoch 9/20
6375/6375 [==============================] - 17s 3ms/step - loss: 0.1136 -
accuracy: 0.9679 - val_loss: 0.1321 - val_accuracy: 0.9652
Epoch 10/20
6375/6375 [==============================] - 17s 3ms/step - loss: 0.1089 -
accuracy: 0.9696 - val_loss: 0.1320 - val_accuracy: 0.9633
Epoch 11/20
```

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6375/6375 [==============================] - 17s 3ms/step - loss: 0.1048 -
accuracy: 0.9701 - val_loss: 0.1428 - val_accuracy: 0.9628
Epoch 12/20
6375/6375 [==============================] - 16s 3ms/step - loss: 0.1020 -
accuracy: 0.9718 - val_loss: 0.1563 - val_accuracy: 0.9620
Epoch 13/20
6375/6375 [==============================] - 16s 3ms/step - loss: 0.1057 -
accuracy: 0.9704 - val_loss: 0.1350 - val_accuracy: 0.9659
Epoch 14/20
6375/6375 [==============================] - 16s 3ms/step - loss: 0.1041 -
accuracy: 0.9710 - val_loss: 0.1376 - val_accuracy: 0.9649
Epoch 15/20
6375/6375 [==============================] - 17s 3ms/step - loss: 0.1026 -
accuracy: 0.9707 - val_loss: 0.1229 - val_accuracy: 0.9694
Epoch 16/20
6375/6375 [==============================] - 16s 3ms/step - loss: 0.0995 -
accuracy: 0.9720 - val_loss: 0.1427 - val_accuracy: 0.9658
Epoch 17/20
6375/6375 [==============================] - 16s 3ms/step - loss: 0.0949 -
accuracy: 0.9739 - val_loss: 0.1274 - val_accuracy: 0.9662
Epoch 18/20
6375/6375 [==============================] - 17s 3ms/step - loss: 0.0939 -
accuracy: 0.9735 - val_loss: 0.1253 - val_accuracy: 0.9674
Epoch 19/20
6375/6375 [==============================] - 16s 3ms/step - loss: 0.0894 -
accuracy: 0.9750 - val_loss: 0.1307 - val_accuracy: 0.9653
Epoch 20/20
6375/6375 [==============================] - 17s 3ms/step - loss: 0.0900 -
accuracy: 0.9753 - val_loss: 0.1251 - val_accuracy: 0.9678

Accuracy: 96.78%

Iteration:  69
Epoch 1/20
797/797 [==============================] - 3s 3ms/step - loss: 1.3264 -
accuracy: 0.4659 - val_loss: 0.9660 - val_accuracy: 0.6303
Epoch 2/20
797/797 [==============================] - 2s 3ms/step - loss: 0.7850 -
accuracy: 0.7101 - val_loss: 0.5261 - val_accuracy: 0.8211
Epoch 3/20
797/797 [==============================] - 3s 3ms/step - loss: 0.4125 -
accuracy: 0.8870 - val_loss: 0.2960 - val_accuracy: 0.9254
Epoch 4/20
797/797 [==============================] - 2s 3ms/step - loss: 0.3169 -
accuracy: 0.9192 - val_loss: 0.2928 - val_accuracy: 0.9292
Epoch 5/20
797/797 [==============================] - 3s 3ms/step - loss: 0.2808 -
accuracy: 0.9281 - val_loss: 0.2665 - val_accuracy: 0.9359
```

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Epoch 6/20
797/797 [==============================] - 2s 3ms/step - loss: 0.2487 -
accuracy: 0.9362 - val_loss: 0.2268 - val_accuracy: 0.9432
Epoch 7/20
797/797 [==============================] - 2s 3ms/step - loss: 0.2294 -
accuracy: 0.9411 - val_loss: 0.2472 - val_accuracy: 0.9408
Epoch 8/20
797/797 [==============================] - 2s 3ms/step - loss: 0.2295 -
accuracy: 0.9408 - val_loss: 0.2018 - val_accuracy: 0.9503
Epoch 9/20
797/797 [==============================] - 2s 3ms/step - loss: 0.2149 -
accuracy: 0.9445 - val_loss: 0.2151 - val_accuracy: 0.9442
Epoch 10/20
797/797 [==============================] - 2s 3ms/step - loss: 0.2033 -
accuracy: 0.9475 - val_loss: 0.2047 - val_accuracy: 0.9469
Epoch 11/20
797/797 [==============================] - 2s 3ms/step - loss: 0.1938 -
accuracy: 0.9494 - val_loss: 0.1909 - val_accuracy: 0.9507
Epoch 12/20
797/797 [==============================] - 2s 3ms/step - loss: 0.1873 -
accuracy: 0.9512 - val_loss: 0.1909 - val_accuracy: 0.9479
Epoch 13/20
797/797 [==============================] - 2s 3ms/step - loss: 0.1883 -
accuracy: 0.9509 - val_loss: 0.1881 - val_accuracy: 0.9516
Epoch 14/20
797/797 [==============================] - 2s 3ms/step - loss: 0.1789 -
accuracy: 0.9525 - val_loss: 0.1819 - val_accuracy: 0.9550
Epoch 15/20
797/797 [==============================] - 3s 3ms/step - loss: 0.1797 -
accuracy: 0.9524 - val_loss: 0.1796 - val_accuracy: 0.9521
Epoch 16/20
797/797 [==============================] - 2s 3ms/step - loss: 0.1745 -
accuracy: 0.9542 - val_loss: 0.2333 - val_accuracy: 0.9418
Epoch 17/20
797/797 [==============================] - 2s 3ms/step - loss: 0.1796 -
accuracy: 0.9532 - val_loss: 0.1924 - val_accuracy: 0.9501
Epoch 18/20
797/797 [==============================] - 2s 3ms/step - loss: 0.1683 -
accuracy: 0.9555 - val_loss: 0.1751 - val_accuracy: 0.9562
Epoch 19/20
797/797 [==============================] - 2s 3ms/step - loss: 0.1560 -
accuracy: 0.9585 - val_loss: 0.1851 - val_accuracy: 0.9540
Epoch 20/20
797/797 [==============================] - 3s 3ms/step - loss: 0.1639 -
accuracy: 0.9562 - val_loss: 0.1800 - val_accuracy: 0.9559

Accuracy: 95.59%
```

```
Iteration:  70
Epoch 1/20
444/444 [==============================] - 2s 3ms/step - loss: 2.5662 -
accuracy: 0.1050 - val_loss: 2.3092 - val_accuracy: 0.1093
Epoch 2/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3070 -
accuracy: 0.1051 - val_loss: 2.3068 - val_accuracy: 0.0997
Epoch 3/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3089 -
accuracy: 0.1048 - val_loss: 2.3055 - val_accuracy: 0.1093
Epoch 4/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3092 -
accuracy: 0.1048 - val_loss: 2.3121 - val_accuracy: 0.1063
Epoch 5/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3084 -
accuracy: 0.1053 - val_loss: 2.3120 - val_accuracy: 0.1063
Epoch 6/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3093 -
accuracy: 0.1055 - val_loss: 2.3076 - val_accuracy: 0.1063
Epoch 7/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3094 -
accuracy: 0.1059 - val_loss: 2.3087 - val_accuracy: 0.1063
Epoch 8/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3087 -
accuracy: 0.1039 - val_loss: 2.3036 - val_accuracy: 0.0993
Epoch 9/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3097 -
accuracy: 0.1017 - val_loss: 2.3126 - val_accuracy: 0.1063
Epoch 10/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3091 -
accuracy: 0.1052 - val_loss: 2.3044 - val_accuracy: 0.1063
Epoch 11/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3094 -
accuracy: 0.1052 - val_loss: 2.3064 - val_accuracy: 0.1063
Epoch 12/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3081 -
accuracy: 0.1072 - val_loss: 2.3093 - val_accuracy: 0.1063
Epoch 13/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3103 -
accuracy: 0.1031 - val_loss: 2.3053 - val_accuracy: 0.1063
Epoch 14/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3094 -
accuracy: 0.1058 - val_loss: 2.3077 - val_accuracy: 0.1028
Epoch 15/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3084 -
accuracy: 0.1053 - val_loss: 2.3090 - val_accuracy: 0.1028
Epoch 16/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3087 -
```

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accuracy: 0.1050 - val_loss: 2.3080 - val_accuracy: 0.1063
Epoch 17/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3087 -
accuracy: 0.1055 - val_loss: 2.3057 - val_accuracy: 0.0993
Epoch 18/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3086 -
accuracy: 0.1025 - val_loss: 2.3080 - val_accuracy: 0.1063
Epoch 19/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3094 -
accuracy: 0.1031 - val_loss: 2.3089 - val_accuracy: 0.0916
Epoch 20/20
444/444 [==============================] - 1s 3ms/step - loss: 2.3083 -
accuracy: 0.1051 - val_loss: 2.3069 - val_accuracy: 0.0959

Accuracy: 9.59%

Iteration:  71
Epoch 1/20
549/549 [==============================] - 2s 3ms/step - loss: 0.3293 -
accuracy: 0.9022 - val_loss: 0.1742 - val_accuracy: 0.9477
Epoch 2/20
549/549 [==============================] - 2s 3ms/step - loss: 0.1537 -
accuracy: 0.9565 - val_loss: 0.1262 - val_accuracy: 0.9630
Epoch 3/20
549/549 [==============================] - 2s 3ms/step - loss: 0.1269 -
accuracy: 0.9643 - val_loss: 0.1305 - val_accuracy: 0.9633
Epoch 4/20
549/549 [==============================] - 2s 3ms/step - loss: 0.1146 -
accuracy: 0.9679 - val_loss: 0.1533 - val_accuracy: 0.9619
Epoch 5/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0983 -
accuracy: 0.9727 - val_loss: 0.1454 - val_accuracy: 0.9654
Epoch 6/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0926 -
accuracy: 0.9744 - val_loss: 0.1596 - val_accuracy: 0.9620
Epoch 7/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0879 -
accuracy: 0.9761 - val_loss: 0.1736 - val_accuracy: 0.9636
Epoch 8/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0912 -
accuracy: 0.9759 - val_loss: 0.1746 - val_accuracy: 0.9661
Epoch 9/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0828 -
accuracy: 0.9791 - val_loss: 0.1365 - val_accuracy: 0.9718
Epoch 10/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0792 -
accuracy: 0.9795 - val_loss: 0.1556 - val_accuracy: 0.9672
Epoch 11/20
```

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549/549 [==============================] - 2s 3ms/step - loss: 0.0831 -
accuracy: 0.9781 - val_loss: 0.1637 - val_accuracy: 0.9679
Epoch 12/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0683 -
accuracy: 0.9820 - val_loss: 0.1606 - val_accuracy: 0.9711
Epoch 13/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0664 -
accuracy: 0.9833 - val_loss: 0.1827 - val_accuracy: 0.9682
Epoch 14/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0813 -
accuracy: 0.9799 - val_loss: 0.2298 - val_accuracy: 0.9664
Epoch 15/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0768 -
accuracy: 0.9809 - val_loss: 0.1757 - val_accuracy: 0.9660
Epoch 16/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0684 -
accuracy: 0.9833 - val_loss: 0.2333 - val_accuracy: 0.9657
Epoch 17/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0644 -
accuracy: 0.9838 - val_loss: 0.2196 - val_accuracy: 0.9693
Epoch 18/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0644 -
accuracy: 0.9842 - val_loss: 0.2306 - val_accuracy: 0.9683
Epoch 19/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0656 -
accuracy: 0.9836 - val_loss: 0.2403 - val_accuracy: 0.9643
Epoch 20/20
549/549 [==============================] - 2s 3ms/step - loss: 0.0707 -
accuracy: 0.9829 - val_loss: 0.2193 - val_accuracy: 0.9679

Accuracy: 96.79%

Iteration:  72
Epoch 1/20
5100/5100 [==============================] - 14s 3ms/step - loss: 1.8439 -
accuracy: 0.1944 - val_loss: 1.8160 - val_accuracy: 0.2049
Epoch 2/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7718 -
accuracy: 0.2023 - val_loss: 1.7436 - val_accuracy: 0.1921
Epoch 3/20
5100/5100 [==============================] - 14s 3ms/step - loss: 1.7614 -
accuracy: 0.1995 - val_loss: 1.7834 - val_accuracy: 0.2017
Epoch 4/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7472 -
accuracy: 0.2017 - val_loss: 1.7456 - val_accuracy: 0.2039
Epoch 5/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7524 -
accuracy: 0.1998 - val_loss: 1.7255 - val_accuracy: 0.2010
```

```
Epoch 6/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7449 -
accuracy: 0.1995 - val_loss: 1.7167 - val_accuracy: 0.2010
Epoch 7/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7423 -
accuracy: 0.2032 - val_loss: 1.7182 - val_accuracy: 0.2000
Epoch 8/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7388 -
accuracy: 0.2015 - val_loss: 1.7637 - val_accuracy: 0.2010
Epoch 9/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7399 -
accuracy: 0.1998 - val_loss: 1.7159 - val_accuracy: 0.2088
Epoch 10/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7310 -
accuracy: 0.1996 - val_loss: 1.7179 - val_accuracy: 0.2034
Epoch 11/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7311 -
accuracy: 0.2042 - val_loss: 1.7394 - val_accuracy: 0.2010
Epoch 12/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7297 -
accuracy: 0.2043 - val_loss: 1.7207 - val_accuracy: 0.1918
Epoch 13/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7312 -
accuracy: 0.2016 - val_loss: 1.7497 - val_accuracy: 0.2017
Epoch 14/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7307 -
accuracy: 0.2024 - val_loss: 1.7128 - val_accuracy: 0.2040
Epoch 15/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7237 -
accuracy: 0.2036 - val_loss: 1.7157 - val_accuracy: 0.1946
Epoch 16/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7265 -
accuracy: 0.2033 - val_loss: 1.7383 - val_accuracy: 0.1881
Epoch 17/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7239 -
accuracy: 0.2039 - val_loss: 1.7309 - val_accuracy: 0.1880
Epoch 18/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7257 -
accuracy: 0.2049 - val_loss: 1.7544 - val_accuracy: 0.1984
Epoch 19/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7308 -
accuracy: 0.2031 - val_loss: 1.7146 - val_accuracy: 0.1959
Epoch 20/20
5100/5100 [==============================] - 13s 3ms/step - loss: 1.7222 -
accuracy: 0.2037 - val_loss: 1.7117 - val_accuracy: 0.2026

Accuracy: 20.26%
```

```
Iteration:  73
Epoch 1/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.9854 -
accuracy: 0.6850 - val_loss: 0.4583 - val_accuracy: 0.8728
Epoch 2/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.3766 -
accuracy: 0.9036 - val_loss: 0.2907 - val_accuracy: 0.9206
Epoch 3/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2588 -
accuracy: 0.9331 - val_loss: 0.2209 - val_accuracy: 0.9421
Epoch 4/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2050 -
accuracy: 0.9469 - val_loss: 0.1910 - val_accuracy: 0.9487
Epoch 5/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1762 -
accuracy: 0.9527 - val_loss: 0.1659 - val_accuracy: 0.9562
Epoch 6/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1555 -
accuracy: 0.9586 - val_loss: 0.1728 - val_accuracy: 0.9537
Epoch 7/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1440 -
accuracy: 0.9609 - val_loss: 0.1573 - val_accuracy: 0.9580
Epoch 8/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1321 -
accuracy: 0.9642 - val_loss: 0.1884 - val_accuracy: 0.9499
Epoch 9/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1223 -
accuracy: 0.9654 - val_loss: 0.1592 - val_accuracy: 0.9554
Epoch 10/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1124 -
accuracy: 0.9682 - val_loss: 0.1689 - val_accuracy: 0.9543
Epoch 11/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1081 -
accuracy: 0.9696 - val_loss: 0.1488 - val_accuracy: 0.9610
Epoch 12/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.1003 -
accuracy: 0.9713 - val_loss: 0.1528 - val_accuracy: 0.9600
Epoch 13/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.0934 -
accuracy: 0.9737 - val_loss: 0.1585 - val_accuracy: 0.9577
Epoch 14/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.0910 -
accuracy: 0.9738 - val_loss: 0.1611 - val_accuracy: 0.9579
Epoch 15/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.0852 -
accuracy: 0.9754 - val_loss: 0.1668 - val_accuracy: 0.9577
Epoch 16/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.0842 -
```

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accuracy: 0.9757 - val_loss: 0.1664 - val_accuracy: 0.9580
Epoch 17/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.0790 -
accuracy: 0.9768 - val_loss: 0.1705 - val_accuracy: 0.9567
Epoch 18/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.0735 -
accuracy: 0.9789 - val_loss: 0.1589 - val_accuracy: 0.9599
Epoch 19/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.0723 -
accuracy: 0.9788 - val_loss: 0.1742 - val_accuracy: 0.9598
Epoch 20/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.0716 -
accuracy: 0.9791 - val_loss: 0.1691 - val_accuracy: 0.9577

Accuracy: 95.77%

Iteration:  74
Epoch 1/20
797/797 [==============================] - 3s 3ms/step - loss: 2.9346 -
accuracy: 0.1016 - val_loss: 2.3168 - val_accuracy: 0.1063
Epoch 2/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3154 -
accuracy: 0.1048 - val_loss: 2.3113 - val_accuracy: 0.0993
Epoch 3/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3171 -
accuracy: 0.0993 - val_loss: 2.3065 - val_accuracy: 0.1028
Epoch 4/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3152 -
accuracy: 0.1048 - val_loss: 2.3215 - val_accuracy: 0.0959
Epoch 5/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3148 -
accuracy: 0.1045 - val_loss: 2.3174 - val_accuracy: 0.1063
Epoch 6/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3159 -
accuracy: 0.1019 - val_loss: 2.3086 - val_accuracy: 0.0997
Epoch 7/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3153 -
accuracy: 0.1030 - val_loss: 2.3101 - val_accuracy: 0.1063
Epoch 8/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3146 -
accuracy: 0.1011 - val_loss: 2.3201 - val_accuracy: 0.1002
Epoch 9/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3157 -
accuracy: 0.1036 - val_loss: 2.3104 - val_accuracy: 0.0959
Epoch 10/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3160 -
accuracy: 0.1025 - val_loss: 2.3144 - val_accuracy: 0.0990
Epoch 11/20
```

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797/797 [==============================] - 2s 3ms/step - loss: 2.3149 -
accuracy: 0.1027 - val_loss: 2.3125 - val_accuracy: 0.1093
Epoch 12/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3154 -
accuracy: 0.1029 - val_loss: 2.3164 - val_accuracy: 0.1063
Epoch 13/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3151 -
accuracy: 0.1014 - val_loss: 2.3056 - val_accuracy: 0.1063
Epoch 14/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3135 -
accuracy: 0.1026 - val_loss: 2.3210 - val_accuracy: 0.0993
Epoch 15/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3144 -
accuracy: 0.1060 - val_loss: 2.3157 - val_accuracy: 0.1063
Epoch 16/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3152 -
accuracy: 0.1028 - val_loss: 2.3077 - val_accuracy: 0.1002
Epoch 17/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3155 -
accuracy: 0.1031 - val_loss: 2.3139 - val_accuracy: 0.0990
Epoch 18/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3162 -
accuracy: 0.1026 - val_loss: 2.3128 - val_accuracy: 0.0990
Epoch 19/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3155 -
accuracy: 0.1010 - val_loss: 2.3185 - val_accuracy: 0.0959
Epoch 20/20
797/797 [==============================] - 2s 3ms/step - loss: 2.3137 -
accuracy: 0.1028 - val_loss: 2.3192 - val_accuracy: 0.0993

Accuracy: 9.93%

Iteration:  75
Epoch 1/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3123 -
accuracy: 0.1046 - val_loss: 2.3191 - val_accuracy: 0.0993
Epoch 2/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3094 -
accuracy: 0.1048 - val_loss: 2.3051 - val_accuracy: 0.1028
Epoch 3/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3101 -
accuracy: 0.1032 - val_loss: 2.3094 - val_accuracy: 0.0959
Epoch 4/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3103 -
accuracy: 0.1040 - val_loss: 2.3035 - val_accuracy: 0.1063
Epoch 5/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3096 -
accuracy: 0.1066 - val_loss: 2.3118 - val_accuracy: 0.0997
```

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Epoch 6/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3101 -
accuracy: 0.1028 - val_loss: 2.3071 - val_accuracy: 0.0997
Epoch 7/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3112 -
accuracy: 0.1015 - val_loss: 2.3111 - val_accuracy: 0.1093
Epoch 8/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3095 -
accuracy: 0.1062 - val_loss: 2.3063 - val_accuracy: 0.1093
Epoch 9/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3102 -
accuracy: 0.1038 - val_loss: 2.3088 - val_accuracy: 0.0993
Epoch 10/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3102 -
accuracy: 0.1033 - val_loss: 2.3072 - val_accuracy: 0.1093
Epoch 11/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3107 -
accuracy: 0.1022 - val_loss: 2.3158 - val_accuracy: 0.0997
Epoch 12/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3098 -
accuracy: 0.1030 - val_loss: 2.3077 - val_accuracy: 0.0959
Epoch 13/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3106 -
accuracy: 0.1039 - val_loss: 2.3079 - val_accuracy: 0.1063
Epoch 14/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3100 -
accuracy: 0.1036 - val_loss: 2.3064 - val_accuracy: 0.1093
Epoch 15/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3092 -
accuracy: 0.1042 - val_loss: 2.3134 - val_accuracy: 0.1028
Epoch 16/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3100 -
accuracy: 0.1035 - val_loss: 2.3106 - val_accuracy: 0.1063
Epoch 17/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3098 -
accuracy: 0.1038 - val_loss: 2.3116 - val_accuracy: 0.1002
Epoch 18/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3102 -
accuracy: 0.1035 - val_loss: 2.3066 - val_accuracy: 0.0993
Epoch 19/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3103 -
accuracy: 0.1063 - val_loss: 2.3164 - val_accuracy: 0.1002
Epoch 20/20
1700/1700 [==============================] - 5s 3ms/step - loss: 2.3098 -
accuracy: 0.1043 - val_loss: 2.3080 - val_accuracy: 0.1093

Accuracy: 10.93%
```

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Iteration:  76
Epoch 1/20
456/456 [==============================] - 2s 3ms/step - loss: 2.3023 -
accuracy: 0.1118 - val_loss: 2.3030 - val_accuracy: 0.1028
Epoch 2/20
456/456 [==============================] - 1s 3ms/step - loss: 2.0504 -
accuracy: 0.1710 - val_loss: 1.7737 - val_accuracy: 0.2150
Epoch 3/20
456/456 [==============================] - 1s 3ms/step - loss: 1.6175 -
accuracy: 0.2798 - val_loss: 1.2340 - val_accuracy: 0.4396
Epoch 4/20
456/456 [==============================] - 1s 3ms/step - loss: 1.1956 -
accuracy: 0.4559 - val_loss: 1.1547 - val_accuracy: 0.4594
Epoch 5/20
456/456 [==============================] - 1s 3ms/step - loss: 1.0290 -
accuracy: 0.5959 - val_loss: 0.8522 - val_accuracy: 0.7101
Epoch 6/20
456/456 [==============================] - 1s 3ms/step - loss: 0.7784 -
accuracy: 0.7504 - val_loss: 0.6863 - val_accuracy: 0.8122
Epoch 7/20
456/456 [==============================] - 1s 3ms/step - loss: 0.6411 -
accuracy: 0.8428 - val_loss: 0.5647 - val_accuracy: 0.8994
Epoch 8/20
456/456 [==============================] - 1s 3ms/step - loss: 0.5162 -
accuracy: 0.9078 - val_loss: 0.4650 - val_accuracy: 0.9277
Epoch 9/20
456/456 [==============================] - 1s 3ms/step - loss: 0.4160 -
accuracy: 0.9303 - val_loss: 0.4086 - val_accuracy: 0.9356
Epoch 10/20
456/456 [==============================] - 1s 3ms/step - loss: 0.3603 -
accuracy: 0.9366 - val_loss: 0.3784 - val_accuracy: 0.9370
Epoch 11/20
456/456 [==============================] - 1s 3ms/step - loss: 0.3150 -
accuracy: 0.9448 - val_loss: 0.3666 - val_accuracy: 0.9428
Epoch 12/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2818 -
accuracy: 0.9483 - val_loss: 0.3461 - val_accuracy: 0.9421
Epoch 13/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2633 -
accuracy: 0.9514 - val_loss: 0.3241 - val_accuracy: 0.9429
Epoch 14/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2372 -
accuracy: 0.9551 - val_loss: 0.3496 - val_accuracy: 0.9418
Epoch 15/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2220 -
accuracy: 0.9583 - val_loss: 0.4124 - val_accuracy: 0.9200
Epoch 16/20
456/456 [==============================] - 1s 3ms/step - loss: 0.2147 -
```

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accuracy: 0.9578 - val_loss: 0.3063 - val_accuracy: 0.9461
Epoch 17/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1946 -
accuracy: 0.9627 - val_loss: 0.3128 - val_accuracy: 0.9470
Epoch 18/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1975 -
accuracy: 0.9605 - val_loss: 0.3137 - val_accuracy: 0.9468
Epoch 19/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1767 -
accuracy: 0.9649 - val_loss: 0.3287 - val_accuracy: 0.9456
Epoch 20/20
456/456 [==============================] - 1s 3ms/step - loss: 0.1689 -
accuracy: 0.9661 - val_loss: 0.3448 - val_accuracy: 0.9440

Accuracy: 94.40%

Iteration:  77
Epoch 1/20
740/740 [==============================] - 3s 3ms/step - loss: 2.3157 -
accuracy: 0.1042 - val_loss: 2.3343 - val_accuracy: 0.1063
Epoch 2/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3125 -
accuracy: 0.1045 - val_loss: 2.3192 - val_accuracy: 0.1002
Epoch 3/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3133 -
accuracy: 0.1050 - val_loss: 2.3167 - val_accuracy: 0.0993
Epoch 4/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3119 -
accuracy: 0.1037 - val_loss: 2.3108 - val_accuracy: 0.0990
Epoch 5/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3131 -
accuracy: 0.1050 - val_loss: 2.3147 - val_accuracy: 0.1063
Epoch 6/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3138 -
accuracy: 0.1050 - val_loss: 2.3136 - val_accuracy: 0.1063
Epoch 7/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3141 -
accuracy: 0.1047 - val_loss: 2.3109 - val_accuracy: 0.0993
Epoch 8/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3140 -
accuracy: 0.1054 - val_loss: 2.3037 - val_accuracy: 0.1093
Epoch 9/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3128 -
accuracy: 0.1040 - val_loss: 2.3083 - val_accuracy: 0.1028
Epoch 10/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3141 -
accuracy: 0.1031 - val_loss: 2.3075 - val_accuracy: 0.0990
Epoch 11/20
```

```
740/740 [==============================] - 2s 3ms/step - loss: 2.3143 -
accuracy: 0.1010 - val_loss: 2.3110 - val_accuracy: 0.0997
Epoch 12/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3138 -
accuracy: 0.1035 - val_loss: 2.3160 - val_accuracy: 0.0993
Epoch 13/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3140 -
accuracy: 0.1053 - val_loss: 2.3250 - val_accuracy: 0.1063
Epoch 14/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3130 -
accuracy: 0.1061 - val_loss: 2.3191 - val_accuracy: 0.1063
Epoch 15/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3141 -
accuracy: 0.1039 - val_loss: 2.3111 - val_accuracy: 0.1063
Epoch 16/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3136 -
accuracy: 0.1043 - val_loss: 2.3095 - val_accuracy: 0.1028
Epoch 17/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3133 -
accuracy: 0.1023 - val_loss: 2.3101 - val_accuracy: 0.1093
Epoch 18/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3135 -
accuracy: 0.1034 - val_loss: 2.3140 - val_accuracy: 0.0959
Epoch 19/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3146 -
accuracy: 0.1034 - val_loss: 2.3081 - val_accuracy: 0.0997
Epoch 20/20
740/740 [==============================] - 2s 3ms/step - loss: 2.3139 -
accuracy: 0.1032 - val_loss: 2.3253 - val_accuracy: 0.0997

Accuracy: 9.97%

Iteration:  78
Epoch 1/20
486/486 [==============================] - 2s 3ms/step - loss: 0.7386 -
accuracy: 0.7476 - val_loss: 0.2135 - val_accuracy: 0.9437
Epoch 2/20
486/486 [==============================] - 1s 3ms/step - loss: 0.1878 -
accuracy: 0.9496 - val_loss: 0.1637 - val_accuracy: 0.9556
Epoch 3/20
486/486 [==============================] - 1s 3ms/step - loss: 0.1379 -
accuracy: 0.9626 - val_loss: 0.1604 - val_accuracy: 0.9579
Epoch 4/20
486/486 [==============================] - 1s 3ms/step - loss: 0.1137 -
accuracy: 0.9683 - val_loss: 0.1186 - val_accuracy: 0.9694
Epoch 5/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0956 -
accuracy: 0.9736 - val_loss: 0.1351 - val_accuracy: 0.9691
```

```
Epoch 6/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0876 -
accuracy: 0.9755 - val_loss: 0.1272 - val_accuracy: 0.9707
Epoch 7/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0801 -
accuracy: 0.9782 - val_loss: 0.1835 - val_accuracy: 0.9640
Epoch 8/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0749 -
accuracy: 0.9790 - val_loss: 0.1444 - val_accuracy: 0.9680
Epoch 9/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0750 -
accuracy: 0.9796 - val_loss: 0.1652 - val_accuracy: 0.9683
Epoch 10/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0677 -
accuracy: 0.9815 - val_loss: 0.1730 - val_accuracy: 0.9677
Epoch 11/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0595 -
accuracy: 0.9829 - val_loss: 0.1696 - val_accuracy: 0.9653
Epoch 12/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0568 -
accuracy: 0.9846 - val_loss: 0.1729 - val_accuracy: 0.9721
Epoch 13/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0606 -
accuracy: 0.9838 - val_loss: 0.1881 - val_accuracy: 0.9690
Epoch 14/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0484 -
accuracy: 0.9861 - val_loss: 0.2192 - val_accuracy: 0.9680
Epoch 15/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0566 -
accuracy: 0.9853 - val_loss: 0.1882 - val_accuracy: 0.9671
Epoch 16/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0495 -
accuracy: 0.9863 - val_loss: 0.1878 - val_accuracy: 0.9689
Epoch 17/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0486 -
accuracy: 0.9865 - val_loss: 0.1912 - val_accuracy: 0.9696
Epoch 18/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0474 -
accuracy: 0.9875 - val_loss: 0.1883 - val_accuracy: 0.9704
Epoch 19/20
486/486 [==============================] - 2s 3ms/step - loss: 0.0490 -
accuracy: 0.9876 - val_loss: 0.2410 - val_accuracy: 0.9689
Epoch 20/20
486/486 [==============================] - 1s 3ms/step - loss: 0.0505 -
accuracy: 0.9874 - val_loss: 0.2091 - val_accuracy: 0.9698

Accuracy: 96.98%
```

```
Iteration:  79
Epoch 1/20
1086/1086 [==============================] - 4s 3ms/step - loss: 0.4854 -
accuracy: 0.8574 - val_loss: 0.2741 - val_accuracy: 0.9293
Epoch 2/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.2400 -
accuracy: 0.9347 - val_loss: 0.2523 - val_accuracy: 0.9361
Epoch 3/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.2160 -
accuracy: 0.9401 - val_loss: 0.1906 - val_accuracy: 0.9463
Epoch 4/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.2042 -
accuracy: 0.9446 - val_loss: 0.2043 - val_accuracy: 0.9487
Epoch 5/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1908 -
accuracy: 0.9470 - val_loss: 0.1945 - val_accuracy: 0.9462
Epoch 6/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1897 -
accuracy: 0.9469 - val_loss: 0.1790 - val_accuracy: 0.9483
Epoch 7/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1763 -
accuracy: 0.9492 - val_loss: 0.1793 - val_accuracy: 0.9551
Epoch 8/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1821 -
accuracy: 0.9491 - val_loss: 0.1652 - val_accuracy: 0.9549
Epoch 9/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1792 -
accuracy: 0.9490 - val_loss: 0.1799 - val_accuracy: 0.9543
Epoch 10/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1631 -
accuracy: 0.9543 - val_loss: 0.1786 - val_accuracy: 0.9471
Epoch 11/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1606 -
accuracy: 0.9550 - val_loss: 0.1838 - val_accuracy: 0.9479
Epoch 12/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1558 -
accuracy: 0.9558 - val_loss: 0.1699 - val_accuracy: 0.9560
Epoch 13/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1690 -
accuracy: 0.9524 - val_loss: 0.1732 - val_accuracy: 0.9547
Epoch 14/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1573 -
accuracy: 0.9557 - val_loss: 0.1611 - val_accuracy: 0.9564
Epoch 15/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1599 -
accuracy: 0.9549 - val_loss: 0.1960 - val_accuracy: 0.9469
Epoch 16/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1652 -
```

```
accuracy: 0.9543 - val_loss: 0.1624 - val_accuracy: 0.9573
Epoch 17/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1581 -
accuracy: 0.9563 - val_loss: 0.1693 - val_accuracy: 0.9552
Epoch 18/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1474 -
accuracy: 0.9582 - val_loss: 0.1545 - val_accuracy: 0.9577
Epoch 19/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1564 -
accuracy: 0.9557 - val_loss: 0.1716 - val_accuracy: 0.9543
Epoch 20/20
1086/1086 [==============================] - 3s 3ms/step - loss: 0.1611 -
accuracy: 0.9546 - val_loss: 0.1642 - val_accuracy: 0.9579

Accuracy: 95.79%

Iteration:  80
Epoch 1/20
460/460 [==============================] - 2s 3ms/step - loss: 2.1006 -
accuracy: 0.1655 - val_loss: 1.8602 - val_accuracy: 0.2099
Epoch 2/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8809 -
accuracy: 0.2027 - val_loss: 1.8239 - val_accuracy: 0.1913
Epoch 3/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8429 -
accuracy: 0.2002 - val_loss: 1.7901 - val_accuracy: 0.2040
Epoch 4/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8243 -
accuracy: 0.2008 - val_loss: 1.7871 - val_accuracy: 0.1974
Epoch 5/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8407 -
accuracy: 0.2013 - val_loss: 1.7890 - val_accuracy: 0.1947
Epoch 6/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8266 -
accuracy: 0.1993 - val_loss: 1.8011 - val_accuracy: 0.2006
Epoch 7/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8326 -
accuracy: 0.2017 - val_loss: 1.7991 - val_accuracy: 0.1939
Epoch 8/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8225 -
accuracy: 0.2029 - val_loss: 1.7874 - val_accuracy: 0.2121
Epoch 9/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8164 -
accuracy: 0.2007 - val_loss: 1.8087 - val_accuracy: 0.1959
Epoch 10/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8370 -
accuracy: 0.1994 - val_loss: 1.9290 - val_accuracy: 0.2136
Epoch 11/20
```

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460/460 [==============================] - 1s 3ms/step - loss: 1.8510 -
accuracy: 0.2013 - val_loss: 1.8631 - val_accuracy: 0.1998
Epoch 12/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8548 -
accuracy: 0.1954 - val_loss: 1.8168 - val_accuracy: 0.1988
Epoch 13/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8187 -
accuracy: 0.2015 - val_loss: 1.7904 - val_accuracy: 0.2104
Epoch 14/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8273 -
accuracy: 0.2039 - val_loss: 1.8051 - val_accuracy: 0.2001
Epoch 15/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8309 -
accuracy: 0.2011 - val_loss: 1.8224 - val_accuracy: 0.2044
Epoch 16/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8207 -
accuracy: 0.2032 - val_loss: 1.8143 - val_accuracy: 0.1893
Epoch 17/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8264 -
accuracy: 0.1991 - val_loss: 1.8898 - val_accuracy: 0.1928
Epoch 18/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8172 -
accuracy: 0.2053 - val_loss: 1.7981 - val_accuracy: 0.1969
Epoch 19/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8105 -
accuracy: 0.2033 - val_loss: 1.7864 - val_accuracy: 0.1992
Epoch 20/20
460/460 [==============================] - 1s 3ms/step - loss: 1.8155 -
accuracy: 0.2009 - val_loss: 1.7956 - val_accuracy: 0.2103

Accuracy: 21.03%

Iteration:  81
Epoch 1/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.8366 -
accuracy: 0.6942 - val_loss: 0.4817 - val_accuracy: 0.8233
Epoch 2/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.4304 -
accuracy: 0.8781 - val_loss: 0.3577 - val_accuracy: 0.9179
Epoch 3/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.3480 -
accuracy: 0.9163 - val_loss: 0.3001 - val_accuracy: 0.9291
Epoch 4/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.3382 -
accuracy: 0.9181 - val_loss: 0.2659 - val_accuracy: 0.9382
Epoch 5/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.3136 -
accuracy: 0.9246 - val_loss: 0.2891 - val_accuracy: 0.9360
```

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Epoch 6/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2990 -
accuracy: 0.9294 - val_loss: 0.2760 - val_accuracy: 0.9360
Epoch 7/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2933 -
accuracy: 0.9300 - val_loss: 0.2664 - val_accuracy: 0.9388
Epoch 8/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2845 -
accuracy: 0.9326 - val_loss: 0.2808 - val_accuracy: 0.9340
Epoch 9/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2790 -
accuracy: 0.9337 - val_loss: 0.2497 - val_accuracy: 0.9441
Epoch 10/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2693 -
accuracy: 0.9357 - val_loss: 0.2509 - val_accuracy: 0.9409
Epoch 11/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2715 -
accuracy: 0.9362 - val_loss: 0.2530 - val_accuracy: 0.9399
Epoch 12/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2551 -
accuracy: 0.9404 - val_loss: 0.2546 - val_accuracy: 0.9378
Epoch 13/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2548 -
accuracy: 0.9412 - val_loss: 0.2763 - val_accuracy: 0.9387
Epoch 14/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2446 -
accuracy: 0.9436 - val_loss: 0.2599 - val_accuracy: 0.9393
Epoch 15/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2446 -
accuracy: 0.9431 - val_loss: 0.2218 - val_accuracy: 0.9483
Epoch 16/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2327 -
accuracy: 0.9455 - val_loss: 0.2307 - val_accuracy: 0.9474
Epoch 17/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2421 -
accuracy: 0.9437 - val_loss: 0.2477 - val_accuracy: 0.9447
Epoch 18/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2219 -
accuracy: 0.9495 - val_loss: 0.2794 - val_accuracy: 0.9389
Epoch 19/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2338 -
accuracy: 0.9465 - val_loss: 0.2387 - val_accuracy: 0.9469
Epoch 20/20
1000/1000 [==============================] - 3s 3ms/step - loss: 0.2227 -
accuracy: 0.9485 - val_loss: 0.2333 - val_accuracy: 0.9463

Accuracy: 94.63%
```

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Iteration:  82
Epoch 1/20
537/537 [==============================] - 2s 3ms/step - loss: 0.9108 -
accuracy: 0.6513 - val_loss: 0.6963 - val_accuracy: 0.7149
Epoch 2/20
537/537 [==============================] - 2s 3ms/step - loss: 0.7984 -
accuracy: 0.6967 - val_loss: 1.0070 - val_accuracy: 0.5904
Epoch 3/20
537/537 [==============================] - 2s 3ms/step - loss: 1.4482 -
accuracy: 0.4770 - val_loss: 1.4437 - val_accuracy: 0.4628
Epoch 4/20
537/537 [==============================] - 2s 3ms/step - loss: 1.6160 -
accuracy: 0.3497 - val_loss: 1.4686 - val_accuracy: 0.3559
Epoch 5/20
537/537 [==============================] - 2s 3ms/step - loss: 1.8139 -
accuracy: 0.2725 - val_loss: 1.9532 - val_accuracy: 0.1772
Epoch 6/20
537/537 [==============================] - 2s 3ms/step - loss: 2.2907 -
accuracy: 0.1112 - val_loss: 2.3061 - val_accuracy: 0.1028
Epoch 7/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3043 -
accuracy: 0.1072 - val_loss: 2.3049 - val_accuracy: 0.1002
Epoch 8/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3050 -
accuracy: 0.1053 - val_loss: 2.3047 - val_accuracy: 0.1063
Epoch 9/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3040 -
accuracy: 0.1084 - val_loss: 2.3032 - val_accuracy: 0.0993
Epoch 10/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3047 -
accuracy: 0.1063 - val_loss: 2.3050 - val_accuracy: 0.1093
Epoch 11/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3045 -
accuracy: 0.1069 - val_loss: 2.3042 - val_accuracy: 0.1063
Epoch 12/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3040 -
accuracy: 0.1072 - val_loss: 2.3045 - val_accuracy: 0.1063
Epoch 13/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3048 -
accuracy: 0.1076 - val_loss: 2.3068 - val_accuracy: 0.0959
Epoch 14/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3047 -
accuracy: 0.1077 - val_loss: 2.3050 - val_accuracy: 0.1063
Epoch 15/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3046 -
accuracy: 0.1075 - val_loss: 2.3050 - val_accuracy: 0.1063
Epoch 16/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3043 -
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accuracy: 0.1067 - val_loss: 2.3066 - val_accuracy: 0.1063
Epoch 17/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3044 -
accuracy: 0.1085 - val_loss: 2.3078 - val_accuracy: 0.1063
Epoch 18/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3042 -
accuracy: 0.1063 - val_loss: 2.3059 - val_accuracy: 0.1028
Epoch 19/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3047 -
accuracy: 0.1040 - val_loss: 2.3054 - val_accuracy: 0.1063
Epoch 20/20
537/537 [==============================] - 2s 3ms/step - loss: 2.3043 -
accuracy: 0.1090 - val_loss: 2.3027 - val_accuracy: 0.1063

Accuracy: 10.63%

Iteration:  83
Epoch 1/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9204 -
accuracy: 0.2040 - val_loss: 1.8398 - val_accuracy: 0.2452
Epoch 2/20
663/663 [==============================] - 2s 3ms/step - loss: 1.8948 -
accuracy: 0.2128 - val_loss: 1.9917 - val_accuracy: 0.1846
Epoch 3/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9445 -
accuracy: 0.2043 - val_loss: 1.9876 - val_accuracy: 0.2136
Epoch 4/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9483 -
accuracy: 0.1997 - val_loss: 1.8906 - val_accuracy: 0.2010
Epoch 5/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9309 -
accuracy: 0.2034 - val_loss: 2.0158 - val_accuracy: 0.2048
Epoch 6/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9264 -
accuracy: 0.1994 - val_loss: 1.8965 - val_accuracy: 0.1881
Epoch 7/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9319 -
accuracy: 0.1956 - val_loss: 1.9198 - val_accuracy: 0.2003
Epoch 8/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9193 -
accuracy: 0.1984 - val_loss: 1.8761 - val_accuracy: 0.1842
Epoch 9/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9562 -
accuracy: 0.1984 - val_loss: 1.9330 - val_accuracy: 0.2109
Epoch 10/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9580 -
accuracy: 0.1997 - val_loss: 1.9473 - val_accuracy: 0.2100
Epoch 11/20
```

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663/663 [==============================] - 2s 3ms/step - loss: 1.9644 -
accuracy: 0.1946 - val_loss: 2.0280 - val_accuracy: 0.1874
Epoch 12/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9963 -
accuracy: 0.1950 - val_loss: 1.9311 - val_accuracy: 0.2113
Epoch 13/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9421 -
accuracy: 0.1998 - val_loss: 1.9104 - val_accuracy: 0.1878
Epoch 14/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9782 -
accuracy: 0.1977 - val_loss: 1.9410 - val_accuracy: 0.2003
Epoch 15/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9307 -
accuracy: 0.1972 - val_loss: 1.9399 - val_accuracy: 0.1866
Epoch 16/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9278 -
accuracy: 0.1983 - val_loss: 1.9027 - val_accuracy: 0.1897
Epoch 17/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9306 -
accuracy: 0.2015 - val_loss: 1.9354 - val_accuracy: 0.2002
Epoch 18/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9443 -
accuracy: 0.1977 - val_loss: 1.9096 - val_accuracy: 0.1936
Epoch 19/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9271 -
accuracy: 0.2039 - val_loss: 1.8830 - val_accuracy: 0.1919
Epoch 20/20
663/663 [==============================] - 2s 3ms/step - loss: 1.9228 -
accuracy: 0.2022 - val_loss: 1.8949 - val_accuracy: 0.2040

Accuracy: 20.40%

Iteration:  84
Epoch 1/20
719/719 [==============================] - 3s 3ms/step - loss: 0.5011 -
accuracy: 0.8587 - val_loss: 0.3048 - val_accuracy: 0.9256
Epoch 2/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3411 -
accuracy: 0.9170 - val_loss: 0.3036 - val_accuracy: 0.9249
Epoch 3/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3286 -
accuracy: 0.9197 - val_loss: 0.2931 - val_accuracy: 0.9359
Epoch 4/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3457 -
accuracy: 0.9179 - val_loss: 0.2879 - val_accuracy: 0.9247
Epoch 5/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3044 -
accuracy: 0.9252 - val_loss: 0.3337 - val_accuracy: 0.9373
```

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Epoch 6/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3207 -
accuracy: 0.9265 - val_loss: 0.2986 - val_accuracy: 0.9317
Epoch 7/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3148 -
accuracy: 0.9236 - val_loss: 0.3053 - val_accuracy: 0.9341
Epoch 8/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3112 -
accuracy: 0.9235 - val_loss: 0.2956 - val_accuracy: 0.9221
Epoch 9/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3620 -
accuracy: 0.9131 - val_loss: 0.4321 - val_accuracy: 0.8938
Epoch 10/20
719/719 [==============================] - 2s 3ms/step - loss: 0.4711 -
accuracy: 0.8841 - val_loss: 0.4730 - val_accuracy: 0.9023
Epoch 11/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3778 -
accuracy: 0.9094 - val_loss: 0.3507 - val_accuracy: 0.9192
Epoch 12/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3767 -
accuracy: 0.9099 - val_loss: 0.3118 - val_accuracy: 0.9316
Epoch 13/20
719/719 [==============================] - 2s 3ms/step - loss: 0.4385 -
accuracy: 0.8976 - val_loss: 0.4257 - val_accuracy: 0.9044
Epoch 14/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3863 -
accuracy: 0.9040 - val_loss: 0.3967 - val_accuracy: 0.8994
Epoch 15/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3827 -
accuracy: 0.9028 - val_loss: 0.3574 - val_accuracy: 0.9080
Epoch 16/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3805 -
accuracy: 0.9054 - val_loss: 0.4021 - val_accuracy: 0.9020
Epoch 17/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3544 -
accuracy: 0.9166 - val_loss: 0.3488 - val_accuracy: 0.9154
Epoch 18/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3585 -
accuracy: 0.9134 - val_loss: 0.2991 - val_accuracy: 0.9287
Epoch 19/20
719/719 [==============================] - 2s 3ms/step - loss: 0.3648 -
accuracy: 0.9108 - val_loss: 0.3370 - val_accuracy: 0.9309
Epoch 20/20
719/719 [==============================] - 2s 3ms/step - loss: 0.4584 -
accuracy: 0.8841 - val_loss: 0.4830 - val_accuracy: 0.8973

Accuracy: 89.73%
```

```
Iteration:  85
Epoch 1/20
762/762 [==============================] - 3s 3ms/step - loss: 0.6680 -
accuracy: 0.8162 - val_loss: 0.3267 - val_accuracy: 0.9171
Epoch 2/20
762/762 [==============================] - 2s 3ms/step - loss: 0.3117 -
accuracy: 0.9216 - val_loss: 0.2684 - val_accuracy: 0.9313
Epoch 3/20
762/762 [==============================] - 2s 3ms/step - loss: 0.2654 -
accuracy: 0.9338 - val_loss: 0.2198 - val_accuracy: 0.9451
Epoch 4/20
762/762 [==============================] - 2s 3ms/step - loss: 0.2375 -
accuracy: 0.9399 - val_loss: 0.2212 - val_accuracy: 0.9453
Epoch 5/20
762/762 [==============================] - 2s 3ms/step - loss: 0.2174 -
accuracy: 0.9450 - val_loss: 0.2119 - val_accuracy: 0.9463
Epoch 6/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1997 -
accuracy: 0.9486 - val_loss: 0.1974 - val_accuracy: 0.9539
Epoch 7/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1916 -
accuracy: 0.9501 - val_loss: 0.2039 - val_accuracy: 0.9501
Epoch 8/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1781 -
accuracy: 0.9545 - val_loss: 0.2011 - val_accuracy: 0.9522
Epoch 9/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1730 -
accuracy: 0.9556 - val_loss: 0.1863 - val_accuracy: 0.9556
Epoch 10/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1647 -
accuracy: 0.9570 - val_loss: 0.1963 - val_accuracy: 0.9488
Epoch 11/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1632 -
accuracy: 0.9576 - val_loss: 0.1783 - val_accuracy: 0.9551
Epoch 12/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1563 -
accuracy: 0.9594 - val_loss: 0.1699 - val_accuracy: 0.9568
Epoch 13/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1471 -
accuracy: 0.9612 - val_loss: 0.1541 - val_accuracy: 0.9633
Epoch 14/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1382 -
accuracy: 0.9634 - val_loss: 0.1781 - val_accuracy: 0.9560
Epoch 15/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1410 -
accuracy: 0.9620 - val_loss: 0.1920 - val_accuracy: 0.9510
Epoch 16/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1389 -
```

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accuracy: 0.9634 - val_loss: 0.1591 - val_accuracy: 0.9617
Epoch 17/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1301 -
accuracy: 0.9658 - val_loss: 0.1722 - val_accuracy: 0.9591
Epoch 18/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1314 -
accuracy: 0.9654 - val_loss: 0.1672 - val_accuracy: 0.9608
Epoch 19/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1233 -
accuracy: 0.9679 - val_loss: 0.1812 - val_accuracy: 0.9552
Epoch 20/20
762/762 [==============================] - 2s 3ms/step - loss: 0.1219 -
accuracy: 0.9678 - val_loss: 0.1800 - val_accuracy: 0.9578

Accuracy: 95.78%

Iteration:  86
Epoch 1/20
505/505 [==============================] - 2s 3ms/step - loss: 1.0617 -
accuracy: 0.6823 - val_loss: 0.6329 - val_accuracy: 0.7810
Epoch 2/20
505/505 [==============================] - 2s 3ms/step - loss: 0.5390 -
accuracy: 0.8494 - val_loss: 0.4105 - val_accuracy: 0.9071
Epoch 3/20
505/505 [==============================] - 2s 3ms/step - loss: 0.4020 -
accuracy: 0.9080 - val_loss: 0.3437 - val_accuracy: 0.9254
Epoch 4/20
505/505 [==============================] - 2s 3ms/step - loss: 0.3466 -
accuracy: 0.9221 - val_loss: 0.3186 - val_accuracy: 0.9327
Epoch 5/20
505/505 [==============================] - 2s 3ms/step - loss: 0.3102 -
accuracy: 0.9317 - val_loss: 0.2761 - val_accuracy: 0.9409
Epoch 6/20
505/505 [==============================] - 2s 3ms/step - loss: 0.2867 -
accuracy: 0.9351 - val_loss: 0.2916 - val_accuracy: 0.9356
Epoch 7/20
505/505 [==============================] - 2s 3ms/step - loss: 0.2668 -
accuracy: 0.9397 - val_loss: 0.2856 - val_accuracy: 0.9399
Epoch 8/20
505/505 [==============================] - 2s 3ms/step - loss: 0.2642 -
accuracy: 0.9396 - val_loss: 0.2771 - val_accuracy: 0.9389
Epoch 9/20
505/505 [==============================] - 2s 3ms/step - loss: 0.2424 -
accuracy: 0.9456 - val_loss: 0.2307 - val_accuracy: 0.9470
Epoch 10/20
505/505 [==============================] - 2s 3ms/step - loss: 0.2300 -
accuracy: 0.9470 - val_loss: 0.2501 - val_accuracy: 0.9486
Epoch 11/20
```

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505/505 [==============================] - 2s 3ms/step - loss: 0.2187 -
accuracy: 0.9512 - val_loss: 0.2413 - val_accuracy: 0.9482
Epoch 12/20
505/505 [==============================] - 2s 3ms/step - loss: 0.2109 -
accuracy: 0.9522 - val_loss: 0.2549 - val_accuracy: 0.9439
Epoch 13/20
505/505 [==============================] - 2s 3ms/step - loss: 0.2132 -
accuracy: 0.9518 - val_loss: 0.2600 - val_accuracy: 0.9407
Epoch 14/20
505/505 [==============================] - 2s 3ms/step - loss: 0.2134 -
accuracy: 0.9514 - val_loss: 0.2641 - val_accuracy: 0.9423
Epoch 15/20
505/505 [==============================] - 2s 3ms/step - loss: 0.1985 -
accuracy: 0.9556 - val_loss: 0.2213 - val_accuracy: 0.9528
Epoch 16/20
505/505 [==============================] - 2s 3ms/step - loss: 0.1882 -
accuracy: 0.9576 - val_loss: 0.2305 - val_accuracy: 0.9512
Epoch 17/20
505/505 [==============================] - 2s 3ms/step - loss: 0.1910 -
accuracy: 0.9568 - val_loss: 0.2262 - val_accuracy: 0.9516
Epoch 18/20
505/505 [==============================] - 2s 3ms/step - loss: 0.1917 -
accuracy: 0.9561 - val_loss: 0.2078 - val_accuracy: 0.9559
Epoch 19/20
505/505 [==============================] - 2s 3ms/step - loss: 0.1753 -
accuracy: 0.9607 - val_loss: 0.2179 - val_accuracy: 0.9523
Epoch 20/20
505/505 [==============================] - 2s 3ms/step - loss: 0.1875 -
accuracy: 0.9581 - val_loss: 0.2241 - val_accuracy: 0.9509

Accuracy: 95.09%

Iteration:  87
Epoch 1/20
516/516 [==============================] - 2s 3ms/step - loss: 1.0050 -
accuracy: 0.6190 - val_loss: 0.6169 - val_accuracy: 0.7463
Epoch 2/20
516/516 [==============================] - 2s 3ms/step - loss: 0.5381 -
accuracy: 0.7887 - val_loss: 0.2711 - val_accuracy: 0.9339
Epoch 3/20
516/516 [==============================] - 2s 3ms/step - loss: 0.2334 -
accuracy: 0.9399 - val_loss: 0.1820 - val_accuracy: 0.9539
Epoch 4/20
516/516 [==============================] - 2s 3ms/step - loss: 0.1606 -
accuracy: 0.9580 - val_loss: 0.1785 - val_accuracy: 0.9546
Epoch 5/20
516/516 [==============================] - 2s 3ms/step - loss: 0.1315 -
accuracy: 0.9655 - val_loss: 0.1686 - val_accuracy: 0.9561
```

```
Epoch 6/20
516/516 [==============================] - 2s 3ms/step - loss: 0.1130 -
accuracy: 0.9706 - val_loss: 0.1483 - val_accuracy: 0.9613
Epoch 7/20
516/516 [==============================] - 2s 3ms/step - loss: 0.1029 -
accuracy: 0.9732 - val_loss: 0.1542 - val_accuracy: 0.9636
Epoch 8/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0856 -
accuracy: 0.9766 - val_loss: 0.1607 - val_accuracy: 0.9618
Epoch 9/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0837 -
accuracy: 0.9776 - val_loss: 0.1286 - val_accuracy: 0.9699
Epoch 10/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0720 -
accuracy: 0.9808 - val_loss: 0.1409 - val_accuracy: 0.9673
Epoch 11/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0682 -
accuracy: 0.9811 - val_loss: 0.1526 - val_accuracy: 0.9649
Epoch 12/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0670 -
accuracy: 0.9819 - val_loss: 0.1599 - val_accuracy: 0.9641
Epoch 13/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0556 -
accuracy: 0.9854 - val_loss: 0.1472 - val_accuracy: 0.9669
Epoch 14/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0547 -
accuracy: 0.9852 - val_loss: 0.1272 - val_accuracy: 0.9714
Epoch 15/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0429 -
accuracy: 0.9883 - val_loss: 0.1483 - val_accuracy: 0.9677
Epoch 16/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0474 -
accuracy: 0.9875 - val_loss: 0.1621 - val_accuracy: 0.9684
Epoch 17/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0498 -
accuracy: 0.9873 - val_loss: 0.1376 - val_accuracy: 0.9696
Epoch 18/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0463 -
accuracy: 0.9877 - val_loss: 0.1530 - val_accuracy: 0.9704
Epoch 19/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0375 -
accuracy: 0.9899 - val_loss: 0.1536 - val_accuracy: 0.9704
Epoch 20/20
516/516 [==============================] - 2s 3ms/step - loss: 0.0381 -
accuracy: 0.9898 - val_loss: 0.1436 - val_accuracy: 0.9682

Accuracy: 96.82%
```

```
Iteration:  88
Epoch 1/20
740/740 [==============================] - 3s 3ms/step - loss: 1.7714 -
accuracy: 0.3036 - val_loss: 1.4375 - val_accuracy: 0.3700
Epoch 2/20
740/740 [==============================] - 2s 3ms/step - loss: 1.3639 -
accuracy: 0.4394 - val_loss: 1.2831 - val_accuracy: 0.4684
Epoch 3/20
740/740 [==============================] - 2s 3ms/step - loss: 1.2514 -
accuracy: 0.4787 - val_loss: 1.2163 - val_accuracy: 0.4720
Epoch 4/20
740/740 [==============================] - 2s 3ms/step - loss: 1.1827 -
accuracy: 0.4848 - val_loss: 1.1616 - val_accuracy: 0.4798
Epoch 5/20
740/740 [==============================] - 2s 3ms/step - loss: 1.1292 -
accuracy: 0.4933 - val_loss: 1.1979 - val_accuracy: 0.4690
Epoch 6/20
740/740 [==============================] - 2s 3ms/step - loss: 1.1025 -
accuracy: 0.5038 - val_loss: 1.1165 - val_accuracy: 0.5378
Epoch 7/20
740/740 [==============================] - 2s 3ms/step - loss: 1.0658 -
accuracy: 0.5260 - val_loss: 1.1083 - val_accuracy: 0.5111
Epoch 8/20
740/740 [==============================] - 2s 3ms/step - loss: 1.0436 -
accuracy: 0.5344 - val_loss: 1.1026 - val_accuracy: 0.5318
Epoch 9/20
740/740 [==============================] - 2s 3ms/step - loss: 1.0299 -
accuracy: 0.5440 - val_loss: 1.1110 - val_accuracy: 0.5282
Epoch 10/20
740/740 [==============================] - 2s 3ms/step - loss: 1.0162 -
accuracy: 0.5431 - val_loss: 1.1135 - val_accuracy: 0.5296
Epoch 11/20
740/740 [==============================] - 2s 3ms/step - loss: 0.9980 -
accuracy: 0.5506 - val_loss: 1.1678 - val_accuracy: 0.5386
Epoch 12/20
740/740 [==============================] - 2s 3ms/step - loss: 0.9841 -
accuracy: 0.5633 - val_loss: 1.0975 - val_accuracy: 0.5687
Epoch 13/20
740/740 [==============================] - 2s 3ms/step - loss: 0.9711 -
accuracy: 0.6110 - val_loss: 1.0985 - val_accuracy: 0.6024
Epoch 14/20
740/740 [==============================] - 2s 3ms/step - loss: 0.9481 -
accuracy: 0.6236 - val_loss: 1.0761 - val_accuracy: 0.5967
Epoch 15/20
740/740 [==============================] - 2s 3ms/step - loss: 0.9461 -
accuracy: 0.6247 - val_loss: 1.1247 - val_accuracy: 0.6141
Epoch 16/20
740/740 [==============================] - 2s 3ms/step - loss: 0.9199 -
```

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accuracy: 0.6312 - val_loss: 1.1124 - val_accuracy: 0.6128
Epoch 17/20
740/740 [==============================] - 2s 3ms/step - loss: 0.9151 -
accuracy: 0.6318 - val_loss: 1.1261 - val_accuracy: 0.6060
Epoch 18/20
740/740 [==============================] - 2s 3ms/step - loss: 0.9061 -
accuracy: 0.6322 - val_loss: 1.1887 - val_accuracy: 0.6200
Epoch 19/20
740/740 [==============================] - 2s 3ms/step - loss: 0.9183 -
accuracy: 0.6316 - val_loss: 1.0883 - val_accuracy: 0.6142
Epoch 20/20
740/740 [==============================] - 2s 3ms/step - loss: 0.8918 -
accuracy: 0.6349 - val_loss: 1.1167 - val_accuracy: 0.6221

Accuracy: 62.21%

Iteration:  89
Epoch 1/20
500/500 [==============================] - 2s 3ms/step - loss: 2.3132 -
accuracy: 0.1061 - val_loss: 2.3138 - val_accuracy: 0.0993
Epoch 2/20
500/500 [==============================] - 2s 3ms/step - loss: 2.3118 -
accuracy: 0.1060 - val_loss: 2.3084 - val_accuracy: 0.0959
Epoch 3/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3121 -
accuracy: 0.1026 - val_loss: 2.3096 - val_accuracy: 0.1002
Epoch 4/20
500/500 [==============================] - 2s 3ms/step - loss: 2.3111 -
accuracy: 0.1035 - val_loss: 2.3116 - val_accuracy: 0.1063
Epoch 5/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3121 -
accuracy: 0.1022 - val_loss: 2.3105 - val_accuracy: 0.1093
Epoch 6/20
500/500 [==============================] - 2s 3ms/step - loss: 2.3123 -
accuracy: 0.1047 - val_loss: 2.3139 - val_accuracy: 0.1063
Epoch 7/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3125 -
accuracy: 0.1030 - val_loss: 2.3207 - val_accuracy: 0.1063
Epoch 8/20
500/500 [==============================] - 2s 3ms/step - loss: 2.3120 -
accuracy: 0.1025 - val_loss: 2.3111 - val_accuracy: 0.0959
Epoch 9/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3121 -
accuracy: 0.1032 - val_loss: 2.3117 - val_accuracy: 0.0997
Epoch 10/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3120 -
accuracy: 0.1048 - val_loss: 2.3053 - val_accuracy: 0.1093
Epoch 11/20
```

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500/500 [==============================] - 2s 3ms/step - loss: 2.3111 -
accuracy: 0.1033 - val_loss: 2.3176 - val_accuracy: 0.1063
Epoch 12/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3125 -
accuracy: 0.1042 - val_loss: 2.3084 - val_accuracy: 0.1028
Epoch 13/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3118 -
accuracy: 0.1040 - val_loss: 2.3097 - val_accuracy: 0.1093
Epoch 14/20
500/500 [==============================] - 2s 3ms/step - loss: 2.3120 -
accuracy: 0.1032 - val_loss: 2.3211 - val_accuracy: 0.0959
Epoch 15/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3103 -
accuracy: 0.1026 - val_loss: 2.3149 - val_accuracy: 0.1002
Epoch 16/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3113 -
accuracy: 0.1052 - val_loss: 2.3106 - val_accuracy: 0.0997
Epoch 17/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3116 -
accuracy: 0.1030 - val_loss: 2.3090 - val_accuracy: 0.1028
Epoch 18/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3120 -
accuracy: 0.1032 - val_loss: 2.3093 - val_accuracy: 0.0993
Epoch 19/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3132 -
accuracy: 0.1010 - val_loss: 2.3076 - val_accuracy: 0.0959
Epoch 20/20
500/500 [==============================] - 1s 3ms/step - loss: 2.3111 -
accuracy: 0.1051 - val_loss: 2.3061 - val_accuracy: 0.1093

Accuracy: 10.93%

Iteration:  90
Epoch 1/20
482/482 [==============================] - 2s 3ms/step - loss: 0.3684 -
accuracy: 0.8994 - val_loss: 0.1407 - val_accuracy: 0.9580
Epoch 2/20
482/482 [==============================] - 1s 3ms/step - loss: 0.1105 -
accuracy: 0.9671 - val_loss: 0.0971 - val_accuracy: 0.9716
Epoch 3/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0795 -
accuracy: 0.9759 - val_loss: 0.0875 - val_accuracy: 0.9742
Epoch 4/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0652 -
accuracy: 0.9795 - val_loss: 0.0884 - val_accuracy: 0.9738
Epoch 5/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0490 -
accuracy: 0.9850 - val_loss: 0.1010 - val_accuracy: 0.9712
```

```
Epoch 6/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0444 -
accuracy: 0.9858 - val_loss: 0.0886 - val_accuracy: 0.9748
Epoch 7/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0403 -
accuracy: 0.9871 - val_loss: 0.0929 - val_accuracy: 0.9737
Epoch 8/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0389 -
accuracy: 0.9869 - val_loss: 0.1035 - val_accuracy: 0.9728
Epoch 9/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0368 -
accuracy: 0.9878 - val_loss: 0.1192 - val_accuracy: 0.9682
Epoch 10/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0314 -
accuracy: 0.9893 - val_loss: 0.0991 - val_accuracy: 0.9750
Epoch 11/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0287 -
accuracy: 0.9904 - val_loss: 0.1001 - val_accuracy: 0.9756
Epoch 12/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0312 -
accuracy: 0.9896 - val_loss: 0.1078 - val_accuracy: 0.9739
Epoch 13/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0321 -
accuracy: 0.9894 - val_loss: 0.1097 - val_accuracy: 0.9719
Epoch 14/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0276 -
accuracy: 0.9907 - val_loss: 0.1023 - val_accuracy: 0.9767
Epoch 15/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0274 -
accuracy: 0.9907 - val_loss: 0.0967 - val_accuracy: 0.9762
Epoch 16/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0254 -
accuracy: 0.9916 - val_loss: 0.1138 - val_accuracy: 0.9734
Epoch 17/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0287 -
accuracy: 0.9904 - val_loss: 0.1122 - val_accuracy: 0.9742
Epoch 18/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0271 -
accuracy: 0.9907 - val_loss: 0.1077 - val_accuracy: 0.9761
Epoch 19/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0258 -
accuracy: 0.9920 - val_loss: 0.1100 - val_accuracy: 0.9744
Epoch 20/20
482/482 [==============================] - 1s 3ms/step - loss: 0.0232 -
accuracy: 0.9923 - val_loss: 0.1054 - val_accuracy: 0.9766

Accuracy: 97.66%
```

```
Iteration:  91
Epoch 1/20
555/555 [==============================] - 2s 4ms/step - loss: 3.6071 -
accuracy: 0.1043 - val_loss: 2.3051 - val_accuracy: 0.0993
Epoch 2/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3098 -
accuracy: 0.1029 - val_loss: 2.3072 - val_accuracy: 0.0997
Epoch 3/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3105 -
accuracy: 0.1034 - val_loss: 2.3199 - val_accuracy: 0.0916
Epoch 4/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3118 -
accuracy: 0.1054 - val_loss: 2.3262 - val_accuracy: 0.1063
Epoch 5/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3107 -
accuracy: 0.1020 - val_loss: 2.3137 - val_accuracy: 0.1063
Epoch 6/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3117 -
accuracy: 0.1040 - val_loss: 2.3143 - val_accuracy: 0.0990
Epoch 7/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3109 -
accuracy: 0.1032 - val_loss: 2.3089 - val_accuracy: 0.0959
Epoch 8/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3102 -
accuracy: 0.1028 - val_loss: 2.3086 - val_accuracy: 0.0916
Epoch 9/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3105 -
accuracy: 0.1047 - val_loss: 2.3122 - val_accuracy: 0.0959
Epoch 10/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3107 -
accuracy: 0.1023 - val_loss: 2.3198 - val_accuracy: 0.0997
Epoch 11/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3113 -
accuracy: 0.1030 - val_loss: 2.3055 - val_accuracy: 0.0993
Epoch 12/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3107 -
accuracy: 0.1044 - val_loss: 2.3097 - val_accuracy: 0.1028
Epoch 13/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3125 -
accuracy: 0.1047 - val_loss: 2.3066 - val_accuracy: 0.0990
Epoch 14/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3112 -
accuracy: 0.1016 - val_loss: 2.3135 - val_accuracy: 0.1063
Epoch 15/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3132 -
accuracy: 0.1031 - val_loss: 2.3078 - val_accuracy: 0.0997
Epoch 16/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3109 -
```

```
accuracy: 0.1053 - val_loss: 2.3065 - val_accuracy: 0.1028
Epoch 17/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3121 -
accuracy: 0.1030 - val_loss: 2.3118 - val_accuracy: 0.0993
Epoch 18/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3121 -
accuracy: 0.1027 - val_loss: 2.3127 - val_accuracy: 0.1063
Epoch 19/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3115 -
accuracy: 0.1017 - val_loss: 2.3098 - val_accuracy: 0.1063
Epoch 20/20
555/555 [==============================] - 2s 3ms/step - loss: 2.3112 -
accuracy: 0.1036 - val_loss: 2.3173 - val_accuracy: 0.1063

Accuracy: 10.63%

Iteration:  92
Epoch 1/20
762/762 [==============================] - 3s 3ms/step - loss: 2.3121 -
accuracy: 0.1061 - val_loss: 2.3122 - val_accuracy: 0.0959
Epoch 2/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3057 -
accuracy: 0.1069 - val_loss: 2.3064 - val_accuracy: 0.1002
Epoch 3/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3061 -
accuracy: 0.1057 - val_loss: 2.3054 - val_accuracy: 0.1063
Epoch 4/20
762/762 [==============================] - 3s 3ms/step - loss: 2.3060 -
accuracy: 0.1045 - val_loss: 2.3070 - val_accuracy: 0.1063
Epoch 5/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3054 -
accuracy: 0.1074 - val_loss: 2.3045 - val_accuracy: 0.1063
Epoch 6/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3058 -
accuracy: 0.1047 - val_loss: 2.3042 - val_accuracy: 0.1093
Epoch 7/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3058 -
accuracy: 0.1083 - val_loss: 2.3056 - val_accuracy: 0.1093
Epoch 8/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3056 -
accuracy: 0.1053 - val_loss: 2.3094 - val_accuracy: 0.1028
Epoch 9/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3059 -
accuracy: 0.1046 - val_loss: 2.3068 - val_accuracy: 0.0990
Epoch 10/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3056 -
accuracy: 0.1070 - val_loss: 2.3065 - val_accuracy: 0.1093
Epoch 11/20
```

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762/762 [==============================] - 2s 3ms/step - loss: 2.3065 -
accuracy: 0.1042 - val_loss: 2.3050 - val_accuracy: 0.1063
Epoch 12/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3056 -
accuracy: 0.1051 - val_loss: 2.3090 - val_accuracy: 0.0997
Epoch 13/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3058 -
accuracy: 0.1055 - val_loss: 2.3041 - val_accuracy: 0.1063
Epoch 14/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3069 -
accuracy: 0.1030 - val_loss: 2.3073 - val_accuracy: 0.1063
Epoch 15/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3060 -
accuracy: 0.1066 - val_loss: 2.3164 - val_accuracy: 0.0959
Epoch 16/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3059 -
accuracy: 0.1072 - val_loss: 2.3058 - val_accuracy: 0.1063
Epoch 17/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3057 -
accuracy: 0.1059 - val_loss: 2.3042 - val_accuracy: 0.0990
Epoch 18/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3060 -
accuracy: 0.1057 - val_loss: 2.3061 - val_accuracy: 0.0990
Epoch 19/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3056 -
accuracy: 0.1075 - val_loss: 2.3037 - val_accuracy: 0.1093
Epoch 20/20
762/762 [==============================] - 2s 3ms/step - loss: 2.3054 -
accuracy: 0.1047 - val_loss: 2.3054 - val_accuracy: 0.1093

Accuracy: 10.93%

Iteration:  93
Epoch 1/20
402/402 [==============================] - 2s 4ms/step - loss: 1.1968 -
accuracy: 0.6380 - val_loss: 0.3616 - val_accuracy: 0.9403
Epoch 2/20
402/402 [==============================] - 1s 3ms/step - loss: 0.2461 -
accuracy: 0.9481 - val_loss: 0.1817 - val_accuracy: 0.9588
Epoch 3/20
402/402 [==============================] - 1s 3ms/step - loss: 0.1424 -
accuracy: 0.9661 - val_loss: 0.1489 - val_accuracy: 0.9640
Epoch 4/20
402/402 [==============================] - 1s 3ms/step - loss: 0.1014 -
accuracy: 0.9752 - val_loss: 0.1326 - val_accuracy: 0.9667
Epoch 5/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0800 -
accuracy: 0.9810 - val_loss: 0.1271 - val_accuracy: 0.9706
```

```
Epoch 6/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0626 -
accuracy: 0.9844 - val_loss: 0.1209 - val_accuracy: 0.9721
Epoch 7/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0533 -
accuracy: 0.9864 - val_loss: 0.1247 - val_accuracy: 0.9707
Epoch 8/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0445 -
accuracy: 0.9886 - val_loss: 0.1194 - val_accuracy: 0.9717
Epoch 9/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0388 -
accuracy: 0.9902 - val_loss: 0.1196 - val_accuracy: 0.9744
Epoch 10/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0390 -
accuracy: 0.9895 - val_loss: 0.1126 - val_accuracy: 0.9740
Epoch 11/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0334 -
accuracy: 0.9912 - val_loss: 0.1104 - val_accuracy: 0.9744
Epoch 12/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0291 -
accuracy: 0.9923 - val_loss: 0.1234 - val_accuracy: 0.9730
Epoch 13/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0266 -
accuracy: 0.9928 - val_loss: 0.1159 - val_accuracy: 0.9750
Epoch 14/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0257 -
accuracy: 0.9933 - val_loss: 0.1238 - val_accuracy: 0.9717
Epoch 15/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0243 -
accuracy: 0.9932 - val_loss: 0.1269 - val_accuracy: 0.9733
Epoch 16/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0234 -
accuracy: 0.9932 - val_loss: 0.1199 - val_accuracy: 0.9742
Epoch 17/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0225 -
accuracy: 0.9937 - val_loss: 0.1215 - val_accuracy: 0.9753
Epoch 18/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0187 -
accuracy: 0.9951 - val_loss: 0.1202 - val_accuracy: 0.9761
Epoch 19/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0160 -
accuracy: 0.9958 - val_loss: 0.1259 - val_accuracy: 0.9723
Epoch 20/20
402/402 [==============================] - 1s 3ms/step - loss: 0.0196 -
accuracy: 0.9948 - val_loss: 0.1236 - val_accuracy: 0.9762

Accuracy: 97.62%
```

```
Iteration:  94
Epoch 1/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3349 -
accuracy: 0.1052 - val_loss: 2.3071 - val_accuracy: 0.1093
Epoch 2/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3082 -
accuracy: 0.1045 - val_loss: 2.3081 - val_accuracy: 0.1093
Epoch 3/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3088 -
accuracy: 0.1033 - val_loss: 2.3063 - val_accuracy: 0.1063
Epoch 4/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3081 -
accuracy: 0.1030 - val_loss: 2.3082 - val_accuracy: 0.0959
Epoch 5/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3077 -
accuracy: 0.1054 - val_loss: 2.3078 - val_accuracy: 0.0993
Epoch 6/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3081 -
accuracy: 0.1046 - val_loss: 2.3114 - val_accuracy: 0.1063
Epoch 7/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3078 -
accuracy: 0.1065 - val_loss: 2.3092 - val_accuracy: 0.0959
Epoch 8/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3082 -
accuracy: 0.1062 - val_loss: 2.3063 - val_accuracy: 0.1002
Epoch 9/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3086 -
accuracy: 0.1046 - val_loss: 2.3055 - val_accuracy: 0.0993
Epoch 10/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3080 -
accuracy: 0.1021 - val_loss: 2.3067 - val_accuracy: 0.0990
Epoch 11/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3089 -
accuracy: 0.1045 - val_loss: 2.3087 - val_accuracy: 0.0997
Epoch 12/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3080 -
accuracy: 0.1042 - val_loss: 2.3070 - val_accuracy: 0.1093
Epoch 13/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3087 -
accuracy: 0.1034 - val_loss: 2.3077 - val_accuracy: 0.1002
Epoch 14/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3075 -
accuracy: 0.1047 - val_loss: 2.3096 - val_accuracy: 0.1002
Epoch 15/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3095 -
accuracy: 0.1021 - val_loss: 2.3082 - val_accuracy: 0.0959
Epoch 16/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3079 -
```

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accuracy: 0.1043 - val_loss: 2.3082 - val_accuracy: 0.1063
Epoch 17/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3081 -
accuracy: 0.1040 - val_loss: 2.3078 - val_accuracy: 0.1063
Epoch 18/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3079 -
accuracy: 0.1039 - val_loss: 2.3052 - val_accuracy: 0.0959
Epoch 19/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3087 -
accuracy: 0.1039 - val_loss: 2.3073 - val_accuracy: 0.1093
Epoch 20/20
880/880 [==============================] - 3s 3ms/step - loss: 2.3081 -
accuracy: 0.1072 - val_loss: 2.3093 - val_accuracy: 0.0997

Accuracy: 9.97%

Iteration:  95
Epoch 1/20
1160/1160 [==============================] - 4s 3ms/step - loss: 0.7559 -
accuracy: 0.7346 - val_loss: 0.4046 - val_accuracy: 0.8974
Epoch 2/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.3391 -
accuracy: 0.9148 - val_loss: 0.3903 - val_accuracy: 0.8932
Epoch 3/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.3026 -
accuracy: 0.9226 - val_loss: 0.2741 - val_accuracy: 0.9298
Epoch 4/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2767 -
accuracy: 0.9302 - val_loss: 0.2792 - val_accuracy: 0.9283
Epoch 5/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2718 -
accuracy: 0.9323 - val_loss: 0.2267 - val_accuracy: 0.9468
Epoch 6/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2661 -
accuracy: 0.9331 - val_loss: 0.2389 - val_accuracy: 0.9456
Epoch 7/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2633 -
accuracy: 0.9347 - val_loss: 0.2389 - val_accuracy: 0.9448
Epoch 8/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2454 -
accuracy: 0.9394 - val_loss: 0.2273 - val_accuracy: 0.9476
Epoch 9/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2468 -
accuracy: 0.9395 - val_loss: 0.2346 - val_accuracy: 0.9459
Epoch 10/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2474 -
accuracy: 0.9393 - val_loss: 0.2265 - val_accuracy: 0.9479
Epoch 11/20
```

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1160/1160 [==============================] - 3s 3ms/step - loss: 0.2355 -
accuracy: 0.9430 - val_loss: 0.2319 - val_accuracy: 0.9466
Epoch 12/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2350 -
accuracy: 0.9417 - val_loss: 0.2273 - val_accuracy: 0.9497
Epoch 13/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2331 -
accuracy: 0.9452 - val_loss: 0.2356 - val_accuracy: 0.9446
Epoch 14/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2378 -
accuracy: 0.9427 - val_loss: 0.2395 - val_accuracy: 0.9426
Epoch 15/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2475 -
accuracy: 0.9395 - val_loss: 0.2365 - val_accuracy: 0.9450
Epoch 16/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2394 -
accuracy: 0.9424 - val_loss: 0.2442 - val_accuracy: 0.9424
Epoch 17/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2254 -
accuracy: 0.9473 - val_loss: 0.2389 - val_accuracy: 0.9460
Epoch 18/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2268 -
accuracy: 0.9460 - val_loss: 0.2822 - val_accuracy: 0.9302
Epoch 19/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2238 -
accuracy: 0.9483 - val_loss: 0.2385 - val_accuracy: 0.9459
Epoch 20/20
1160/1160 [==============================] - 3s 3ms/step - loss: 0.2284 -
accuracy: 0.9460 - val_loss: 0.2551 - val_accuracy: 0.9403

Accuracy: 94.03%

Iteration:  96
Epoch 1/20
440/440 [==============================] - 2s 3ms/step - loss: 2.3376 -
accuracy: 0.1086 - val_loss: 2.3053 - val_accuracy: 0.1028
Epoch 2/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3036 -
accuracy: 0.1063 - val_loss: 2.3039 - val_accuracy: 0.1063
Epoch 3/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3035 -
accuracy: 0.1106 - val_loss: 2.3046 - val_accuracy: 0.0997
Epoch 4/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3035 -
accuracy: 0.1073 - val_loss: 2.3044 - val_accuracy: 0.1063
Epoch 5/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3035 -
accuracy: 0.1085 - val_loss: 2.3049 - val_accuracy: 0.1093
```

```
Epoch 6/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3037 -
accuracy: 0.1093 - val_loss: 2.3046 - val_accuracy: 0.1063
Epoch 7/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3037 -
accuracy: 0.1061 - val_loss: 2.3046 - val_accuracy: 0.1063
Epoch 8/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3036 -
accuracy: 0.1072 - val_loss: 2.3031 - val_accuracy: 0.1063
Epoch 9/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3038 -
accuracy: 0.1084 - val_loss: 2.3030 - val_accuracy: 0.1028
Epoch 10/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3034 -
accuracy: 0.1082 - val_loss: 2.3052 - val_accuracy: 0.1063
Epoch 11/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3039 -
accuracy: 0.1079 - val_loss: 2.3026 - val_accuracy: 0.1093
Epoch 12/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3040 -
accuracy: 0.1067 - val_loss: 2.3029 - val_accuracy: 0.1093
Epoch 13/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3034 -
accuracy: 0.1081 - val_loss: 2.3072 - val_accuracy: 0.0990
Epoch 14/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3039 -
accuracy: 0.1075 - val_loss: 2.3056 - val_accuracy: 0.0990
Epoch 15/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3038 -
accuracy: 0.1061 - val_loss: 2.3045 - val_accuracy: 0.1063
Epoch 16/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3034 -
accuracy: 0.1062 - val_loss: 2.3051 - val_accuracy: 0.0993
Epoch 17/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3038 -
accuracy: 0.1088 - val_loss: 2.3093 - val_accuracy: 0.1002
Epoch 18/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3037 -
accuracy: 0.1077 - val_loss: 2.3039 - val_accuracy: 0.1063
Epoch 19/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3035 -
accuracy: 0.1098 - val_loss: 2.3042 - val_accuracy: 0.1063
Epoch 20/20
440/440 [==============================] - 1s 3ms/step - loss: 2.3035 -
accuracy: 0.1095 - val_loss: 2.3071 - val_accuracy: 0.1063

Accuracy: 10.63%
```

```
Iteration:  97
Epoch 1/20
425/425 [==============================] - 2s 3ms/step - loss: 2.3131 -
accuracy: 0.1047 - val_loss: 2.3129 - val_accuracy: 0.1063
Epoch 2/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3106 -
accuracy: 0.1044 - val_loss: 2.3176 - val_accuracy: 0.0959
Epoch 3/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3115 -
accuracy: 0.1040 - val_loss: 2.3111 - val_accuracy: 0.0959
Epoch 4/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3118 -
accuracy: 0.1059 - val_loss: 2.3156 - val_accuracy: 0.1063
Epoch 5/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3105 -
accuracy: 0.1033 - val_loss: 2.3177 - val_accuracy: 0.1028
Epoch 6/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3115 -
accuracy: 0.1033 - val_loss: 2.3106 - val_accuracy: 0.0959
Epoch 7/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3105 -
accuracy: 0.1057 - val_loss: 2.3133 - val_accuracy: 0.1063
Epoch 8/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3115 -
accuracy: 0.1047 - val_loss: 2.3091 - val_accuracy: 0.0993
Epoch 9/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3108 -
accuracy: 0.1047 - val_loss: 2.3161 - val_accuracy: 0.0959
Epoch 10/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3116 -
accuracy: 0.1064 - val_loss: 2.3115 - val_accuracy: 0.1063
Epoch 11/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3119 -
accuracy: 0.1028 - val_loss: 2.3126 - val_accuracy: 0.0993
Epoch 12/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3096 -
accuracy: 0.1054 - val_loss: 2.3151 - val_accuracy: 0.1063
Epoch 13/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3125 -
accuracy: 0.1032 - val_loss: 2.3110 - val_accuracy: 0.0993
Epoch 14/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3109 -
accuracy: 0.1012 - val_loss: 2.3122 - val_accuracy: 0.0997
Epoch 15/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3115 -
accuracy: 0.1032 - val_loss: 2.3200 - val_accuracy: 0.1063
Epoch 16/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3106 -
```

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accuracy: 0.1041 - val_loss: 2.3141 - val_accuracy: 0.1028
Epoch 17/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3103 -
accuracy: 0.1061 - val_loss: 2.3111 - val_accuracy: 0.1063
Epoch 18/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3112 -
accuracy: 0.1069 - val_loss: 2.3059 - val_accuracy: 0.0993
Epoch 19/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3107 -
accuracy: 0.1019 - val_loss: 2.3099 - val_accuracy: 0.1093
Epoch 20/20
425/425 [==============================] - 1s 3ms/step - loss: 2.3103 -
accuracy: 0.1058 - val_loss: 2.3200 - val_accuracy: 0.1002

Accuracy: 10.02%

Iteration:  98
Epoch 1/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.6405 -
accuracy: 0.7994 - val_loss: 0.2820 - val_accuracy: 0.9267
Epoch 2/20
2834/2834 [==============================] - 8s 3ms/step - loss: 0.3043 -
accuracy: 0.9179 - val_loss: 0.2089 - val_accuracy: 0.9427
Epoch 3/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.2592 -
accuracy: 0.9291 - val_loss: 0.2226 - val_accuracy: 0.9427
Epoch 4/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.2361 -
accuracy: 0.9355 - val_loss: 0.2073 - val_accuracy: 0.9428
Epoch 5/20
2834/2834 [==============================] - 8s 3ms/step - loss: 0.2193 -
accuracy: 0.9390 - val_loss: 0.2208 - val_accuracy: 0.9397
Epoch 6/20
2834/2834 [==============================] - 8s 3ms/step - loss: 0.2061 -
accuracy: 0.9436 - val_loss: 0.1943 - val_accuracy: 0.9483
Epoch 7/20
2834/2834 [==============================] - 8s 3ms/step - loss: 0.2015 -
accuracy: 0.9432 - val_loss: 0.1998 - val_accuracy: 0.9473
Epoch 8/20
2834/2834 [==============================] - 8s 3ms/step - loss: 0.1921 -
accuracy: 0.9453 - val_loss: 0.2191 - val_accuracy: 0.9418
Epoch 9/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.1807 -
accuracy: 0.9491 - val_loss: 0.1967 - val_accuracy: 0.9510
Epoch 10/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.1776 -
accuracy: 0.9507 - val_loss: 0.1850 - val_accuracy: 0.9541
Epoch 11/20
```

```
2834/2834 [==============================] - 8s 3ms/step - loss: 0.1737 -
accuracy: 0.9520 - val_loss: 0.1712 - val_accuracy: 0.9524
Epoch 12/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.1724 -
accuracy: 0.9518 - val_loss: 0.2058 - val_accuracy: 0.9458
Epoch 13/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.1643 -
accuracy: 0.9538 - val_loss: 0.1792 - val_accuracy: 0.9540
Epoch 14/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.1636 -
accuracy: 0.9546 - val_loss: 0.1756 - val_accuracy: 0.9531
Epoch 15/20
2834/2834 [==============================] - 8s 3ms/step - loss: 0.1625 -
accuracy: 0.9550 - val_loss: 0.1785 - val_accuracy: 0.9563
Epoch 16/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.1507 -
accuracy: 0.9585 - val_loss: 0.1648 - val_accuracy: 0.9547
Epoch 17/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.1549 -
accuracy: 0.9561 - val_loss: 0.1701 - val_accuracy: 0.9556
Epoch 18/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.1472 -
accuracy: 0.9603 - val_loss: 0.1630 - val_accuracy: 0.9588
Epoch 19/20
2834/2834 [==============================] - 9s 3ms/step - loss: 0.1464 -
accuracy: 0.9589 - val_loss: 0.1792 - val_accuracy: 0.9548
Epoch 20/20
2834/2834 [==============================] - 8s 3ms/step - loss: 0.1470 -
accuracy: 0.9585 - val_loss: 0.1642 - val_accuracy: 0.9584

Accuracy: 95.84%

Iteration:  99
Epoch 1/20
491/491 [==============================] - 2s 3ms/step - loss: 0.6904 -
accuracy: 0.7832 - val_loss: 0.4082 - val_accuracy: 0.8817
Epoch 2/20
491/491 [==============================] - 2s 3ms/step - loss: 0.4544 -
accuracy: 0.8723 - val_loss: 0.3664 - val_accuracy: 0.8938
Epoch 3/20
491/491 [==============================] - 2s 3ms/step - loss: 0.4277 -
accuracy: 0.8813 - val_loss: 0.3488 - val_accuracy: 0.9080
Epoch 4/20
491/491 [==============================] - 1s 3ms/step - loss: 0.4156 -
accuracy: 0.8842 - val_loss: 0.3523 - val_accuracy: 0.8991
Epoch 5/20
491/491 [==============================] - 2s 3ms/step - loss: 0.3881 -
accuracy: 0.8906 - val_loss: 0.3271 - val_accuracy: 0.9084
```

```
Epoch 6/20
491/491 [==============================] - 1s 3ms/step - loss: 0.4109 -
accuracy: 0.8831 - val_loss: 0.3711 - val_accuracy: 0.8992
Epoch 7/20
491/491 [==============================] - 2s 3ms/step - loss: 0.3855 -
accuracy: 0.8902 - val_loss: 0.3811 - val_accuracy: 0.8801
Epoch 8/20
491/491 [==============================] - 1s 3ms/step - loss: 0.3753 -
accuracy: 0.8948 - val_loss: 0.3285 - val_accuracy: 0.9098
Epoch 9/20
491/491 [==============================] - 2s 3ms/step - loss: 0.4000 -
accuracy: 0.8864 - val_loss: 0.3457 - val_accuracy: 0.9044
Epoch 10/20
491/491 [==============================] - 2s 3ms/step - loss: 0.3767 -
accuracy: 0.8885 - val_loss: 0.3272 - val_accuracy: 0.9059
Epoch 11/20
491/491 [==============================] - 1s 3ms/step - loss: 0.4065 -
accuracy: 0.8821 - val_loss: 0.3433 - val_accuracy: 0.9073
Epoch 12/20
491/491 [==============================] - 2s 3ms/step - loss: 0.3710 -
accuracy: 0.8942 - val_loss: 0.3379 - val_accuracy: 0.9087
Epoch 13/20
491/491 [==============================] - 1s 3ms/step - loss: 0.3788 -
accuracy: 0.8930 - val_loss: 0.3392 - val_accuracy: 0.9054
Epoch 14/20
491/491 [==============================] - 1s 3ms/step - loss: 0.3589 -
accuracy: 0.8984 - val_loss: 0.3258 - val_accuracy: 0.9078
Epoch 15/20
491/491 [==============================] - 1s 3ms/step - loss: 0.3620 -
accuracy: 0.8970 - val_loss: 0.3783 - val_accuracy: 0.8914
Epoch 16/20
491/491 [==============================] - 1s 3ms/step - loss: 0.3598 -
accuracy: 0.8950 - val_loss: 0.3275 - val_accuracy: 0.9019
Epoch 17/20
491/491 [==============================] - 1s 3ms/step - loss: 0.3641 -
accuracy: 0.8941 - val_loss: 0.3413 - val_accuracy: 0.8993
Epoch 18/20
491/491 [==============================] - 1s 3ms/step - loss: 0.3761 -
accuracy: 0.8896 - val_loss: 0.3499 - val_accuracy: 0.8984
Epoch 19/20
491/491 [==============================] - 1s 3ms/step - loss: 0.3735 -
accuracy: 0.8937 - val_loss: 0.3354 - val_accuracy: 0.9053
Epoch 20/20
491/491 [==============================] - 2s 3ms/step - loss: 0.3653 -
accuracy: 0.8958 - val_loss: 0.3425 - val_accuracy: 0.9008

Accuracy: 90.08%
```

```
Iteration:  100
Epoch 1/20
773/773 [==============================] - 3s 3ms/step - loss: 1.1299 -
accuracy: 0.5737 - val_loss: 0.5082 - val_accuracy: 0.8756
Epoch 2/20
773/773 [==============================] - 2s 3ms/step - loss: 0.4599 -
accuracy: 0.8883 - val_loss: 0.3884 - val_accuracy: 0.9087
Epoch 3/20
773/773 [==============================] - 2s 3ms/step - loss: 0.3792 -
accuracy: 0.9093 - val_loss: 0.3115 - val_accuracy: 0.9267
Epoch 4/20
773/773 [==============================] - 2s 3ms/step - loss: 0.3287 -
accuracy: 0.9211 - val_loss: 0.2719 - val_accuracy: 0.9398
Epoch 5/20
773/773 [==============================] - 2s 3ms/step - loss: 0.3101 -
accuracy: 0.9238 - val_loss: 0.2752 - val_accuracy: 0.9338
Epoch 6/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2890 -
accuracy: 0.9298 - val_loss: 0.2691 - val_accuracy: 0.9338
Epoch 7/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2698 -
accuracy: 0.9315 - val_loss: 0.2518 - val_accuracy: 0.9359
Epoch 8/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2577 -
accuracy: 0.9365 - val_loss: 0.2301 - val_accuracy: 0.9442
Epoch 9/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2559 -
accuracy: 0.9356 - val_loss: 0.2298 - val_accuracy: 0.9474
Epoch 10/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2443 -
accuracy: 0.9395 - val_loss: 0.2573 - val_accuracy: 0.9350
Epoch 11/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2369 -
accuracy: 0.9403 - val_loss: 0.2172 - val_accuracy: 0.9467
Epoch 12/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2346 -
accuracy: 0.9422 - val_loss: 0.2282 - val_accuracy: 0.9463
Epoch 13/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2295 -
accuracy: 0.9428 - val_loss: 0.2156 - val_accuracy: 0.9467
Epoch 14/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2232 -
accuracy: 0.9443 - val_loss: 0.1997 - val_accuracy: 0.9503
Epoch 15/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2119 -
accuracy: 0.9466 - val_loss: 0.2239 - val_accuracy: 0.9467
Epoch 16/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2216 -
```

```
accuracy: 0.9436 - val_loss: 0.2163 - val_accuracy: 0.9436
Epoch 17/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2238 -
accuracy: 0.9429 - val_loss: 0.2153 - val_accuracy: 0.9443
Epoch 18/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2085 -
accuracy: 0.9458 - val_loss: 0.2193 - val_accuracy: 0.9469
Epoch 19/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2100 -
accuracy: 0.9475 - val_loss: 0.2100 - val_accuracy: 0.9508
Epoch 20/20
773/773 [==============================] - 2s 3ms/step - loss: 0.2041 -
accuracy: 0.9481 - val_loss: 0.2225 - val_accuracy: 0.9447

Accuracy: 94.47%
```

[ ]:
```
print(best_results)
```

```
[0.008384610951889282, 3, 194, 26, 'relu', 44, 0.9786666631698608]
```

[ ]:
```
results
```

[ ]:
```
[[0.03275177220475209, 3, 188, 21, 'relu', 89, 0.7277777791023254],
 [0.029863672437724486, 3, 44, 18, 'sigmoid', 29, 0.9395555257797241],
 [0.06437322298735856, 1, 478, 5, 'sigmoid', 106, 0.0958888903260231],
 [0.007233298202346897, 3, 164, 8, 'relu', 9, 0.9636666774749756],
 [0.19706765150537875, 3, 506, 20, 'sigmoid', 82, 0.0958888903260231],
 [0.006996863427233354, 1, 356, 20, 'sigmoid', 102, 0.9758889079093933],
 [0.06803935820807058, 4, 4, 8, 'sigmoid', 35, 0.4238888919353485],
 [0.10213232309588141, 4, 360, 4, 'relu', 117, 0.0989999994635582],
 [0.026633585716561717, 3, 464, 23, 'sigmoid', 17, 0.10633333027362823],
 [0.013854191076355483, 2, 274, 19, 'relu', 53, 0.9660000205039978],
 [0.06581535611293016, 1, 438, 21, 'sigmoid', 55, 0.0958888903260231],
 [0.14292118324159045, 2, 256, 19, 'sigmoid', 12, 0.109333336353302],
 [0.12793421050863038, 3, 390, 17, 'relu', 1, 0.10022222250699997],
 [0.019315720035733164, 1, 464, 19, 'sigmoid', 61, 0.9446666836738586],
 [0.09915940250473528, 2, 84, 24, 'relu', 108, 0.10277777910232544],
 [0.008384610951889282, 3, 194, 26, 'relu', 44, 0.9786666631698608],
 [0.005668844818808548, 1, 496, 3, 'relu', 88, 0.961222231388092],
 [0.1656697242034905, 3, 272, 14, 'sigmoid', 74, 0.109333336353302],
 [0.024284996692974452, 4, 242, 3, 'sigmoid', 16, 0.2917777895927429],
 [0.019675655972062688, 1, 398, 25, 'relu', 9, 0.9003333449363708],
 [0.026732113949479427, 1, 158, 11, 'sigmoid', 70, 0.9589999914169312],
 [0.05719894474413977, 4, 46, 10, 'relu', 56, 0.43522220849990845],
 [0.010502831523228399, 1, 338, 3, 'relu', 21, 0.9536666870117188],
 [0.00823122735959573, 1, 504, 5, 'relu', 40, 0.9741111397743225],
```

[0.06679468254700728, 3, 10, 6, 'relu', 31, 0.28333333134651184],
[0.04466245089743304, 3, 358, 19, 'relu', 20, 0.09966666996479034],
[0.03227157415514816, 4, 222, 12, 'relu', 29, 0.10022222250699997],
[0.12652481251621955, 1, 268, 20, 'sigmoid', 106, 0.109333336353302],
[0.05826481004429197, 3, 464, 13, 'sigmoid', 6, 0.109333336353302],
[0.008635991879143561, 4, 146, 5, 'relu', 41, 0.9559999704360962],
[0.12421023520674607, 4, 366, 26, 'sigmoid', 66, 0.0958888903260231],
[0.039247710174376206, 1, 52, 18, 'relu', 4, 0.0958888903260231],
[0.0074777224721053435, 3, 322, 16, 'sigmoid', 33, 0.9683333039283752],
[0.015194022475304051, 2, 506, 26, 'sigmoid', 107, 0.9666666388511658],
[0.011646863384981408, 2, 128, 10, 'relu', 7, 0.9399999976158142],
[0.16445073616660283, 4, 96, 8, 'relu', 90, 0.0958888903260231],
[0.014216962526570596, 4, 392, 1, 'sigmoid', 72, 0.3253333270549774],
[0.16384460974999643, 1, 412, 6, 'sigmoid', 124, 0.09966666996479034],
[0.011820167638891784, 4, 202, 25, 'relu', 68, 0.9702222347259521],
[0.015882421897321582, 4, 62, 6, 'relu', 120, 0.9514444470405579],
[0.09176075208743704, 3, 260, 7, 'relu', 30, 0.09933333098888397],
[0.010310698335710172, 4, 148, 23, 'sigmoid', 82, 0.9681110978126526],
[0.056152577814225196, 1, 112, 2, 'sigmoid', 4, 0.10633333027362823],
[0.010425552309770318, 1, 116, 5, 'relu', 91, 0.9653333425521851],
[0.1103672311333934, 4, 62, 9, 'sigmoid', 124, 0.109333336353302],
[0.01110098085889354, 2, 186, 27, 'sigmoid', 80, 0.9750000238418579],
[0.006194161098119677, 1, 484, 3, 'sigmoid', 52, 0.9685555696487427],
[0.05293111954843996, 1, 24, 13, 'sigmoid', 77, 0.9359999895095825],
[0.016298302492071925, 4, 400, 4, 'sigmoid', 60, 0.109333336353302],
[0.012679240668413106, 4, 322, 23, 'relu', 102, 0.9623333215713501],
[0.08305352042021888, 1, 484, 8, 'relu', 69, 0.10633333027362823],
[0.005149906136788399, 4, 150, 26, 'sigmoid', 68, 0.9728888869285583],
[0.0624994138509709, 4, 374, 18, 'sigmoid', 68, 0.09933333098888397],
[0.008894909515131234, 2, 20, 17, 'relu', 51, 0.9423333406448364],
[0.021340757003694276, 3, 174, 22, 'sigmoid', 44, 0.9444444179534912],
[0.016178380545832607, 3, 158, 16, 'relu', 111, 0.9701111316680908],
[0.0074777224721053435, 1, 460, 24, 'sigmoid', 70, 0.9758889079093933],
[0.14451322534564692, 4, 210, 16, 'relu', 55, 0.0958888903260231],
[0.011060065275870543, 2, 324, 19, 'sigmoid', 107, 0.972777783870697],
[0.1095551555712299, 4, 336, 11, 'relu', 43, 0.0958888903260231],
[0.012632507993991704, 2, 510, 8, 'sigmoid', 1, 0.0958888903260231],
[0.09486148901187084, 3, 128, 4, 'sigmoid', 94, 0.5569999814033508],
[0.06389956861813231, 4, 172, 17, 'sigmoid', 58, 0.109333336353302],
[0.014535460679266851, 4, 474, 21, 'relu', 125, 0.9711111187934875],
[0.12746267534627995, 2, 290, 14, 'sigmoid', 99, 0.109333336353302],
[0.02846397739454339, 3, 144, 12, 'sigmoid', 84, 0.9266666769981384],
[0.006148584826936363, 4, 176, 22, 'relu', 13, 0.9664444327354431],
[0.005860403802891585, 3, 316, 21, 'sigmoid', 8, 0.9677777886390686],
[0.018753468046486473, 4, 92, 9, 'sigmoid', 64, 0.9558888673782349],
[0.1183885650523541, 3, 502, 7, 'relu', 115, 0.0958888903260231],
[0.01605934097818438, 1, 338, 11, 'relu', 93, 0.9678888916969299],

```
[0.020116443522038775, 3, 444, 2, 'sigmoid', 10, 0.2025555521249771],
[0.005245871303187837, 4, 34, 19, 'sigmoid', 51, 0.9576666951179504],
[0.16324071737162832, 1, 338, 27, 'relu', 64, 0.09933333098888397],
[0.06630321122148913, 4, 86, 18, 'relu', 30, 0.109333336353302],
[0.014589233132988022, 1, 362, 2, 'sigmoid', 112, 0.9440000057220459],
[0.1477507098101902, 4, 386, 14, 'sigmoid', 69, 0.09966666996479034],
[0.011907784412654472, 1, 474, 6, 'relu', 105, 0.9697777628898621],
[0.015194022475304051, 3, 472, 23, 'sigmoid', 47, 0.9578889012336731],
[0.07974762271777591, 2, 302, 15, 'sigmoid', 111, 0.21033333241939545],
[0.02165830550135906, 2, 320, 15, 'sigmoid', 51, 0.9463333487510681],
[0.04352280787931705, 3, 482, 25, 'relu', 95, 0.10633333027362823],
[0.11159664496056187, 2, 264, 16, 'sigmoid', 77, 0.20399999618530273],
[0.040874704315014034, 2, 50, 25, 'relu', 71, 0.8973333239555359],
[0.020265556287172585, 1, 144, 4, 'sigmoid', 67, 0.9577777981758118],
[0.022225427381851903, 2, 148, 4, 'sigmoid', 101, 0.9508888721466064],
[0.007874457328332661, 3, 256, 6, 'relu', 99, 0.9682222008705139],
[0.005168957689093439, 1, 128, 1, 'relu', 69, 0.6221110820770264],
[0.15790486901843698, 4, 168, 18, 'sigmoid', 102, 0.109333336353302],
[0.009436265526970512, 1, 280, 26, 'sigmoid', 106, 0.9765555262565613],
[0.14186957762428806, 3, 374, 24, 'relu', 92, 0.10633333027362823],
[0.05254165549990104, 4, 222, 25, 'relu', 67, 0.109333336353302],
[0.005093171762601568, 3, 302, 14, 'sigmoid', 127, 0.9762222170829773],
[0.07572973801611271, 4, 92, 13, 'relu', 58, 0.09966666996479034],
[0.017874502597014043, 1, 374, 10, 'sigmoid', 44, 0.9403333067893982],
[0.039247710174376206, 1, 454, 16, 'relu', 116, 0.10633333027362823],
[0.1596638189110357, 2, 88, 21, 'sigmoid', 120, 0.10022222250699997],
[0.010619825726729542, 4, 26, 27, 'sigmoid', 18, 0.9584444165229797],
[0.07657331437558784, 2, 22, 18, 'sigmoid', 104, 0.9007777571678162],
[0.020265556287172585, 4, 166, 15, 'sigmoid', 66, 0.9446666836738586]]
```

[ ]:
```
random_res = np.array(results)
```

[ ]:
```
random_res_df = pd.DataFrame(random_res, columns = ["learning rate","hidden layers","input layer nodes","hidden layer nodes",
                                                    "activation function","batch size","accuracy"])
```

[ ]:
```
random_res_df.head()
```

[ ]:
```
          learning rate hidden layers input layer nodes hidden layer nodes  \
0   0.03275177220475209             3               188                 21
1  0.029863672437724486             3                44                 18
2   0.06437322298735856             1               478                  5
3  0.007233298202346897             3               164                  8
4   0.19706765150537875             3               506                 20

  activation function batch size            accuracy
```

```
0                relu          89  0.7277777791023254
1             sigmoid          29  0.9395555257797241
2             sigmoid         106  0.0958888903260231
3                relu           9  0.9636666774749756
4             sigmoid          82  0.0958888903260231
```

[ ]:
```
random_res_df.to_csv("random_df.csv")
```

[ ]:
```
gp_model = create_model(best_results[0], best_results[1], best_results[2],␣
↪best_results[3], best_results[4])
gp_model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense (Dense)               (None, 194)               152290

 layer_dense_1 (Dense)       (None, 26)                5070

 layer_dense_2 (Dense)       (None, 26)                702

 layer_dense_3 (Dense)       (None, 26)                702

 dense_1 (Dense)             (None, 10)                270

=================================================================
Total params: 159,034
Trainable params: 159,034
Non-trainable params: 0
_________________________________________________________________
```

**Retrain the best model architecture with random search**

[ ]:
```
gp_model.fit(X_train, y_train, batch_size=best_results[5], epochs =20,␣
↪validation_split=0.15)
gp_model.evaluate(X_train,y_train)
```

[ ]:
```
gp_model.evaluate(X_test,y_test)
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.1306 -
accuracy: 0.9778
```

[ ]:
```
[0.13056840002536774, 0.9778000116348267]
```