In [1]:

```
# import keras
# from keras.datasets import cifar10
# from keras.models import Model, Sequential
# from keras.layers import Dense, Dropout, Flatten, Input, AveragePooling2D, merge, Activation
# from keras.layers import Conv2D, MaxPooling2D, BatchNormalization
# from keras.layers import Concatenate
# from keras.optimizers import Adam
from tensorflow.keras import models, layers
from tensorflow.keras.models import Model
from tensorflow.keras.layers import BatchNormalization, Activation, Flatten
from tensorflow.keras.optimizers import Adam
```

```
The default version of TensorFlow in Colab will soon switch to TensorFlow 2.x.
We recommend you upgrade now or ensure your notebook will continue to use TensorFlow 1.x via the %tensorflow_version 1.x magic: more info.
```

In [0]:

```
# this part will prevent tensorflow to allocate all the avaliable GPU Memory
# backend
import tensorflow as tf
```

In [0]:

```
# Hyperparameters
batch_size = 128
num_classes = 10
epochs = 10
l = 40
num_filter = 12
compression = 0.5
dropout_rate = 0.2
```

In [4]:

```
# Load CIFAR10 Data
(X_train, y_train), (X_test, y_test) = tf.keras.datasets.cifar10.load_data()
img_height, img_width, channel = X_train.shape[1],X_train.shape[2],X_train.shape[3]

# convert to one hot encoing
y_train = tf.keras.utils.to_categorical(y_train, num_classes)
y_test = tf.keras.utils.to_categorical(y_test, num_classes)
```

```
Downloading data from https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz
170500096/170498071 [==============================] - 4s 0us/step
```

In [5]:

```
X_train.shape
```

Out[5]:

```
(50000, 32, 32, 3)
```

In [6]:

```
X_test.shape
```

Out[6]:

```
(10000, 32, 32, 3)
```

In [0]:

```
# Dense Block
def denseblock(input, num_filter = 12, dropout_rate = 0.2):
    global compression
    temp = input
    for _ in range(l):
        BatchNorm = layers.BatchNormalization()(temp)
        relu = layers.Activation('relu')(BatchNorm)
        Conv2D_3_3 = layers.Conv2D(int(num_filter*compression), (3,3), use_bias=False ,padding='sam
e')(relu)
        if dropout_rate>0:
            Conv2D_3_3 = layers.Dropout(dropout_rate)(Conv2D_3_3)
        concat = layers.Concatenate(axis=-1)([temp,Conv2D_3_3])

        temp = concat

    return temp

## transition Blosck
def transition(input, num_filter = 12, dropout_rate = 0.2):
    global compression
    BatchNorm = layers.BatchNormalization()(input)
    relu = layers.Activation('relu')(BatchNorm)
    Conv2D_BottleNeck = layers.Conv2D(int(num_filter*compression), (1,1), use_bias=False ,padding='
same')(relu)
    if dropout_rate>0:
         Conv2D_BottleNeck = layers.Dropout(dropout_rate)(Conv2D_BottleNeck)
    avg = layers.AveragePooling2D(pool_size=(2,2))(Conv2D_BottleNeck)
    return avg

#output layer
def output_layer(input):
    global compression
    BatchNorm = layers.BatchNormalization()(input)
    relu = layers.Activation('relu')(BatchNorm)
    AvgPooling = layers.AveragePooling2D(pool_size=(2,2))(relu)
    flat = layers.Flatten()(AvgPooling)
    output = layers.Dense(num_classes, activation='softmax')(flat)
    return output
```

In [0]:

```
num_filter = 12
dropout_rate = 0.2
l = 12
input = layers.Input(shape=(img_height, img_width, channel,))
First_Conv2D = layers.Conv2D(num_filter, (3,3), use_bias=False ,padding='same')(input)

First_Block = denseblock(First_Conv2D, num_filter, dropout_rate)
First_Transition = transition(First_Block, num_filter, dropout_rate)

Second_Block = denseblock(First_Transition, num_filter, dropout_rate)
Second_Transition = transition(Second_Block, num_filter, dropout_rate)

Third_Block = denseblock(Second_Transition, num_filter, dropout_rate)
Third_Transition = transition(Third_Block, num_filter, dropout_rate)

Last_Block = denseblock(Third_Transition,  num_filter, dropout_rate)
output = output_layer(Last_Block)
```

In [0]:

```
#https://arxiv.org/pdf/1608.06993.pdf
from IPython.display import IFrame, YouTubeVideo
YouTubeVideo(id='-W6y8xnd--U', width=600)
```

Out[0]:

In [0]:

```
model = Model(inputs=[input], outputs=[output])
model.summary()
```

```
Model: "model"
```

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 32, 32, 3)]	0	
conv2d (Conv2D)	(None, 32, 32, 12)	324	input_1[0][0]
batch_normalization (BatchNorma	(None, 32, 32, 12)	48	conv2d[0][0]
activation (Activation)	(None, 32, 32, 12)	0	batch_normalization[0][0]
conv2d_1 (Conv2D)	(None, 32, 32, 6)	648	activation[0][0]
dropout (Dropout)	(None, 32, 32, 6)	0	conv2d_1[0][0]
concatenate (Concatenate)	(None, 32, 32, 18)	0	conv2d[0][0] dropout[0][0]
batch_normalization_1 (BatchNor	(None, 32, 32, 18)	72	concatenate[0][0]
activation_1 (Activation)	(None, 32, 32, 18)	0	batch_normalization_1[0][0]
conv2d_2 (Conv2D)	(None, 32, 32, 6)	972	activation_1[0][0]
dropout_1 (Dropout)	(None, 32, 32, 6)	0	conv2d_2[0][0]
concatenate_1 (Concatenate)	(None, 32, 32, 24)	0	concatenate[0][0] dropout_1[0][0]
batch_normalization_2 (BatchNor	(None, 32, 32, 24)	96	concatenate_1[0][0]
activation_2 (Activation)	(None, 32, 32, 24)	0	batch_normalization_2[0][0]
conv2d_3 (Conv2D)	(None, 32, 32, 6)	1296	activation_2[0][0]
dropout_2 (Dropout)	(None, 32, 32, 6)	0	conv2d_3[0][0]
concatenate_2 (Concatenate)	(None, 32, 32, 30)	0	concatenate_1[0][0] dropout_2[0][0]
batch_normalization_3 (BatchNor	(None, 32, 32, 30)	120	concatenate_2[0][0]
activation_3 (Activation)	(None, 32, 32, 30)	0	batch_normalization_3[0][0]
conv2d_4 (Conv2D)	(None, 32, 32, 6)	1620	activation_3[0][0]
dropout_3 (Dropout)	(None, 32, 32, 6)	0	conv2d_4[0][0]
concatenate_3 (Concatenate)	(None, 32, 32, 36)	0	concatenate_2[0][0] dropout_3[0][0]
batch_normalization_4 (BatchNor	(None, 32, 32, 36)	144	concatenate_3[0][0]
activation_4 (Activation)	(None, 32, 32, 36)	0	batch_normalization_4[0][0]
conv2d_5 (Conv2D)	(None, 32, 32, 6)	1944	activation_4[0][0]
dropout_4 (Dropout)	(None, 32, 32, 6)	0	conv2d_5[0][0]

concatenate_4 (Concatenate)	(None, 32, 32, 42)	0	concatenate_3[0][0] dropout_4[0][0]
batch_normalization_5 (BatchNor	(None, 32, 32, 42)	168	concatenate_4[0][0]
activation_5 (Activation)	(None, 32, 32, 42)	0	batch_normalization_5[0][0]
conv2d_6 (Conv2D)	(None, 32, 32, 6)	2268	activation_5[0][0]
dropout_5 (Dropout)	(None, 32, 32, 6)	0	conv2d_6[0][0]
concatenate_5 (Concatenate)	(None, 32, 32, 48)	0	concatenate_4[0][0] dropout_5[0][0]
batch_normalization_6 (BatchNor	(None, 32, 32, 48)	192	concatenate_5[0][0]
activation_6 (Activation)	(None, 32, 32, 48)	0	batch_normalization_6[0][0]
conv2d_7 (Conv2D)	(None, 32, 32, 6)	2592	activation_6[0][0]
dropout_6 (Dropout)	(None, 32, 32, 6)	0	conv2d_7[0][0]
concatenate_6 (Concatenate)	(None, 32, 32, 54)	0	concatenate_5[0][0] dropout_6[0][0]
batch_normalization_7 (BatchNor	(None, 32, 32, 54)	216	concatenate_6[0][0]
activation_7 (Activation)	(None, 32, 32, 54)	0	batch_normalization_7[0][0]
conv2d_8 (Conv2D)	(None, 32, 32, 6)	2916	activation_7[0][0]
dropout_7 (Dropout)	(None, 32, 32, 6)	0	conv2d_8[0][0]
concatenate_7 (Concatenate)	(None, 32, 32, 60)	0	concatenate_6[0][0] dropout_7[0][0]
batch_normalization_8 (BatchNor	(None, 32, 32, 60)	240	concatenate_7[0][0]
activation_8 (Activation)	(None, 32, 32, 60)	0	batch_normalization_8[0][0]
conv2d_9 (Conv2D)	(None, 32, 32, 6)	3240	activation_8[0][0]
dropout_8 (Dropout)	(None, 32, 32, 6)	0	conv2d_9[0][0]
concatenate_8 (Concatenate)	(None, 32, 32, 66)	0	concatenate_7[0][0] dropout_8[0][0]
batch_normalization_9 (BatchNor	(None, 32, 32, 66)	264	concatenate_8[0][0]
activation_9 (Activation)	(None, 32, 32, 66)	0	batch_normalization_9[0][0]
conv2d_10 (Conv2D)	(None, 32, 32, 6)	3564	activation_9[0][0]
dropout_9 (Dropout)	(None, 32, 32, 6)	0	conv2d_10[0][0]
concatenate_9 (Concatenate)	(None, 32, 32, 72)	0	concatenate_8[0][0] dropout_9[0][0]
batch_normalization_10 (BatchNo	(None, 32, 32, 72)	288	concatenate_9[0][0]
activation_10 (Activation)	(None, 32, 32, 72)	0	batch_normalization_10[0][0]
conv2d_11 (Conv2D)	(None, 32, 32, 6)	3888	activation_10[0][0]
dropout_10 (Dropout)	(None, 32, 32, 6)	0	conv2d_11[0][0]
concatenate_10 (Concatenate)	(None, 32, 32, 78)	0	concatenate_9[0][0] dropout_10[0][0]
batch_normalization_11 (BatchNo	(None, 32, 32, 78)	312	concatenate_10[0][0]
activation_11 (Activation)	(None, 32, 32, 78)	0	batch_normalization_11[0][0]
conv2d_12 (Conv2D)	(None, 32, 32, 6)	4212	activation_11[0][0]
dropout_11 (Dropout)	(None, 32, 32, 6)	0	conv2d_12[0][0]

concatenate_11 (Concatenate)	(None, 32, 32, 84)	0	concatenate_10[0][0] dropout_11[0][0]
batch_normalization_12 (BatchNo	(None, 32, 32, 84)	336	concatenate_11[0][0]
activation_12 (Activation)	(None, 32, 32, 84)	0	batch_normalization_12[0][0]
conv2d_13 (Conv2D)	(None, 32, 32, 6)	504	activation_12[0][0]
dropout_12 (Dropout)	(None, 32, 32, 6)	0	conv2d_13[0][0]
average_pooling2d (AveragePooli	(None, 16, 16, 6)	0	dropout_12[0][0]
batch_normalization_13 (BatchNo	(None, 16, 16, 6)	24	average_pooling2d[0][0]
activation_13 (Activation)	(None, 16, 16, 6)	0	batch_normalization_13[0][0]
conv2d_14 (Conv2D)	(None, 16, 16, 6)	324	activation_13[0][0]
dropout_13 (Dropout)	(None, 16, 16, 6)	0	conv2d_14[0][0]
concatenate_12 (Concatenate)	(None, 16, 16, 12)	0	average_pooling2d[0][0] dropout_13[0][0]
batch_normalization_14 (BatchNo	(None, 16, 16, 12)	48	concatenate_12[0][0]
activation_14 (Activation)	(None, 16, 16, 12)	0	batch_normalization_14[0][0]
conv2d_15 (Conv2D)	(None, 16, 16, 6)	648	activation_14[0][0]
dropout_14 (Dropout)	(None, 16, 16, 6)	0	conv2d_15[0][0]
concatenate_13 (Concatenate)	(None, 16, 16, 18)	0	concatenate_12[0][0] dropout_14[0][0]
batch_normalization_15 (BatchNo	(None, 16, 16, 18)	72	concatenate_13[0][0]
activation_15 (Activation)	(None, 16, 16, 18)	0	batch_normalization_15[0][0]
conv2d_16 (Conv2D)	(None, 16, 16, 6)	972	activation_15[0][0]
dropout_15 (Dropout)	(None, 16, 16, 6)	0	conv2d_16[0][0]
concatenate_14 (Concatenate)	(None, 16, 16, 24)	0	concatenate_13[0][0] dropout_15[0][0]
batch_normalization_16 (BatchNo	(None, 16, 16, 24)	96	concatenate_14[0][0]
activation_16 (Activation)	(None, 16, 16, 24)	0	batch_normalization_16[0][0]
conv2d_17 (Conv2D)	(None, 16, 16, 6)	1296	activation_16[0][0]
dropout_16 (Dropout)	(None, 16, 16, 6)	0	conv2d_17[0][0]
concatenate_15 (Concatenate)	(None, 16, 16, 30)	0	concatenate_14[0][0] dropout_16[0][0]
batch_normalization_17 (BatchNo	(None, 16, 16, 30)	120	concatenate_15[0][0]
activation_17 (Activation)	(None, 16, 16, 30)	0	batch_normalization_17[0][0]
conv2d_18 (Conv2D)	(None, 16, 16, 6)	1620	activation_17[0][0]
dropout_17 (Dropout)	(None, 16, 16, 6)	0	conv2d_18[0][0]
concatenate_16 (Concatenate)	(None, 16, 16, 36)	0	concatenate_15[0][0] dropout_17[0][0]
batch_normalization_18 (BatchNo	(None, 16, 16, 36)	144	concatenate_16[0][0]
activation_18 (Activation)	(None, 16, 16, 36)	0	batch_normalization_18[0][0]
conv2d_19 (Conv2D)	(None, 16, 16, 6)	1944	activation_18[0][0]
dropout_18 (Dropout)	(None, 16, 16, 6)	0	conv2d_19[0][0]

concatenate_17 (Concatenate)	(None, 16, 16, 42)	0	concatenate_16[0][0] dropout_18[0][0]
batch_normalization_19 (BatchNo	(None, 16, 16, 42)	168	concatenate_17[0][0]
activation_19 (Activation)	(None, 16, 16, 42)	0	batch_normalization_19[0][0]
conv2d_20 (Conv2D)	(None, 16, 16, 6)	2268	activation_19[0][0]
dropout_19 (Dropout)	(None, 16, 16, 6)	0	conv2d_20[0][0]
concatenate_18 (Concatenate)	(None, 16, 16, 48)	0	concatenate_17[0][0] dropout_19[0][0]
batch_normalization_20 (BatchNo	(None, 16, 16, 48)	192	concatenate_18[0][0]
activation_20 (Activation)	(None, 16, 16, 48)	0	batch_normalization_20[0][0]
conv2d_21 (Conv2D)	(None, 16, 16, 6)	2592	activation_20[0][0]
dropout_20 (Dropout)	(None, 16, 16, 6)	0	conv2d_21[0][0]
concatenate_19 (Concatenate)	(None, 16, 16, 54)	0	concatenate_18[0][0] dropout_20[0][0]
batch_normalization_21 (BatchNo	(None, 16, 16, 54)	216	concatenate_19[0][0]
activation_21 (Activation)	(None, 16, 16, 54)	0	batch_normalization_21[0][0]
conv2d_22 (Conv2D)	(None, 16, 16, 6)	2916	activation_21[0][0]
dropout_21 (Dropout)	(None, 16, 16, 6)	0	conv2d_22[0][0]
concatenate_20 (Concatenate)	(None, 16, 16, 60)	0	concatenate_19[0][0] dropout_21[0][0]
batch_normalization_22 (BatchNo	(None, 16, 16, 60)	240	concatenate_20[0][0]
activation_22 (Activation)	(None, 16, 16, 60)	0	batch_normalization_22[0][0]
conv2d_23 (Conv2D)	(None, 16, 16, 6)	3240	activation_22[0][0]
dropout_22 (Dropout)	(None, 16, 16, 6)	0	conv2d_23[0][0]
concatenate_21 (Concatenate)	(None, 16, 16, 66)	0	concatenate_20[0][0] dropout_22[0][0]
batch_normalization_23 (BatchNo	(None, 16, 16, 66)	264	concatenate_21[0][0]
activation_23 (Activation)	(None, 16, 16, 66)	0	batch_normalization_23[0][0]
conv2d_24 (Conv2D)	(None, 16, 16, 6)	3564	activation_23[0][0]
dropout_23 (Dropout)	(None, 16, 16, 6)	0	conv2d_24[0][0]
concatenate_22 (Concatenate)	(None, 16, 16, 72)	0	concatenate_21[0][0] dropout_23[0][0]
batch_normalization_24 (BatchNo	(None, 16, 16, 72)	288	concatenate_22[0][0]
activation_24 (Activation)	(None, 16, 16, 72)	0	batch_normalization_24[0][0]
conv2d_25 (Conv2D)	(None, 16, 16, 6)	3888	activation_24[0][0]
dropout_24 (Dropout)	(None, 16, 16, 6)	0	conv2d_25[0][0]
concatenate_23 (Concatenate)	(None, 16, 16, 78)	0	concatenate_22[0][0] dropout_24[0][0]
batch_normalization_25 (BatchNo	(None, 16, 16, 78)	312	concatenate_23[0][0]
activation_25 (Activation)	(None, 16, 16, 78)	0	batch_normalization_25[0][0]
conv2d_26 (Conv2D)	(None, 16, 16, 6)	468	activation_25[0][0]
dropout_25 (Dropout)	(None, 16, 16, 6)	0	conv2d_26[0][0]

average_pooling2d_1 (AveragePoo	(None, 8, 8, 6)	0	dropout_25[0][0]
batch_normalization_26 (BatchNo	(None, 8, 8, 6)	24	average_pooling2d_1[0][0]
activation_26 (Activation)	(None, 8, 8, 6)	0	batch_normalization_26[0][0]
conv2d_27 (Conv2D)	(None, 8, 8, 6)	324	activation_26[0][0]
dropout_26 (Dropout)	(None, 8, 8, 6)	0	conv2d_27[0][0]
concatenate_24 (Concatenate)	(None, 8, 8, 12)	0	average_pooling2d_1[0][0] dropout_26[0][0]
batch_normalization_27 (BatchNo	(None, 8, 8, 12)	48	concatenate_24[0][0]
activation_27 (Activation)	(None, 8, 8, 12)	0	batch_normalization_27[0][0]
conv2d_28 (Conv2D)	(None, 8, 8, 6)	648	activation_27[0][0]
dropout_27 (Dropout)	(None, 8, 8, 6)	0	conv2d_28[0][0]
concatenate_25 (Concatenate)	(None, 8, 8, 18)	0	concatenate_24[0][0] dropout_27[0][0]
batch_normalization_28 (BatchNo	(None, 8, 8, 18)	72	concatenate_25[0][0]
activation_28 (Activation)	(None, 8, 8, 18)	0	batch_normalization_28[0][0]
conv2d_29 (Conv2D)	(None, 8, 8, 6)	972	activation_28[0][0]
dropout_28 (Dropout)	(None, 8, 8, 6)	0	conv2d_29[0][0]
concatenate_26 (Concatenate)	(None, 8, 8, 24)	0	concatenate_25[0][0] dropout_28[0][0]
batch_normalization_29 (BatchNo	(None, 8, 8, 24)	96	concatenate_26[0][0]
activation_29 (Activation)	(None, 8, 8, 24)	0	batch_normalization_29[0][0]
conv2d_30 (Conv2D)	(None, 8, 8, 6)	1296	activation_29[0][0]
dropout_29 (Dropout)	(None, 8, 8, 6)	0	conv2d_30[0][0]
concatenate_27 (Concatenate)	(None, 8, 8, 30)	0	concatenate_26[0][0] dropout_29[0][0]
batch_normalization_30 (BatchNo	(None, 8, 8, 30)	120	concatenate_27[0][0]
activation_30 (Activation)	(None, 8, 8, 30)	0	batch_normalization_30[0][0]
conv2d_31 (Conv2D)	(None, 8, 8, 6)	1620	activation_30[0][0]
dropout_30 (Dropout)	(None, 8, 8, 6)	0	conv2d_31[0][0]
concatenate_28 (Concatenate)	(None, 8, 8, 36)	0	concatenate_27[0][0] dropout_30[0][0]
batch_normalization_31 (BatchNo	(None, 8, 8, 36)	144	concatenate_28[0][0]
activation_31 (Activation)	(None, 8, 8, 36)	0	batch_normalization_31[0][0]
conv2d_32 (Conv2D)	(None, 8, 8, 6)	1944	activation_31[0][0]
dropout_31 (Dropout)	(None, 8, 8, 6)	0	conv2d_32[0][0]
concatenate_29 (Concatenate)	(None, 8, 8, 42)	0	concatenate_28[0][0] dropout_31[0][0]
batch_normalization_32 (BatchNo	(None, 8, 8, 42)	168	concatenate_29[0][0]
activation_32 (Activation)	(None, 8, 8, 42)	0	batch_normalization_32[0][0]
conv2d_33 (Conv2D)	(None, 8, 8, 6)	2268	activation_32[0][0]
dropout_32 (Dropout)	(None, 8, 8, 6)	0	conv2d_33[0][0]
concatenate_30 (Concatenate)	(None, 8, 8, 48)	0	concatenate_29[0][0]

concatenate_30 (Concatenate)	(None, 8, 8, 48)	0	concatenate_29[0][0] dropout_32[0][0]
batch_normalization_33 (BatchNo	(None, 8, 8, 48)	192	concatenate_30[0][0]
activation_33 (Activation)	(None, 8, 8, 48)	0	batch_normalization_33[0][0]
conv2d_34 (Conv2D)	(None, 8, 8, 6)	2592	activation_33[0][0]
dropout_33 (Dropout)	(None, 8, 8, 6)	0	conv2d_34[0][0]
concatenate_31 (Concatenate)	(None, 8, 8, 54)	0	concatenate_30[0][0] dropout_33[0][0]
batch_normalization_34 (BatchNo	(None, 8, 8, 54)	216	concatenate_31[0][0]
activation_34 (Activation)	(None, 8, 8, 54)	0	batch_normalization_34[0][0]
conv2d_35 (Conv2D)	(None, 8, 8, 6)	2916	activation_34[0][0]
dropout_34 (Dropout)	(None, 8, 8, 6)	0	conv2d_35[0][0]
concatenate_32 (Concatenate)	(None, 8, 8, 60)	0	concatenate_31[0][0] dropout_34[0][0]
batch_normalization_35 (BatchNo	(None, 8, 8, 60)	240	concatenate_32[0][0]
activation_35 (Activation)	(None, 8, 8, 60)	0	batch_normalization_35[0][0]
conv2d_36 (Conv2D)	(None, 8, 8, 6)	3240	activation_35[0][0]
dropout_35 (Dropout)	(None, 8, 8, 6)	0	conv2d_36[0][0]
concatenate_33 (Concatenate)	(None, 8, 8, 66)	0	concatenate_32[0][0] dropout_35[0][0]
batch_normalization_36 (BatchNo	(None, 8, 8, 66)	264	concatenate_33[0][0]
activation_36 (Activation)	(None, 8, 8, 66)	0	batch_normalization_36[0][0]
conv2d_37 (Conv2D)	(None, 8, 8, 6)	3564	activation_36[0][0]
dropout_36 (Dropout)	(None, 8, 8, 6)	0	conv2d_37[0][0]
concatenate_34 (Concatenate)	(None, 8, 8, 72)	0	concatenate_33[0][0] dropout_36[0][0]
batch_normalization_37 (BatchNo	(None, 8, 8, 72)	288	concatenate_34[0][0]
activation_37 (Activation)	(None, 8, 8, 72)	0	batch_normalization_37[0][0]
conv2d_38 (Conv2D)	(None, 8, 8, 6)	3888	activation_37[0][0]
dropout_37 (Dropout)	(None, 8, 8, 6)	0	conv2d_38[0][0]
concatenate_35 (Concatenate)	(None, 8, 8, 78)	0	concatenate_34[0][0] dropout_37[0][0]
batch_normalization_38 (BatchNo	(None, 8, 8, 78)	312	concatenate_35[0][0]
activation_38 (Activation)	(None, 8, 8, 78)	0	batch_normalization_38[0][0]
conv2d_39 (Conv2D)	(None, 8, 8, 6)	468	activation_38[0][0]
dropout_38 (Dropout)	(None, 8, 8, 6)	0	conv2d_39[0][0]
average_pooling2d_2 (AveragePoo	(None, 4, 4, 6)	0	dropout_38[0][0]
batch_normalization_39 (BatchNo	(None, 4, 4, 6)	24	average_pooling2d_2[0][0]
activation_39 (Activation)	(None, 4, 4, 6)	0	batch_normalization_39[0][0]
conv2d_40 (Conv2D)	(None, 4, 4, 6)	324	activation_39[0][0]
dropout_39 (Dropout)	(None, 4, 4, 6)	0	conv2d_40[0][0]
concatenate_36 (Concatenate)	(None, 4, 4, 12)	0	average_pooling2d_2[0][0] dropout_39[0][0]

			dropout_39[0][0]
batch_normalization_40 (BatchNo	(None, 4, 4, 12)	48	concatenate_36[0][0]
activation_40 (Activation)	(None, 4, 4, 12)	0	batch_normalization_40[0][0]
conv2d_41 (Conv2D)	(None, 4, 4, 6)	648	activation_40[0][0]
dropout_40 (Dropout)	(None, 4, 4, 6)	0	conv2d_41[0][0]
concatenate_37 (Concatenate)	(None, 4, 4, 18)	0	concatenate_36[0][0] dropout_40[0][0]
batch_normalization_41 (BatchNo	(None, 4, 4, 18)	72	concatenate_37[0][0]
activation_41 (Activation)	(None, 4, 4, 18)	0	batch_normalization_41[0][0]
conv2d_42 (Conv2D)	(None, 4, 4, 6)	972	activation_41[0][0]
dropout_41 (Dropout)	(None, 4, 4, 6)	0	conv2d_42[0][0]
concatenate_38 (Concatenate)	(None, 4, 4, 24)	0	concatenate_37[0][0] dropout_41[0][0]
batch_normalization_42 (BatchNo	(None, 4, 4, 24)	96	concatenate_38[0][0]
activation_42 (Activation)	(None, 4, 4, 24)	0	batch_normalization_42[0][0]
conv2d_43 (Conv2D)	(None, 4, 4, 6)	1296	activation_42[0][0]
dropout_42 (Dropout)	(None, 4, 4, 6)	0	conv2d_43[0][0]
concatenate_39 (Concatenate)	(None, 4, 4, 30)	0	concatenate_38[0][0] dropout_42[0][0]
batch_normalization_43 (BatchNo	(None, 4, 4, 30)	120	concatenate_39[0][0]
activation_43 (Activation)	(None, 4, 4, 30)	0	batch_normalization_43[0][0]
conv2d_44 (Conv2D)	(None, 4, 4, 6)	1620	activation_43[0][0]
dropout_43 (Dropout)	(None, 4, 4, 6)	0	conv2d_44[0][0]
concatenate_40 (Concatenate)	(None, 4, 4, 36)	0	concatenate_39[0][0] dropout_43[0][0]
batch_normalization_44 (BatchNo	(None, 4, 4, 36)	144	concatenate_40[0][0]
activation_44 (Activation)	(None, 4, 4, 36)	0	batch_normalization_44[0][0]
conv2d_45 (Conv2D)	(None, 4, 4, 6)	1944	activation_44[0][0]
dropout_44 (Dropout)	(None, 4, 4, 6)	0	conv2d_45[0][0]
concatenate_41 (Concatenate)	(None, 4, 4, 42)	0	concatenate_40[0][0] dropout_44[0][0]
batch_normalization_45 (BatchNo	(None, 4, 4, 42)	168	concatenate_41[0][0]
activation_45 (Activation)	(None, 4, 4, 42)	0	batch_normalization_45[0][0]
conv2d_46 (Conv2D)	(None, 4, 4, 6)	2268	activation_45[0][0]
dropout_45 (Dropout)	(None, 4, 4, 6)	0	conv2d_46[0][0]
concatenate_42 (Concatenate)	(None, 4, 4, 48)	0	concatenate_41[0][0] dropout_45[0][0]
batch_normalization_46 (BatchNo	(None, 4, 4, 48)	192	concatenate_42[0][0]
activation_46 (Activation)	(None, 4, 4, 48)	0	batch_normalization_46[0][0]
conv2d_47 (Conv2D)	(None, 4, 4, 6)	2592	activation_46[0][0]
dropout_46 (Dropout)	(None, 4, 4, 6)	0	conv2d_47[0][0]
concatenate_43 (Concatenate)	(None, 4, 4, 54)	0	concatenate_42[0][0] dropout_46[0][0]

				dropout_46[0][0]
batch_normalization_47 (BatchNo	(None, 4, 4, 54)	216	concatenate_43[0][0]	
activation_47 (Activation)	(None, 4, 4, 54)	0	batch_normalization_47[0][0]	
conv2d_48 (Conv2D)	(None, 4, 4, 6)	2916	activation_47[0][0]	
dropout_47 (Dropout)	(None, 4, 4, 6)	0	conv2d_48[0][0]	
concatenate_44 (Concatenate)	(None, 4, 4, 60)	0	concatenate_43[0][0] dropout_47[0][0]	
batch_normalization_48 (BatchNo	(None, 4, 4, 60)	240	concatenate_44[0][0]	
activation_48 (Activation)	(None, 4, 4, 60)	0	batch_normalization_48[0][0]	
conv2d_49 (Conv2D)	(None, 4, 4, 6)	3240	activation_48[0][0]	
dropout_48 (Dropout)	(None, 4, 4, 6)	0	conv2d_49[0][0]	
concatenate_45 (Concatenate)	(None, 4, 4, 66)	0	concatenate_44[0][0] dropout_48[0][0]	
batch_normalization_49 (BatchNo	(None, 4, 4, 66)	264	concatenate_45[0][0]	
activation_49 (Activation)	(None, 4, 4, 66)	0	batch_normalization_49[0][0]	
conv2d_50 (Conv2D)	(None, 4, 4, 6)	3564	activation_49[0][0]	
dropout_49 (Dropout)	(None, 4, 4, 6)	0	conv2d_50[0][0]	
concatenate_46 (Concatenate)	(None, 4, 4, 72)	0	concatenate_45[0][0] dropout_49[0][0]	
batch_normalization_50 (BatchNo	(None, 4, 4, 72)	288	concatenate_46[0][0]	
activation_50 (Activation)	(None, 4, 4, 72)	0	batch_normalization_50[0][0]	
conv2d_51 (Conv2D)	(None, 4, 4, 6)	3888	activation_50[0][0]	
dropout_50 (Dropout)	(None, 4, 4, 6)	0	conv2d_51[0][0]	
concatenate_47 (Concatenate)	(None, 4, 4, 78)	0	concatenate_46[0][0] dropout_50[0][0]	
batch_normalization_51 (BatchNo	(None, 4, 4, 78)	312	concatenate_47[0][0]	
activation_51 (Activation)	(None, 4, 4, 78)	0	batch_normalization_51[0][0]	
average_pooling2d_3 (AveragePoo	(None, 2, 2, 78)	0	activation_51[0][0]	
flatten (Flatten)	(None, 312)	0	average_pooling2d_3[0][0]	
dense (Dense)	(None, 10)	3130	flatten[0][0]	

Total params: 118,918
Trainable params: 114,394
Non-trainable params: 4,524

In [0]:

```
# determine Loss function and Optimizer
model.compile(loss='categorical_crossentropy',
              optimizer=Adam(),
              metrics=['accuracy'])
```

In [0]:

```
model.fit(X_train, y_train,
                    batch_size=batch_size,
                    epochs=epochs,
                    verbose=1,
                    validation_data=(X_test, y_test))
```

```
Train on 50000 samples, validate on 10000 samples
Epoch 1/10
50000/50000 [==============================] - 66s 1ms/sample - loss: 1.5326 - acc: 0.4339 - val_l
oss: 1.7971 - val_acc: 0.3777
Epoch 2/10
50000/50000 [==============================] - 63s 1ms/sample - loss: 1.3113 - acc: 0.5198 - val_l
oss: 1.5268 - val_acc: 0.4811
Epoch 3/10
50000/50000 [==============================] - 63s 1ms/sample - loss: 1.1942 - acc: 0.5669 - val_l
oss: 1.2360 - val_acc: 0.5562
Epoch 4/10
50000/50000 [==============================] - 63s 1ms/sample - loss: 1.1025 - acc: 0.6053 - val_l
oss: 1.1624 - val_acc: 0.5958
Epoch 5/10
50000/50000 [==============================] - 63s 1ms/sample - loss: 1.0459 - acc: 0.6238 - val_l
oss: 1.2096 - val_acc: 0.5858
Epoch 6/10
50000/50000 [==============================] - 63s 1ms/sample - loss: 0.9942 - acc: 0.6443 - val_l
oss: 1.1280 - val_acc: 0.6099
Epoch 7/10
50000/50000 [==============================] - 62s 1ms/sample - loss: 0.9592 - acc: 0.6570 - val_l
oss: 1.0519 - val_acc: 0.6422
Epoch 8/10
50000/50000 [==============================] - 63s 1ms/sample - loss: 0.9149 - acc: 0.6730 - val_l
oss: 0.9730 - val_acc: 0.6655
Epoch 9/10
50000/50000 [==============================] - 62s 1ms/sample - loss: 0.8915 - acc: 0.6814 - val_l
oss: 1.1207 - val_acc: 0.6436
Epoch 10/10
50000/50000 [==============================] - 62s 1ms/sample - loss: 0.8643 - acc: 0.6907 - val_l
oss: 0.9504 - val_acc: 0.6701
```

Out[0]:

```
<tensorflow.python.keras.callbacks.History at 0x7fe423c45780>
```

In [0]:

```
# Test the model
score = model.evaluate(X_test, y_test, verbose=1)
print('Test loss:', score[0])
print('Test accuracy:', score[1])
```

In [0]:

```
# Save the trained weights in to .h5 format
model.save_weights("DNST_model.h5")
print("Saved model to disk")
```

```
Saved model to disk
```

CNN on CIFR Assignment:

In [0]:

```
X_train[1:2,1:2,1:2]
```

Out[0]:

```
array([[[[145, 153, 154]]]], dtype=uint8)
```

Dataset is not normalized ,need to normalize the data set.

In [0]:

```
print(X_train.max(),X_train.min())
```

```
255 0
```

In [0]:

```
#X => (X - Xmin)/(Xmax-Xmin) = X/255
X_train=X_train/255
X_test=X_test/255
X_train[1:2,1:2,1:2]
```

Out[0]:

```
array([[[[0.56862745, 0.6       , 0.60392157]]]])
```

2 .created a copy of DenseNet

3 .Removed Dense Layers abd DropOut layers.

In [0]:

```
# Dense Block
#Remove dropout layer by setting dropout_rate = 0
def denseblock_1(input, num_filter = 12, dropout_rate = 0):
  global compression
  temp = input
  for _ in range(l):
    BatchNorm = layers.BatchNormalization()(temp)
    relu = layers.Activation('relu')(BatchNorm)
    Conv2D_3_3 = layers.Conv2D(int(num_filter*compression), (3,3), use_bias=False ,padding='same')(
relu)
    if dropout_rate>0:
      Conv2D_3_3 = layers.Dropout(dropout_rate)(Conv2D_3_3)
    concat = layers.Concatenate(axis=-1)([temp,Conv2D_3_3])
    temp = concat

  return temp

## transition Blosck
#Remove dropout layer by setting dropout_rate = 0
def transition_1(input, num_filter = 12, dropout_rate = 0):
  global compression
  BatchNorm = layers.BatchNormalization()(input)
  relu = layers.Activation('relu')(BatchNorm)
  Conv2D_BottleNeck = layers.Conv2D(int(num_filter*compression), (1,1), use_bias=False ,padding='sa
me')(relu)
  if dropout_rate>0:
    Conv2D_BottleNeck = layers.Dropout(dropout_rate)(Conv2D_BottleNeck)
  avg = layers.AveragePooling2D(pool_size=(2,2))(Conv2D_BottleNeck)
  return avg

#output layer
def output_layer_1(input):
  global compression
  BatchNorm = layers.BatchNormalization()(input)
  relu = layers.Activation('relu')(BatchNorm)
  AvgPooling = layers.AveragePooling2D(pool_size=(2,2))(relu)
  conv=layers.Conv2D(num_classes, kernel_size = (2,2))(AvgPooling)
  output = Activation('softmax')(conv)

  #output = layers.Dense(num_classes, activation='softmax')(flat)
  # got error as mentioned "A target array with shape (50000, 10) was passed for an output of shap
e (None, 1, 1, 10)" so added flatten layer at the end
  output = Flatten()(output)
  return output
```

In [0]:

```
tf.keras.backend.clear_session()
num_filter = 36
dropout_rate = 0
l = 12
input = layers.Input(shape=(img_height, img_width, channel,))
First_Conv2D = layers.Conv2D(num_filter, (3,3), use_bias=False ,padding='same')(input)
```

```
First_Conv2D = layers.Conv2D(num_filter, (3,3), use_bias=False ,padding='same')(input)

First_Block = denseblock_1(First_Conv2D, num_filter, dropout_rate)
First_Transition = transition_1(First_Block, num_filter, dropout_rate)

Second_Block = denseblock_1(First_Transition, num_filter, dropout_rate)
Second_Transition = transition_1(Second_Block, num_filter, dropout_rate)

Third_Block = denseblock_1(Second_Transition, num_filter, dropout_rate)
Third_Transition = transition_1(Third_Block, num_filter, dropout_rate)

Last_Block = denseblock_1(Third_Transition,  num_filter, dropout_rate)
output = output_layer_1(Last_Block)
```

In [0]:

```
model_2 = Model(inputs=[input], outputs=[output])
model_2.summary()
```

Model: "model"

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 32, 32, 3)]	0	
conv2d (Conv2D)	(None, 32, 32, 36)	972	input_1[0][0]
batch_normalization (BatchNorma	(None, 32, 32, 36)	144	conv2d[0][0]
activation (Activation)	(None, 32, 32, 36)	0	batch_normalization[0][0]
conv2d_1 (Conv2D)	(None, 32, 32, 18)	5832	activation[0][0]
concatenate (Concatenate)	(None, 32, 32, 54)	0	conv2d[0][0] conv2d_1[0][0]
batch_normalization_1 (BatchNor	(None, 32, 32, 54)	216	concatenate[0][0]
activation_1 (Activation)	(None, 32, 32, 54)	0	batch_normalization_1[0][0]
conv2d_2 (Conv2D)	(None, 32, 32, 18)	8748	activation_1[0][0]
concatenate_1 (Concatenate)	(None, 32, 32, 72)	0	concatenate[0][0] conv2d_2[0][0]
batch_normalization_2 (BatchNor	(None, 32, 32, 72)	288	concatenate_1[0][0]
activation_2 (Activation)	(None, 32, 32, 72)	0	batch_normalization_2[0][0]
conv2d_3 (Conv2D)	(None, 32, 32, 18)	11664	activation_2[0][0]
concatenate_2 (Concatenate)	(None, 32, 32, 90)	0	concatenate_1[0][0] conv2d_3[0][0]
batch_normalization_3 (BatchNor	(None, 32, 32, 90)	360	concatenate_2[0][0]
activation_3 (Activation)	(None, 32, 32, 90)	0	batch_normalization_3[0][0]
conv2d_4 (Conv2D)	(None, 32, 32, 18)	14580	activation_3[0][0]
concatenate_3 (Concatenate)	(None, 32, 32, 108)	0	concatenate_2[0][0] conv2d_4[0][0]
batch_normalization_4 (BatchNor	(None, 32, 32, 108)	432	concatenate_3[0][0]
activation_4 (Activation)	(None, 32, 32, 108)	0	batch_normalization_4[0][0]
conv2d_5 (Conv2D)	(None, 32, 32, 18)	17496	activation_4[0][0]
concatenate_4 (Concatenate)	(None, 32, 32, 126)	0	concatenate_3[0][0] conv2d_5[0][0]
batch_normalization_5 (BatchNor	(None, 32, 32, 126)	504	concatenate_4[0][0]
activation_5 (Activation)	(None, 32, 32, 126)	0	batch_normalization_5[0][0]

conv2d_6 (Conv2D)	(None, 32, 32, 18)	20412	activation_5[0][0]
concatenate_5 (Concatenate)	(None, 32, 32, 144)	0	concatenate_4[0][0] conv2d_6[0][0]
batch_normalization_6 (BatchNor	(None, 32, 32, 144)	576	concatenate_5[0][0]
activation_6 (Activation)	(None, 32, 32, 144)	0	batch_normalization_6[0][0]
conv2d_7 (Conv2D)	(None, 32, 32, 18)	23328	activation_6[0][0]
concatenate_6 (Concatenate)	(None, 32, 32, 162)	0	concatenate_5[0][0] conv2d_7[0][0]
batch_normalization_7 (BatchNor	(None, 32, 32, 162)	648	concatenate_6[0][0]
activation_7 (Activation)	(None, 32, 32, 162)	0	batch_normalization_7[0][0]
conv2d_8 (Conv2D)	(None, 32, 32, 18)	26244	activation_7[0][0]
concatenate_7 (Concatenate)	(None, 32, 32, 180)	0	concatenate_6[0][0] conv2d_8[0][0]
batch_normalization_8 (BatchNor	(None, 32, 32, 180)	720	concatenate_7[0][0]
activation_8 (Activation)	(None, 32, 32, 180)	0	batch_normalization_8[0][0]
conv2d_9 (Conv2D)	(None, 32, 32, 18)	29160	activation_8[0][0]
concatenate_8 (Concatenate)	(None, 32, 32, 198)	0	concatenate_7[0][0] conv2d_9[0][0]
batch_normalization_9 (BatchNor	(None, 32, 32, 198)	792	concatenate_8[0][0]
activation_9 (Activation)	(None, 32, 32, 198)	0	batch_normalization_9[0][0]
conv2d_10 (Conv2D)	(None, 32, 32, 18)	32076	activation_9[0][0]
concatenate_9 (Concatenate)	(None, 32, 32, 216)	0	concatenate_8[0][0] conv2d_10[0][0]
batch_normalization_10 (BatchNo	(None, 32, 32, 216)	864	concatenate_9[0][0]
activation_10 (Activation)	(None, 32, 32, 216)	0	batch_normalization_10[0][0]
conv2d_11 (Conv2D)	(None, 32, 32, 18)	34992	activation_10[0][0]
concatenate_10 (Concatenate)	(None, 32, 32, 234)	0	concatenate_9[0][0] conv2d_11[0][0]
batch_normalization_11 (BatchNo	(None, 32, 32, 234)	936	concatenate_10[0][0]
activation_11 (Activation)	(None, 32, 32, 234)	0	batch_normalization_11[0][0]
conv2d_12 (Conv2D)	(None, 32, 32, 18)	37908	activation_11[0][0]
concatenate_11 (Concatenate)	(None, 32, 32, 252)	0	concatenate_10[0][0] conv2d_12[0][0]
batch_normalization_12 (BatchNo	(None, 32, 32, 252)	1008	concatenate_11[0][0]
activation_12 (Activation)	(None, 32, 32, 252)	0	batch_normalization_12[0][0]
conv2d_13 (Conv2D)	(None, 32, 32, 18)	4536	activation_12[0][0]
average_pooling2d (AveragePooli	(None, 16, 16, 18)	0	conv2d_13[0][0]
batch_normalization_13 (BatchNo	(None, 16, 16, 18)	72	average_pooling2d[0][0]
activation_13 (Activation)	(None, 16, 16, 18)	0	batch_normalization_13[0][0]
conv2d_14 (Conv2D)	(None, 16, 16, 18)	2916	activation_13[0][0]
concatenate_12 (Concatenate)	(None, 16, 16, 36)	0	average_pooling2d[0][0] conv2d_14[0][0]
batch_normalization_14 (BatchNo	(None, 16, 16, 36)	144	concatenate_12[0][0]

activation_14 (Activation)	(None, 16, 16, 36)	0	batch_normalization_14[0][0]
conv2d_15 (Conv2D)	(None, 16, 16, 18)	5832	activation_14[0][0]
concatenate_13 (Concatenate)	(None, 16, 16, 54)	0	concatenate_12[0][0] conv2d_15[0][0]
batch_normalization_15 (BatchNo	(None, 16, 16, 54)	216	concatenate_13[0][0]
activation_15 (Activation)	(None, 16, 16, 54)	0	batch_normalization_15[0][0]
conv2d_16 (Conv2D)	(None, 16, 16, 18)	8748	activation_15[0][0]
concatenate_14 (Concatenate)	(None, 16, 16, 72)	0	concatenate_13[0][0] conv2d_16[0][0]
batch_normalization_16 (BatchNo	(None, 16, 16, 72)	288	concatenate_14[0][0]
activation_16 (Activation)	(None, 16, 16, 72)	0	batch_normalization_16[0][0]
conv2d_17 (Conv2D)	(None, 16, 16, 18)	11664	activation_16[0][0]
concatenate_15 (Concatenate)	(None, 16, 16, 90)	0	concatenate_14[0][0] conv2d_17[0][0]
batch_normalization_17 (BatchNo	(None, 16, 16, 90)	360	concatenate_15[0][0]
activation_17 (Activation)	(None, 16, 16, 90)	0	batch_normalization_17[0][0]
conv2d_18 (Conv2D)	(None, 16, 16, 18)	14580	activation_17[0][0]
concatenate_16 (Concatenate)	(None, 16, 16, 108)	0	concatenate_15[0][0] conv2d_18[0][0]
batch_normalization_18 (BatchNo	(None, 16, 16, 108)	432	concatenate_16[0][0]
activation_18 (Activation)	(None, 16, 16, 108)	0	batch_normalization_18[0][0]
conv2d_19 (Conv2D)	(None, 16, 16, 18)	17496	activation_18[0][0]
concatenate_17 (Concatenate)	(None, 16, 16, 126)	0	concatenate_16[0][0] conv2d_19[0][0]
batch_normalization_19 (BatchNo	(None, 16, 16, 126)	504	concatenate_17[0][0]
activation_19 (Activation)	(None, 16, 16, 126)	0	batch_normalization_19[0][0]
conv2d_20 (Conv2D)	(None, 16, 16, 18)	20412	activation_19[0][0]
concatenate_18 (Concatenate)	(None, 16, 16, 144)	0	concatenate_17[0][0] conv2d_20[0][0]
batch_normalization_20 (BatchNo	(None, 16, 16, 144)	576	concatenate_18[0][0]
activation_20 (Activation)	(None, 16, 16, 144)	0	batch_normalization_20[0][0]
conv2d_21 (Conv2D)	(None, 16, 16, 18)	23328	activation_20[0][0]
concatenate_19 (Concatenate)	(None, 16, 16, 162)	0	concatenate_18[0][0] conv2d_21[0][0]
batch_normalization_21 (BatchNo	(None, 16, 16, 162)	648	concatenate_19[0][0]
activation_21 (Activation)	(None, 16, 16, 162)	0	batch_normalization_21[0][0]
conv2d_22 (Conv2D)	(None, 16, 16, 18)	26244	activation_21[0][0]
concatenate_20 (Concatenate)	(None, 16, 16, 180)	0	concatenate_19[0][0] conv2d_22[0][0]
batch_normalization_22 (BatchNo	(None, 16, 16, 180)	720	concatenate_20[0][0]
activation_22 (Activation)	(None, 16, 16, 180)	0	batch_normalization_22[0][0]
conv2d_23 (Conv2D)	(None, 16, 16, 18)	29160	activation_22[0][0]

concatenate_21 (Concatenate)	(None, 16, 16, 198)	0	concatenate_20[0][0] conv2d_23[0][0]
batch_normalization_23 (BatchNo	(None, 16, 16, 198)	792	concatenate_21[0][0]
activation_23 (Activation)	(None, 16, 16, 198)	0	batch_normalization_23[0][0]
conv2d_24 (Conv2D)	(None, 16, 16, 18)	32076	activation_23[0][0]
concatenate_22 (Concatenate)	(None, 16, 16, 216)	0	concatenate_21[0][0] conv2d_24[0][0]
batch_normalization_24 (BatchNo	(None, 16, 16, 216)	864	concatenate_22[0][0]
activation_24 (Activation)	(None, 16, 16, 216)	0	batch_normalization_24[0][0]
conv2d_25 (Conv2D)	(None, 16, 16, 18)	34992	activation_24[0][0]
concatenate_23 (Concatenate)	(None, 16, 16, 234)	0	concatenate_22[0][0] conv2d_25[0][0]
batch_normalization_25 (BatchNo	(None, 16, 16, 234)	936	concatenate_23[0][0]
activation_25 (Activation)	(None, 16, 16, 234)	0	batch_normalization_25[0][0]
conv2d_26 (Conv2D)	(None, 16, 16, 18)	4212	activation_25[0][0]
average_pooling2d_1 (AveragePoo	(None, 8, 8, 18)	0	conv2d_26[0][0]
batch_normalization_26 (BatchNo	(None, 8, 8, 18)	72	average_pooling2d_1[0][0]
activation_26 (Activation)	(None, 8, 8, 18)	0	batch_normalization_26[0][0]
conv2d_27 (Conv2D)	(None, 8, 8, 18)	2916	activation_26[0][0]
concatenate_24 (Concatenate)	(None, 8, 8, 36)	0	average_pooling2d_1[0][0] conv2d_27[0][0]
batch_normalization_27 (BatchNo	(None, 8, 8, 36)	144	concatenate_24[0][0]
activation_27 (Activation)	(None, 8, 8, 36)	0	batch_normalization_27[0][0]
conv2d_28 (Conv2D)	(None, 8, 8, 18)	5832	activation_27[0][0]
concatenate_25 (Concatenate)	(None, 8, 8, 54)	0	concatenate_24[0][0] conv2d_28[0][0]
batch_normalization_28 (BatchNo	(None, 8, 8, 54)	216	concatenate_25[0][0]
activation_28 (Activation)	(None, 8, 8, 54)	0	batch_normalization_28[0][0]
conv2d_29 (Conv2D)	(None, 8, 8, 18)	8748	activation_28[0][0]
concatenate_26 (Concatenate)	(None, 8, 8, 72)	0	concatenate_25[0][0] conv2d_29[0][0]
batch_normalization_29 (BatchNo	(None, 8, 8, 72)	288	concatenate_26[0][0]
activation_29 (Activation)	(None, 8, 8, 72)	0	batch_normalization_29[0][0]
conv2d_30 (Conv2D)	(None, 8, 8, 18)	11664	activation_29[0][0]
concatenate_27 (Concatenate)	(None, 8, 8, 90)	0	concatenate_26[0][0] conv2d_30[0][0]
batch_normalization_30 (BatchNo	(None, 8, 8, 90)	360	concatenate_27[0][0]
activation_30 (Activation)	(None, 8, 8, 90)	0	batch_normalization_30[0][0]
conv2d_31 (Conv2D)	(None, 8, 8, 18)	14580	activation_30[0][0]
concatenate_28 (Concatenate)	(None, 8, 8, 108)	0	concatenate_27[0][0] conv2d_31[0][0]
batch_normalization_31 (BatchNo	(None, 8, 8, 108)	432	concatenate_28[0][0]
activation_31 (Activation)	(None, 8, 8, 108)	0	batch_normalization_31[0][0]

activation_31 (Activation)	(None, 8, 8, 108)	0	batch_normalization_31[0][0]
conv2d_32 (Conv2D)	(None, 8, 8, 18)	17496	activation_31[0][0]
concatenate_29 (Concatenate)	(None, 8, 8, 126)	0	concatenate_28[0][0] conv2d_32[0][0]
batch_normalization_32 (BatchNo	(None, 8, 8, 126)	504	concatenate_29[0][0]
activation_32 (Activation)	(None, 8, 8, 126)	0	batch_normalization_32[0][0]
conv2d_33 (Conv2D)	(None, 8, 8, 18)	20412	activation_32[0][0]
concatenate_30 (Concatenate)	(None, 8, 8, 144)	0	concatenate_29[0][0] conv2d_33[0][0]
batch_normalization_33 (BatchNo	(None, 8, 8, 144)	576	concatenate_30[0][0]
activation_33 (Activation)	(None, 8, 8, 144)	0	batch_normalization_33[0][0]
conv2d_34 (Conv2D)	(None, 8, 8, 18)	23328	activation_33[0][0]
concatenate_31 (Concatenate)	(None, 8, 8, 162)	0	concatenate_30[0][0] conv2d_34[0][0]
batch_normalization_34 (BatchNo	(None, 8, 8, 162)	648	concatenate_31[0][0]
activation_34 (Activation)	(None, 8, 8, 162)	0	batch_normalization_34[0][0]
conv2d_35 (Conv2D)	(None, 8, 8, 18)	26244	activation_34[0][0]
concatenate_32 (Concatenate)	(None, 8, 8, 180)	0	concatenate_31[0][0] conv2d_35[0][0]
batch_normalization_35 (BatchNo	(None, 8, 8, 180)	720	concatenate_32[0][0]
activation_35 (Activation)	(None, 8, 8, 180)	0	batch_normalization_35[0][0]
conv2d_36 (Conv2D)	(None, 8, 8, 18)	29160	activation_35[0][0]
concatenate_33 (Concatenate)	(None, 8, 8, 198)	0	concatenate_32[0][0] conv2d_36[0][0]
batch_normalization_36 (BatchNo	(None, 8, 8, 198)	792	concatenate_33[0][0]
activation_36 (Activation)	(None, 8, 8, 198)	0	batch_normalization_36[0][0]
conv2d_37 (Conv2D)	(None, 8, 8, 18)	32076	activation_36[0][0]
concatenate_34 (Concatenate)	(None, 8, 8, 216)	0	concatenate_33[0][0] conv2d_37[0][0]
batch_normalization_37 (BatchNo	(None, 8, 8, 216)	864	concatenate_34[0][0]
activation_37 (Activation)	(None, 8, 8, 216)	0	batch_normalization_37[0][0]
conv2d_38 (Conv2D)	(None, 8, 8, 18)	34992	activation_37[0][0]
concatenate_35 (Concatenate)	(None, 8, 8, 234)	0	concatenate_34[0][0] conv2d_38[0][0]
batch_normalization_38 (BatchNo	(None, 8, 8, 234)	936	concatenate_35[0][0]
activation_38 (Activation)	(None, 8, 8, 234)	0	batch_normalization_38[0][0]
conv2d_39 (Conv2D)	(None, 8, 8, 18)	4212	activation_38[0][0]
average_pooling2d_2 (AveragePoo	(None, 4, 4, 18)	0	conv2d_39[0][0]
batch_normalization_39 (BatchNo	(None, 4, 4, 18)	72	average_pooling2d_2[0][0]
activation_39 (Activation)	(None, 4, 4, 18)	0	batch_normalization_39[0][0]
conv2d_40 (Conv2D)	(None, 4, 4, 18)	2916	activation_39[0][0]
concatenate_36 (Concatenate)	(None, 4, 4, 36)	0	average_pooling2d_2[0][0] conv2d_40[0][0]

batch_normalization_40 (BatchNo	(None, 4, 4, 36)	144	concatenate_36[0][0]
activation_40 (Activation)	(None, 4, 4, 36)	0	batch_normalization_40[0][0]
conv2d_41 (Conv2D)	(None, 4, 4, 18)	5832	activation_40[0][0]
concatenate_37 (Concatenate)	(None, 4, 4, 54)	0	concatenate_36[0][0] conv2d_41[0][0]
batch_normalization_41 (BatchNo	(None, 4, 4, 54)	216	concatenate_37[0][0]
activation_41 (Activation)	(None, 4, 4, 54)	0	batch_normalization_41[0][0]
conv2d_42 (Conv2D)	(None, 4, 4, 18)	8748	activation_41[0][0]
concatenate_38 (Concatenate)	(None, 4, 4, 72)	0	concatenate_37[0][0] conv2d_42[0][0]
batch_normalization_42 (BatchNo	(None, 4, 4, 72)	288	concatenate_38[0][0]
activation_42 (Activation)	(None, 4, 4, 72)	0	batch_normalization_42[0][0]
conv2d_43 (Conv2D)	(None, 4, 4, 18)	11664	activation_42[0][0]
concatenate_39 (Concatenate)	(None, 4, 4, 90)	0	concatenate_38[0][0] conv2d_43[0][0]
batch_normalization_43 (BatchNo	(None, 4, 4, 90)	360	concatenate_39[0][0]
activation_43 (Activation)	(None, 4, 4, 90)	0	batch_normalization_43[0][0]
conv2d_44 (Conv2D)	(None, 4, 4, 18)	14580	activation_43[0][0]
concatenate_40 (Concatenate)	(None, 4, 4, 108)	0	concatenate_39[0][0] conv2d_44[0][0]
batch_normalization_44 (BatchNo	(None, 4, 4, 108)	432	concatenate_40[0][0]
activation_44 (Activation)	(None, 4, 4, 108)	0	batch_normalization_44[0][0]
conv2d_45 (Conv2D)	(None, 4, 4, 18)	17496	activation_44[0][0]
concatenate_41 (Concatenate)	(None, 4, 4, 126)	0	concatenate_40[0][0] conv2d_45[0][0]
batch_normalization_45 (BatchNo	(None, 4, 4, 126)	504	concatenate_41[0][0]
activation_45 (Activation)	(None, 4, 4, 126)	0	batch_normalization_45[0][0]
conv2d_46 (Conv2D)	(None, 4, 4, 18)	20412	activation_45[0][0]
concatenate_42 (Concatenate)	(None, 4, 4, 144)	0	concatenate_41[0][0] conv2d_46[0][0]
batch_normalization_46 (BatchNo	(None, 4, 4, 144)	576	concatenate_42[0][0]
activation_46 (Activation)	(None, 4, 4, 144)	0	batch_normalization_46[0][0]
conv2d_47 (Conv2D)	(None, 4, 4, 18)	23328	activation_46[0][0]
concatenate_43 (Concatenate)	(None, 4, 4, 162)	0	concatenate_42[0][0] conv2d_47[0][0]
batch_normalization_47 (BatchNo	(None, 4, 4, 162)	648	concatenate_43[0][0]
activation_47 (Activation)	(None, 4, 4, 162)	0	batch_normalization_47[0][0]
conv2d_48 (Conv2D)	(None, 4, 4, 18)	26244	activation_47[0][0]
concatenate_44 (Concatenate)	(None, 4, 4, 180)	0	concatenate_43[0][0] conv2d_48[0][0]
batch_normalization_48 (BatchNo	(None, 4, 4, 180)	720	concatenate_44[0][0]
activation_48 (Activation)	(None, 4, 4, 180)	0	batch_normalization_48[0][0]
conv2d_49 (Conv2D)	(None, 4, 4, 18)	29160	activation_48[0][0]

```
conv2d_49 (Conv2D)              (None, 4, 4, 18)     29160       activation_48[0][0]
__________________________________________________________________________________________________
concatenate_45 (Concatenate)    (None, 4, 4, 198)    0           concatenate_44[0][0]
                                                                 conv2d_49[0][0]
__________________________________________________________________________________________________
batch_normalization_49 (BatchNo (None, 4, 4, 198)    792         concatenate_45[0][0]
__________________________________________________________________________________________________
activation_49 (Activation)      (None, 4, 4, 198)    0           batch_normalization_49[0][0]
__________________________________________________________________________________________________
conv2d_50 (Conv2D)              (None, 4, 4, 18)     32076       activation_49[0][0]
__________________________________________________________________________________________________
concatenate_46 (Concatenate)    (None, 4, 4, 216)    0           concatenate_45[0][0]
                                                                 conv2d_50[0][0]
__________________________________________________________________________________________________
batch_normalization_50 (BatchNo (None, 4, 4, 216)    864         concatenate_46[0][0]
__________________________________________________________________________________________________
activation_50 (Activation)      (None, 4, 4, 216)    0           batch_normalization_50[0][0]
__________________________________________________________________________________________________
conv2d_51 (Conv2D)              (None, 4, 4, 18)     34992       activation_50[0][0]
__________________________________________________________________________________________________
concatenate_47 (Concatenate)    (None, 4, 4, 234)    0           concatenate_46[0][0]
                                                                 conv2d_51[0][0]
__________________________________________________________________________________________________
batch_normalization_51 (BatchNo (None, 4, 4, 234)    936         concatenate_47[0][0]
__________________________________________________________________________________________________
activation_51 (Activation)      (None, 4, 4, 234)    0           batch_normalization_51[0][0]
__________________________________________________________________________________________________
average_pooling2d_3 (AveragePoo (None, 2, 2, 234)    0           activation_51[0][0]
__________________________________________________________________________________________________
conv2d_52 (Conv2D)              (None, 1, 1, 10)     9370        average_pooling2d_3[0][0]
__________________________________________________________________________________________________
activation_52 (Activation)      (None, 1, 1, 10)     0           conv2d_52[0][0]
__________________________________________________________________________________________________
flatten (Flatten)               (None, 10)           0           activation_52[0][0]
==================================================================================================
Total params: 995,230
Trainable params: 981,658
Non-trainable params: 13,572
__________________________________________________________________________________________________
```

In [0]:

```
# determine Loss function and Optimizer
model_2.compile(loss='categorical_crossentropy',
              optimizer=Adam(),
              metrics=['accuracy'])
```

1. Without use Image Augmentation Techniques

In [0]:

```
model_2.fit(X_train, y_train,
                    batch_size=batch_size,
                    epochs=300,
                    verbose=1,
                    validation_data=(X_test, y_test))
```

```
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/tensorflow_core/python/ops/math_grad.py:1424: where (from
tensorflow.python.ops.array_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
Train on 50000 samples, validate on 10000 samples
Epoch 1/300
50000/50000 [==============================] - 134s 3ms/sample - loss: 1.3443 - acc: 0.5108 - val_
loss: 1.7591 - val_acc: 0.3901
Epoch 2/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.8689 - acc: 0.6896 - val_
loss: 1.0018 - val_acc: 0.6554
Epoch 3/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.6847 - acc: 0.7581 - val_
loss: 0.7081 - val_acc: 0.7513
Epoch 4/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.5676 - acc: 0.8010 - val
```

```
loss: 1.1526 - val_acc: 0.6628
Epoch 5/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.4913 - acc: 0.8289 - val_
loss: 0.7590 - val_acc: 0.7545
Epoch 6/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.4226 - acc: 0.8523 - val_
loss: 0.9314 - val_acc: 0.7074
Epoch 7/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.3659 - acc: 0.8716 - val_
loss: 1.0074 - val_acc: 0.6984
Epoch 8/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.3170 - acc: 0.8898 - val_
loss: 0.7834 - val_acc: 0.7677
Epoch 9/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.2743 - acc: 0.9029 - val_
loss: 0.6990 - val_acc: 0.7790
Epoch 10/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.2382 - acc: 0.9162 - val_
loss: 0.9570 - val_acc: 0.7351
Epoch 11/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.2081 - acc: 0.9265 - val_
loss: 0.6206 - val_acc: 0.8150
Epoch 12/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.1690 - acc: 0.9396 - val_
loss: 1.0392 - val_acc: 0.7457
Epoch 13/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.1503 - acc: 0.9470 - val_
loss: 0.8672 - val_acc: 0.7866
Epoch 14/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.1271 - acc: 0.9546 - val_
loss: 0.8370 - val_acc: 0.7919
Epoch 15/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.1151 - acc: 0.9591 - val_
loss: 0.8448 - val_acc: 0.7972
Epoch 16/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0935 - acc: 0.9669 - val_
loss: 0.8797 - val_acc: 0.7936
Epoch 17/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0960 - acc: 0.9660 - val_
loss: 0.7592 - val_acc: 0.8196
Epoch 18/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0761 - acc: 0.9728 - val_
loss: 0.9563 - val_acc: 0.7972
Epoch 19/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0838 - acc: 0.9702 - val_
loss: 0.9347 - val_acc: 0.8002
Epoch 20/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0660 - acc: 0.9766 - val_
loss: 1.0032 - val_acc: 0.7975
Epoch 21/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0676 - acc: 0.9762 - val_
loss: 0.9245 - val_acc: 0.8000
Epoch 22/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0674 - acc: 0.9760 - val_
loss: 0.9856 - val_acc: 0.8007
Epoch 23/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0640 - acc: 0.9775 - val_
loss: 1.0772 - val_acc: 0.7841
Epoch 24/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0504 - acc: 0.9824 - val_
loss: 0.9070 - val_acc: 0.8209
Epoch 25/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0436 - acc: 0.9850 - val_
loss: 1.1382 - val_acc: 0.7765
Epoch 26/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0586 - acc: 0.9791 - val_
loss: 0.8974 - val_acc: 0.8084
Epoch 27/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0440 - acc: 0.9850 - val_
loss: 0.8772 - val_acc: 0.8171
Epoch 28/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0431 - acc: 0.9852 - val_
loss: 1.0561 - val_acc: 0.7990
Epoch 29/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0467 - acc: 0.9838 - val_
loss: 0.9764 - val_acc: 0.8187
Epoch 30/300
```

```
Epoch 30/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0474 - acc: 0.9835 - val_
loss: 1.0974 - val_acc: 0.7971
Epoch 31/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0367 - acc: 0.9870 - val_
loss: 0.9546 - val_acc: 0.8085
Epoch 32/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0339 - acc: 0.9879 - val_
loss: 1.0321 - val_acc: 0.8132
Epoch 33/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0390 - acc: 0.9864 - val_
loss: 0.9516 - val_acc: 0.8219
Epoch 34/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0338 - acc: 0.9878 - val_
loss: 0.9801 - val_acc: 0.8212
Epoch 35/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0335 - acc: 0.9885 - val_
loss: 1.0146 - val_acc: 0.8207
Epoch 36/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0441 - acc: 0.9842 - val_
loss: 1.0133 - val_acc: 0.8154
Epoch 37/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0282 - acc: 0.9905 - val_
loss: 1.2679 - val_acc: 0.7763
Epoch 38/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0266 - acc: 0.9908 - val_
loss: 0.9807 - val_acc: 0.8241
Epoch 39/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0298 - acc: 0.9897 - val_
loss: 1.0016 - val_acc: 0.8216
Epoch 40/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0310 - acc: 0.9896 - val_
loss: 1.2716 - val_acc: 0.7904
Epoch 41/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0380 - acc: 0.9863 - val_
loss: 1.2115 - val_acc: 0.7935
Epoch 42/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0285 - acc: 0.9899 - val_
loss: 1.0746 - val_acc: 0.8132
Epoch 43/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0198 - acc: 0.9934 - val_
loss: 0.9930 - val_acc: 0.8297
Epoch 44/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0252 - acc: 0.9915 - val_
loss: 1.0507 - val_acc: 0.8265
Epoch 45/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0358 - acc: 0.9880 - val_
loss: 1.1530 - val_acc: 0.8064
Epoch 46/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0221 - acc: 0.9925 - val_
loss: 0.9613 - val_acc: 0.8270
Epoch 47/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0230 - acc: 0.9918 - val_
loss: 1.0209 - val_acc: 0.8217
Epoch 48/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0311 - acc: 0.9894 - val_
loss: 1.0780 - val_acc: 0.8212
Epoch 49/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0182 - acc: 0.9937 - val_
loss: 0.9739 - val_acc: 0.8303
Epoch 50/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0235 - acc: 0.9918 - val_
loss: 1.0470 - val_acc: 0.8298
Epoch 51/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0275 - acc: 0.9906 - val_
loss: 1.1015 - val_acc: 0.8055
Epoch 52/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0220 - acc: 0.9922 - val_
loss: 1.1770 - val_acc: 0.8105
Epoch 53/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0244 - acc: 0.9914 - val_
loss: 1.1219 - val_acc: 0.8148
Epoch 54/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0195 - acc: 0.9931 - val_
loss: 0.9504 - val_acc: 0.8317
Epoch 55/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0186 - acc: 0.9934 - val_
loss: 1.1449 - val_acc: 0.8101
```

```
loss: 1.1449 - val_acc: 0.8101
Epoch 56/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0225 - acc: 0.9922 - val_
loss: 1.1274 - val_acc: 0.8251
Epoch 57/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0221 - acc: 0.9923 - val_
loss: 1.0067 - val_acc: 0.8282
Epoch 58/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0240 - acc: 0.9916 - val_
loss: 0.9781 - val_acc: 0.8329
Epoch 59/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0231 - acc: 0.9921 - val_
loss: 0.9233 - val_acc: 0.8407
Epoch 60/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0080 - acc: 0.9975 - val_
loss: 0.9485 - val_acc: 0.8420
Epoch 61/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0059 - acc: 0.9985 - val_
loss: 1.0705 - val_acc: 0.8358
Epoch 62/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0375 - acc: 0.9873 - val_
loss: 1.0968 - val_acc: 0.8207
Epoch 63/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0222 - acc: 0.9925 - val_
loss: 1.0349 - val_acc: 0.8293
Epoch 64/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0105 - acc: 0.9967 - val_
loss: 1.0016 - val_acc: 0.8368
Epoch 65/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0224 - acc: 0.9922 - val_
loss: 1.3154 - val_acc: 0.8017
Epoch 66/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0184 - acc: 0.9940 - val_
loss: 0.9403 - val_acc: 0.8362
Epoch 67/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0065 - acc: 0.9978 - val_
loss: 0.9529 - val_acc: 0.8444
Epoch 68/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0097 - acc: 0.9968 - val_
loss: 1.1523 - val_acc: 0.8139
Epoch 69/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0380 - acc: 0.9871 - val_
loss: 0.9573 - val_acc: 0.8355
Epoch 70/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0164 - acc: 0.9943 - val_
loss: 0.9756 - val_acc: 0.8389
Epoch 71/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0047 - acc: 0.9986 - val_
loss: 0.8990 - val_acc: 0.8505
Epoch 72/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0026 - acc: 0.9994 - val_
loss: 1.0073 - val_acc: 0.8402
Epoch 73/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0347 - acc: 0.9881 - val_
loss: 1.2522 - val_acc: 0.8061
Epoch 74/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0214 - acc: 0.9924 - val_
loss: 0.9833 - val_acc: 0.8272
Epoch 75/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0100 - acc: 0.9966 - val_
loss: 0.9767 - val_acc: 0.8374
Epoch 76/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0081 - acc: 0.9972 - val_
loss: 1.0905 - val_acc: 0.8318
Epoch 77/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0163 - acc: 0.9944 - val_
loss: 0.9995 - val_acc: 0.8351
Epoch 78/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0209 - acc: 0.9925 - val_
loss: 0.9669 - val_acc: 0.8431
Epoch 79/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0123 - acc: 0.9960 - val_
loss: 1.0251 - val_acc: 0.8295
Epoch 80/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0116 - acc: 0.9962 - val_
loss: 1.0408 - val_acc: 0.8378
Epoch 81/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0210 - acc: 0.9930 - val_
```

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50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0210 - acc: 0.9930 - val_
loss: 1.0576 - val_acc: 0.8344
Epoch 82/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0144 - acc: 0.9950 - val_
loss: 1.0200 - val_acc: 0.8338
Epoch 83/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0118 - acc: 0.9962 - val_
loss: 1.0747 - val_acc: 0.8344
Epoch 84/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0125 - acc: 0.9957 - val_
loss: 1.1207 - val_acc: 0.8274
Epoch 85/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0124 - acc: 0.9958 - val_
loss: 0.9849 - val_acc: 0.8421
Epoch 86/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0161 - acc: 0.9948 - val_
loss: 1.1589 - val_acc: 0.8315
Epoch 87/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0144 - acc: 0.9950 - val_
loss: 1.0566 - val_acc: 0.8328
Epoch 88/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0042 - acc: 0.9986 - val_
loss: 1.0330 - val_acc: 0.8420
Epoch 89/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0035 - acc: 0.9990 - val_
loss: 1.0778 - val_acc: 0.8383
Epoch 90/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0331 - acc: 0.9887 - val_
loss: 1.1734 - val_acc: 0.8148
Epoch 91/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0157 - acc: 0.9943 - val_
loss: 1.0388 - val_acc: 0.8297
Epoch 92/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0046 - acc: 0.9984 - val_
loss: 0.9206 - val_acc: 0.8540
Epoch 93/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0023 - acc: 0.9994 - val_
loss: 0.9516 - val_acc: 0.8476
Epoch 94/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0016 - acc: 0.9996 - val_
loss: 0.9895 - val_acc: 0.8480
Epoch 95/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0317 - acc: 0.9892 - val_
loss: 1.1777 - val_acc: 0.8218
Epoch 96/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0147 - acc: 0.9952 - val_
loss: 0.9128 - val_acc: 0.8473
Epoch 97/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0032 - acc: 0.9991 - val_
loss: 0.9211 - val_acc: 0.8512
Epoch 98/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0034 - acc: 0.9990 - val_
loss: 1.1220 - val_acc: 0.8262
Epoch 99/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0204 - acc: 0.9932 - val_
loss: 1.1817 - val_acc: 0.8169
Epoch 100/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0229 - acc: 0.9922 - val_
loss: 0.9790 - val_acc: 0.8399
Epoch 101/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0093 - acc: 0.9968 - val_
loss: 0.9600 - val_acc: 0.8449
Epoch 102/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0039 - acc: 0.9988 - val_
loss: 0.9762 - val_acc: 0.8465
Epoch 103/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0029 - acc: 0.9991 - val_
loss: 1.0058 - val_acc: 0.8447
Epoch 104/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0173 - acc: 0.9944 - val_
loss: 1.1525 - val_acc: 0.8236
Epoch 105/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0158 - acc: 0.9947 - val_
loss: 1.1299 - val_acc: 0.8232
Epoch 106/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0097 - acc: 0.9967 - val_
loss: 1.1331 - val_acc: 0.8363
Epoch 107/300
```

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Epoch 107/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0082 - acc: 0.9973 - val_
loss: 1.0398 - val_acc: 0.8406
Epoch 108/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0125 - acc: 0.9956 - val_
loss: 1.1235 - val_acc: 0.8261
Epoch 109/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0157 - acc: 0.9949 - val_
loss: 1.1041 - val_acc: 0.8291
Epoch 110/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0029 - acc: 0.9991 - val_
loss: 0.9362 - val_acc: 0.8543
Epoch 111/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0036 - acc: 0.9989 - val_
loss: 1.0206 - val_acc: 0.8425
Epoch 112/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0191 - acc: 0.9936 - val_
loss: 1.1841 - val_acc: 0.8292
Epoch 113/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0148 - acc: 0.9951 - val_
loss: 1.0483 - val_acc: 0.8394
Epoch 114/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0085 - acc: 0.9972 - val_
loss: 1.0114 - val_acc: 0.8432
Epoch 115/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0042 - acc: 0.9986 - val_
loss: 0.9619 - val_acc: 0.8529
Epoch 116/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 8.9669e-04 - acc: 0.9999 -
val_loss: 0.9091 - val_acc: 0.8596
Epoch 117/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 3.0840e-04 - acc: 1.0000 -
val_loss: 0.9442 - val_acc: 0.8570
Epoch 118/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 1.9222e-04 - acc: 1.0000 -
val_loss: 0.9284 - val_acc: 0.8572
Epoch 119/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 2.0548e-04 - acc: 1.0000 -
val_loss: 0.9723 - val_acc: 0.8513
Epoch 120/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0502 - acc: 0.9854 - val_
loss: 1.1841 - val_acc: 0.8177
Epoch 121/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0111 - acc: 0.9965 - val_
loss: 0.9051 - val_acc: 0.8509
Epoch 122/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0035 - acc: 0.9992 - val_
loss: 0.8652 - val_acc: 0.8551
Epoch 123/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0011 - acc: 0.9998 - val_
loss: 0.8946 - val_acc: 0.8559
Epoch 124/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 3.3141e-04 - acc: 1.0000 -
val_loss: 0.8955 - val_acc: 0.8559
Epoch 125/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 3.4934e-04 - acc: 1.0000 -
val_loss: 0.8984 - val_acc: 0.8590
Epoch 126/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 2.0631e-04 - acc: 1.0000 -
val_loss: 0.9179 - val_acc: 0.8571
Epoch 127/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 1.4972e-04 - acc: 1.0000 -
val_loss: 0.9160 - val_acc: 0.8590
Epoch 128/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 7.2511e-05 - acc: 1.0000 -
val_loss: 0.9216 - val_acc: 0.8591
Epoch 129/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0060 - acc: 0.9984 - val_
loss: 1.8173 - val_acc: 0.7557
Epoch 130/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0664 - acc: 0.9784 - val_
loss: 0.9688 - val_acc: 0.8289
Epoch 131/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0043 - acc: 0.9989 - val_
loss: 0.8175 - val_acc: 0.8540
Epoch 132/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0011 - acc: 0.9998 - val_
```

```
loss: 0.8294 - val_acc: 0.8596
Epoch 133/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 4.4160e-04 - acc: 1.0000 -
val_loss: 0.8324 - val_acc: 0.8611
Epoch 134/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 2.0742e-04 - acc: 1.0000 -
val_loss: 0.8410 - val_acc: 0.8625
Epoch 135/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 9.0745e-04 - acc: 0.9999 -
val_loss: 0.8997 - val_acc: 0.8569
Epoch 136/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0343 - acc: 0.9887 - val_
loss: 0.9916 - val_acc: 0.8271
Epoch 137/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0110 - acc: 0.9961 - val_
loss: 0.9545 - val_acc: 0.8420
Epoch 138/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0043 - acc: 0.9987 - val_
loss: 0.9190 - val_acc: 0.8482
Epoch 139/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 0.0017 - acc: 0.9996 - val_
loss: 0.9074 - val_acc: 0.8524
Epoch 140/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 3.9840e-04 - acc: 1.0000 -
val_loss: 0.9010 - val_acc: 0.8547
Epoch 141/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 2.6018e-04 - acc: 1.0000 -
val_loss: 0.8995 - val_acc: 0.8551
Epoch 142/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 1.3516e-04 - acc: 1.0000 -
val_loss: 0.9033 - val_acc: 0.8548
Epoch 143/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 7.2716e-05 - acc: 1.0000 -
val_loss: 0.9054 - val_acc: 0.8559
Epoch 144/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 5.4286e-05 - acc: 1.0000 -
val_loss: 0.9119 - val_acc: 0.8580
Epoch 145/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 4.3497e-05 - acc: 1.0000 -
val_loss: 0.9145 - val_acc: 0.8586
Epoch 146/300
50000/50000 [==============================] - 114s 2ms/sample - loss: 3.5640e-05 - acc: 1.0000 -
val_loss: 0.9263 - val_acc: 0.8567
Epoch 147/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 3.2485e-05 - acc: 1.0000 -
val_loss: 0.9253 - val_acc: 0.8555
Epoch 148/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 3.7064e-05 - acc: 1.0000 -
val_loss: 0.9363 - val_acc: 0.8567
Epoch 149/300
50000/50000 [==============================] - 115s 2ms/sample - loss: 3.0460e-05 - acc: 1.0000 -
val_loss: 0.9485 - val_acc: 0.8570
Epoch 150/300
25472/50000 [==============>.............] - ETA: 53s - loss: 2.1300e-05 - acc: 1.0000Buffered d
ata was truncated after reaching the output size limit.
```

1. Using Image Augmentation Techniques

In [0]:

```
from keras.preprocessing.image import ImageDataGenerator
# Data augementation
image_gen = ImageDataGenerator(rotation_range=20,width_shift_range=0.125,height_shift_range=0.125,
horizontal_flip=True,fill_mode='nearest',zoom_range=0.10)

image_gen.fit(X_train)
```

```
Using TensorFlow backend.
```

In [0]:

```
X_train.shape
```

Out[0]:

```
(50000, 32, 32, 3)
```

In [0]:

```
# determine Loss function and Optimizer

model_3 = Model(inputs=[input], outputs=[output])
model_3.summary()
```

```
Model: "model"
```

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 32, 32, 3)]	0	
conv2d (Conv2D)	(None, 32, 32, 36)	972	input_1[0][0]
batch_normalization (BatchNorma	(None, 32, 32, 36)	144	conv2d[0][0]
activation (Activation)	(None, 32, 32, 36)	0	batch_normalization[0][0]
conv2d_1 (Conv2D)	(None, 32, 32, 18)	5832	activation[0][0]
concatenate (Concatenate)	(None, 32, 32, 54)	0	conv2d[0][0] conv2d_1[0][0]
batch_normalization_1 (BatchNor	(None, 32, 32, 54)	216	concatenate[0][0]
activation_1 (Activation)	(None, 32, 32, 54)	0	batch_normalization_1[0][0]
conv2d_2 (Conv2D)	(None, 32, 32, 18)	8748	activation_1[0][0]
concatenate_1 (Concatenate)	(None, 32, 32, 72)	0	concatenate[0][0] conv2d_2[0][0]
batch_normalization_2 (BatchNor	(None, 32, 32, 72)	288	concatenate_1[0][0]
activation_2 (Activation)	(None, 32, 32, 72)	0	batch_normalization_2[0][0]
conv2d_3 (Conv2D)	(None, 32, 32, 18)	11664	activation_2[0][0]
concatenate_2 (Concatenate)	(None, 32, 32, 90)	0	concatenate_1[0][0] conv2d_3[0][0]
batch_normalization_3 (BatchNor	(None, 32, 32, 90)	360	concatenate_2[0][0]
activation_3 (Activation)	(None, 32, 32, 90)	0	batch_normalization_3[0][0]
conv2d_4 (Conv2D)	(None, 32, 32, 18)	14580	activation_3[0][0]
concatenate_3 (Concatenate)	(None, 32, 32, 108)	0	concatenate_2[0][0] conv2d_4[0][0]
batch_normalization_4 (BatchNor	(None, 32, 32, 108)	432	concatenate_3[0][0]
activation_4 (Activation)	(None, 32, 32, 108)	0	batch_normalization_4[0][0]
conv2d_5 (Conv2D)	(None, 32, 32, 18)	17496	activation_4[0][0]
concatenate_4 (Concatenate)	(None, 32, 32, 126)	0	concatenate_3[0][0] conv2d_5[0][0]
batch_normalization_5 (BatchNor	(None, 32, 32, 126)	504	concatenate_4[0][0]
activation_5 (Activation)	(None, 32, 32, 126)	0	batch_normalization_5[0][0]
conv2d_6 (Conv2D)	(None, 32, 32, 18)	20412	activation_5[0][0]
concatenate_5 (Concatenate)	(None, 32, 32, 144)	0	concatenate_4[0][0] conv2d_6[0][0]
batch_normalization_6 (BatchNor	(None, 32, 32, 144)	576	concatenate_5[0][0]
activation_6 (Activation)	(None, 32, 32, 144)	0	batch_normalization_6[0][0]

activation_6 (Activation)	(None, 32, 32, 144)	0	batch_normalization_6[0][0]
conv2d_7 (Conv2D)	(None, 32, 32, 18)	23328	activation_6[0][0]
concatenate_6 (Concatenate)	(None, 32, 32, 162)	0	concatenate_5[0][0] conv2d_7[0][0]
batch_normalization_7 (BatchNor	(None, 32, 32, 162)	648	concatenate_6[0][0]
activation_7 (Activation)	(None, 32, 32, 162)	0	batch_normalization_7[0][0]
conv2d_8 (Conv2D)	(None, 32, 32, 18)	26244	activation_7[0][0]
concatenate_7 (Concatenate)	(None, 32, 32, 180)	0	concatenate_6[0][0] conv2d_8[0][0]
batch_normalization_8 (BatchNor	(None, 32, 32, 180)	720	concatenate_7[0][0]
activation_8 (Activation)	(None, 32, 32, 180)	0	batch_normalization_8[0][0]
conv2d_9 (Conv2D)	(None, 32, 32, 18)	29160	activation_8[0][0]
concatenate_8 (Concatenate)	(None, 32, 32, 198)	0	concatenate_7[0][0] conv2d_9[0][0]
batch_normalization_9 (BatchNor	(None, 32, 32, 198)	792	concatenate_8[0][0]
activation_9 (Activation)	(None, 32, 32, 198)	0	batch_normalization_9[0][0]
conv2d_10 (Conv2D)	(None, 32, 32, 18)	32076	activation_9[0][0]
concatenate_9 (Concatenate)	(None, 32, 32, 216)	0	concatenate_8[0][0] conv2d_10[0][0]
batch_normalization_10 (BatchNo	(None, 32, 32, 216)	864	concatenate_9[0][0]
activation_10 (Activation)	(None, 32, 32, 216)	0	batch_normalization_10[0][0]
conv2d_11 (Conv2D)	(None, 32, 32, 18)	34992	activation_10[0][0]
concatenate_10 (Concatenate)	(None, 32, 32, 234)	0	concatenate_9[0][0] conv2d_11[0][0]
batch_normalization_11 (BatchNo	(None, 32, 32, 234)	936	concatenate_10[0][0]
activation_11 (Activation)	(None, 32, 32, 234)	0	batch_normalization_11[0][0]
conv2d_12 (Conv2D)	(None, 32, 32, 18)	37908	activation_11[0][0]
concatenate_11 (Concatenate)	(None, 32, 32, 252)	0	concatenate_10[0][0] conv2d_12[0][0]
batch_normalization_12 (BatchNo	(None, 32, 32, 252)	1008	concatenate_11[0][0]
activation_12 (Activation)	(None, 32, 32, 252)	0	batch_normalization_12[0][0]
conv2d_13 (Conv2D)	(None, 32, 32, 18)	4536	activation_12[0][0]
average_pooling2d (AveragePooli	(None, 16, 16, 18)	0	conv2d_13[0][0]
batch_normalization_13 (BatchNo	(None, 16, 16, 18)	72	average_pooling2d[0][0]
activation_13 (Activation)	(None, 16, 16, 18)	0	batch_normalization_13[0][0]
conv2d_14 (Conv2D)	(None, 16, 16, 18)	2916	activation_13[0][0]
concatenate_12 (Concatenate)	(None, 16, 16, 36)	0	average_pooling2d[0][0] conv2d_14[0][0]
batch_normalization_14 (BatchNo	(None, 16, 16, 36)	144	concatenate_12[0][0]
activation_14 (Activation)	(None, 16, 16, 36)	0	batch_normalization_14[0][0]
conv2d_15 (Conv2D)	(None, 16, 16, 18)	5832	activation_14[0][0]
concatenate_13 (Concatenate)	(None, 16, 16, 54)	0	concatenate_12[0][0] conv2d_15[0][0]

batch_normalization_15 (BatchNo	(None, 16, 16, 54)	216	concatenate_13[0][0]
activation_15 (Activation)	(None, 16, 16, 54)	0	batch_normalization_15[0][0]
conv2d_16 (Conv2D)	(None, 16, 16, 18)	8748	activation_15[0][0]
concatenate_14 (Concatenate)	(None, 16, 16, 72)	0	concatenate_13[0][0] conv2d_16[0][0]
batch_normalization_16 (BatchNo	(None, 16, 16, 72)	288	concatenate_14[0][0]
activation_16 (Activation)	(None, 16, 16, 72)	0	batch_normalization_16[0][0]
conv2d_17 (Conv2D)	(None, 16, 16, 18)	11664	activation_16[0][0]
concatenate_15 (Concatenate)	(None, 16, 16, 90)	0	concatenate_14[0][0] conv2d_17[0][0]
batch_normalization_17 (BatchNo	(None, 16, 16, 90)	360	concatenate_15[0][0]
activation_17 (Activation)	(None, 16, 16, 90)	0	batch_normalization_17[0][0]
conv2d_18 (Conv2D)	(None, 16, 16, 18)	14580	activation_17[0][0]
concatenate_16 (Concatenate)	(None, 16, 16, 108)	0	concatenate_15[0][0] conv2d_18[0][0]
batch_normalization_18 (BatchNo	(None, 16, 16, 108)	432	concatenate_16[0][0]
activation_18 (Activation)	(None, 16, 16, 108)	0	batch_normalization_18[0][0]
conv2d_19 (Conv2D)	(None, 16, 16, 18)	17496	activation_18[0][0]
concatenate_17 (Concatenate)	(None, 16, 16, 126)	0	concatenate_16[0][0] conv2d_19[0][0]
batch_normalization_19 (BatchNo	(None, 16, 16, 126)	504	concatenate_17[0][0]
activation_19 (Activation)	(None, 16, 16, 126)	0	batch_normalization_19[0][0]
conv2d_20 (Conv2D)	(None, 16, 16, 18)	20412	activation_19[0][0]
concatenate_18 (Concatenate)	(None, 16, 16, 144)	0	concatenate_17[0][0] conv2d_20[0][0]
batch_normalization_20 (BatchNo	(None, 16, 16, 144)	576	concatenate_18[0][0]
activation_20 (Activation)	(None, 16, 16, 144)	0	batch_normalization_20[0][0]
conv2d_21 (Conv2D)	(None, 16, 16, 18)	23328	activation_20[0][0]
concatenate_19 (Concatenate)	(None, 16, 16, 162)	0	concatenate_18[0][0] conv2d_21[0][0]
batch_normalization_21 (BatchNo	(None, 16, 16, 162)	648	concatenate_19[0][0]
activation_21 (Activation)	(None, 16, 16, 162)	0	batch_normalization_21[0][0]
conv2d_22 (Conv2D)	(None, 16, 16, 18)	26244	activation_21[0][0]
concatenate_20 (Concatenate)	(None, 16, 16, 180)	0	concatenate_19[0][0] conv2d_22[0][0]
batch_normalization_22 (BatchNo	(None, 16, 16, 180)	720	concatenate_20[0][0]
activation_22 (Activation)	(None, 16, 16, 180)	0	batch_normalization_22[0][0]
conv2d_23 (Conv2D)	(None, 16, 16, 18)	29160	activation_22[0][0]
concatenate_21 (Concatenate)	(None, 16, 16, 198)	0	concatenate_20[0][0] conv2d_23[0][0]
batch_normalization_23 (BatchNo	(None, 16, 16, 198)	792	concatenate_21[0][0]
activation_23 (Activation)	(None, 16, 16, 198)	0	batch_normalization_23[0][0]

conv2d_24 (Conv2D)	(None, 16, 16, 18)	32076	activation_23[0][0]
concatenate_22 (Concatenate)	(None, 16, 16, 216)	0	concatenate_21[0][0] conv2d_24[0][0]
batch_normalization_24 (BatchNo	(None, 16, 16, 216)	864	concatenate_22[0][0]
activation_24 (Activation)	(None, 16, 16, 216)	0	batch_normalization_24[0][0]
conv2d_25 (Conv2D)	(None, 16, 16, 18)	34992	activation_24[0][0]
concatenate_23 (Concatenate)	(None, 16, 16, 234)	0	concatenate_22[0][0] conv2d_25[0][0]
batch_normalization_25 (BatchNo	(None, 16, 16, 234)	936	concatenate_23[0][0]
activation_25 (Activation)	(None, 16, 16, 234)	0	batch_normalization_25[0][0]
conv2d_26 (Conv2D)	(None, 16, 16, 18)	4212	activation_25[0][0]
average_pooling2d_1 (AveragePoo	(None, 8, 8, 18)	0	conv2d_26[0][0]
batch_normalization_26 (BatchNo	(None, 8, 8, 18)	72	average_pooling2d_1[0][0]
activation_26 (Activation)	(None, 8, 8, 18)	0	batch_normalization_26[0][0]
conv2d_27 (Conv2D)	(None, 8, 8, 18)	2916	activation_26[0][0]
concatenate_24 (Concatenate)	(None, 8, 8, 36)	0	average_pooling2d_1[0][0] conv2d_27[0][0]
batch_normalization_27 (BatchNo	(None, 8, 8, 36)	144	concatenate_24[0][0]
activation_27 (Activation)	(None, 8, 8, 36)	0	batch_normalization_27[0][0]
conv2d_28 (Conv2D)	(None, 8, 8, 18)	5832	activation_27[0][0]
concatenate_25 (Concatenate)	(None, 8, 8, 54)	0	concatenate_24[0][0] conv2d_28[0][0]
batch_normalization_28 (BatchNo	(None, 8, 8, 54)	216	concatenate_25[0][0]
activation_28 (Activation)	(None, 8, 8, 54)	0	batch_normalization_28[0][0]
conv2d_29 (Conv2D)	(None, 8, 8, 18)	8748	activation_28[0][0]
concatenate_26 (Concatenate)	(None, 8, 8, 72)	0	concatenate_25[0][0] conv2d_29[0][0]
batch_normalization_29 (BatchNo	(None, 8, 8, 72)	288	concatenate_26[0][0]
activation_29 (Activation)	(None, 8, 8, 72)	0	batch_normalization_29[0][0]
conv2d_30 (Conv2D)	(None, 8, 8, 18)	11664	activation_29[0][0]
concatenate_27 (Concatenate)	(None, 8, 8, 90)	0	concatenate_26[0][0] conv2d_30[0][0]
batch_normalization_30 (BatchNo	(None, 8, 8, 90)	360	concatenate_27[0][0]
activation_30 (Activation)	(None, 8, 8, 90)	0	batch_normalization_30[0][0]
conv2d_31 (Conv2D)	(None, 8, 8, 18)	14580	activation_30[0][0]
concatenate_28 (Concatenate)	(None, 8, 8, 108)	0	concatenate_27[0][0] conv2d_31[0][0]
batch_normalization_31 (BatchNo	(None, 8, 8, 108)	432	concatenate_28[0][0]
activation_31 (Activation)	(None, 8, 8, 108)	0	batch_normalization_31[0][0]
conv2d_32 (Conv2D)	(None, 8, 8, 18)	17496	activation_31[0][0]
concatenate_29 (Concatenate)	(None, 8, 8, 126)	0	concatenate_28[0][0] conv2d_32[0][0]
batch_normalization_32 (BatchNo	(None, 8, 8, 126)	504	concatenate_29[0][0]

activation_32 (Activation)	(None, 8, 8, 126)	0	batch_normalization_32[0][0]
conv2d_33 (Conv2D)	(None, 8, 8, 18)	20412	activation_32[0][0]
concatenate_30 (Concatenate)	(None, 8, 8, 144)	0	concatenate_29[0][0] conv2d_33[0][0]
batch_normalization_33 (BatchNo	(None, 8, 8, 144)	576	concatenate_30[0][0]
activation_33 (Activation)	(None, 8, 8, 144)	0	batch_normalization_33[0][0]
conv2d_34 (Conv2D)	(None, 8, 8, 18)	23328	activation_33[0][0]
concatenate_31 (Concatenate)	(None, 8, 8, 162)	0	concatenate_30[0][0] conv2d_34[0][0]
batch_normalization_34 (BatchNo	(None, 8, 8, 162)	648	concatenate_31[0][0]
activation_34 (Activation)	(None, 8, 8, 162)	0	batch_normalization_34[0][0]
conv2d_35 (Conv2D)	(None, 8, 8, 18)	26244	activation_34[0][0]
concatenate_32 (Concatenate)	(None, 8, 8, 180)	0	concatenate_31[0][0] conv2d_35[0][0]
batch_normalization_35 (BatchNo	(None, 8, 8, 180)	720	concatenate_32[0][0]
activation_35 (Activation)	(None, 8, 8, 180)	0	batch_normalization_35[0][0]
conv2d_36 (Conv2D)	(None, 8, 8, 18)	29160	activation_35[0][0]
concatenate_33 (Concatenate)	(None, 8, 8, 198)	0	concatenate_32[0][0] conv2d_36[0][0]
batch_normalization_36 (BatchNo	(None, 8, 8, 198)	792	concatenate_33[0][0]
activation_36 (Activation)	(None, 8, 8, 198)	0	batch_normalization_36[0][0]
conv2d_37 (Conv2D)	(None, 8, 8, 18)	32076	activation_36[0][0]
concatenate_34 (Concatenate)	(None, 8, 8, 216)	0	concatenate_33[0][0] conv2d_37[0][0]
batch_normalization_37 (BatchNo	(None, 8, 8, 216)	864	concatenate_34[0][0]
activation_37 (Activation)	(None, 8, 8, 216)	0	batch_normalization_37[0][0]
conv2d_38 (Conv2D)	(None, 8, 8, 18)	34992	activation_37[0][0]
concatenate_35 (Concatenate)	(None, 8, 8, 234)	0	concatenate_34[0][0] conv2d_38[0][0]
batch_normalization_38 (BatchNo	(None, 8, 8, 234)	936	concatenate_35[0][0]
activation_38 (Activation)	(None, 8, 8, 234)	0	batch_normalization_38[0][0]
conv2d_39 (Conv2D)	(None, 8, 8, 18)	4212	activation_38[0][0]
average_pooling2d_2 (AveragePoo	(None, 4, 4, 18)	0	conv2d_39[0][0]
batch_normalization_39 (BatchNo	(None, 4, 4, 18)	72	average_pooling2d_2[0][0]
activation_39 (Activation)	(None, 4, 4, 18)	0	batch_normalization_39[0][0]
conv2d_40 (Conv2D)	(None, 4, 4, 18)	2916	activation_39[0][0]
concatenate_36 (Concatenate)	(None, 4, 4, 36)	0	average_pooling2d_2[0][0] conv2d_40[0][0]
batch_normalization_40 (BatchNo	(None, 4, 4, 36)	144	concatenate_36[0][0]
activation_40 (Activation)	(None, 4, 4, 36)	0	batch_normalization_40[0][0]
conv2d_41 (Conv2D)	(None, 4, 4, 18)	5832	activation_40[0][0]
concatenate_37 (Concatenate)	(None, 4, 4, 54)	0	concatenate_36[0][0]

			conv2d_41[0][0]
batch_normalization_41 (BatchNo	(None, 4, 4, 54)	216	concatenate_37[0][0]
activation_41 (Activation)	(None, 4, 4, 54)	0	batch_normalization_41[0][0]
conv2d_42 (Conv2D)	(None, 4, 4, 18)	8748	activation_41[0][0]
concatenate_38 (Concatenate)	(None, 4, 4, 72)	0	concatenate_37[0][0] conv2d_42[0][0]
batch_normalization_42 (BatchNo	(None, 4, 4, 72)	288	concatenate_38[0][0]
activation_42 (Activation)	(None, 4, 4, 72)	0	batch_normalization_42[0][0]
conv2d_43 (Conv2D)	(None, 4, 4, 18)	11664	activation_42[0][0]
concatenate_39 (Concatenate)	(None, 4, 4, 90)	0	concatenate_38[0][0] conv2d_43[0][0]
batch_normalization_43 (BatchNo	(None, 4, 4, 90)	360	concatenate_39[0][0]
activation_43 (Activation)	(None, 4, 4, 90)	0	batch_normalization_43[0][0]
conv2d_44 (Conv2D)	(None, 4, 4, 18)	14580	activation_43[0][0]
concatenate_40 (Concatenate)	(None, 4, 4, 108)	0	concatenate_39[0][0] conv2d_44[0][0]
batch_normalization_44 (BatchNo	(None, 4, 4, 108)	432	concatenate_40[0][0]
activation_44 (Activation)	(None, 4, 4, 108)	0	batch_normalization_44[0][0]
conv2d_45 (Conv2D)	(None, 4, 4, 18)	17496	activation_44[0][0]
concatenate_41 (Concatenate)	(None, 4, 4, 126)	0	concatenate_40[0][0] conv2d_45[0][0]
batch_normalization_45 (BatchNo	(None, 4, 4, 126)	504	concatenate_41[0][0]
activation_45 (Activation)	(None, 4, 4, 126)	0	batch_normalization_45[0][0]
conv2d_46 (Conv2D)	(None, 4, 4, 18)	20412	activation_45[0][0]
concatenate_42 (Concatenate)	(None, 4, 4, 144)	0	concatenate_41[0][0] conv2d_46[0][0]
batch_normalization_46 (BatchNo	(None, 4, 4, 144)	576	concatenate_42[0][0]
activation_46 (Activation)	(None, 4, 4, 144)	0	batch_normalization_46[0][0]
conv2d_47 (Conv2D)	(None, 4, 4, 18)	23328	activation_46[0][0]
concatenate_43 (Concatenate)	(None, 4, 4, 162)	0	concatenate_42[0][0] conv2d_47[0][0]
batch_normalization_47 (BatchNo	(None, 4, 4, 162)	648	concatenate_43[0][0]
activation_47 (Activation)	(None, 4, 4, 162)	0	batch_normalization_47[0][0]
conv2d_48 (Conv2D)	(None, 4, 4, 18)	26244	activation_47[0][0]
concatenate_44 (Concatenate)	(None, 4, 4, 180)	0	concatenate_43[0][0] conv2d_48[0][0]
batch_normalization_48 (BatchNo	(None, 4, 4, 180)	720	concatenate_44[0][0]
activation_48 (Activation)	(None, 4, 4, 180)	0	batch_normalization_48[0][0]
conv2d_49 (Conv2D)	(None, 4, 4, 18)	29160	activation_48[0][0]
concatenate_45 (Concatenate)	(None, 4, 4, 198)	0	concatenate_44[0][0] conv2d_49[0][0]
batch_normalization_49 (BatchNo	(None, 4, 4, 198)	792	concatenate_45[0][0]
activation_49 (Activation)	(None, 4, 4, 198)	0	batch_normalization_49[0][0]

```
conv2d_50 (Conv2D)               (None, 4, 4, 18)      32076       activation_49[0][0]
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concatenate_46 (Concatenate)     (None, 4, 4, 216)     0           concatenate_45[0][0]
                                                                   conv2d_50[0][0]
__________________________________________________________________________________________________
batch_normalization_50 (BatchNo (None, 4, 4, 216)     864         concatenate_46[0][0]
__________________________________________________________________________________________________
activation_50 (Activation)       (None, 4, 4, 216)     0           batch_normalization_50[0][0]
__________________________________________________________________________________________________
conv2d_51 (Conv2D)               (None, 4, 4, 18)      34992       activation_50[0][0]
__________________________________________________________________________________________________
concatenate_47 (Concatenate)     (None, 4, 4, 234)     0           concatenate_46[0][0]
                                                                   conv2d_51[0][0]
__________________________________________________________________________________________________
batch_normalization_51 (BatchNo (None, 4, 4, 234)     936         concatenate_47[0][0]
__________________________________________________________________________________________________
activation_51 (Activation)       (None, 4, 4, 234)     0           batch_normalization_51[0][0]
__________________________________________________________________________________________________
average_pooling2d_3 (AveragePoo (None, 2, 2, 234)     0           activation_51[0][0]
__________________________________________________________________________________________________
conv2d_52 (Conv2D)               (None, 1, 1, 10)      9370        average_pooling2d_3[0][0]
__________________________________________________________________________________________________
activation_52 (Activation)       (None, 1, 1, 10)      0           conv2d_52[0][0]
__________________________________________________________________________________________________
flatten (Flatten)                (None, 10)            0           activation_52[0][0]
==================================================================================================
Total params: 995,230
Trainable params: 981,658
Non-trainable params: 13,572
__________________________________________________________________________________________________
```

In [0]:

```
model_3.compile(loss='categorical_crossentropy',
              optimizer=Adam(),
              metrics=['accuracy'])
model_3.fit_generator(image_gen.flow(X_train, y_train, batch_size), steps_per_epoch =
X_train.shape[0]/batch_size, epochs = 300, validation_data =(X_test,y_test),)
```

```
Epoch 1/300
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/tensorflow_core/python/ops/math_grad.py:1424: where (from
tensorflow.python.ops.array_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
390/390 [==============================>.] - ETA: 0s - loss: 1.5481 - acc: 0.4338Epoch 1/300
10000/390
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==================================================] - 5s 509us/sample - loss: 1.7327 - acc: 0.4521
391/390 [==============================] - 90s 229ms/step - loss: 1.5474 - acc: 0.4341 - val_loss:
1.6082 - val_acc: 0.4521
Epoch 2/300
390/390 [==============================>.] - ETA: 0s - loss: 1.1386 - acc: 0.5915Epoch 1/300
10000/390
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==================================================] - 3s 339us/sample - loss: 1.7233 - acc: 0.4773
391/390 [==============================] - 69s 176ms/step - loss: 1.1380 - acc: 0.5917 - val_loss:
1.8910 - val_acc: 0.4773
Epoch 3/300
390/390 [==============================>.] - ETA: 0s - loss: 0.9522 - acc: 0.6614Epoch 1/300
10000/390
[==============================================================================================
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==============================================] - 3s 337us/sample - loss: 1.2473 - acc: 0.5218
391/390 [==============================] - 69s 177ms/step - loss: 0.9521 - acc: 0.6614 - val_loss:
1.5820 - val_acc: 0.5218
Epoch 4/300
390/390 [============================>.] - ETA: 0s - loss: 0.8329 - acc: 0.7059Epoch 1/300
10000/390
[==============================================================================================================
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==============================================] - 3s 337us/sample - loss: 0.9265 - acc: 0.6709
391/390 [==============================] - 69s 176ms/step - loss: 0.8325 - acc: 0.7060 - val_loss:
1.0040 - val_acc: 0.6709
Epoch 5/300
390/390 [============================>.] - ETA: 0s - loss: 0.7502 - acc: 0.7357Epoch 1/300
10000/390
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==============================================] - 3s 344us/sample - loss: 0.8072 - acc: 0.7050
391/390 [==============================] - 69s 177ms/step - loss: 0.7499 - acc: 0.7358 - val_loss:
0.8748 - val_acc: 0.7050
Epoch 6/300
390/390 [============================>.] - ETA: 0s - loss: 0.6915 - acc: 0.7607Epoch 1/300
10000/390
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==============================================] - 3s 344us/sample - loss: 0.6871 - acc: 0.7196
391/390 [==============================] - 69s 177ms/step - loss: 0.6912 - acc: 0.7608 - val_loss:
0.8572 - val_acc: 0.7196
Epoch 7/300
390/390 [============================>.] - ETA: 0s - loss: 0.6498 - acc: 0.7745Epoch 1/300
10000/390
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==============================================] - 3s 341us/sample - loss: 0.7215 - acc: 0.7353
391/390 [==============================] - 69s 177ms/step - loss: 0.6497 - acc: 0.7745 - val_loss:
0.8115 - val_acc: 0.7353
Epoch 8/300
390/390 [============================>.] - ETA: 0s - loss: 0.6065 - acc: 0.7890Epoch 1/300
10000/390
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==============================================] - 3s 339us/sample - loss: 0.7783 - acc: 0.6901
391/390 [==============================] - 69s 177ms/step - loss: 0.6063 - acc: 0.7890 - val_loss:
1.0597 - val_acc: 0.6901
Epoch 9/300
390/390 [============================>.] - ETA: 0s - loss: 0.5721 - acc: 0.8015Epoch 1/300
10000/390
[
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==============================================] - 3s 336us/sample - loss: 0.6258 - acc: 0.7591
391/390 [==============================] - 69s 176ms/step - loss: 0.5722 - acc: 0.8014 - val_loss:
0.7261 - val_acc: 0.7591
Epoch 10/300
390/390 [============================>.] - ETA: 0s - loss: 0.5369 - acc: 0.8130Epoch 1/300
10000/390
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==============================================] - 3s 340us/sample - loss: 0.8036 - acc: 0.7417
391/390 [==============================] - 69s 177ms/step - loss: 0.5368 - acc: 0.8130 - val_loss:
0.8459 - val_acc: 0.7417
Epoch 11/300
390/390 [============================>.] - ETA: 0s - loss: 0.5085 - acc: 0.8233Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 1.0177 - acc: 0.6947
391/390 [==============================] - 69s 177ms/step - loss: 0.5081 - acc: 0.8235 - val_loss:
0.9929 - val_acc: 0.6947
Epoch 12/300
390/390 [============================>.] - ETA: 0s - loss: 0.4957 - acc: 0.8272Epoch 1/300
10000/390
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==============================================] - 3s 339us/sample - loss: 0.5870 - acc: 0.8132
391/390 [==============================] - 69s 176ms/step - loss: 0.4954 - acc: 0.8273 - val_loss:
0.5635 - val_acc: 0.8132
Epoch 13/300
390/390 [============================>.] - ETA: 0s - loss: 0.4705 - acc: 0.8375Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.5254 - acc: 0.8088
391/390 [==============================] - 69s 176ms/step - loss: 0.4704 - acc: 0.8376 - val_loss:
0.5729 - val_acc: 0.8088
Epoch 14/300
390/390 [============================>.] - ETA: 0s - loss: 0.4514 - acc: 0.8425Epoch 1/300
10000/390
[==============================================================================
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==============================================] - 3s 337us/sample - loss: 0.4249 - acc: 0.8329
391/390 [==============================] - 69s 176ms/step - loss: 0.4513 - acc: 0.8425 - val_loss:
0.5048 - val_acc: 0.8329
Epoch 15/300
390/390 [============================>.] - ETA: 0s - loss: 0.4345 - acc: 0.8498Epoch 1/300
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10000/390
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==================================================] - 3s 337us/sample - loss: 0.4717 - acc: 0.8317
391/390 [==============================] - 69s 177ms/step - loss: 0.4345 - acc: 0.8498 - val_loss:
0.4998 - val_acc: 0.8317
Epoch 16/300
390/390 [============================>.] - ETA: 0s - loss: 0.4225 - acc: 0.8538Epoch 1/300
10000/390
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==================================================] - 3s 338us/sample - loss: 0.9650 - acc: 0.7500
391/390 [==============================] - 69s 176ms/step - loss: 0.4223 - acc: 0.8539 - val_loss:
0.8666 - val_acc: 0.7500
Epoch 17/300
390/390 [============================>.] - ETA: 0s - loss: 0.4108 - acc: 0.8580Epoch 1/300
10000/390
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==================================================] - 3s 339us/sample - loss: 0.5146 - acc: 0.8142
391/390 [==============================] - 69s 176ms/step - loss: 0.4109 - acc: 0.8579 - val_loss:
0.5921 - val_acc: 0.8142
Epoch 18/300
390/390 [============================>.] - ETA: 0s - loss: 0.3909 - acc: 0.8637Epoch 1/300
10000/390
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==================================================] - 3s 336us/sample - loss: 0.6491 - acc: 0.8210
391/390 [==============================] - 69s 176ms/step - loss: 0.3911 - acc: 0.8636 - val_loss:
0.5658 - val_acc: 0.8210
Epoch 19/300
390/390 [============================>.] - ETA: 0s - loss: 0.3798 - acc: 0.8683Epoch 1/300
10000/390
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==================================================] - 3s 339us/sample - loss: 0.6690 - acc: 0.8157
391/390 [==============================] - 69s 176ms/step - loss: 0.3800 - acc: 0.8683 - val_loss:
0.5763 - val_acc: 0.8157
Epoch 20/300
390/390 [============================>.] - ETA: 0s - loss: 0.3700 - acc: 0.8726Epoch 1/300
10000/390
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==================================================] - 3s 339us/sample - loss: 0.7150 - acc: 0.7832
391/390 [==============================] - 69s 176ms/step - loss: 0.3704 - acc: 0.8725 - val_loss:
0.7143 - val_acc: 0.7832
Epoch 21/300
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390/390 [==============================>.] - ETA: 0s - loss: 0.3567 - acc: 0.8769Epoch 1/300
10000/390
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==============================================] - 3s 337us/sample - loss: 0.5130 - acc: 0.8306
391/390 [==============================] - 69s 176ms/step - loss: 0.3567 - acc: 0.8769 - val_loss:
0.5496 - val_acc: 0.8306
Epoch 22/300
390/390 [==============================>.] - ETA: 0s - loss: 0.3473 - acc: 0.8807Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.5707 - acc: 0.8435
391/390 [==============================] - 69s 176ms/step - loss: 0.3474 - acc: 0.8807 - val_loss:
0.4788 - val_acc: 0.8435
Epoch 23/300
390/390 [==============================>.] - ETA: 0s - loss: 0.3330 - acc: 0.8851Epoch 1/300
10000/390
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==============================================] - 3s 339us/sample - loss: 0.4656 - acc: 0.8315
391/390 [==============================] - 69s 176ms/step - loss: 0.3329 - acc: 0.8851 - val_loss:
0.5568 - val_acc: 0.8315
Epoch 24/300
390/390 [==============================>.] - ETA: 0s - loss: 0.3278 - acc: 0.8858Epoch 1/300
10000/390
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==============================================] - 3s 339us/sample - loss: 0.5528 - acc: 0.8466
391/390 [==============================] - 69s 176ms/step - loss: 0.3276 - acc: 0.8859 - val_loss:
0.4982 - val_acc: 0.8466
Epoch 25/300
390/390 [==============================>.] - ETA: 0s - loss: 0.3196 - acc: 0.8882Epoch 1/300
10000/390
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==============================================] - 3s 339us/sample - loss: 0.6492 - acc: 0.8354
391/390 [==============================] - 69s 176ms/step - loss: 0.3200 - acc: 0.8880 - val_loss:
0.5288 - val_acc: 0.8354
Epoch 26/300
390/390 [==============================>.] - ETA: 0s - loss: 0.3148 - acc: 0.8905Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.5578 - acc: 0.8315
391/390 [==============================] - 69s 176ms/step - loss: 0.3151 - acc: 0.8904 - val_loss:
0.5329 - val_acc: 0.8315
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Epoch 27/300
390/390 [==============================>.] - ETA: 0s - loss: 0.3040 - acc: 0.8946Epoch 1/300
10000/390
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==============================================] - 3s 342us/sample - loss: 0.8301 - acc: 0.8098
391/390 [==============================] - 69s 176ms/step - loss: 0.3042 - acc: 0.8945 - val_loss:
0.6771 - val_acc: 0.8098
Epoch 28/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2988 - acc: 0.8960Epoch 1/300
10000/390
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==============================================] - 3s 341us/sample - loss: 0.7485 - acc: 0.8066
391/390 [==============================] - 69s 176ms/step - loss: 0.2987 - acc: 0.8960 - val_loss:
0.6179 - val_acc: 0.8066
Epoch 29/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2889 - acc: 0.8996Epoch 1/300
10000/390
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==============================================] - 3s 347us/sample - loss: 0.4320 - acc: 0.8778
391/390 [==============================] - 69s 176ms/step - loss: 0.2888 - acc: 0.8995 - val_loss:
0.3772 - val_acc: 0.8778
Epoch 30/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2821 - acc: 0.9004Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.3719 - acc: 0.8606
391/390 [==============================] - 69s 176ms/step - loss: 0.2821 - acc: 0.9004 - val_loss:
0.4475 - val_acc: 0.8606
Epoch 31/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2757 - acc: 0.9042Epoch 1/300
10000/390
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==============================================] - 3s 337us/sample - loss: 0.4802 - acc: 0.8757
391/390 [==============================] - 68s 175ms/step - loss: 0.2755 - acc: 0.9043 - val_loss:
0.3875 - val_acc: 0.8757
Epoch 32/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2707 - acc: 0.9060Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.3427 - acc: 0.8823
391/390 [==============================] - 68s 174ms/step - loss: 0.2709 - acc: 0.9060 - val_loss:
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0.3598 - val_acc: 0.8823
Epoch 33/300
390/390 [============================>.] - ETA: 0s - loss: 0.2638 - acc: 0.9091Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.3545 - acc: 0.8537
391/390 [==============================] - 68s 173ms/step - loss: 0.2638 - acc: 0.9091 - val_loss:
0.4642 - val_acc: 0.8537
Epoch 34/300
390/390 [============================>.] - ETA: 0s - loss: 0.2549 - acc: 0.9099Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.6909 - acc: 0.8425
391/390 [==============================] - 68s 174ms/step - loss: 0.2548 - acc: 0.9099 - val_loss:
0.5350 - val_acc: 0.8425
Epoch 35/300
390/390 [============================>.] - ETA: 0s - loss: 0.2540 - acc: 0.9117Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.6957 - acc: 0.8284
391/390 [==============================] - 68s 175ms/step - loss: 0.2540 - acc: 0.9117 - val_loss:
0.6168 - val_acc: 0.8284
Epoch 36/300
390/390 [============================>.] - ETA: 0s - loss: 0.2513 - acc: 0.9121Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.3315 - acc: 0.8371
391/390 [==============================] - 68s 175ms/step - loss: 0.2515 - acc: 0.9120 - val_loss:
0.5412 - val_acc: 0.8371
Epoch 37/300
390/390 [============================>.] - ETA: 0s - loss: 0.2435 - acc: 0.9153Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.7685 - acc: 0.8094
391/390 [==============================] - 68s 175ms/step - loss: 0.2435 - acc: 0.9153 - val_loss:
0.7127 - val_acc: 0.8094
Epoch 38/300
390/390 [============================>.] - ETA: 0s - loss: 0.2346 - acc: 0.9187Epoch 1/300
10000/390
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==============================================] - 3s 339us/sample - loss: 0.6370 - acc: 0.8591
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391/390 [==============================] - 68s 175ms/step - loss: 0.2348 - acc: 0.9186 - val_loss:
0.4915 - val_acc: 0.8591
Epoch 39/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2347 - acc: 0.9183Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.3515 - acc: 0.8781
391/390 [==============================] - 69s 175ms/step - loss: 0.2346 - acc: 0.9183 - val_loss:
0.3853 - val_acc: 0.8781
Epoch 40/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2277 - acc: 0.9202Epoch 1/300
10000/390
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==============================================] - 3s 338us/sample - loss: 0.3638 - acc: 0.8855
391/390 [==============================] - 69s 176ms/step - loss: 0.2279 - acc: 0.9202 - val_loss:
0.3650 - val_acc: 0.8855
Epoch 41/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2259 - acc: 0.9212Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.3647 - acc: 0.8739
391/390 [==============================] - 69s 175ms/step - loss: 0.2261 - acc: 0.9211 - val_loss:
0.4158 - val_acc: 0.8739
Epoch 42/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2182 - acc: 0.9234Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.3555 - acc: 0.8724
391/390 [==============================] - 68s 175ms/step - loss: 0.2180 - acc: 0.9235 - val_loss:
0.4094 - val_acc: 0.8724
Epoch 43/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2151 - acc: 0.9236Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.4644 - acc: 0.8797
391/390 [==============================] - 68s 175ms/step - loss: 0.2154 - acc: 0.9235 - val_loss:
0.3958 - val_acc: 0.8797
Epoch 44/300
390/390 [==============================>.] - ETA: 0s - loss: 0.2114 - acc: 0.9263Epoch 1/300
10000/390
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==========] - 3s 343us/sample - loss: 0.4282 - acc: 0.8603
391/390 [==============================] - 69s 176ms/step - loss: 0.2113 - acc: 0.9264 - val_loss: 0.4765 - val_acc: 0.8603
Epoch 45/300
390/390 [============================>.] - ETA: 0s - loss: 0.2082 - acc: 0.9276Epoch 1/300
10000/390
[==
==========] - 3s 338us/sample - loss: 0.6363 - acc: 0.8301
391/390 [==============================] - 69s 176ms/step - loss: 0.2082 - acc: 0.9275 - val_loss: 0.5865 - val_acc: 0.8301
Epoch 46/300
390/390 [============================>.] - ETA: 0s - loss: 0.2059 - acc: 0.9274Epoch 1/300
10000/390
[==
==========] - 3s 339us/sample - loss: 0.3934 - acc: 0.8516
391/390 [==============================] - 69s 176ms/step - loss: 0.2058 - acc: 0.9275 - val_loss: 0.5119 - val_acc: 0.8516
Epoch 47/300
390/390 [============================>.] - ETA: 0s - loss: 0.2037 - acc: 0.9280Epoch 1/300
10000/390
[==
==========] - 3s 340us/sample - loss: 0.4406 - acc: 0.8651
391/390 [==============================] - 69s 176ms/step - loss: 0.2038 - acc: 0.9279 - val_loss: 0.4614 - val_acc: 0.8651
Epoch 48/300
390/390 [============================>.] - ETA: 0s - loss: 0.1955 - acc: 0.9313Epoch 1/300
10000/390
[==
==========] - 3s 340us/sample - loss: 0.3795 - acc: 0.8717
391/390 [==============================] - 69s 176ms/step - loss: 0.1955 - acc: 0.9313 - val_loss: 0.4190 - val_acc: 0.8717
Epoch 49/300
390/390 [============================>.] - ETA: 0s - loss: 0.1877 - acc: 0.9347Epoch 1/300
10000/390
[==
==========] - 3s 339us/sample - loss: 0.3601 - acc: 0.8640
391/390 [==============================] - 69s 175ms/step - loss: 0.1878 - acc: 0.9347 - val_loss: 0.4544 - val_acc: 0.8640
Epoch 50/300
390/390 [============================>.] - ETA: 0s - loss: 0.1919 - acc: 0.9330Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.6376 - acc: 0.8649
391/390 [==============================] - 68s 175ms/step - loss: 0.1918 - acc: 0.9330 - val_loss:
0.4450 - val_acc: 0.8649
Epoch 51/300
390/390 [============================>.] - ETA: 0s - loss: 0.1869 - acc: 0.9341Epoch 1/300
10000/390
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==============================================] - 3s 341us/sample - loss: 0.2816 - acc: 0.8772
391/390 [==============================] - 69s 175ms/step - loss: 0.1869 - acc: 0.9340 - val_loss:
0.4033 - val_acc: 0.8772
Epoch 52/300
390/390 [============================>.] - ETA: 0s - loss: 0.1831 - acc: 0.9346Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.3694 - acc: 0.8690
391/390 [==============================] - 68s 175ms/step - loss: 0.1830 - acc: 0.9347 - val_loss:
0.4499 - val_acc: 0.8690
Epoch 53/300
390/390 [============================>.] - ETA: 0s - loss: 0.1843 - acc: 0.9339Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.4245 - acc: 0.8923
391/390 [==============================] - 68s 175ms/step - loss: 0.1844 - acc: 0.9339 - val_loss:
0.3606 - val_acc: 0.8923
Epoch 54/300
390/390 [============================>.] - ETA: 0s - loss: 0.1769 - acc: 0.9378Epoch 1/300
10000/390
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==============================================] - 3s 338us/sample - loss: 0.3912 - acc: 0.8773
391/390 [==============================] - 69s 175ms/step - loss: 0.1770 - acc: 0.9378 - val_loss:
0.4068 - val_acc: 0.8773
Epoch 55/300
390/390 [============================>.] - ETA: 0s - loss: 0.1751 - acc: 0.9387Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.2148 - acc: 0.8832
391/390 [==============================] - 69s 175ms/step - loss: 0.1752 - acc: 0.9386 - val_loss:
0.3894 - val_acc: 0.8832
Epoch 56/300
390/390 [============================>.] - ETA: 0s - loss: 0.1747 - acc: 0.9381Epoch 1/300
10000/390
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==========] - 3s 342us/sample - loss: 0.3085 - acc: 0.8742
391/390 [==============================] - 69s 176ms/step - loss: 0.1748 - acc: 0.9381 - val_loss: 0.4441 - val_acc: 0.8742
Epoch 57/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1681 - acc: 0.9406Epoch 1/300
10000/390
==========] - 3s 338us/sample - loss: 0.3132 - acc: 0.8868
391/390 [==============================] - 69s 176ms/step - loss: 0.1681 - acc: 0.9406 - val_loss: 0.3905 - val_acc: 0.8868
Epoch 58/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1670 - acc: 0.9415Epoch 1/300
10000/390
==========] - 3s 343us/sample - loss: 0.3557 - acc: 0.8667
391/390 [==============================] - 69s 176ms/step - loss: 0.1670 - acc: 0.9414 - val_loss: 0.4810 - val_acc: 0.8667
Epoch 59/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1677 - acc: 0.9415Epoch 1/300
10000/390
==========] - 3s 337us/sample - loss: 0.3181 - acc: 0.8894
391/390 [==============================] - 69s 176ms/step - loss: 0.1677 - acc: 0.9415 - val_loss: 0.3741 - val_acc: 0.8894
Epoch 60/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1637 - acc: 0.9418Epoch 1/300
10000/390
==========] - 3s 335us/sample - loss: 0.3213 - acc: 0.8811
391/390 [==============================] - 69s 176ms/step - loss: 0.1635 - acc: 0.9419 - val_loss: 0.4141 - val_acc: 0.8811
Epoch 61/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1593 - acc: 0.9436Epoch 1/300
10000/390
==========] - 3s 341us/sample - loss: 0.3554 - acc: 0.8815
391/390 [==============================] - 69s 176ms/step - loss: 0.1592 - acc: 0.9436 - val_loss: 0.4172 - val_acc: 0.8815
Epoch 62/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1579 - acc: 0.9440Epoch 1/300
10000/390

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==========================================================] - 3s 337us/sample - loss: 0.5743 - acc: 0.8
778
391/390 [==============================] - 69s 175ms/step - loss: 0.1580 - acc: 0.9438 - val_loss:
0.4537 - val_acc: 0.8778
Epoch 63/300
390/390 [============================>.] - ETA: 0s - loss: 0.1531 - acc: 0.9458Epoch 1/300
10000/390
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================================================] - 3s 338us/sample - loss: 0.3914 - acc: 0.8831
391/390 [==============================] - 69s 175ms/step - loss: 0.1529 - acc: 0.9459 - val_loss:
0.3959 - val_acc: 0.8831
Epoch 64/300
390/390 [============================>.] - ETA: 0s - loss: 0.1557 - acc: 0.9457Epoch 1/300
10000/390
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================================================] - 3s 336us/sample - loss: 0.4871 - acc: 0.8714
391/390 [==============================] - 69s 176ms/step - loss: 0.1558 - acc: 0.9457 - val_loss:
0.4499 - val_acc: 0.8714
Epoch 65/300
390/390 [============================>.] - ETA: 0s - loss: 0.1527 - acc: 0.9458Epoch 1/300
10000/390
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================================================] - 3s 332us/sample - loss: 0.4058 - acc: 0.8986
391/390 [==============================] - 68s 174ms/step - loss: 0.1528 - acc: 0.9458 - val_loss:
0.3362 - val_acc: 0.8986
Epoch 66/300
390/390 [============================>.] - ETA: 0s - loss: 0.1483 - acc: 0.9474Epoch 1/300
10000/390
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================================================] - 3s 335us/sample - loss: 0.2216 - acc: 0.8965
391/390 [==============================] - 68s 175ms/step - loss: 0.1486 - acc: 0.9473 - val_loss:
0.3574 - val_acc: 0.8965
Epoch 67/300
390/390 [============================>.] - ETA: 0s - loss: 0.1458 - acc: 0.9495Epoch 1/300
10000/390
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================================================] - 3s 335us/sample - loss: 0.2477 - acc: 0.9056
391/390 [==============================] - 68s 174ms/step - loss: 0.1458 - acc: 0.9495 - val_loss:
0.3252 - val_acc: 0.9056
Epoch 68/300
390/390 [============================>.] - ETA: 0s - loss: 0.1425 - acc: 0.9490Epoch 1/300
10000/390
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==============================================]  - 3s 334us/sample - loss: 0.4238 - acc: 0.8676
391/390 [==============================] - 68s 174ms/step - loss: 0.1424 - acc: 0.9490 - val_loss:
0.5040 - val_acc: 0.8676
Epoch 69/300
390/390 [============================>.] - ETA: 0s - loss: 0.1438 - acc: 0.9497Epoch 1/300
10000/390
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==============================================]  - 3s 332us/sample - loss: 0.5749 - acc: 0.8885
391/390 [==============================] - 68s 174ms/step - loss: 0.1437 - acc: 0.9497 - val_loss:
0.3925 - val_acc: 0.8885
Epoch 70/300
390/390 [============================>.] - ETA: 0s - loss: 0.1379 - acc: 0.9509Epoch 1/300
10000/390
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==============================================]  - 3s 336us/sample - loss: 0.5235 - acc: 0.8786
391/390 [==============================] - 68s 174ms/step - loss: 0.1378 - acc: 0.9509 - val_loss:
0.4320 - val_acc: 0.8786
Epoch 71/300
390/390 [============================>.] - ETA: 0s - loss: 0.1437 - acc: 0.9496Epoch 1/300
10000/390
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==============================================]  - 3s 334us/sample - loss: 0.2309 - acc: 0.8856
391/390 [==============================] - 68s 173ms/step - loss: 0.1437 - acc: 0.9496 - val_loss:
0.4060 - val_acc: 0.8856
Epoch 72/300
390/390 [============================>.] - ETA: 0s - loss: 0.1337 - acc: 0.9531Epoch 1/300
10000/390
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==============================================]  - 3s 332us/sample - loss: 0.2554 - acc: 0.8928
391/390 [==============================] - 68s 173ms/step - loss: 0.1337 - acc: 0.9532 - val_loss:
0.3851 - val_acc: 0.8928
Epoch 73/300
390/390 [============================>.] - ETA: 0s - loss: 0.1357 - acc: 0.9515Epoch 1/300
10000/390
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==============================================]  - 3s 333us/sample - loss: 0.3755 - acc: 0.8917
391/390 [==============================] - 68s 173ms/step - loss: 0.1358 - acc: 0.9515 - val_loss:
0.3875 - val_acc: 0.8917
Epoch 74/300
390/390 [============================>.] - ETA: 0s - loss: 0.1328 - acc: 0.9526Epoch 1/300
10000/390
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==] - 3s 333us/sample - loss: 0.3174 - acc: 0.8872
391/390 [==============================] - 68s 173ms/step - loss: 0.1328 - acc: 0.9525 - val_loss:
0.3960 - val_acc: 0.8872
Epoch 75/300
390/390 [============================>.] - ETA: 0s - loss: 0.1285 - acc: 0.9544Epoch 1/300
10000/390
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==] - 3s 333us/sample - loss: 0.2406 - acc: 0.8848
391/390 [==============================] - 68s 173ms/step - loss: 0.1286 - acc: 0.9544 - val_loss:
0.4021 - val_acc: 0.8848
Epoch 76/300
390/390 [============================>.] - ETA: 0s - loss: 0.1311 - acc: 0.9534Epoch 1/300
10000/390
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==] - 3s 334us/sample - loss: 0.3164 - acc: 0.8652
391/390 [==============================] - 68s 173ms/step - loss: 0.1314 - acc: 0.9533 - val_loss:
0.5008 - val_acc: 0.8652
Epoch 77/300
390/390 [============================>.] - ETA: 0s - loss: 0.1267 - acc: 0.9551Epoch 1/300
10000/390
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==] - 3s 334us/sample - loss: 0.3567 - acc: 0.8837
391/390 [==============================] - 68s 173ms/step - loss: 0.1267 - acc: 0.9550 - val_loss:
0.4267 - val_acc: 0.8837
Epoch 78/300
390/390 [============================>.] - ETA: 0s - loss: 0.1230 - acc: 0.9566Epoch 1/300
10000/390
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==] - 3s 334us/sample - loss: 0.2548 - acc: 0.8965
391/390 [==============================] - 68s 174ms/step - loss: 0.1231 - acc: 0.9566 - val_loss:
0.3682 - val_acc: 0.8965
Epoch 79/300
390/390 [============================>.] - ETA: 0s - loss: 0.1238 - acc: 0.9568Epoch 1/300
10000/390
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==] - 3s 333us/sample - loss: 0.4017 - acc: 0.8935
391/390 [==============================] - 68s 173ms/step - loss: 0.1239 - acc: 0.9568 - val_loss:
0.4058 - val_acc: 0.8935
Epoch 80/300
390/390 [============================>.] - ETA: 0s - loss: 0.1239 - acc: 0.9564Epoch 1/300
10000/390

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==] - 3s 333us/sample - loss: 0.2939 - acc: 0.8877
391/390 [==============================] - 68s 174ms/step - loss: 0.1239 - acc: 0.9564 - val_loss:
0.3991 - val_acc: 0.8877
Epoch 81/300
390/390 [============================>.] - ETA: 0s - loss: 0.1209 - acc: 0.9576Epoch 1/300
10000/390
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==] - 3s 335us/sample - loss: 0.4480 - acc: 0.8811
391/390 [==============================] - 68s 173ms/step - loss: 0.1209 - acc: 0.9576 - val_loss:
0.4491 - val_acc: 0.8811
Epoch 82/300
390/390 [============================>.] - ETA: 0s - loss: 0.1177 - acc: 0.9580Epoch 1/300
10000/390
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==] - 3s 333us/sample - loss: 0.4173 - acc: 0.8912
391/390 [==============================] - 68s 173ms/step - loss: 0.1178 - acc: 0.9580 - val_loss:
0.4105 - val_acc: 0.8912
Epoch 83/300
390/390 [============================>.] - ETA: 0s - loss: 0.1190 - acc: 0.9582Epoch 1/300
10000/390
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==] - 3s 333us/sample - loss: 0.2585 - acc: 0.8923
391/390 [==============================] - 68s 173ms/step - loss: 0.1190 - acc: 0.9582 - val_loss:
0.3995 - val_acc: 0.8923
Epoch 84/300
390/390 [============================>.] - ETA: 0s - loss: 0.1158 - acc: 0.9587Epoch 1/300
10000/390
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==] - 3s 336us/sample - loss: 0.2096 - acc: 0.8954
391/390 [==============================] - 68s 174ms/step - loss: 0.1161 - acc: 0.9586 - val_loss:
0.3878 - val_acc: 0.8954
Epoch 85/300
390/390 [============================>.] - ETA: 0s - loss: 0.1131 - acc: 0.9605Epoch 1/300
10000/390
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==] - 3s 338us/sample - loss: 0.3145 - acc: 0.8950
391/390 [==============================] - 68s 174ms/step - loss: 0.1132 - acc: 0.9605 - val_loss:
0.3756 - val_acc: 0.8950
Epoch 86/300
390/390 [============================>.] - ETA: 0s - loss: 0.1174 - acc: 0.9592Epoch 1/300

390/390 [==============================>.] - ETA: 0s - loss: 0.1171 - acc: 0.9592Epoch 1/300
10000/390
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==] - 3s 335us/sample - loss: 0.2854 - acc: 0.8945
391/390 [==============================] - 68s 174ms/step - loss: 0.1177 - acc: 0.9591 - val_loss:
0.3840 - val_acc: 0.8945
Epoch 87/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1156 - acc: 0.9584Epoch 1/300
10000/390
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==] - 3s 340us/sample - loss: 0.6287 - acc: 0.8656
391/390 [==============================] - 69s 175ms/step - loss: 0.1156 - acc: 0.9584 - val_loss:
0.5710 - val_acc: 0.8656
Epoch 88/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1122 - acc: 0.9594Epoch 1/300
10000/390
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==] - 3s 334us/sample - loss: 0.1931 - acc: 0.8991
391/390 [==============================] - 68s 174ms/step - loss: 0.1122 - acc: 0.9594 - val_loss:
0.3633 - val_acc: 0.8991
Epoch 89/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1120 - acc: 0.9597Epoch 1/300
10000/390
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==] - 3s 337us/sample - loss: 0.2540 - acc: 0.8925
391/390 [==============================] - 68s 175ms/step - loss: 0.1120 - acc: 0.9597 - val_loss:
0.3907 - val_acc: 0.8925
Epoch 90/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1113 - acc: 0.9611Epoch 1/300
10000/390
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==] - 3s 335us/sample - loss: 0.4606 - acc: 0.8907
391/390 [==============================] - 68s 174ms/step - loss: 0.1112 - acc: 0.9612 - val_loss:
0.4222 - val_acc: 0.8907
Epoch 91/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1109 - acc: 0.9608Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.3028 - acc: 0.9049
391/390 [==============================] - 68s 173ms/step - loss: 0.1109 - acc: 0.9608 - val_loss:
0.3507 - val_acc: 0.9049
Epoch 92/300

Epoch 92/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1078 - acc: 0.9609Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.4239 - acc: 0.8872
391/390 [==============================] - 68s 173ms/step - loss: 0.1079 - acc: 0.9609 - val_loss:
0.4318 - val_acc: 0.8872
Epoch 93/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1084 - acc: 0.9614Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.2307 - acc: 0.8829
391/390 [==============================] - 68s 174ms/step - loss: 0.1083 - acc: 0.9615 - val_loss:
0.4456 - val_acc: 0.8829
Epoch 94/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1072 - acc: 0.9628Epoch 1/300
10000/390
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==] - 3s 333us/sample - loss: 0.4247 - acc: 0.8860
391/390 [==============================] - 68s 173ms/step - loss: 0.1071 - acc: 0.9628 - val_loss:
0.4287 - val_acc: 0.8860
Epoch 95/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1064 - acc: 0.9619Epoch 1/300
10000/390
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==] - 3s 334us/sample - loss: 0.2623 - acc: 0.8915
391/390 [==============================] - 68s 173ms/step - loss: 0.1066 - acc: 0.9619 - val_loss:
0.4034 - val_acc: 0.8915
Epoch 96/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1019 - acc: 0.9643Epoch 1/300
10000/390
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==] - 3s 334us/sample - loss: 0.3176 - acc: 0.8927
391/390 [==============================] - 68s 173ms/step - loss: 0.1020 - acc: 0.9643 - val_loss:
0.4108 - val_acc: 0.8927
Epoch 97/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1021 - acc: 0.9643Epoch 1/300
10000/390
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==] - 3s 333us/sample - loss: 0.4375 - acc: 0.9007
391/390 [==============================] - 68s 173ms/step - loss: 0.1021 - acc: 0.9643 - val_loss:
0.3516 - val_acc: 0.9007

0.3516 - val_acc: 0.9007
Epoch 98/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1012 - acc: 0.9625Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.2799 - acc: 0.8886
391/390 [==============================] - 68s 173ms/step - loss: 0.1012 - acc: 0.9625 - val_loss:
0.4387 - val_acc: 0.8886
Epoch 99/300
390/390 [==============================>.] - ETA: 0s - loss: 0.1061 - acc: 0.9610Epoch 1/300
10000/390
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==] - 3s 336us/sample - loss: 0.3715 - acc: 0.9005
391/390 [==============================] - 68s 173ms/step - loss: 0.1062 - acc: 0.9610 - val_loss:
0.3770 - val_acc: 0.9005
Epoch 100/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0989 - acc: 0.9651Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.2092 - acc: 0.9030
391/390 [==============================] - 67s 172ms/step - loss: 0.0990 - acc: 0.9651 - val_loss:
0.3550 - val_acc: 0.9030
Epoch 101/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0962 - acc: 0.9658Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.3279 - acc: 0.9020
391/390 [==============================] - 67s 172ms/step - loss: 0.0962 - acc: 0.9657 - val_loss:
0.3614 - val_acc: 0.9020
Epoch 102/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0950 - acc: 0.9666Epoch 1/300
10000/390
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==] - 3s 338us/sample - loss: 0.6647 - acc: 0.8811
391/390 [==============================] - 68s 173ms/step - loss: 0.0951 - acc: 0.9666 - val_loss:
0.4777 - val_acc: 0.8811
Epoch 103/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0970 - acc: 0.9651Epoch 1/300
10000/390
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==] - 3s 336us/sample - loss: 0.2073 - acc: 0.9033
391/390 [==============================] - 68s 174ms/step - loss: 0.0971 - acc: 0.9651 - val_loss:

391/390 [==============================] - 68s 174ms/step - loss: 0.0971 - acc: 0.9651 - val_loss:
0.3907 - val_acc: 0.9033
Epoch 104/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0930 - acc: 0.9675Epoch 1/300
10000/390
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==] - 3s 335us/sample - loss: 0.3069 - acc: 0.9048
391/390 [==============================] - 68s 174ms/step - loss: 0.0931 - acc: 0.9675 - val_loss:
0.3598 - val_acc: 0.9048
Epoch 105/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0971 - acc: 0.9662Epoch 1/300
10000/390
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==] - 3s 329us/sample - loss: 0.3901 - acc: 0.8884
391/390 [==============================] - 68s 173ms/step - loss: 0.0972 - acc: 0.9662 - val_loss:
0.4545 - val_acc: 0.8884
Epoch 106/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0949 - acc: 0.9668Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.2916 - acc: 0.8987
391/390 [==============================] - 68s 173ms/step - loss: 0.0951 - acc: 0.9668 - val_loss:
0.3866 - val_acc: 0.8987
Epoch 107/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0917 - acc: 0.9681Epoch 1/300
10000/390
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==] - 3s 331us/sample - loss: 0.2595 - acc: 0.8966
391/390 [==============================] - 68s 173ms/step - loss: 0.0915 - acc: 0.9681 - val_loss:
0.4119 - val_acc: 0.8966
Epoch 108/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0916 - acc: 0.9674Epoch 1/300
10000/390
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==] - 3s 333us/sample - loss: 0.2969 - acc: 0.9051
391/390 [==============================] - 67s 172ms/step - loss: 0.0917 - acc: 0.9673 - val_loss:
0.3713 - val_acc: 0.9051
Epoch 109/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0907 - acc: 0.9671Epoch 1/300
10000/390
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==========] - 3s 336us/sample - loss: 0.3588 - acc: 0.8782
391/390 [==============================] - 68s 174ms/step - loss: 0.0909 - acc: 0.9671 - val_loss: 0.5313 - val_acc: 0.8782
Epoch 110/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0902 - acc: 0.9687Epoch 1/300
10000/390
[==========] - 3s 334us/sample - loss: 0.2582 - acc: 0.8942
391/390 [==============================] - 68s 174ms/step - loss: 0.0902 - acc: 0.9687 - val_loss: 0.4131 - val_acc: 0.8942
Epoch 111/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0874 - acc: 0.9692Epoch 1/300
10000/390
[==========] - 3s 334us/sample - loss: 0.3610 - acc: 0.8958
391/390 [==============================] - 68s 174ms/step - loss: 0.0875 - acc: 0.9692 - val_loss: 0.4062 - val_acc: 0.8958
Epoch 112/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0874 - acc: 0.9691Epoch 1/300
10000/390
[==========] - 3s 336us/sample - loss: 0.5092 - acc: 0.9043
391/390 [==============================] - 68s 174ms/step - loss: 0.0874 - acc: 0.9691 - val_loss: 0.3669 - val_acc: 0.9043
Epoch 113/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0893 - acc: 0.9683Epoch 1/300
10000/390
[==========] - 3s 342us/sample - loss: 0.4200 - acc: 0.8984
391/390 [==============================] - 69s 175ms/step - loss: 0.0892 - acc: 0.9684 - val_loss: 0.4007 - val_acc: 0.8984
Epoch 114/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0923 - acc: 0.9660Epoch 1/300
10000/390
[==========] - 3s 336us/sample - loss: 0.5627 - acc: 0.8716
391/390 [==============================] - 68s 175ms/step - loss: 0.0922 - acc: 0.9660 - val_loss: 0.5331 - val_acc: 0.8716
Epoch 115/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0899 - acc: 0.9679Epoch 1/300
10000/390
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==========] - 3s 336us/sample - loss: 0.3260 - acc: 0.8959
391/390 [==============================] - 68s 174ms/step - loss: 0.0899 - acc: 0.9679 - val_loss: 0.4010 - val_acc: 0.8959
Epoch 116/300
390/390 [============================>.] - ETA: 0s - loss: 0.0834 - acc: 0.9697Epoch 1/300
10000/390
==========] - 3s 332us/sample - loss: 0.2590 - acc: 0.9053
391/390 [==============================] - 68s 173ms/step - loss: 0.0834 - acc: 0.9697 - val_loss: 0.3746 - val_acc: 0.9053
Epoch 117/300
390/390 [============================>.] - ETA: 0s - loss: 0.0849 - acc: 0.9696Epoch 1/300
10000/390
==========] - 3s 333us/sample - loss: 0.2556 - acc: 0.9006
391/390 [==============================] - 67s 173ms/step - loss: 0.0850 - acc: 0.9696 - val_loss: 0.3733 - val_acc: 0.9006
Epoch 118/300
390/390 [============================>.] - ETA: 0s - loss: 0.0846 - acc: 0.9688Epoch 1/300
10000/390
==========] - 3s 334us/sample - loss: 0.2765 - acc: 0.9013
391/390 [==============================] - 68s 174ms/step - loss: 0.0846 - acc: 0.9688 - val_loss: 0.4118 - val_acc: 0.9013
Epoch 119/300
390/390 [============================>.] - ETA: 0s - loss: 0.0834 - acc: 0.9697Epoch 1/300
10000/390
==========] - 3s 331us/sample - loss: 0.3051 - acc: 0.9015
391/390 [==============================] - 68s 174ms/step - loss: 0.0834 - acc: 0.9697 - val_loss: 0.3926 - val_acc: 0.9015
Epoch 120/300
390/390 [============================>.] - ETA: 0s - loss: 0.0841 - acc: 0.9706Epoch 1/300
10000/390
==========] - 3s 333us/sample - loss: 0.1941 - acc: 0.9084
391/390 [==============================] - 68s 173ms/step - loss: 0.0841 - acc: 0.9706 - val_loss: 0.3621 - val_acc: 0.9084
Epoch 121/300
390/390 [============================>.] - ETA: 0s - loss: 0.0783 - acc: 0.9724Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.2898 - acc: 0.8771
391/390 [==============================] - 68s 174ms/step - loss: 0.0783 - acc: 0.9724 - val_loss:
0.5488 - val_acc: 0.8771
Epoch 122/300
390/390 [============================>.] - ETA: 0s - loss: 0.0825 - acc: 0.9712Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2611 - acc: 0.8898
391/390 [==============================] - 68s 173ms/step - loss: 0.0825 - acc: 0.9711 - val_loss:
0.4611 - val_acc: 0.8898
Epoch 123/300
390/390 [============================>.] - ETA: 0s - loss: 0.0827 - acc: 0.9705Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.3261 - acc: 0.8831
391/390 [==============================] - 68s 173ms/step - loss: 0.0828 - acc: 0.9704 - val_loss:
0.4872 - val_acc: 0.8831
Epoch 124/300
390/390 [============================>.] - ETA: 0s - loss: 0.0808 - acc: 0.9723Epoch 1/300
10000/390
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==============================================] - 3s 329us/sample - loss: 0.4722 - acc: 0.9011
391/390 [==============================] - 68s 173ms/step - loss: 0.0807 - acc: 0.9723 - val_loss:
0.4257 - val_acc: 0.9011
Epoch 125/300
390/390 [============================>.] - ETA: 0s - loss: 0.0815 - acc: 0.9705Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.4419 - acc: 0.8861
391/390 [==============================] - 68s 173ms/step - loss: 0.0816 - acc: 0.9705 - val_loss:
0.4865 - val_acc: 0.8861
Epoch 126/300
390/390 [============================>.] - ETA: 0s - loss: 0.0769 - acc: 0.9724Epoch 1/300
10000/390
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==============================================] - 3s 339us/sample - loss: 0.3348 - acc: 0.9087
391/390 [==============================] - 68s 173ms/step - loss: 0.0770 - acc: 0.9724 - val_loss:
0.3887 - val_acc: 0.9087
Epoch 127/300
390/390 [============================>.] - ETA: 0s - loss: 0.0817 - acc: 0.9712Epoch 1/300
10000/390
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==============================================] - 3s 342us/sample - loss: 0.2405 - acc: 0.9016
391/390 [==============================] - 68s 175ms/step - loss: 0.0816 - acc: 0.9712 - val_loss:
0.3975 - val_acc: 0.9016
Epoch 128/300
390/390 [============================>.] - ETA: 0s - loss: 0.0767 - acc: 0.9726Epoch 1/300
10000/390
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==============================================] - 3s 338us/sample - loss: 0.2721 - acc: 0.8904
391/390 [==============================] - 69s 175ms/step - loss: 0.0767 - acc: 0.9726 - val_loss:
0.4798 - val_acc: 0.8904
Epoch 129/300
390/390 [============================>.] - ETA: 0s - loss: 0.0789 - acc: 0.9722Epoch 1/300
10000/390
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==============================================] - 3s 333us/sample - loss: 0.2263 - acc: 0.9065
391/390 [==============================] - 68s 174ms/step - loss: 0.0788 - acc: 0.9722 - val_loss:
0.3674 - val_acc: 0.9065
Epoch 130/300
390/390 [============================>.] - ETA: 0s - loss: 0.0773 - acc: 0.9719Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.3115 - acc: 0.8945
391/390 [==============================] - 68s 173ms/step - loss: 0.0772 - acc: 0.9720 - val_loss:
0.4335 - val_acc: 0.8945
Epoch 131/300
390/390 [============================>.] - ETA: 0s - loss: 0.0788 - acc: 0.9717Epoch 1/300
10000/390
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==============================================] - 3s 333us/sample - loss: 0.2449 - acc: 0.9112
391/390 [==============================] - 67s 173ms/step - loss: 0.0789 - acc: 0.9716 - val_loss:
0.3587 - val_acc: 0.9112
Epoch 132/300
390/390 [============================>.] - ETA: 0s - loss: 0.0724 - acc: 0.9733Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.2498 - acc: 0.8987
391/390 [==============================] - 67s 173ms/step - loss: 0.0723 - acc: 0.9733 - val_loss:
0.4305 - val_acc: 0.8987
Epoch 133/300
390/390 [============================>.] - ETA: 0s - loss: 0.0768 - acc: 0.9726Epoch 1/300
10000/390
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================================================] - 3s 332us/sample - loss: 0.2946 - acc: 0.9123
391/390 [==============================] - 68s 173ms/step - loss: 0.0768 - acc: 0.9726 - val_loss:
0.3468 - val_acc: 0.9123
Epoch 134/300
390/390 [============================>.] - ETA: 0s - loss: 0.0717 - acc: 0.9743Epoch 1/300
10000/390
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================================================] - 3s 328us/sample - loss: 0.2516 - acc: 0.9107
391/390 [==============================] - 67s 172ms/step - loss: 0.0717 - acc: 0.9743 - val_loss:
0.3725 - val_acc: 0.9107
Epoch 135/300
390/390 [============================>.] - ETA: 0s - loss: 0.0731 - acc: 0.9742Epoch 1/300
10000/390
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================================================] - 3s 335us/sample - loss: 0.3386 - acc: 0.8978
391/390 [==============================] - 68s 173ms/step - loss: 0.0730 - acc: 0.9742 - val_loss:
0.4258 - val_acc: 0.8978
Epoch 136/300
390/390 [============================>.] - ETA: 0s - loss: 0.0700 - acc: 0.9755Epoch 1/300
10000/390
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================================================] - 3s 334us/sample - loss: 0.3485 - acc: 0.9054
391/390 [==============================] - 68s 173ms/step - loss: 0.0699 - acc: 0.9755 - val_loss:
0.3810 - val_acc: 0.9054
Epoch 137/300
390/390 [============================>.] - ETA: 0s - loss: 0.0733 - acc: 0.9737Epoch 1/300
10000/390
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================================================] - 3s 335us/sample - loss: 0.3418 - acc: 0.9075
391/390 [==============================] - 67s 173ms/step - loss: 0.0734 - acc: 0.9736 - val_loss:
0.3712 - val_acc: 0.9075
Epoch 138/300
390/390 [============================>.] - ETA: 0s - loss: 0.0742 - acc: 0.9740Epoch 1/300
10000/390
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================================================] - 3s 333us/sample - loss: 0.3075 - acc: 0.9015
391/390 [==============================] - 68s 173ms/step - loss: 0.0742 - acc: 0.9740 - val_loss:
0.4090 - val_acc: 0.9015
Epoch 139/300
390/390 [============================>.] - ETA: 0s - loss: 0.0700 - acc: 0.9752Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.1869 - acc: 0.9127
391/390 [==============================] - 68s 173ms/step - loss: 0.0700 - acc: 0.9751 - val_loss:
0.3595 - val_acc: 0.9127
Epoch 140/300
390/390 [============================>.] - ETA: 0s - loss: 0.0706 - acc: 0.9749Epoch 1/300
10000/390
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==============================================] - 3s 329us/sample - loss: 0.2199 - acc: 0.8979
391/390 [==============================] - 67s 172ms/step - loss: 0.0708 - acc: 0.9748 - val_loss:
0.4145 - val_acc: 0.8979
Epoch 141/300
390/390 [============================>.] - ETA: 0s - loss: 0.0737 - acc: 0.9741Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2320 - acc: 0.8981
391/390 [==============================] - 67s 172ms/step - loss: 0.0737 - acc: 0.9741 - val_loss:
0.4266 - val_acc: 0.8981
Epoch 142/300
390/390 [============================>.] - ETA: 0s - loss: 0.0697 - acc: 0.9754Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.2246 - acc: 0.9039
391/390 [==============================] - 68s 173ms/step - loss: 0.0698 - acc: 0.9754 - val_loss:
0.4070 - val_acc: 0.9039
Epoch 143/300
390/390 [============================>.] - ETA: 0s - loss: 0.0724 - acc: 0.9747Epoch 1/300
10000/390
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==============================================] - 3s 337us/sample - loss: 0.5342 - acc: 0.8727
391/390 [==============================] - 68s 174ms/step - loss: 0.0726 - acc: 0.9747 - val_loss:
0.6029 - val_acc: 0.8727
Epoch 144/300
390/390 [============================>.] - ETA: 0s - loss: 0.0683 - acc: 0.9762Epoch 1/300
10000/390
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==============================================] - 4s 371us/sample - loss: 0.3058 - acc: 0.8877
391/390 [==============================] - 68s 175ms/step - loss: 0.0683 - acc: 0.9762 - val_loss:
0.4855 - val_acc: 0.8877
Epoch 145/300
390/390 [============================>.] - ETA: 0s - loss: 0.0696 - acc: 0.9758Epoch 1/300
10000/390
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==============================================] - 3s 331us/sample - loss: 0.1952 - acc: 0.9113
391/390 [==============================] - 68s 173ms/step - loss: 0.0696 - acc: 0.9758 - val_loss:
0.3784 - val_acc: 0.9113
Epoch 146/300
390/390 [============================>.] - ETA: 0s - loss: 0.0716 - acc: 0.9749Epoch 1/300
10000/390
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==============================================] - 3s 333us/sample - loss: 0.1981 - acc: 0.9078
391/390 [==============================] - 67s 172ms/step - loss: 0.0716 - acc: 0.9749 - val_loss:
0.3762 - val_acc: 0.9078
Epoch 147/300
390/390 [============================>.] - ETA: 0s - loss: 0.0666 - acc: 0.9769Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.2515 - acc: 0.8977
391/390 [==============================] - 67s 172ms/step - loss: 0.0667 - acc: 0.9768 - val_loss:
0.4278 - val_acc: 0.8977
Epoch 148/300
390/390 [============================>.] - ETA: 0s - loss: 0.0673 - acc: 0.9765Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.2373 - acc: 0.8899
391/390 [==============================] - 67s 172ms/step - loss: 0.0672 - acc: 0.9766 - val_loss:
0.4539 - val_acc: 0.8899
Epoch 149/300
390/390 [============================>.] - ETA: 0s - loss: 0.0673 - acc: 0.9768Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2645 - acc: 0.9022
391/390 [==============================] - 67s 172ms/step - loss: 0.0673 - acc: 0.9769 - val_loss:
0.4130 - val_acc: 0.9022
Epoch 150/300
390/390 [============================>.] - ETA: 0s - loss: 0.0658 - acc: 0.9774Epoch 1/300
10000/390
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==============================================] - 3s 331us/sample - loss: 0.1753 - acc: 0.9163
391/390 [==============================] - 67s 172ms/step - loss: 0.0657 - acc: 0.9775 - val_loss:
0.3368 - val_acc: 0.9163
Epoch 151/300
390/390 [============================>.] - ETA: 0s - loss: 0.0655 - acc: 0.9770Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.5023 - acc: 0.8871
391/390 [==============================] - 67s 172ms/step - loss: 0.0655 - acc: 0.9770 - val_loss:
0.5098 - val_acc: 0.8871
Epoch 152/300
390/390 [============================>.] - ETA: 0s - loss: 0.0667 - acc: 0.9763Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.4149 - acc: 0.8847
391/390 [==============================] - 67s 172ms/step - loss: 0.0669 - acc: 0.9763 - val_loss:
0.5128 - val_acc: 0.8847
Epoch 153/300
390/390 [============================>.] - ETA: 0s - loss: 0.0679 - acc: 0.9761Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.2770 - acc: 0.8997
391/390 [==============================] - 67s 172ms/step - loss: 0.0679 - acc: 0.9760 - val_loss:
0.4215 - val_acc: 0.8997
Epoch 154/300
390/390 [============================>.] - ETA: 0s - loss: 0.0640 - acc: 0.9779Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.4149 - acc: 0.9091
391/390 [==============================] - 67s 172ms/step - loss: 0.0640 - acc: 0.9779 - val_loss:
0.3968 - val_acc: 0.9091
Epoch 155/300
390/390 [============================>.] - ETA: 0s - loss: 0.0664 - acc: 0.9759Epoch 1/300
10000/390
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==============================================] - 3s 342us/sample - loss: 0.3687 - acc: 0.8801
391/390 [==============================] - 68s 174ms/step - loss: 0.0665 - acc: 0.9758 - val_loss:
0.5243 - val_acc: 0.8801
Epoch 156/300
390/390 [============================>.] - ETA: 0s - loss: 0.0622 - acc: 0.9777Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2952 - acc: 0.9072
391/390 [==============================] - 67s 172ms/step - loss: 0.0621 - acc: 0.9777 - val_loss:
0.4328 - val_acc: 0.9072
Epoch 157/300
390/390 [============================>.] - ETA: 0s - loss: 0.0608 - acc: 0.9785Epoch 1/300
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10000/390
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==============================================] - 3s 331us/sample - loss: 0.3168 - acc: 0.8917
391/390 [==============================] - 67s 172ms/step - loss: 0.0611 - acc: 0.9784 - val_loss:
0.4697 - val_acc: 0.8917
Epoch 158/300
390/390 [============================>.] - ETA: 0s - loss: 0.0657 - acc: 0.9758Epoch 1/300
10000/390
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==============================================] - 3s 328us/sample - loss: 0.4888 - acc: 0.8917
391/390 [==============================] - 67s 172ms/step - loss: 0.0657 - acc: 0.9758 - val_loss:
0.5031 - val_acc: 0.8917
Epoch 159/300
390/390 [============================>.] - ETA: 0s - loss: 0.0619 - acc: 0.9786Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.2032 - acc: 0.9108
391/390 [==============================] - 67s 172ms/step - loss: 0.0619 - acc: 0.9786 - val_loss:
0.3874 - val_acc: 0.9108
Epoch 160/300
390/390 [============================>.] - ETA: 0s - loss: 0.0669 - acc: 0.9760Epoch 1/300
10000/390
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==============================================] - 3s 337us/sample - loss: 0.3402 - acc: 0.9066
391/390 [==============================] - 68s 175ms/step - loss: 0.0669 - acc: 0.9760 - val_loss:
0.4221 - val_acc: 0.9066
Epoch 161/300
390/390 [============================>.] - ETA: 0s - loss: 0.0623 - acc: 0.9777Epoch 1/300
10000/390
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==============================================] - 3s 331us/sample - loss: 0.5949 - acc: 0.8899
391/390 [==============================] - 68s 174ms/step - loss: 0.0624 - acc: 0.9776 - val_loss:
0.5035 - val_acc: 0.8899
Epoch 162/300
390/390 [============================>.] - ETA: 0s - loss: 0.0597 - acc: 0.9786Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.2174 - acc: 0.9066
391/390 [==============================] - 68s 173ms/step - loss: 0.0597 - acc: 0.9786 - val_loss:
0.3980 - val_acc: 0.9066
Epoch 163/300
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390/390 [==============================>.] - ETA: 0s - loss: 0.0624 - acc: 0.9785Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.2648 - acc: 0.9141
391/390 [==============================] - 67s 173ms/step - loss: 0.0624 - acc: 0.9785 - val_loss:
0.3614 - val_acc: 0.9141
Epoch 164/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0602 - acc: 0.9790Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.2386 - acc: 0.9046
391/390 [==============================] - 67s 172ms/step - loss: 0.0602 - acc: 0.9791 - val_loss:
0.4212 - val_acc: 0.9046
Epoch 165/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0627 - acc: 0.9774Epoch 1/300
10000/390
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==] - 3s 330us/sample - loss: 0.3768 - acc: 0.8983
391/390 [==============================] - 67s 172ms/step - loss: 0.0627 - acc: 0.9774 - val_loss:
0.4579 - val_acc: 0.8983
Epoch 166/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0615 - acc: 0.9788Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.3056 - acc: 0.8994
391/390 [==============================] - 67s 172ms/step - loss: 0.0615 - acc: 0.9789 - val_loss:
0.4470 - val_acc: 0.8994
Epoch 167/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0611 - acc: 0.9783Epoch 1/300
10000/390
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==] - 3s 329us/sample - loss: 0.2456 - acc: 0.8994
391/390 [==============================] - 67s 172ms/step - loss: 0.0610 - acc: 0.9783 - val_loss:
0.4510 - val_acc: 0.8994
Epoch 168/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0613 - acc: 0.9785Epoch 1/300
10000/390
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==] - 3s 333us/sample - loss: 0.2285 - acc: 0.9135
391/390 [==============================] - 67s 172ms/step - loss: 0.0613 - acc: 0.9785 - val_loss:
0.3645 - val acc: 0.9135

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Epoch 169/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0600 - acc: 0.9791Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.6568 - acc: 0.8866
391/390 [==============================] - 67s 172ms/step - loss: 0.0599 - acc: 0.9792 - val_loss:
0.5635 - val_acc: 0.8866
Epoch 170/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0574 - acc: 0.9798Epoch 1/300
10000/390
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==============================================] - 3s 328us/sample - loss: 0.2769 - acc: 0.9092
391/390 [==============================] - 67s 171ms/step - loss: 0.0574 - acc: 0.9798 - val_loss:
0.4101 - val_acc: 0.9092
Epoch 171/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0587 - acc: 0.9787Epoch 1/300
10000/390
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==============================================] - 3s 331us/sample - loss: 0.5186 - acc: 0.9053
391/390 [==============================] - 67s 172ms/step - loss: 0.0586 - acc: 0.9787 - val_loss:
0.4069 - val_acc: 0.9053
Epoch 172/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0610 - acc: 0.9787Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.3869 - acc: 0.8811
391/390 [==============================] - 67s 172ms/step - loss: 0.0611 - acc: 0.9786 - val_loss:
0.5319 - val_acc: 0.8811
Epoch 173/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0599 - acc: 0.9788Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.3471 - acc: 0.9096
391/390 [==============================] - 68s 173ms/step - loss: 0.0598 - acc: 0.9788 - val_loss:
0.3706 - val_acc: 0.9096
Epoch 174/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0596 - acc: 0.9786Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.3825 - acc: 0.9108
391/390 [==============================] - 67s 172ms/step - loss: 0.0595 - acc: 0.9787 - val_loss:
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0.3956 - val_acc: 0.9108
Epoch 175/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0567 - acc: 0.9796Epoch 1/300
10000/390
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==] - 3s 331us/sample - loss: 0.3469 - acc: 0.9011
391/390 [==============================] - 67s 172ms/step - loss: 0.0567 - acc: 0.9796 - val_loss:
0.4197 - val_acc: 0.9011
Epoch 176/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0568 - acc: 0.9798Epoch 1/300
10000/390
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==] - 3s 329us/sample - loss: 0.2543 - acc: 0.9139
391/390 [==============================] - 67s 172ms/step - loss: 0.0569 - acc: 0.9798 - val_loss:
0.3742 - val_acc: 0.9139
Epoch 177/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0561 - acc: 0.9803Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.2645 - acc: 0.8987
391/390 [==============================] - 67s 172ms/step - loss: 0.0561 - acc: 0.9804 - val_loss:
0.4642 - val_acc: 0.8987
Epoch 178/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0560 - acc: 0.9803Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.2681 - acc: 0.9077
391/390 [==============================] - 67s 172ms/step - loss: 0.0560 - acc: 0.9803 - val_loss:
0.4024 - val_acc: 0.9077
Epoch 179/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0568 - acc: 0.9798Epoch 1/300
10000/390
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==] - 3s 332us/sample - loss: 0.2538 - acc: 0.9055
391/390 [==============================] - 67s 172ms/step - loss: 0.0569 - acc: 0.9798 - val_loss:
0.4078 - val_acc: 0.9055
Epoch 180/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0543 - acc: 0.9814Epoch 1/300
10000/390
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==] - 3s 327us/sample - loss: 0.2868 - acc: 0.8885

391/390 [==============================] - 67s 172ms/step - loss: 0.0544 - acc: 0.9813 - val_loss: 0.5212 - val_acc: 0.8885
Epoch 181/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0551 - acc: 0.9805Epoch 1/300
10000/390
[==============================] - 3s 333us/sample - loss: 0.4897 - acc: 0.8901
391/390 [==============================] - 67s 172ms/step - loss: 0.0551 - acc: 0.9805 - val_loss: 0.5214 - val_acc: 0.8901
Epoch 182/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0505 - acc: 0.9820Epoch 1/300
10000/390
[==============================] - 3s 333us/sample - loss: 0.4202 - acc: 0.9066
391/390 [==============================] - 67s 172ms/step - loss: 0.0505 - acc: 0.9820 - val_loss: 0.4125 - val_acc: 0.9066
Epoch 183/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0562 - acc: 0.9801Epoch 1/300
10000/390
[==============================] - 3s 332us/sample - loss: 0.2143 - acc: 0.9101
391/390 [==============================] - 68s 173ms/step - loss: 0.0561 - acc: 0.9801 - val_loss: 0.4078 - val_acc: 0.9101
Epoch 184/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0537 - acc: 0.9814Epoch 1/300
10000/390
[==============================] - 3s 333us/sample - loss: 0.3030 - acc: 0.9028
391/390 [==============================] - 68s 173ms/step - loss: 0.0536 - acc: 0.9814 - val_loss: 0.4657 - val_acc: 0.9028
Epoch 185/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0566 - acc: 0.9803Epoch 1/300
10000/390
[==============================] - 3s 329us/sample - loss: 0.2503 - acc: 0.9031
391/390 [==============================] - 68s 173ms/step - loss: 0.0565 - acc: 0.9803 - val_loss: 0.4624 - val_acc: 0.9031
Epoch 186/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0532 - acc: 0.9815Epoch 1/300
10000/390
[==============================]

==========] - 3s 328us/sample - loss: 0.3124 - acc: 0.9064
391/390 [==========] - 67s 172ms/step - loss: 0.0531 - acc: 0.9815 - val_loss: 0.4146 - val_acc: 0.9064
Epoch 187/300
390/390 [==========>.] - ETA: 0s - loss: 0.0566 - acc: 0.9806Epoch 1/300
10000/390
[==========] - 3s 332us/sample - loss: 0.2530 - acc: 0.8991
391/390 [==========] - 67s 172ms/step - loss: 0.0566 - acc: 0.9806 - val_loss: 0.4579 - val_acc: 0.8991
Epoch 188/300
390/390 [==========>.] - ETA: 0s - loss: 0.0530 - acc: 0.9815Epoch 1/300
10000/390
[==========] - 3s 333us/sample - loss: 0.2192 - acc: 0.9052
391/390 [==========] - 67s 172ms/step - loss: 0.0529 - acc: 0.9815 - val_loss: 0.4128 - val_acc: 0.9052
Epoch 189/300
390/390 [==========>.] - ETA: 0s - loss: 0.0497 - acc: 0.9832Epoch 1/300
10000/390
[==========] - 3s 331us/sample - loss: 0.2395 - acc: 0.9128
391/390 [==========] - 67s 172ms/step - loss: 0.0497 - acc: 0.9832 - val_loss: 0.3875 - val_acc: 0.9128
Epoch 190/300
390/390 [==========>.] - ETA: 0s - loss: 0.0547 - acc: 0.9810Epoch 1/300
10000/390
[==========] - 3s 332us/sample - loss: 0.4854 - acc: 0.8998
391/390 [==========] - 67s 172ms/step - loss: 0.0547 - acc: 0.9809 - val_loss: 0.4558 - val_acc: 0.8998
Epoch 191/300
390/390 [==========>.] - ETA: 0s - loss: 0.0569 - acc: 0.9803Epoch 1/300
10000/390
[==========] - 3s 332us/sample - loss: 0.2623 - acc: 0.8980
391/390 [==========] - 67s 172ms/step - loss: 0.0571 - acc: 0.9803 - val_loss: 0.4292 - val_acc: 0.8980
Epoch 192/300
390/390 [==========>.] - ETA: 0s - loss: 0.0507 - acc: 0.9820Epoch 1/300
10000/390
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==============================================] - 3s 329us/sample - loss: 0.5556 - acc: 0.9079
391/390 [==============================] - 67s 172ms/step - loss: 0.0508 - acc: 0.9820 - val_loss:
0.4002 - val_acc: 0.9079
Epoch 193/300
390/390 [============================>.] - ETA: 0s - loss: 0.0502 - acc: 0.9829Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.4262 - acc: 0.8974
391/390 [==============================] - 67s 172ms/step - loss: 0.0504 - acc: 0.9828 - val_loss:
0.4576 - val_acc: 0.8974
Epoch 194/300
390/390 [============================>.] - ETA: 0s - loss: 0.0557 - acc: 0.9803Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.2308 - acc: 0.9088
391/390 [==============================] - 67s 172ms/step - loss: 0.0556 - acc: 0.9803 - val_loss:
0.4170 - val_acc: 0.9088
Epoch 195/300
390/390 [============================>.] - ETA: 0s - loss: 0.0517 - acc: 0.9821Epoch 1/300
10000/390
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==============================================] - 3s 333us/sample - loss: 0.2311 - acc: 0.9061
391/390 [==============================] - 68s 173ms/step - loss: 0.0517 - acc: 0.9821 - val_loss:
0.4162 - val_acc: 0.9061
Epoch 196/300
390/390 [============================>.] - ETA: 0s - loss: 0.0540 - acc: 0.9811Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.3200 - acc: 0.8887
391/390 [==============================] - 68s 174ms/step - loss: 0.0540 - acc: 0.9811 - val_loss:
0.5003 - val_acc: 0.8887
Epoch 197/300
390/390 [============================>.] - ETA: 0s - loss: 0.0509 - acc: 0.9820Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.3042 - acc: 0.9078
391/390 [==============================] - 68s 174ms/step - loss: 0.0509 - acc: 0.9820 - val_loss:
0.4120 - val_acc: 0.9078
Epoch 198/300
390/390 [============================>.] - ETA: 0s - loss: 0.0525 - acc: 0.9826Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.5716 - acc: 0.9068
391/390 [==============================] - 68s 173ms/step - loss: 0.0526 - acc: 0.9825 - val_loss:
0.4189 - val_acc: 0.9068
Epoch 199/300
390/390 [============================>.] - ETA: 0s - loss: 0.0513 - acc: 0.9823Epoch 1/300
10000/390
[==============================================] - 3s 328us/sample - loss: 0.3280 - acc: 0.9037
391/390 [==============================] - 67s 172ms/step - loss: 0.0513 - acc: 0.9823 - val_loss:
0.4467 - val_acc: 0.9037
Epoch 200/300
390/390 [============================>.] - ETA: 0s - loss: 0.0500 - acc: 0.9823Epoch 1/300
10000/390
[==============================================] - 4s 355us/sample - loss: 0.3409 - acc: 0.8968
391/390 [==============================] - 68s 173ms/step - loss: 0.0500 - acc: 0.9823 - val_loss:
0.4728 - val_acc: 0.8968
Epoch 201/300
390/390 [============================>.] - ETA: 0s - loss: 0.0526 - acc: 0.9824Epoch 1/300
10000/390
[==============================================] - 3s 339us/sample - loss: 0.2546 - acc: 0.9101
391/390 [==============================] - 68s 174ms/step - loss: 0.0526 - acc: 0.9823 - val_loss:
0.3783 - val_acc: 0.9101
Epoch 202/300
390/390 [============================>.] - ETA: 0s - loss: 0.0488 - acc: 0.9827Epoch 1/300
10000/390
[==============================================] - 3s 329us/sample - loss: 0.2196 - acc: 0.9118
391/390 [==============================] - 68s 173ms/step - loss: 0.0489 - acc: 0.9827 - val_loss:
0.4014 - val_acc: 0.9118
Epoch 203/300
390/390 [============================>.] - ETA: 0s - loss: 0.0479 - acc: 0.9829Epoch 1/300
10000/390
[==============================================] - 3s 331us/sample - loss: 0.2650 - acc: 0.9038
391/390 [==============================] - 68s 174ms/step - loss: 0.0478 - acc: 0.9829 - val_loss:
0.4300 - val_acc: 0.9038
Epoch 204/300
390/390 [============================>.] - ETA: 0s - loss: 0.0481 - acc: 0.9826Epoch 1/300
10000/390
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==========] - 3s 338us/sample - loss: 0.3652 - acc: 0.8763
391/390 [==============================] - 68s 174ms/step - loss: 0.0481 - acc: 0.9825 - val_loss: 0.5940 - val_acc: 0.8763
Epoch 205/300
390/390 [============================>.] - ETA: 0s - loss: 0.0480 - acc: 0.9831Epoch 1/300
10000/390
==========] - 3s 335us/sample - loss: 0.3242 - acc: 0.9019
391/390 [==============================] - 68s 174ms/step - loss: 0.0480 - acc: 0.9831 - val_loss: 0.4712 - val_acc: 0.9019
Epoch 206/300
390/390 [============================>.] - ETA: 0s - loss: 0.0523 - acc: 0.9815Epoch 1/300
10000/390
==========] - 3s 335us/sample - loss: 0.3140 - acc: 0.9062
391/390 [==============================] - 68s 173ms/step - loss: 0.0524 - acc: 0.9815 - val_loss: 0.4457 - val_acc: 0.9062
Epoch 207/300
390/390 [============================>.] - ETA: 0s - loss: 0.0466 - acc: 0.9839Epoch 1/300
10000/390
==========] - 3s 329us/sample - loss: 0.3176 - acc: 0.9139
391/390 [==============================] - 67s 173ms/step - loss: 0.0466 - acc: 0.9839 - val_loss: 0.4014 - val_acc: 0.9139
Epoch 208/300
390/390 [============================>.] - ETA: 0s - loss: 0.0526 - acc: 0.9820Epoch 1/300
10000/390
==========] - 3s 329us/sample - loss: 0.3530 - acc: 0.9016
391/390 [==============================] - 68s 173ms/step - loss: 0.0526 - acc: 0.9820 - val_loss: 0.4682 - val_acc: 0.9016
Epoch 209/300
390/390 [============================>.] - ETA: 0s - loss: 0.0501 - acc: 0.9831Epoch 1/300
10000/390
==========] - 3s 332us/sample - loss: 0.3131 - acc: 0.9053
391/390 [==============================] - 68s 173ms/step - loss: 0.0500 - acc: 0.9832 - val_loss: 0.4359 - val_acc: 0.9053
Epoch 210/300
390/390 [============================>.] - ETA: 0s - loss: 0.0483 - acc: 0.9826Epoch 1/300
10000/390

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==============================================] - 3s 329us/sample - loss: 0.2573 - acc: 0.9128
391/390 [==============================] - 68s 173ms/step - loss: 0.0482 - acc: 0.9826 - val_loss:
0.3801 - val_acc: 0.9128
Epoch 211/300
390/390 [============================>.] - ETA: 0s - loss: 0.0474 - acc: 0.9835Epoch 1/300
10000/390
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==============================================] - 3s 333us/sample - loss: 0.3132 - acc: 0.9161
391/390 [==============================] - 67s 172ms/step - loss: 0.0474 - acc: 0.9835 - val_loss:
0.3800 - val_acc: 0.9161
Epoch 212/300
390/390 [============================>.] - ETA: 0s - loss: 0.0477 - acc: 0.9838Epoch 1/300
10000/390
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==============================================] - 3s 329us/sample - loss: 0.2543 - acc: 0.9054
391/390 [==============================] - 67s 172ms/step - loss: 0.0476 - acc: 0.9838 - val_loss:
0.4420 - val_acc: 0.9054
Epoch 213/300
390/390 [============================>.] - ETA: 0s - loss: 0.0455 - acc: 0.9836Epoch 1/300
10000/390
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==============================================] - 3s 331us/sample - loss: 0.2110 - acc: 0.9065
391/390 [==============================] - 67s 172ms/step - loss: 0.0455 - acc: 0.9836 - val_loss:
0.4090 - val_acc: 0.9065
Epoch 214/300
390/390 [============================>.] - ETA: 0s - loss: 0.0503 - acc: 0.9826Epoch 1/300
10000/390
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==============================================] - 3s 328us/sample - loss: 0.2440 - acc: 0.9092
391/390 [==============================] - 67s 171ms/step - loss: 0.0502 - acc: 0.9826 - val_loss:
0.4166 - val_acc: 0.9092
Epoch 215/300
390/390 [============================>.] - ETA: 0s - loss: 0.0506 - acc: 0.9818Epoch 1/300
10000/390
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==============================================] - 3s 331us/sample - loss: 0.2066 - acc: 0.9124
391/390 [==============================] - 67s 172ms/step - loss: 0.0507 - acc: 0.9818 - val_loss:
0.3937 - val_acc: 0.9124
Epoch 216/300
390/390 [============================>.] - ETA: 0s - loss: 0.0459 - acc: 0.9842Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2767 - acc: 0.9010
391/390 [==============================] - 67s 172ms/step - loss: 0.0458 - acc: 0.9842 - val_loss:
0.4680 - val_acc: 0.9010
Epoch 217/300
390/390 [============================>.] - ETA: 0s - loss: 0.0481 - acc: 0.9838Epoch 1/300
10000/390
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==============================================] - 3s 331us/sample - loss: 0.2739 - acc: 0.9098
391/390 [==============================] - 67s 172ms/step - loss: 0.0482 - acc: 0.9838 - val_loss:
0.4210 - val_acc: 0.9098
Epoch 218/300
390/390 [============================>.] - ETA: 0s - loss: 0.0443 - acc: 0.9846Epoch 1/300
10000/390
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==============================================] - 3s 329us/sample - loss: 0.2966 - acc: 0.9095
391/390 [==============================] - 67s 172ms/step - loss: 0.0443 - acc: 0.9846 - val_loss:
0.4340 - val_acc: 0.9095
Epoch 219/300
390/390 [============================>.] - ETA: 0s - loss: 0.0451 - acc: 0.9838Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.2462 - acc: 0.9065
391/390 [==============================] - 67s 172ms/step - loss: 0.0451 - acc: 0.9838 - val_loss:
0.4023 - val_acc: 0.9065
Epoch 220/300
390/390 [============================>.] - ETA: 0s - loss: 0.0470 - acc: 0.9840Epoch 1/300
10000/390
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==============================================] - 3s 328us/sample - loss: 0.2859 - acc: 0.8996
391/390 [==============================] - 67s 172ms/step - loss: 0.0471 - acc: 0.9840 - val_loss:
0.4776 - val_acc: 0.8996
Epoch 221/300
390/390 [============================>.] - ETA: 0s - loss: 0.0470 - acc: 0.9830Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.2901 - acc: 0.8978
391/390 [==============================] - 67s 172ms/step - loss: 0.0470 - acc: 0.9830 - val_loss:
0.4905 - val_acc: 0.8978
Epoch 222/300
390/390 [============================>.] - ETA: 0s - loss: 0.0456 - acc: 0.9845Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.2757 - acc: 0.9056
391/390 [==============================] - 67s 173ms/step - loss: 0.0455 - acc: 0.9845 - val_loss:
0.4395 - val_acc: 0.9056
Epoch 223/300
390/390 [============================>.] - ETA: 0s - loss: 0.0454 - acc: 0.9841Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.2064 - acc: 0.9172
391/390 [==============================] - 67s 172ms/step - loss: 0.0454 - acc: 0.9841 - val_loss:
0.3814 - val_acc: 0.9172
Epoch 224/300
390/390 [============================>.] - ETA: 0s - loss: 0.0452 - acc: 0.9841Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.5371 - acc: 0.8801
391/390 [==============================] - 67s 172ms/step - loss: 0.0451 - acc: 0.9841 - val_loss:
0.6431 - val_acc: 0.8801
Epoch 225/300
390/390 [============================>.] - ETA: 0s - loss: 0.0459 - acc: 0.9839Epoch 1/300
10000/390
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==============================================] - 3s 328us/sample - loss: 0.2364 - acc: 0.9054
391/390 [==============================] - 67s 172ms/step - loss: 0.0459 - acc: 0.9839 - val_loss:
0.4498 - val_acc: 0.9054
Epoch 226/300
390/390 [============================>.] - ETA: 0s - loss: 0.0471 - acc: 0.9835Epoch 1/300
10000/390
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==============================================] - 3s 331us/sample - loss: 0.2151 - acc: 0.9123
391/390 [==============================] - 67s 172ms/step - loss: 0.0471 - acc: 0.9835 - val_loss:
0.4188 - val_acc: 0.9123
Epoch 227/300
390/390 [============================>.] - ETA: 0s - loss: 0.0439 - acc: 0.9847Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.2925 - acc: 0.9043
391/390 [==============================] - 68s 174ms/step - loss: 0.0440 - acc: 0.9847 - val_loss:
0.4697 - val_acc: 0.9043
Epoch 228/300
390/390 [============================>.] - ETA: 0s - loss: 0.0430 - acc: 0.9842Epoch 1/300
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10000/390
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==============================================] - 3s 334us/sample - loss: 0.2539 - acc: 0.9038
391/390 [==============================] - 68s 173ms/step - loss: 0.0431 - acc: 0.9841 - val_loss:
0.4629 - val_acc: 0.9038
Epoch 229/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0443 - acc: 0.9846Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.2666 - acc: 0.9046
391/390 [==============================] - 68s 174ms/step - loss: 0.0442 - acc: 0.9846 - val_loss:
0.4860 - val_acc: 0.9046
Epoch 230/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0458 - acc: 0.9840Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2359 - acc: 0.9025
391/390 [==============================] - 68s 173ms/step - loss: 0.0459 - acc: 0.9840 - val_loss:
0.4643 - val_acc: 0.9025
Epoch 231/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0478 - acc: 0.9827Epoch 1/300
10000/390
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==============================================] - 3s 336us/sample - loss: 0.3427 - acc: 0.9050
391/390 [==============================] - 68s 174ms/step - loss: 0.0477 - acc: 0.9828 - val_loss:
0.4420 - val_acc: 0.9050
Epoch 232/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0433 - acc: 0.9852Epoch 1/300
10000/390
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==============================================] - 3s 335us/sample - loss: 0.2556 - acc: 0.9009
391/390 [==============================] - 68s 173ms/step - loss: 0.0434 - acc: 0.9851 - val_loss:
0.4807 - val_acc: 0.9009
Epoch 233/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0458 - acc: 0.9840Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.5184 - acc: 0.8916
391/390 [==============================] - 67s 172ms/step - loss: 0.0459 - acc: 0.9840 - val_loss:
0.5658 - val_acc: 0.8916
Epoch 234/300
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390/390 [==============================>.] - ETA: 0s - loss: 0.0467 - acc: 0.9839Epoch 1/300
10000/390
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==============================================] - 3s 331us/sample - loss: 0.2761 - acc: 0.9111
391/390 [==============================] - 67s 172ms/step - loss: 0.0467 - acc: 0.9839 - val_loss:
0.4064 - val_acc: 0.9111
Epoch 235/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0435 - acc: 0.9840Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2652 - acc: 0.9043
391/390 [==============================] - 68s 173ms/step - loss: 0.0435 - acc: 0.9840 - val_loss:
0.4536 - val_acc: 0.9043
Epoch 236/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0433 - acc: 0.9852Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.5414 - acc: 0.8865
391/390 [==============================] - 67s 172ms/step - loss: 0.0432 - acc: 0.9853 - val_loss:
0.5819 - val_acc: 0.8865
Epoch 237/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0420 - acc: 0.9856Epoch 1/300
10000/390
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==============================================] - 3s 329us/sample - loss: 0.2304 - acc: 0.9084
391/390 [==============================] - 67s 172ms/step - loss: 0.0421 - acc: 0.9856 - val_loss:
0.4410 - val_acc: 0.9084
Epoch 238/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0452 - acc: 0.9838Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2412 - acc: 0.9016
391/390 [==============================] - 67s 172ms/step - loss: 0.0454 - acc: 0.9838 - val_loss:
0.4652 - val_acc: 0.9016
Epoch 239/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0471 - acc: 0.9836Epoch 1/300
10000/390
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==============================================] - 3s 333us/sample - loss: 0.2617 - acc: 0.9061
391/390 [==============================] - 67s 172ms/step - loss: 0.0473 - acc: 0.9835 - val_loss:
0.4380 - val_acc: 0.9061
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Epoch 240/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0417 - acc: 0.9852Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.3589 - acc: 0.8978
391/390 [==============================] - 68s 173ms/step - loss: 0.0417 - acc: 0.9852 - val_loss:
0.5011 - val_acc: 0.8978
Epoch 241/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0413 - acc: 0.9857Epoch 1/300
10000/390
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==============================================] - 3s 333us/sample - loss: 0.2513 - acc: 0.9074
391/390 [==============================] - 68s 174ms/step - loss: 0.0415 - acc: 0.9856 - val_loss:
0.4401 - val_acc: 0.9074
Epoch 242/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0444 - acc: 0.9843Epoch 1/300
10000/390
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==============================================] - 3s 333us/sample - loss: 0.3392 - acc: 0.9013
391/390 [==============================] - 69s 176ms/step - loss: 0.0445 - acc: 0.9842 - val_loss:
0.4887 - val_acc: 0.9013
Epoch 243/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0375 - acc: 0.9876Epoch 1/300
10000/390
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==============================================] - 3s 333us/sample - loss: 0.3148 - acc: 0.9007
391/390 [==============================] - 68s 173ms/step - loss: 0.0375 - acc: 0.9876 - val_loss:
0.5107 - val_acc: 0.9007
Epoch 244/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0462 - acc: 0.9842Epoch 1/300
10000/390
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==============================================] - 3s 329us/sample - loss: 0.4286 - acc: 0.9069
391/390 [==============================] - 68s 173ms/step - loss: 0.0461 - acc: 0.9843 - val_loss:
0.4298 - val_acc: 0.9069
Epoch 245/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0423 - acc: 0.9850Epoch 1/300
10000/390
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==============================================] - 3s 333us/sample - loss: 0.3057 - acc: 0.9044
391/390 [==============================] - 68s 173ms/step - loss: 0.0424 - acc: 0.9850 - val_loss:
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0.4653 - val_acc: 0.9044
Epoch 246/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0422 - acc: 0.9851Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.6247 - acc: 0.9014
391/390 [==============================] - 68s 173ms/step - loss: 0.0422 - acc: 0.9851 - val_loss:
0.4660 - val_acc: 0.9014
Epoch 247/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0409 - acc: 0.9855Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.3149 - acc: 0.9053
391/390 [==============================] - 67s 172ms/step - loss: 0.0408 - acc: 0.9855 - val_loss:
0.4631 - val_acc: 0.9053
Epoch 248/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0425 - acc: 0.9851Epoch 1/300
10000/390
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==============================================] - 3s 330us/sample - loss: 0.2227 - acc: 0.9076
391/390 [==============================] - 67s 171ms/step - loss: 0.0425 - acc: 0.9852 - val_loss:
0.4374 - val_acc: 0.9076
Epoch 249/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0421 - acc: 0.9851Epoch 1/300
10000/390
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==============================================] - 3s 329us/sample - loss: 0.4410 - acc: 0.9008
391/390 [==============================] - 67s 171ms/step - loss: 0.0421 - acc: 0.9851 - val_loss:
0.4845 - val_acc: 0.9008
Epoch 250/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0412 - acc: 0.9855Epoch 1/300
10000/390
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==============================================] - 3s 329us/sample - loss: 0.3656 - acc: 0.9055
391/390 [==============================] - 67s 172ms/step - loss: 0.0412 - acc: 0.9855 - val_loss:
0.4556 - val_acc: 0.9055
Epoch 251/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0428 - acc: 0.9853Epoch 1/300
10000/390
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==============================================] - 3s 334us/sample - loss: 0.2157 - acc: 0.9115
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391/390 [==============================] - 67s 171ms/step - loss: 0.0428 - acc: 0.9853 - val_loss:
0.4074 - val_acc: 0.9115
Epoch 252/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0405 - acc: 0.9855Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.3096 - acc: 0.9080
391/390 [==============================] - 67s 172ms/step - loss: 0.0405 - acc: 0.9855 - val_loss:
0.4598 - val_acc: 0.9080
Epoch 253/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0401 - acc: 0.9863Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2267 - acc: 0.9116
391/390 [==============================] - 67s 172ms/step - loss: 0.0400 - acc: 0.9864 - val_loss:
0.4337 - val_acc: 0.9116
Epoch 254/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0427 - acc: 0.9851Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.3229 - acc: 0.9062
391/390 [==============================] - 67s 172ms/step - loss: 0.0426 - acc: 0.9851 - val_loss:
0.4560 - val_acc: 0.9062
Epoch 255/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0406 - acc: 0.9858Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2452 - acc: 0.9049
391/390 [==============================] - 67s 172ms/step - loss: 0.0405 - acc: 0.9859 - val_loss:
0.4617 - val_acc: 0.9049
Epoch 256/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0413 - acc: 0.9861Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.2025 - acc: 0.9158
391/390 [==============================] - 67s 172ms/step - loss: 0.0413 - acc: 0.9861 - val_loss:
0.3942 - val_acc: 0.9158
Epoch 257/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0399 - acc: 0.9867Epoch 1/300
10000/390
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==========] - 3s 332us/sample - loss: 0.4118 - acc: 0.9042
391/390 [==============================] - 67s 172ms/step - loss: 0.0399 - acc: 0.9867 - val_loss: 0.4643 - val_acc: 0.9042
Epoch 258/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0431 - acc: 0.9847Epoch 1/300
10000/390
[==========] - 3s 339us/sample - loss: 0.3772 - acc: 0.8950
391/390 [==============================] - 68s 174ms/step - loss: 0.0430 - acc: 0.9847 - val_loss: 0.5159 - val_acc: 0.8950
Epoch 259/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0382 - acc: 0.9867Epoch 1/300
10000/390
[==========] - 3s 344us/sample - loss: 0.3656 - acc: 0.9069
391/390 [==============================] - 69s 176ms/step - loss: 0.0383 - acc: 0.9867 - val_loss: 0.4688 - val_acc: 0.9069
Epoch 260/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0394 - acc: 0.9864Epoch 1/300
10000/390
[==========] - 3s 343us/sample - loss: 0.2981 - acc: 0.9098
391/390 [==============================] - 69s 177ms/step - loss: 0.0394 - acc: 0.9863 - val_loss: 0.4331 - val_acc: 0.9098
Epoch 261/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0422 - acc: 0.9853Epoch 1/300
10000/390
[==========] - 3s 345us/sample - loss: 0.2553 - acc: 0.9166
391/390 [==============================] - 69s 177ms/step - loss: 0.0423 - acc: 0.9853 - val_loss: 0.3970 - val_acc: 0.9166
Epoch 262/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0406 - acc: 0.9857Epoch 1/300
10000/390
[==========] - 3s 344us/sample - loss: 0.3118 - acc: 0.9085
391/390 [==============================] - 69s 177ms/step - loss: 0.0406 - acc: 0.9857 - val_loss: 0.4350 - val_acc: 0.9085
Epoch 263/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0392 - acc: 0.9864Epoch 1/300
10000/390
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==============================================] - 3s 345us/sample - loss: 0.2930 - acc: 0.9077
391/390 [==============================] - 69s 177ms/step - loss: 0.0391 - acc: 0.9864 - val_loss:
0.4406 - val_acc: 0.9077
Epoch 264/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0396 - acc: 0.9863Epoch 1/300
10000/390
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==============================================] - 3s 341us/sample - loss: 0.2182 - acc: 0.9145
391/390 [==============================] - 69s 177ms/step - loss: 0.0397 - acc: 0.9862 - val_loss:
0.4195 - val_acc: 0.9145
Epoch 265/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0391 - acc: 0.9861Epoch 1/300
10000/390
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==============================================] - 3s 344us/sample - loss: 0.2796 - acc: 0.9077
391/390 [==============================] - 69s 177ms/step - loss: 0.0391 - acc: 0.9862 - val_loss:
0.4607 - val_acc: 0.9077
Epoch 266/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0394 - acc: 0.9866Epoch 1/300
10000/390
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==============================================] - 3s 345us/sample - loss: 0.2184 - acc: 0.9070
391/390 [==============================] - 69s 177ms/step - loss: 0.0395 - acc: 0.9866 - val_loss:
0.4221 - val_acc: 0.9070
Epoch 267/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0391 - acc: 0.9864Epoch 1/300
10000/390
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==============================================] - 3s 343us/sample - loss: 0.2555 - acc: 0.9133
391/390 [==============================] - 69s 177ms/step - loss: 0.0391 - acc: 0.9864 - val_loss:
0.4052 - val_acc: 0.9133
Epoch 268/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0379 - acc: 0.9867Epoch 1/300
10000/390
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==============================================] - 3s 332us/sample - loss: 0.3165 - acc: 0.9082
391/390 [==============================] - 69s 176ms/step - loss: 0.0379 - acc: 0.9867 - val_loss:
0.4448 - val_acc: 0.9082
Epoch 269/300
390/390 [==============================>.] - ETA: 0s - loss: 0.0375 - acc: 0.9870Epoch 1/300
10000/390
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==================================================] - 3s 335us/sample - loss: 0.2067 - acc: 0.9147
391/390 [==============================] - 68s 173ms/step - loss: 0.0378 - acc: 0.9870 - val_loss:
0.3931 - val_acc: 0.9147
Epoch 270/300
390/390 [============================>.] - ETA: 0s - loss: 0.0385 - acc: 0.9862Epoch 1/300
10000/390
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==================================================] - 3s 336us/sample - loss: 0.4779 - acc: 0.9048
391/390 [==============================] - 68s 175ms/step - loss: 0.0385 - acc: 0.9862 - val_loss:
0.4834 - val_acc: 0.9048
Epoch 271/300
390/390 [============================>.] - ETA: 0s - loss: 0.0373 - acc: 0.9875Epoch 1/300
10000/390
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==================================================] - 3s 346us/sample - loss: 0.2808 - acc: 0.9059
391/390 [==============================] - 69s 177ms/step - loss: 0.0373 - acc: 0.9875 - val_loss:
0.4710 - val_acc: 0.9059
Epoch 272/300
390/390 [============================>.] - ETA: 0s - loss: 0.0408 - acc: 0.9859Epoch 1/300
10000/390
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==================================================] - 3s 344us/sample - loss: 0.2418 - acc: 0.9139
391/390 [==============================] - 69s 177ms/step - loss: 0.0408 - acc: 0.9859 - val_loss:
0.4033 - val_acc: 0.9139
Epoch 273/300
390/390 [============================>.] - ETA: 0s - loss: 0.0399 - acc: 0.9862Epoch 1/300
10000/390
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==================================================] - 3s 346us/sample - loss: 0.3419 - acc: 0.9142
391/390 [==============================] - 69s 177ms/step - loss: 0.0398 - acc: 0.9862 - val_loss:
0.4278 - val_acc: 0.9142
Epoch 274/300
390/390 [============================>.] - ETA: 0s - loss: 0.0379 - acc: 0.9863Epoch 1/300
10000/390
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==================================================] - 3s 344us/sample - loss: 0.3107 - acc: 0.9010
391/390 [==============================] - 69s 177ms/step - loss: 0.0379 - acc: 0.9863 - val_loss:
0.4926 - val_acc: 0.9010
Epoch 275/300
390/390 [============================>.] - ETA: 0s - loss: 0.0373 - acc: 0.9872Epoch 1/300
10000/390
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==============================================] - 3s 344us/sample - loss: 0.2765 - acc: 0.9111
391/390 [==============================] - 69s 177ms/step - loss: 0.0373 - acc: 0.9872 - val_loss:
0.4311 - val_acc: 0.9111
Epoch 276/300
390/390 [============================>.] - ETA: 0s - loss: 0.0351 - acc: 0.9875Epoch 1/300
10000/390
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==============================================] - 3s 348us/sample - loss: 0.2709 - acc: 0.9121
391/390 [==============================] - 69s 177ms/step - loss: 0.0351 - acc: 0.9875 - val_loss:
0.4221 - val_acc: 0.9121
Epoch 277/300
390/390 [============================>.] - ETA: 0s - loss: 0.0374 - acc: 0.9864Epoch 1/300
10000/390
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==============================================] - 3s 347us/sample - loss: 0.4549 - acc: 0.9103
391/390 [==============================] - 69s 177ms/step - loss: 0.0375 - acc: 0.9864 - val_loss:
0.4319 - val_acc: 0.9103
Epoch 278/300
390/390 [============================>.] - ETA: 0s - loss: 0.0380 - acc: 0.9868Epoch 1/300
10000/390
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==============================================] - 3s 349us/sample - loss: 0.2455 - acc: 0.8987
391/390 [==============================] - 69s 178ms/step - loss: 0.0380 - acc: 0.9868 - val_loss:
0.4732 - val_acc: 0.8987
Epoch 279/300
390/390 [============================>.] - ETA: 0s - loss: 0.0378 - acc: 0.9867Epoch 1/300
10000/390
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==============================================] - 3s 343us/sample - loss: 0.2755 - acc: 0.9014
391/390 [==============================] - 69s 177ms/step - loss: 0.0378 - acc: 0.9867 - val_loss:
0.4916 - val_acc: 0.9014
Epoch 280/300
390/390 [============================>.] - ETA: 0s - loss: 0.0355 - acc: 0.9881Epoch 1/300
10000/390
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==============================================] - 3s 348us/sample - loss: 0.4117 - acc: 0.9114
391/390 [==============================] - 69s 177ms/step - loss: 0.0355 - acc: 0.9881 - val_loss:
0.4344 - val_acc: 0.9114
Epoch 281/300
390/390 [============================>.] - ETA: 0s - loss: 0.0380 - acc: 0.9868Epoch 1/300
10000/390
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==============================================] - 3s 348us/sample - loss: 0.2529 - acc: 0.9059
391/390 [==============================] - 69s 177ms/step - loss: 0.0380 - acc: 0.9868 - val_loss:
0.4551 - val_acc: 0.9059
Epoch 282/300
390/390 [============================>.] - ETA: 0s - loss: 0.0363 - acc: 0.9868Epoch 1/300
10000/390
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==============================================] - 3s 345us/sample - loss: 0.3149 - acc: 0.9118
391/390 [==============================] - 69s 178ms/step - loss: 0.0363 - acc: 0.9869 - val_loss:
0.4407 - val_acc: 0.9118
Epoch 283/300
390/390 [============================>.] - ETA: 0s - loss: 0.0358 - acc: 0.9870Epoch 1/300
10000/390
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==============================================] - 3s 345us/sample - loss: 0.2503 - acc: 0.9173
391/390 [==============================] - 69s 178ms/step - loss: 0.0358 - acc: 0.9871 - val_loss:
0.4180 - val_acc: 0.9173
Epoch 284/300
390/390 [============================>.] - ETA: 0s - loss: 0.0383 - acc: 0.9874Epoch 1/300
10000/390
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==============================================] - 3s 347us/sample - loss: 0.4867 - acc: 0.9080
391/390 [==============================] - 69s 178ms/step - loss: 0.0383 - acc: 0.9875 - val_loss:
0.4521 - val_acc: 0.9080
Epoch 285/300
390/390 [============================>.] - ETA: 0s - loss: 0.0375 - acc: 0.9871Epoch 1/300
10000/390
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==============================================] - 3s 345us/sample - loss: 0.2929 - acc: 0.9104
391/390 [==============================] - 69s 177ms/step - loss: 0.0375 - acc: 0.9871 - val_loss:
0.4483 - val_acc: 0.9104
Epoch 286/300
390/390 [============================>.] - ETA: 0s - loss: 0.0359 - acc: 0.9881Epoch 1/300
10000/390
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==============================================] - 3s 347us/sample - loss: 0.3408 - acc: 0.9182
391/390 [==============================] - 69s 177ms/step - loss: 0.0359 - acc: 0.9881 - val_loss:
0.3899 - val_acc: 0.9182
Epoch 287/300
390/390 [============================>.] - ETA: 0s - loss: 0.0368 - acc: 0.9874Epoch 1/300
10000/390
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==============================================] - 3s 345us/sample - loss: 0.2385 - acc: 0.9114
391/390 [==============================] - 69s 177ms/step - loss: 0.0368 - acc: 0.9874 - val_loss:
0.4374 - val_acc: 0.9114
Epoch 288/300
390/390 [============================>.] - ETA: 0s - loss: 0.0365 - acc: 0.9871Epoch 1/300
10000/390
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==============================================] - 3s 348us/sample - loss: 0.3641 - acc: 0.9110
391/390 [==============================] - 69s 178ms/step - loss: 0.0365 - acc: 0.9871 - val_loss:
0.4455 - val_acc: 0.9110
Epoch 289/300
390/390 [============================>.] - ETA: 0s - loss: 0.0376 - acc: 0.9868Epoch 1/300
10000/390
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==============================================] - 3s 348us/sample - loss: 0.3331 - acc: 0.9073
391/390 [==============================] - 69s 177ms/step - loss: 0.0375 - acc: 0.9868 - val_loss:
0.4537 - val_acc: 0.9073
Epoch 290/300
390/390 [============================>.] - ETA: 0s - loss: 0.0342 - acc: 0.9884Epoch 1/300
10000/390
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==============================================] - 3s 346us/sample - loss: 0.3222 - acc: 0.9067
391/390 [==============================] - 69s 177ms/step - loss: 0.0342 - acc: 0.9883 - val_loss:
0.4422 - val_acc: 0.9067
Epoch 291/300
390/390 [============================>.] - ETA: 0s - loss: 0.0376 - acc: 0.9872Epoch 1/300
10000/390
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==============================================] - 3s 344us/sample - loss: 0.2501 - acc: 0.9033
391/390 [==============================] - 69s 177ms/step - loss: 0.0376 - acc: 0.9872 - val_loss:
0.4894 - val_acc: 0.9033
Epoch 292/300
390/390 [============================>.] - ETA: 0s - loss: 0.0339 - acc: 0.9881Epoch 1/300
10000/390
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==============================================] - 3s 346us/sample - loss: 0.4114 - acc: 0.9097
391/390 [==============================] - 69s 178ms/step - loss: 0.0339 - acc: 0.9881 - val_loss:
0.4619 - val_acc: 0.9097
Epoch 293/300
390/390 [============================>.] - ETA: 0s - loss: 0.0388 - acc: 0.9872Epoch 1/300
10000/390
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==============================================] - 3s 348us/sample - loss: 0.2341 - acc: 0.9057
391/390 [==============================] - 69s 178ms/step - loss: 0.0388 - acc: 0.9872 - val_loss:
0.4554 - val_acc: 0.9057
Epoch 294/300
390/390 [============================>.] - ETA: 0s - loss: 0.0346 - acc: 0.9881Epoch 1/300
10000/390
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==============================================] - 4s 350us/sample - loss: 0.2927 - acc: 0.9047
391/390 [==============================] - 70s 178ms/step - loss: 0.0345 - acc: 0.9881 - val_loss:
0.4910 - val_acc: 0.9047
Epoch 295/300
390/390 [============================>.] - ETA: 0s - loss: 0.0366 - acc: 0.9873Epoch 1/300
10000/390
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==============================================] - 3s 346us/sample - loss: 0.4016 - acc: 0.9131
391/390 [==============================] - 69s 178ms/step - loss: 0.0368 - acc: 0.9873 - val_loss:
0.4055 - val_acc: 0.9131
Epoch 296/300
390/390 [============================>.] - ETA: 0s - loss: 0.0373 - acc: 0.9876Epoch 1/300
10000/390
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==============================================] - 3s 345us/sample - loss: 0.2010 - acc: 0.9217
391/390 [==============================] - 69s 177ms/step - loss: 0.0373 - acc: 0.9876 - val_loss:
0.3906 - val_acc: 0.9217
Epoch 297/300
390/390 [============================>.] - ETA: 0s - loss: 0.0382 - acc: 0.9866Epoch 1/300
10000/390
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==============================================] - 3s 343us/sample - loss: 0.2989 - acc: 0.9014
391/390 [==============================] - 69s 176ms/step - loss: 0.0383 - acc: 0.9866 - val_loss:
0.5025 - val_acc: 0.9014
Epoch 298/300
390/390 [============================>.] - ETA: 0s - loss: 0.0362 - acc: 0.9873Epoch 1/300
10000/390
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==============================================] - 3s 343us/sample - loss: 0.2555 - acc: 0.9031
391/390 [==============================] - 69s 177ms/step - loss: 0.0362 - acc: 0.9873 - val_loss:
0.4706 - val_acc: 0.9031
Epoch 299/300
390/390 [============================>.] - ETA: 0s - loss: 0.0328 - acc: 0.9888Epoch 1/300
10000/390
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==================================================] - 3s 343us/sample - loss: 0.2683 - acc: 0.9130
391/390 [==============================] - 69s 177ms/step - loss: 0.0327 - acc: 0.9888 - val_loss:
0.4708 - val_acc: 0.9130
Epoch 300/300
390/390 [============================>.] - ETA: 0s - loss: 0.0349 - acc: 0.9879Epoch 1/300
10000/390
[==============================================================================================
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==================================================] - 3s 345us/sample - loss: 0.2266 - acc: 0.9112
391/390 [==============================] - 69s 177ms/step - loss: 0.0349 - acc: 0.9879 - val_loss:
0.4413 - val_acc: 0.9112
```

Out[0]:

```
<tensorflow.python.keras.callbacks.History at 0x7fe40e6d7908>
```

In [0]:

```
model_3.evaluate(X_test,y_test)
```

```
10000/10000 [==============================] - 5s 540us/sample - loss: 0.4462 - acc: 0.9112
```

Out[0]:

```
[0.4461723472420126, 0.9112]
```

this model got 91.1% test accuracy