

```
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 available GPU Memory
# backend
from keras.datasets import cifar10
```

```
In [5]: import keras
# Load CIFAR10 Data
(X_train, y_train), (X_test, y_test) = keras.datasets.cifar10.load_data()
img_height, img_width, channel = X_train.shape[1], X_train.shape[2], X_train.shape[3]
```

Downloading data from <https://www.cs.toronto.edu/~kriz/cifar10.html>

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

```
In [6]: X_train = X_train.astype('float32') / 255
X_test = X_test.astype('float32') / 255
print('x_train shape:', X_train.shape)
print(X_train.shape[0], 'train samples')
print(X_test.shape[0], 'test samples')
print('y_train shape:', y_train.shape)
```

```
x_train shape: (50000, 32, 32, 3)
50000 train samples
10000 test samples
y_train shape: (50000, 1)
```

```
In [0]: num_classes = 10
# convert to one hot encoding
y_train = keras.utils.to_categorical(y_train, num_classes)
y_test = keras.utils.to_categorical(y_test, num_classes)
```

```
In [8]: X_train.shape
```

```
Out[8]: (50000, 32, 32, 3)
```

```
In [0]: from keras import models, layers
from keras.models import Model
from keras.layers import BatchNormalization, Activation, Flatten
from keras.optimizers import Adam
from keras import regularizers
```

```
In [0]: batch_size = 64
        num_classes = 10
        epochs = 200
        l = 6
        num_filter = 35
        compression = 1
```

```
In [0]: # Dense Block
def denseblock(input, num_filter = 12):
    global compression
    temp = input
    for _ in range(1):
        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)

        concat = layers.Concatenate(axis=-1)([temp, Conv2D_3_3])

        temp = concat

    return temp

## transition Block
def transition(input, num_filter = 12):
    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)
```

```

ing='same')(relu)

    avg = layers.AveragePooling2D(pool_size=(2,
2))(Conv2D_BottleNeck)
    return avg

#output layer
def output_layer(input):
    global compression
    BatchNorm = layers.BatchNormalization()(inp
ut)
    relu = layers.Activation('relu')(BatchNorm)
    AvgPooling = layers.AveragePooling2D(pool_s
ize=(2,2))(relu)
    c=layers.Conv2D(10, (1, 1), padding='valid'
)(AvgPooling)

    avg=layers.GlobalAveragePooling2D()(c)
    output=layers.Activation('softmax')(avg)

    return output

```

```

In [12]: input = layers.Input(shape=(img_height, img_wid
th, channel,))
First_Conv2D = layers.Conv2D(num_filter, (3,3),
use_bias=False ,padding='same')(input)

First_Block = denseblock(First_Conv2D, num_filt
er)
First_Transition = transition(First_Block, num_
filter)

Second_Block = denseblock(First_Transition, num
_filter)
Second_Transition = transition(Second_Block, nu

```

```
m_filter)

Third_Block = denseblock(Second_Transition, num_
_filter)
Third_Transition = transition(Third_Block, num_
filter)

Last_Block = denseblock(Third_Transition, num_
filter)
output = output_layer(Last_Block)
```

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:66: The name tf.get_default_graph is deprecated. Please use tf.compat.v1.get_default_graph instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:541: The name tf.placeholder is deprecated. Please use tf.compat.v1.placeholder instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:4432: The name tf.random_uniform is deprecated. Please use tf.random.uniform instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:190: The name tf.get_default_session is deprecated. Please use tf.compat.v1.get_default_session instead.

WARNING:tensorflow:From /usr/local/lib/python

thon3.6/dist-packages/keras/backend/tensorflow_backend.py:197: The name tf.ConfigProto is deprecated. Please use tf.compat.v1.ConfigProto instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:203: The name tf.Session is deprecated. Please use tf.compat.v1.Session instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:207: The name tf.global_variables is deprecated. Please use tf.compat.v1.global_variables instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:216: The name tf.is_variable_initialized is deprecated. Please use tf.compat.v1.is_variable_initialized instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:223: The name tf.variables_initializer is deprecated. Please use tf.compat.v1.variables_initializer instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:2041: The name tf.nn.fused_batch_norm is deprecated. Please use tf.compat.v1.nn.fused_batch_norm instead.

```
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:148: The name tf.placeholder_with_default is deprecated. Please use tf.compat.v1.placeholder_with_default instead.
```

```
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:4271: The name tf.nn.avg_pool is deprecated. Please use tf.nn.avg_pool2d instead.
```

```
In [13]: model = Model(inputs=[input], outputs=[output])
         model.summary()
```

```
Model: "model_1"
```

```
_____
_____

Layer (type)                 Output Shape
Param #          Connected to
=====
=====
=====
input_1 (InputLayer)        (None, 32, 3)
2, 32, 3)          0

_____
_____

conv2d_1 (Conv2D)           (None, 32, 35)
2, 32, 35)          945          input_1[0][0]
```

batch_normalization_1	(BatchNor	(None, 3	
2, 32, 35)	140	conv2d_1[0][0]	

activation_1	(Activation)	(None, 3	
2, 32, 35)	0	batch_normalizat	
ion_1[0][0]			

conv2d_2	(Conv2D)	(None, 3	
2, 32, 35)	11025	activation_1[0]	
[0]			

concatenate_1	(Concatenate)	(None, 3	
2, 32, 70)	0	conv2d_1[0][0]	

conv2d_2[0][0]

batch_normalization_2	(BatchNor	(None, 3	
2, 32, 70)	280	concatenate_1[0]	
[0]			

activation_2	(Activation)	(None, 3	
2, 32, 70)	0	batch_normalizat	
ion_2[0][0]			

conv2d_3 (Conv2D)	(None, 3
2, 32, 35)	22050
	activation_2[0]
[0]	

concatenate_2 (Concatenate)	(None, 3
2, 32, 105)	0
	concatenate_1[0]
[0]	

conv2d_3[0][0]

batch_normalization_3 (BatchNor	(None, 3
2, 32, 105)	420
	concatenate_2[0]
[0]	

activation_3 (Activation)	(None, 3
2, 32, 105)	0
	batch_normalizat
ion_3[0][0]	

conv2d_4 (Conv2D)	(None, 3
2, 32, 35)	33075
	activation_3[0]
[0]	

concatenate_3 (Concatenate)	(None, 3
2, 32, 140)	0
	concatenate_2[0]
[0]	

conv2d_4[0][0]

batch_normalization_4 (BatchNor (None, 3
2, 32, 140) 560 concatenate_3[0]
[0]

activation_4 (Activation) (None, 3
2, 32, 140) 0 batch_normalizat
ion_4[0][0]

conv2d_5 (Conv2D) (None, 3
2, 32, 35) 44100 activation_4[0]
[0]

concatenate_4 (Concatenate) (None, 3
2, 32, 175) 0 concatenate_3[0]
[0]

conv2d_5[0][0]

batch_normalization_5 (BatchNor (None, 3
2, 32, 175) 700 concatenate_4[0]
[0]

activation_5	(Activation)	(None, 3
2, 32, 175)	0	batch_normalizat
ion_5[0][0]		

conv2d_6	(Conv2D)	(None, 3
2, 32, 35)	55125	activation_5[0]
[0]		

concatenate_5	(Concatenate)	(None, 3
2, 32, 210)	0	concatenate_4[0]
[0]		

conv2d_6[0][0]

batch_normalization_6	(BatchNor	(None, 3
2, 32, 210)	840	concatenate_5[0]
[0]		

activation_6	(Activation)	(None, 3
2, 32, 210)	0	batch_normalizat
ion_6[0][0]		

conv2d_7	(Conv2D)	(None, 3
2, 32, 35)	66150	activation_6[0]
[0]		

concatenate_6 (Concatenate) (None, 3
2, 32, 245) 0 concatenate_5[0]
[0]

conv2d_7[0][0]

batch_normalization_7 (BatchNor (None, 3
2, 32, 245) 980 concatenate_6[0]
[0]

activation_7 (Activation) (None, 3
2, 32, 245) 0 batch_normalizat
ion_7[0][0]

conv2d_8 (Conv2D) (None, 3
2, 32, 35) 8575 activation_7[0]
[0]

average_pooling2d_1 (AveragePoo (None, 1
6, 16, 35) 0 conv2d_8[0][0]

batch_normalization_8 (BatchNor (None, 1
6, 16, 35) 140 average_pooling2

d_1[0][0]

activation_8 (Activation) (None, 1
6, 16, 35) 0 batch_normalizat
ion_8[0][0]

conv2d_9 (Conv2D) (None, 1
6, 16, 35) 11025 activation_8[0]
[0]

concatenate_7 (Concatenate) (None, 1
6, 16, 70) 0 average_pooling2
d_1[0][0]

conv2d_9[0][0]

batch_normalization_9 (BatchNor (None, 1
6, 16, 70) 280 concatenate_7[0]
[0]

activation_9 (Activation) (None, 1
6, 16, 70) 0 batch_normalizat
ion_9[0][0]

conv2d_10 (Conv2D) (None, 1
6, 16, 35) 22050 activation_9[0]
[0]

concatenate_8 (Concatenate) (None, 1
6, 16, 105) 0 concatenate_7[0]
[0]

conv2d_10[0][0]

batch_normalization_10 (BatchNo (None, 1
6, 16, 105) 420 concatenate_8[0]
[0]

activation_10 (Activation) (None, 1
6, 16, 105) 0 batch_normalizat
ion_10[0][0]

conv2d_11 (Conv2D) (None, 1
6, 16, 35) 33075 activation_10[0]
[0]

concatenate_9 (Concatenate) (None, 1
6, 16, 140) 0 concatenate_8[0]
[0]

conv2d_11[0][0]

batch_normalization_11 (BatchNo (None, 1
6, 16, 140) 560 concatenate_9[0]
[0]

activation_11 (Activation) (None, 1
6, 16, 140) 0 batch_normalizat
ion_11[0][0]

conv2d_12 (Conv2D) (None, 1
6, 16, 35) 44100 activation_11[0]
[0]

concatenate_10 (Concatenate) (None, 1
6, 16, 175) 0 concatenate_9[0]
[0]

conv2d_12[0][0]

batch_normalization_12 (BatchNo (None, 1
6, 16, 175) 700 concatenate_10
[0][0]

activation_12 (Activation) (None, 1
6, 16, 175) 0 batch_normalizat
ion_12[0][0]

conv2d_13 (Conv2D) (None, 1
6, 16, 35) 55125 activation_12[0]
[0]

concatenate_11 (Concatenate) (None, 1
6, 16, 210) 0 concatenate_10
[0][0]

conv2d_13[0][0]

batch_normalization_13 (BatchNo (None, 1
6, 16, 210) 840 concatenate_11
[0][0]

activation_13 (Activation) (None, 1
6, 16, 210) 0 batch_normalizat
ion_13[0][0]

conv2d_14 (Conv2D) (None, 1
6, 16, 35) 66150 activation_13[0]
[0]

concatenate_12 (Concatenate) (None, 1
6, 16, 245) 0 concatenate_11
[0][0]

conv2d_14[0][0]

batch_normalization_14 (BatchNo (None, 1
6, 16, 245) 980 concatenate_12
[0][0]

activation_14 (Activation) (None, 1
6, 16, 245) 0 batch_normalizat
ion_14[0][0]

conv2d_15 (Conv2D) (None, 1
6, 16, 35) 8575 activation_14[0]
[0]

average_pooling2d_2 (AveragePoo (None, 8,
8, 35) 0 conv2d_15[0][0]

batch_normalization_15 (BatchNo (None, 8,
8, 35) 140 average_pooling2d_
2[0][0]

activation_15 (Activation) (None, 8,
8, 35) 0 batch_normalizatio
n_15[0][0]

conv2d_16 (Conv2D) (None, 8,
8, 35) 11025 activation_15[0]
[0]

concatenate_13 (Concatenate) (None, 8,
8, 70) 0 average_pooling2d_
2[0][0]

conv2d_16[0][0]

batch_normalization_16 (BatchNo (None, 8,
8, 70) 280 concatenate_13[0]
[0]

activation_16 (Activation) (None, 8,
8, 70) 0 batch_normalizatio
n_16[0][0]

conv2d_17 (Conv2D) (None, 8,

8, 35) 22050 activation_16[0]
[0]

concatenate_14 (Concatenate) (None, 8,
8, 105) 0 concatenate_13[0]
[0]

conv2d_17[0][0]

batch_normalization_17 (BatchNo (None, 8,
8, 105) 420 concatenate_14[0]
[0]

activation_17 (Activation) (None, 8,
8, 105) 0 batch_normalizatio
n_17[0][0]

conv2d_18 (Conv2D) (None, 8,
8, 35) 33075 activation_17[0]
[0]

concatenate_15 (Concatenate) (None, 8,
8, 140) 0 concatenate_14[0]
[0]

conv2d_18[0][0]

batch_normalization_18 (BatchNo (None, 8,
8, 140) 560 concatenate_15[0]
[0]

activation_18 (Activation) (None, 8,
8, 140) 0 batch_normalizatio
n_18[0][0]

conv2d_19 (Conv2D) (None, 8,
8, 35) 44100 activation_18[0]
[0]

concatenate_16 (Concatenate) (None, 8,
8, 175) 0 concatenate_15[0]
[0]

conv2d_19[0][0]

batch_normalization_19 (BatchNo (None, 8,
8, 175) 700 concatenate_16[0]
[0]

activation_19 (Activation) (None, 8,

8, 175) 0 batch_normalizatio
n_19[0][0]

conv2d_20 (Conv2D) (None, 8,
8, 35) 55125 activation_19[0]
[0]

concatenate_17 (Concatenate) (None, 8,
8, 210) 0 concatenate_16[0]
[0]

conv2d_20[0][0]

batch_normalization_20 (BatchNo (None, 8,
8, 210) 840 concatenate_17[0]
[0]

activation_20 (Activation) (None, 8,
8, 210) 0 batch_normalizatio
n_20[0][0]

conv2d_21 (Conv2D) (None, 8,
8, 35) 66150 activation_20[0]
[0]

concatenate_18 (Concatenate) (None, 8,
8, 245) 0 concatenate_17[0]
[0]

conv2d_21[0][0]

batch_normalization_21 (BatchNo (None, 8,
8, 245) 980 concatenate_18[0]
[0]

activation_21 (Activation) (None, 8,
8, 245) 0 batch_normalizatio
n_21[0][0]

conv2d_22 (Conv2D) (None, 8,
8, 35) 8575 activation_21[0]
[0]

average_pooling2d_3 (AveragePoo (None, 4,
4, 35) 0 conv2d_22[0][0]

batch_normalization_22 (BatchNo (None, 4,
4, 35) 140 average_pooling2d_
3[0][0]

activation_22	(Activation)	(None, 4,
4, 35)	0	batch_normalizatio
n_22[0][0]		

conv2d_23	(Conv2D)	(None, 4,
4, 35)	11025	activation_22[0]
[0]		

concatenate_19	(Concatenate)	(None, 4,
4, 70)	0	average_pooling2d_
3[0][0]		

conv2d_23[0][0]

batch_normalization_23	(BatchNo	(None, 4,
4, 70)	280	concatenate_19[0]
[0]		

activation_23	(Activation)	(None, 4,
4, 70)	0	batch_normalizatio
n_23[0][0]		

conv2d_24	(Conv2D)	(None, 4,
4, 35)	22050	activation_23[0]

[0]

concatenate_20 (Concatenate) (None, 4,
4, 105) 0 concatenate_19[0]
[0]

conv2d_24[0][0]

batch_normalization_24 (BatchNo (None, 4,
4, 105) 420 concatenate_20[0]
[0]

activation_24 (Activation) (None, 4,
4, 105) 0 batch_normalizatio
n_24[0][0]

conv2d_25 (Conv2D) (None, 4,
4, 35) 33075 activation_24[0]
[0]

concatenate_21 (Concatenate) (None, 4,
4, 140) 0 concatenate_20[0]
[0]

conv2d_25[0][0]

batch_normalization_25 (BatchNo (None, 4,
4, 140) 560 concatenate_21[0]
[0]

activation_25 (Activation) (None, 4,
4, 140) 0 batch_normalizatio
n_25[0][0]

conv2d_26 (Conv2D) (None, 4,
4, 35) 44100 activation_25[0]
[0]

concatenate_22 (Concatenate) (None, 4,
4, 175) 0 concatenate_21[0]
[0]

conv2d_26[0][0]

batch_normalization_26 (BatchNo (None, 4,
4, 175) 700 concatenate_22[0]
[0]

activation_26 (Activation) (None, 4,
4, 175) 0 batch_normalizatio

n_26[0][0]

conv2d_27 (Conv2D) (None, 4,
4, 35) 55125 activation_26[0]
[0]

concatenate_23 (Concatenate) (None, 4,
4, 210) 0 concatenate_22[0]
[0]

conv2d_27[0][0]

batch_normalization_27 (BatchNo (None, 4,
4, 210) 840 concatenate_23[0]
[0]

activation_27 (Activation) (None, 4,
4, 210) 0 batch_normalizatio
n_27[0][0]

conv2d_28 (Conv2D) (None, 4,
4, 35) 66150 activation_27[0]
[0]

concatenate_24 (Concatenate) (None, 4,
4, 245) 0 concatenate_23[0]
[0]

conv2d_28[0][0]

batch_normalization_28 (BatchNo (None, 4,
4, 245) 980 concatenate_24[0]
[0]

activation_28 (Activation) (None, 4,
4, 245) 0 batch_normalizatio
n_28[0][0]

average_pooling2d_4 (AveragePoo (None, 2,
2, 245) 0 activation_28[0]
[0]

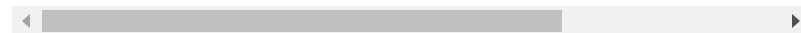
conv2d_29 (Conv2D) (None, 2,
2, 10) 2460 average_pooling2d_
4[0][0]

global_average_pooling2d_1 (Glo (None, 1
0) 0 conv2d_29[0][0]

```

activation_29 (Activation)      (None, 1
0)                               0          global_average_p
ooling2d_1[0][0]
=====
=====
=====
Total params: 970,910
Trainable params: 963,070
Non-trainable params: 7,840

```



```

In [14]: # determine Loss function and Optimizer
model.compile(loss='categorical_crossentropy',
              optimizer=Adam(),
              metrics=['accuracy'])

```

```

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/optimizers.py:793: The name tf.train.Optimizer is deprecated. Please use tf.compat.v1.train.Optimizer instead.

```

```

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:3576: The name tf.log is deprecated. Please use tf.math.log instead.

```

```

In [0]: from keras.callbacks import ModelCheckpoint

filepath="weights-improve-{epoch:02d}-{val_ac

```

```
c:.2f}.hdf5"
checkpoint = ModelCheckpoint(filepath, monitor=
'val_acc', verbose=1, save_best_only=True, mode
='max')
callbacks_list = [checkpoint]
```

Image Agumentation

```
In [0]: from keras.preprocessing.image import ImageData
Generator
datagen = ImageDataGenerator(

    rotation_range=30,  # randomly rotate i
    mages in the range (deg 0 to 180)
    width_shift_range=0.1,  # randomly shif
    t images horizontally
    height_shift_range=0.1,  # randomly shi
    ft images vertically
    horizontal_flip=True,  # randomly flip
    images
    zoom_range=0.10
    ) #
```

```
In [17]: datagen.fit(X_train)

    # fit the model on the batches generated by
    datagen.flow()
history=model.fit_generator(datagen.flow(X_train,
y_train, batch_size=batch_size),
                           steps_per_epoch=X_train
                           .shape[0] // batch_size,
                           validation_data=(X_test
, y_test),
                           epochs=200, verbose=1,
```

```
workers=4,  
  
                                callbacks=callbacks_list  
t  
  
                                )
```

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

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:1033: The name tf.assign_add is deprecated. Please use tf.compat.v1.assign_add instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_backend.py:1020: The name tf.assign is deprecated. Please use tf.compat.v1.assign instead.

Epoch 1/200

781/781 [=====]
- 85s 109ms/step - loss: 1.4650 - acc: 0.4668 - val_loss: 1.7770 - val_acc: 0.4682

Epoch 00001: val_acc improved from -inf to 0.46820, saving model to weights-improvement-01-0.47.hdf5

Epoch 2/200

781/781 [=====]

- 73s 93ms/step - loss: 1.0677 - acc: 0.6
201 - val_loss: 1.2918 - val_acc: 0.5802

Epoch 00002: val_acc improved from 0.4682
0 to 0.58020, saving model to weights-im-
rove-02-0.58.hdf5

Epoch 3/200

781/781 [=====]
- 73s 93ms/step - loss: 0.8965 - acc: 0.6
861 - val_loss: 1.6210 - val_acc: 0.5194

Epoch 00003: val_acc did not improve from
0.58020

Epoch 4/200

781/781 [=====]
- 72s 93ms/step - loss: 0.7890 - acc: 0.7
240 - val_loss: 1.0675 - val_acc: 0.6643

Epoch 00004: val_acc improved from 0.5802
0 to 0.66430, saving model to weights-im-
rove-04-0.66.hdf5

Epoch 5/200

781/781 [=====]
- 71s 91ms/step - loss: 0.7214 - acc: 0.7
479 - val_loss: 0.9055 - val_acc: 0.6996

Epoch 00005: val_acc improved from 0.6643
0 to 0.69960, saving model to weights-im-
rove-05-0.70.hdf5

Epoch 6/200

781/781 [=====]
- 72s 92ms/step - loss: 0.6597 - acc: 0.7
687 - val_loss: 0.7927 - val_acc: 0.7316

Epoch 00006: val_acc improved from 0.6996
0 to 0.73160, saving model to weights-im-

rove-06-0.73.hdf5

Epoch 7/200

781/781 [=====]
- 71s 91ms/step - loss: 0.6207 - acc: 0.7
836 - val_loss: 0.8865 - val_acc: 0.7121

Epoch 00007: val_acc did not improve from
0.73160

Epoch 8/200

781/781 [=====]
- 69s 89ms/step - loss: 0.5835 - acc: 0.7
959 - val_loss: 0.6103 - val_acc: 0.7930

Epoch 00008: val_acc improved from 0.7316
0 to 0.79300, saving model to weights-imp
rove-08-0.79.hdf5

Epoch 9/200

781/781 [=====]
- 70s 90ms/step - loss: 0.5512 - acc: 0.8
080 - val_loss: 0.7761 - val_acc: 0.7463

Epoch 00009: val_acc did not improve from
0.79300

Epoch 10/200

781/781 [=====]
- 72s 92ms/step - loss: 0.5251 - acc: 0.8
186 - val_loss: 0.7951 - val_acc: 0.7502

Epoch 00010: val_acc did not improve from
0.79300

Epoch 11/200

781/781 [=====]
- 72s 92ms/step - loss: 0.5006 - acc: 0.8
271 - val_loss: 0.8520 - val_acc: 0.7506

Epoch 00011: val_acc did not improve from


```
0.79300
Epoch 12/200
781/781 [=====]
- 71s 91ms/step - loss: 0.4744 - acc: 0.8
339 - val_loss: 0.6411 - val_acc: 0.7911

Epoch 00012: val_acc did not improve from
0.79300
Epoch 13/200
781/781 [=====]
- 72s 92ms/step - loss: 0.4572 - acc: 0.8
420 - val_loss: 0.5111 - val_acc: 0.8277

Epoch 00013: val_acc improved from 0.7930
0 to 0.82770, saving model to weights-improvement-13-0.83.hdf5
Epoch 14/200
781/781 [=====]
- 72s 92ms/step - loss: 0.4343 - acc: 0.8
494 - val_loss: 0.6493 - val_acc: 0.7958

Epoch 00014: val_acc did not improve from
0.82770
Epoch 15/200
781/781 [=====]
- 71s 91ms/step - loss: 0.4190 - acc: 0.8
537 - val_loss: 0.5020 - val_acc: 0.8371

Epoch 00015: val_acc improved from 0.8277
0 to 0.83710, saving model to weights-improvement-15-0.84.hdf5
Epoch 16/200
781/781 [=====]
- 72s 92ms/step - loss: 0.4036 - acc: 0.8
597 - val_loss: 0.5840 - val_acc: 0.8061
```

Epoch 00016: val_acc did not improve from
0.83710

Epoch 17/200

781/781 [=====]
- 71s 91ms/step - loss: 0.3909 - acc: 0.8
654 - val_loss: 0.6964 - val_acc: 0.7841

Epoch 00017: val_acc did not improve from
0.83710

Epoch 18/200

781/781 [=====]
- 71s 91ms/step - loss: 0.3800 - acc: 0.8
680 - val_loss: 0.5699 - val_acc: 0.8153

Epoch 00018: val_acc did not improve from
0.83710

Epoch 19/200

781/781 [=====]
- 71s 91ms/step - loss: 0.3657 - acc: 0.8
724 - val_loss: 0.4904 - val_acc: 0.8396

Epoch 00019: val_acc improved from 0.8371
0 to 0.83960, saving model to weights-improvement-19-0.84.hdf5

Epoch 20/200

781/781 [=====]
- 72s 92ms/step - loss: 0.3562 - acc: 0.8
760 - val_loss: 0.5620 - val_acc: 0.8196

Epoch 00020: val_acc did not improve from
0.83960

Epoch 21/200

781/781 [=====]
- 71s 91ms/step - loss: 0.3448 - acc: 0.8
806 - val_loss: 0.5586 - val_acc: 0.8221

Epoch 00021: val_acc did not improve from 0.83960

Epoch 22/200

781/781 [=====]
- 71s 91ms/step - loss: 0.3360 - acc: 0.8829 - val_loss: 0.6034 - val_acc: 0.8162

Epoch 00022: val_acc did not improve from 0.83960

Epoch 23/200

781/781 [=====]
- 71s 91ms/step - loss: 0.3247 - acc: 0.8855 - val_loss: 0.4704 - val_acc: 0.8457

Epoch 00023: val_acc improved from 0.83960 to 0.84570, saving model to weights-improved-23-0.85.hdf5

Epoch 24/200

781/781 [=====]
- 71s 91ms/step - loss: 0.3177 - acc: 0.8891 - val_loss: 0.4120 - val_acc: 0.8627

Epoch 00024: val_acc improved from 0.84570 to 0.86270, saving model to weights-improved-24-0.86.hdf5

Epoch 25/200

781/781 [=====]
- 71s 91ms/step - loss: 0.3090 - acc: 0.8930 - val_loss: 0.5369 - val_acc: 0.8311

Epoch 00025: val_acc did not improve from 0.86270

Epoch 26/200

781/781 [=====]
- 71s 91ms/step - loss: 0.2989 - acc: 0.8973 - val_loss: 0.4237 - val_acc: 0.8645

Epoch 00026: val_acc improved from 0.8627
0 to 0.86450, saving model to weights-im-
rove-26-0.86.hdf5

Epoch 27/200

781/781 [=====]
- 71s 90ms/step - loss: 0.2953 - acc: 0.8
952 - val_loss: 0.4423 - val_acc: 0.8588

Epoch 00027: val_acc did not improve from
0.86450

Epoch 28/200

781/781 [=====]
- 71s 91ms/step - loss: 0.2894 - acc: 0.8
978 - val_loss: 0.4422 - val_acc: 0.8608

Epoch 00028: val_acc did not improve from
0.86450

Epoch 29/200

781/781 [=====]
- 72s 92ms/step - loss: 0.2809 - acc: 0.9
022 - val_loss: 0.4562 - val_acc: 0.8596

Epoch 00029: val_acc did not improve from
0.86450

Epoch 30/200

781/781 [=====]
- 71s 91ms/step - loss: 0.2741 - acc: 0.9
039 - val_loss: 0.5129 - val_acc: 0.8501

Epoch 00030: val_acc did not improve from
0.86450

Epoch 31/200

781/781 [=====]
- 72s 92ms/step - loss: 0.2700 - acc: 0.9
062 - val_loss: 0.5362 - val_acc: 0.8367

Epoch 00031: val_acc did not improve from 0.86450

Epoch 32/200

781/781 [=====]
- 72s 92ms/step - loss: 0.2619 - acc: 0.9079 - val_loss: 0.4369 - val_acc: 0.8658

Epoch 00032: val_acc improved from 0.86450 to 0.86580, saving model to weights-improve-32-0.87.hdf5

Epoch 33/200

781/781 [=====]
- 73s 93ms/step - loss: 0.2594 - acc: 0.9097 - val_loss: 0.4146 - val_acc: 0.8710

Epoch 00033: val_acc improved from 0.86580 to 0.87100, saving model to weights-improve-33-0.87.hdf5

Epoch 34/200

781/781 [=====]
- 72s 92ms/step - loss: 0.2500 - acc: 0.9116 - val_loss: 0.4081 - val_acc: 0.8699

Epoch 00034: val_acc did not improve from 0.87100

Epoch 35/200

781/781 [=====]
- 72s 92ms/step - loss: 0.2490 - acc: 0.9136 - val_loss: 0.4596 - val_acc: 0.8634

Epoch 00035: val_acc did not improve from 0.87100

Epoch 36/200

781/781 [=====]
- 73s 93ms/step - loss: 0.2426 - acc: 0.9

136 - val_loss: 0.3783 - val_acc: 0.8778

Epoch 00036: val_acc improved from 0.8710
0 to 0.87780, saving model to weights-im-
rove-36-0.88.hdf5

Epoch 37/200

781/781 [=====]
- 72s 93ms/step - loss: 0.2346 - acc: 0.9
169 - val_loss: 0.4540 - val_acc: 0.8626

Epoch 00037: val_acc did not improve from
0.87780

Epoch 38/200

781/781 [=====]
- 72s 93ms/step - loss: 0.2329 - acc: 0.9
180 - val_loss: 0.4846 - val_acc: 0.8564

Epoch 00038: val_acc did not improve from
0.87780

Epoch 39/200

781/781 [=====]
- 72s 93ms/step - loss: 0.2256 - acc: 0.9
210 - val_loss: 0.4827 - val_acc: 0.8561

Epoch 00039: val_acc did not improve from
0.87780

Epoch 40/200

781/781 [=====]
- 72s 92ms/step - loss: 0.2246 - acc: 0.9
203 - val_loss: 0.4176 - val_acc: 0.8712

Epoch 00040: val_acc did not improve from
0.87780

Epoch 41/200

781/781 [=====]
- 72s 92ms/step - loss: 0.2204 - acc: 0.9

218 - val_loss: 0.4657 - val_acc: 0.8689

Epoch 00041: val_acc did not improve from 0.87780

Epoch 42/200

781/781 [=====]
- 71s 91ms/step - loss: 0.2143 - acc: 0.9
247 - val_loss: 0.3917 - val_acc: 0.8779

Epoch 00042: val_acc improved from 0.87780 to 0.87790, saving model to weights-improve-42-0.88.hdf5

Epoch 43/200

781/781 [=====]
- 70s 90ms/step - loss: 0.2140 - acc: 0.9
246 - val_loss: 0.3905 - val_acc: 0.8817

Epoch 00043: val_acc improved from 0.87790 to 0.88170, saving model to weights-improve-43-0.88.hdf5

Epoch 44/200

781/781 [=====]
- 70s 89ms/step - loss: 0.2059 - acc: 0.9
270 - val_loss: 0.3617 - val_acc: 0.8922

Epoch 00044: val_acc improved from 0.88170 to 0.89220, saving model to weights-improve-44-0.89.hdf5

Epoch 45/200

781/781 [=====]
- 71s 90ms/step - loss: 0.2044 - acc: 0.9
272 - val_loss: 0.4745 - val_acc: 0.8631

Epoch 00045: val_acc did not improve from 0.89220

Epoch 46/200

781/781 [=====]
- 70s 89ms/step - loss: 0.1988 - acc: 0.9
303 - val_loss: 0.3758 - val_acc: 0.8855

Epoch 00046: val_acc did not improve from
0.89220

Epoch 47/200

781/781 [=====]
- 70s 89ms/step - loss: 0.1979 - acc: 0.9
293 - val_loss: 0.4197 - val_acc: 0.8750

Epoch 00047: val_acc did not improve from
0.89220

Epoch 48/200

781/781 [=====]
- 70s 89ms/step - loss: 0.1948 - acc: 0.9
312 - val_loss: 0.3385 - val_acc: 0.8962

Epoch 00048: val_acc improved from 0.8922
0 to 0.89620, saving model to weights-improvement-48-0.90.hdf5

Epoch 49/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1891 - acc: 0.9
332 - val_loss: 0.3587 - val_acc: 0.8934

Epoch 00049: val_acc did not improve from
0.89620

Epoch 50/200

781/781 [=====]
- 70s 89ms/step - loss: 0.1888 - acc: 0.9
320 - val_loss: 0.5795 - val_acc: 0.8473

Epoch 00050: val_acc did not improve from
0.89620

Epoch 51/200

781/781 [=====]
- 69s 88ms/step - loss: 0.1865 - acc: 0.9
333 - val_loss: 0.3761 - val_acc: 0.8861

Epoch 00051: val_acc did not improve from
0.89620

Epoch 52/200

781/781 [=====]
- 69s 89ms/step - loss: 0.1795 - acc: 0.9
364 - val_loss: 0.3551 - val_acc: 0.8948

Epoch 00052: val_acc did not improve from
0.89620

Epoch 53/200

781/781 [=====]
- 70s 89ms/step - loss: 0.1771 - acc: 0.9
366 - val_loss: 0.4494 - val_acc: 0.8688

Epoch 00053: val_acc did not improve from
0.89620

Epoch 54/200

781/781 [=====]
- 69s 88ms/step - loss: 0.1790 - acc: 0.9
365 - val_loss: 0.3541 - val_acc: 0.8936

Epoch 00054: val_acc did not improve from
0.89620

Epoch 55/200

781/781 [=====]
- 70s 89ms/step - loss: 0.1736 - acc: 0.9
389 - val_loss: 0.3756 - val_acc: 0.8896

Epoch 00055: val_acc did not improve from
0.89620

Epoch 56/200

781/781 [=====]

- 69s 88ms/step - loss: 0.1669 - acc: 0.9412 - val_loss: 0.3674 - val_acc: 0.8931

Epoch 00056: val_acc did not improve from 0.89620

Epoch 57/200

781/781 [=====]
- 70s 89ms/step - loss: 0.1684 - acc: 0.9412 - val_loss: 0.4162 - val_acc: 0.8785

Epoch 00057: val_acc did not improve from 0.89620

Epoch 58/200

781/781 [=====]
- 72s 92ms/step - loss: 0.1648 - acc: 0.9413 - val_loss: 0.3354 - val_acc: 0.8987

Epoch 00058: val_acc improved from 0.89620 to 0.89870, saving model to weights-improve-58-0.90.hdf5

Epoch 59/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1692 - acc: 0.9396 - val_loss: 0.3796 - val_acc: 0.8892

Epoch 00059: val_acc did not improve from 0.89870

Epoch 60/200

781/781 [=====]
- 71s 91ms/step - loss: 0.1561 - acc: 0.9447 - val_loss: 0.3981 - val_acc: 0.8839

Epoch 00060: val_acc did not improve from 0.89870

Epoch 61/200

781/781 [=====]

- 70s 90ms/step - loss: 0.1652 - acc: 0.9
420 - val_loss: 0.3484 - val_acc: 0.8978

Epoch 00061: val_acc did not improve from
0.89870

Epoch 62/200

781/781 [=====]
- 69s 89ms/step - loss: 0.1544 - acc: 0.9
455 - val_loss: 0.4246 - val_acc: 0.8781

Epoch 00062: val_acc did not improve from
0.89870

Epoch 63/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1536 - acc: 0.9
457 - val_loss: 0.4277 - val_acc: 0.8807

Epoch 00063: val_acc did not improve from
0.89870

Epoch 64/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1511 - acc: 0.9
478 - val_loss: 0.4667 - val_acc: 0.8726

Epoch 00064: val_acc did not improve from
0.89870

Epoch 65/200

781/781 [=====]
- 72s 92ms/step - loss: 0.1520 - acc: 0.9
457 - val_loss: 0.4085 - val_acc: 0.8843

Epoch 00065: val_acc did not improve from
0.89870

Epoch 66/200

781/781 [=====]
- 71s 91ms/step - loss: 0.1480 - acc: 0.9

483 - val_loss: 0.3839 - val_acc: 0.8911

Epoch 00066: val_acc did not improve from 0.89870

Epoch 67/200

781/781 [=====]
- 71s 91ms/step - loss: 0.1444 - acc: 0.9
480 - val_loss: 0.3756 - val_acc: 0.8914

Epoch 00067: val_acc did not improve from 0.89870

Epoch 68/200

781/781 [=====]
- 71s 91ms/step - loss: 0.1444 - acc: 0.9
486 - val_loss: 0.3299 - val_acc: 0.9022

Epoch 00068: val_acc improved from 0.89870 to 0.90220, saving model to weights-improved-68-0.90.hdf5

Epoch 69/200

781/781 [=====]
- 71s 91ms/step - loss: 0.1437 - acc: 0.9
487 - val_loss: 0.3803 - val_acc: 0.8917

Epoch 00069: val_acc did not improve from 0.90220

Epoch 70/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1427 - acc: 0.9
496 - val_loss: 0.4054 - val_acc: 0.8884

Epoch 00070: val_acc did not improve from 0.90220

Epoch 71/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1423 - acc: 0.9

488 - val_loss: 0.3723 - val_acc: 0.8938

Epoch 00071: val_acc did not improve from
0.90220

Epoch 72/200

781/781 [=====]
- 71s 91ms/step - loss: 0.1378 - acc: 0.9
510 - val_loss: 0.3942 - val_acc: 0.8909

Epoch 00072: val_acc did not improve from
0.90220

Epoch 73/200

781/781 [=====]
- 71s 90ms/step - loss: 0.1350 - acc: 0.9
513 - val_loss: 0.3606 - val_acc: 0.8959

Epoch 00073: val_acc did not improve from
0.90220

Epoch 74/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1328 - acc: 0.9
528 - val_loss: 0.4207 - val_acc: 0.8870

Epoch 00074: val_acc did not improve from
0.90220

Epoch 75/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1338 - acc: 0.9
524 - val_loss: 0.3921 - val_acc: 0.8907

Epoch 00075: val_acc did not improve from
0.90220

Epoch 76/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1320 - acc: 0.9
523 - val_loss: 0.3740 - val_acc: 0.8953

Epoch 00076: val_acc did not improve from
0.90220

Epoch 77/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1306 - acc: 0.9
542 - val_loss: 0.3914 - val_acc: 0.8917

Epoch 00077: val_acc did not improve from
0.90220

Epoch 78/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1299 - acc: 0.9
540 - val_loss: 0.3516 - val_acc: 0.9015

Epoch 00078: val_acc did not improve from
0.90220

Epoch 79/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1249 - acc: 0.9
556 - val_loss: 0.4577 - val_acc: 0.8819

Epoch 00079: val_acc did not improve from
0.90220

Epoch 80/200

781/781 [=====]
- 70s 90ms/step - loss: 0.1241 - acc: 0.9
554 - val_loss: 0.3700 - val_acc: 0.8980

Epoch 00080: val_acc did not improve from
0.90220

Epoch 81/200

781/781 [=====]
- 69s 89ms/step - loss: 0.1263 - acc: 0.9
553 - val_loss: 0.4214 - val_acc: 0.8823

Epoch 00081: val_acc did not improve from
0.90220

Epoch 82/200

781/781 [=====]
- 72s 92ms/step - loss: 0.1223 - acc: 0.9
563 - val_loss: 0.4953 - val_acc: 0.8748

Epoch 00082: val_acc did not improve from
0.90220

Epoch 83/200

781/781 [=====]
- 72s 92ms/step - loss: 0.1245 - acc: 0.9
555 - val_loss: 0.4062 - val_acc: 0.8916

Epoch 00083: val_acc did not improve from
0.90220

Epoch 84/200

781/781 [=====]
- 72s 92ms/step - loss: 0.1163 - acc: 0.9
589 - val_loss: 0.7051 - val_acc: 0.8495

Epoch 00084: val_acc did not improve from
0.90220

Epoch 85/200

781/781 [=====]
- 72s 92ms/step - loss: 0.1162 - acc: 0.9
592 - val_loss: 0.4217 - val_acc: 0.8888

Epoch 00085: val_acc did not improve from
0.90220

Epoch 86/200

781/781 [=====]
- 73s 93ms/step - loss: 0.1207 - acc: 0.9
562 - val_loss: 0.4531 - val_acc: 0.8843

Epoch 00086: val_acc did not improve from

```
0.90220
Epoch 87/200
781/781 [=====]
- 72s 92ms/step - loss: 0.1217 - acc: 0.9
568 - val_loss: 0.3678 - val_acc: 0.9030

Epoch 00087: val_acc improved from 0.9022
0 to 0.90300, saving model to weights-improve-87-0.90.hdf5
Epoch 88/200
781/781 [=====]
- 72s 92ms/step - loss: 0.1153 - acc: 0.9
589 - val_loss: 0.4884 - val_acc: 0.8754

Epoch 00088: val_acc did not improve from
0.90300
Epoch 89/200
781/781 [=====]
- 72s 93ms/step - loss: 0.1126 - acc: 0.9
596 - val_loss: 0.3771 - val_acc: 0.8979

Epoch 00089: val_acc did not improve from
0.90300
Epoch 90/200
781/781 [=====]
- 72s 92ms/step - loss: 0.1135 - acc: 0.9
599 - val_loss: 0.4525 - val_acc: 0.8883

Epoch 00090: val_acc did not improve from
0.90300
Epoch 91/200
781/781 [=====]
- 73s 94ms/step - loss: 0.1057 - acc: 0.9
625 - val_loss: 0.4594 - val_acc: 0.8883

Epoch 00091: val_acc did not improve from
```



```
0.90300
Epoch 92/200
781/781 [=====]
- 71s 91ms/step - loss: 0.1137 - acc: 0.9
592 - val_loss: 0.5165 - val_acc: 0.8708

Epoch 00092: val_acc did not improve from
0.90300
Epoch 93/200
781/781 [=====]
- 71s 91ms/step - loss: 0.1110 - acc: 0.9
597 - val_loss: 0.3581 - val_acc: 0.9010

Epoch 00093: val_acc did not improve from
0.90300
Epoch 94/200
781/781 [=====]
- 70s 90ms/step - loss: 0.1074 - acc: 0.9
626 - val_loss: 0.3684 - val_acc: 0.8990

Epoch 00094: val_acc did not improve from
0.90300
Epoch 95/200
781/781 [=====]
- 70s 90ms/step - loss: 0.1061 - acc: 0.9
613 - val_loss: 0.4447 - val_acc: 0.8868

Epoch 00095: val_acc did not improve from
0.90300
Epoch 96/200
781/781 [=====]
- 70s 90ms/step - loss: 0.1067 - acc: 0.9
619 - val_loss: 0.3453 - val_acc: 0.9062

Epoch 00096: val_acc improved from 0.9030
0 to 0.90620, saving model to weights-imp
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rove-96-0.91.hdf5
Epoch 97/200
781/781 [=====]
- 71s 90ms/step - loss: 0.1032 - acc: 0.9
643 - val_loss: 0.3922 - val_acc: 0.8991

Epoch 00097: val_acc did not improve from
0.90620
Epoch 98/200
781/781 [=====]
- 71s 90ms/step - loss: 0.1073 - acc: 0.9
619 - val_loss: 0.3024 - val_acc: 0.9147

Epoch 00098: val_acc improved from 0.9062
0 to 0.91470, saving model to weights-imp
rove-98-0.91.hdf5
Epoch 99/200
781/781 [=====]
- 71s 90ms/step - loss: 0.1012 - acc: 0.9
641 - val_loss: 0.4072 - val_acc: 0.8966

Epoch 00099: val_acc did not improve from
0.91470
Epoch 100/200
781/781 [=====]
- 70s 89ms/step - loss: 0.1070 - acc: 0.9
618 - val_loss: 0.5053 - val_acc: 0.8758

Epoch 00100: val_acc did not improve from
0.91470
Epoch 101/200
781/781 [=====]
- 71s 91ms/step - loss: 0.1018 - acc: 0.9
641 - val_loss: 0.5229 - val_acc: 0.8795

Epoch 00101: val_acc did not improve from
```

0.91470
Epoch 102/200
781/781 [=====]
- 71s 91ms/step - loss: 0.1013 - acc: 0.9
639 - val_loss: 0.4354 - val_acc: 0.8909

Epoch 00102: val_acc did not improve from
0.91470
Epoch 103/200
781/781 [=====]
- 71s 91ms/step - loss: 0.1016 - acc: 0.9
639 - val_loss: 0.3521 - val_acc: 0.9054

Epoch 00103: val_acc did not improve from
0.91470
Epoch 104/200
781/781 [=====]
- 72s 92ms/step - loss: 0.0989 - acc: 0.9
652 - val_loss: 0.4028 - val_acc: 0.8941

Epoch 00104: val_acc did not improve from
0.91470
Epoch 105/200
781/781 [=====]
- 71s 91ms/step - loss: 0.1009 - acc: 0.9
639 - val_loss: 0.3638 - val_acc: 0.9032

Epoch 00105: val_acc did not improve from
0.91470
Epoch 106/200
781/781 [=====]
- 72s 92ms/step - loss: 0.0943 - acc: 0.9
677 - val_loss: 0.4666 - val_acc: 0.8862

Epoch 00106: val_acc did not improve from
0.91470

Epoch 107/200
781/781 [=====]
- 72s 92ms/step - loss: 0.0935 - acc: 0.9
662 - val_loss: 0.3219 - val_acc: 0.9137

Epoch 00107: val_acc did not improve from
0.91470
Epoch 108/200
781/781 [=====]
- 72s 93ms/step - loss: 0.0962 - acc: 0.9
664 - val_loss: 0.3731 - val_acc: 0.9048

Epoch 00108: val_acc did not improve from
0.91470
Epoch 109/200
781/781 [=====]
- 72s 92ms/step - loss: 0.0963 - acc: 0.9
655 - val_loss: 0.3692 - val_acc: 0.9033

Epoch 00109: val_acc did not improve from
0.91470
Epoch 110/200
781/781 [=====]
- 71s 91ms/step - loss: 0.0922 - acc: 0.9
672 - val_loss: 0.3888 - val_acc: 0.8999

Epoch 00110: val_acc did not improve from
0.91470
Epoch 111/200
781/781 [=====]
- 71s 91ms/step - loss: 0.0915 - acc: 0.9
678 - val_loss: 0.4625 - val_acc: 0.8900

Epoch 00111: val_acc did not improve from
0.91470
Epoch 112/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0951 - acc: 0.9
673 - val_loss: 0.4160 - val_acc: 0.8976

Epoch 00112: val_acc did not improve from
0.91470

Epoch 113/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0917 - acc: 0.9
677 - val_loss: 0.3718 - val_acc: 0.9077

Epoch 00113: val_acc did not improve from
0.91470

Epoch 114/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0881 - acc: 0.9
683 - val_loss: 0.4272 - val_acc: 0.8972

Epoch 00114: val_acc did not improve from
0.91470

Epoch 115/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0919 - acc: 0.9
673 - val_loss: 0.4102 - val_acc: 0.8942

Epoch 00115: val_acc did not improve from
0.91470

Epoch 116/200

781/781 [=====]
- 72s 93ms/step - loss: 0.0895 - acc: 0.9
690 - val_loss: 0.4212 - val_acc: 0.8978

Epoch 00116: val_acc did not improve from
0.91470

Epoch 117/200

781/781 [=====]

- 72s 92ms/step - loss: 0.0897 - acc: 0.9
681 - val_loss: 0.4187 - val_acc: 0.8966

Epoch 00117: val_acc did not improve from
0.91470

Epoch 118/200

781/781 [=====]
- 72s 93ms/step - loss: 0.0906 - acc: 0.9
678 - val_loss: 0.5544 - val_acc: 0.8755

Epoch 00118: val_acc did not improve from
0.91470

Epoch 119/200

781/781 [=====]
- 74s 95ms/step - loss: 0.0849 - acc: 0.9
699 - val_loss: 0.4388 - val_acc: 0.8952

Epoch 00119: val_acc did not improve from
0.91470

Epoch 120/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0883 - acc: 0.9
689 - val_loss: 0.4108 - val_acc: 0.8979

Epoch 00120: val_acc did not improve from
0.91470

Epoch 121/200

781/781 [=====]
- 72s 93ms/step - loss: 0.0819 - acc: 0.9
705 - val_loss: 0.4151 - val_acc: 0.9012

Epoch 00121: val_acc did not improve from
0.91470

Epoch 122/200

781/781 [=====]
- 72s 93ms/step - loss: 0.0900 - acc: 0.9

675 - val_loss: 0.3731 - val_acc: 0.9024

Epoch 00122: val_acc did not improve from
0.91470

Epoch 123/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0861 - acc: 0.9
697 - val_loss: 0.3805 - val_acc: 0.9087

Epoch 00123: val_acc did not improve from
0.91470

Epoch 124/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0839 - acc: 0.9
705 - val_loss: 0.4792 - val_acc: 0.8907

Epoch 00124: val_acc did not improve from
0.91470

Epoch 125/200

781/781 [=====]
- 71s 90ms/step - loss: 0.0844 - acc: 0.9
695 - val_loss: 0.4788 - val_acc: 0.8884

Epoch 00125: val_acc did not improve from
0.91470

Epoch 126/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0804 - acc: 0.9
710 - val_loss: 0.4039 - val_acc: 0.8977

Epoch 00126: val_acc did not improve from
0.91470

Epoch 127/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0850 - acc: 0.9
701 - val_loss: 0.4183 - val_acc: 0.8983

Epoch 00127: val_acc did not improve from
0.91470

Epoch 128/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0821 - acc: 0.9
708 - val_loss: 0.4265 - val_acc: 0.8967

Epoch 00128: val_acc did not improve from
0.91470

Epoch 129/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0796 - acc: 0.9
720 - val_loss: 0.4125 - val_acc: 0.9023

Epoch 00129: val_acc did not improve from
0.91470

Epoch 130/200

781/781 [=====]
- 70s 90ms/step - loss: 0.0825 - acc: 0.9
708 - val_loss: 0.4129 - val_acc: 0.9010

Epoch 00130: val_acc did not improve from
0.91470

Epoch 131/200

781/781 [=====]
- 70s 90ms/step - loss: 0.0817 - acc: 0.9
711 - val_loss: 0.4421 - val_acc: 0.8947

Epoch 00131: val_acc did not improve from
0.91470

Epoch 132/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0794 - acc: 0.9
715 - val_loss: 0.4449 - val_acc: 0.8956

Epoch 00132: val_acc did not improve from
0.91470

Epoch 133/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0769 - acc: 0.9
722 - val_loss: 0.3812 - val_acc: 0.9031

Epoch 00133: val_acc did not improve from
0.91470

Epoch 134/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0783 - acc: 0.9
721 - val_loss: 0.3701 - val_acc: 0.9090

Epoch 00134: val_acc did not improve from
0.91470

Epoch 135/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0777 - acc: 0.9
723 - val_loss: 0.4446 - val_acc: 0.8966

Epoch 00135: val_acc did not improve from
0.91470

Epoch 136/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0802 - acc: 0.9
720 - val_loss: 0.4079 - val_acc: 0.9019

Epoch 00136: val_acc did not improve from
0.91470

Epoch 137/200

781/781 [=====]
- 72s 93ms/step - loss: 0.0762 - acc: 0.9
727 - val_loss: 0.4002 - val_acc: 0.9083

Epoch 00137: val_acc did not improve from

0.91470
Epoch 138/200
781/781 [=====]
- 71s 91ms/step - loss: 0.0773 - acc: 0.9
726 - val_loss: 0.3777 - val_acc: 0.9097

Epoch 00138: val_acc did not improve from
0.91470
Epoch 139/200
781/781 [=====]
- 71s 91ms/step - loss: 0.0746 - acc: 0.9
736 - val_loss: 0.5664 - val_acc: 0.8815

Epoch 00139: val_acc did not improve from
0.91470
Epoch 140/200
781/781 [=====]
- 70s 90ms/step - loss: 0.0764 - acc: 0.9
718 - val_loss: 0.3855 - val_acc: 0.9067

Epoch 00140: val_acc did not improve from
0.91470
Epoch 141/200
781/781 [=====]
- 70s 90ms/step - loss: 0.0759 - acc: 0.9
733 - val_loss: 0.3965 - val_acc: 0.9038

Epoch 00141: val_acc did not improve from
0.91470
Epoch 142/200
781/781 [=====]
- 70s 90ms/step - loss: 0.0707 - acc: 0.9
748 - val_loss: 0.3958 - val_acc: 0.9021

Epoch 00142: val_acc did not improve from
0.91470

Epoch 143/200
781/781 [=====]
- 70s 89ms/step - loss: 0.0708 - acc: 0.9
742 - val_loss: 0.3851 - val_acc: 0.9088

Epoch 00143: val_acc did not improve from
0.91470

Epoch 144/200
781/781 [=====]
- 69s 89ms/step - loss: 0.0749 - acc: 0.9
730 - val_loss: 0.4244 - val_acc: 0.9022

Epoch 00144: val_acc did not improve from
0.91470

Epoch 145/200
781/781 [=====]
- 69s 89ms/step - loss: 0.0741 - acc: 0.9
738 - val_loss: 0.4340 - val_acc: 0.9008

Epoch 00145: val_acc did not improve from
0.91470

Epoch 146/200
781/781 [=====]
- 70s 90ms/step - loss: 0.0716 - acc: 0.9
745 - val_loss: 0.4244 - val_acc: 0.9021

Epoch 00146: val_acc did not improve from
0.91470

Epoch 147/200
781/781 [=====]
- 69s 88ms/step - loss: 0.0728 - acc: 0.9
748 - val_loss: 0.3694 - val_acc: 0.9107

Epoch 00147: val_acc did not improve from
0.91470

Epoch 148/200

781/781 [=====]
- 70s 89ms/step - loss: 0.0715 - acc: 0.9
746 - val_loss: 0.5003 - val_acc: 0.8927

Epoch 00148: val_acc did not improve from
0.91470

Epoch 149/200

781/781 [=====]
- 70s 89ms/step - loss: 0.0709 - acc: 0.9
758 - val_loss: 0.3780 - val_acc: 0.9103

Epoch 00149: val_acc did not improve from
0.91470

Epoch 150/200

781/781 [=====]
- 71s 90ms/step - loss: 0.0673 - acc: 0.9
760 - val_loss: 0.3599 - val_acc: 0.9088

Epoch 00150: val_acc did not improve from
0.91470

Epoch 151/200

781/781 [=====]
- 70s 90ms/step - loss: 0.0704 - acc: 0.9
752 - val_loss: 0.4261 - val_acc: 0.8990

Epoch 00151: val_acc did not improve from
0.91470

Epoch 152/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0662 - acc: 0.9
771 - val_loss: 0.4348 - val_acc: 0.9012

Epoch 00152: val_acc did not improve from
0.91470

Epoch 153/200

781/781 [=====]

- 71s 91ms/step - loss: 0.0729 - acc: 0.9
743 - val_loss: 0.3692 - val_acc: 0.9145

Epoch 00153: val_acc did not improve from
0.91470

Epoch 154/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0691 - acc: 0.9
757 - val_loss: 0.3550 - val_acc: 0.9145

Epoch 00154: val_acc did not improve from
0.91470

Epoch 155/200

781/781 [=====]
- 72s 93ms/step - loss: 0.0673 - acc: 0.9
762 - val_loss: 0.4330 - val_acc: 0.9058

Epoch 00155: val_acc did not improve from
0.91470

Epoch 156/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0712 - acc: 0.9
749 - val_loss: 0.3922 - val_acc: 0.9057

Epoch 00156: val_acc did not improve from
0.91470

Epoch 157/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0693 - acc: 0.9
752 - val_loss: 0.4181 - val_acc: 0.9036

Epoch 00157: val_acc did not improve from
0.91470

Epoch 158/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0662 - acc: 0.9

765 - val_loss: 0.7173 - val_acc: 0.8604

Epoch 00158: val_acc did not improve from
0.91470

Epoch 159/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0693 - acc: 0.9
755 - val_loss: 0.4366 - val_acc: 0.9015

Epoch 00159: val_acc did not improve from
0.91470

Epoch 160/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0687 - acc: 0.9
759 - val_loss: 0.4352 - val_acc: 0.9010

Epoch 00160: val_acc did not improve from
0.91470

Epoch 161/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0678 - acc: 0.9
760 - val_loss: 0.4275 - val_acc: 0.8962

Epoch 00161: val_acc did not improve from
0.91470

Epoch 162/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0656 - acc: 0.9
765 - val_loss: 0.4154 - val_acc: 0.9033

Epoch 00162: val_acc did not improve from
0.91470

Epoch 163/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0639 - acc: 0.9
778 - val_loss: 0.3790 - val_acc: 0.9103

Epoch 00163: val_acc did not improve from
0.91470

Epoch 164/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0664 - acc: 0.9
761 - val_loss: 0.4958 - val_acc: 0.8910

Epoch 00164: val_acc did not improve from
0.91470

Epoch 165/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0649 - acc: 0.9
772 - val_loss: 0.4252 - val_acc: 0.9040

Epoch 00165: val_acc did not improve from
0.91470

Epoch 166/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0662 - acc: 0.9
761 - val_loss: 0.4126 - val_acc: 0.9075

Epoch 00166: val_acc did not improve from
0.91470

Epoch 167/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0683 - acc: 0.9
760 - val_loss: 0.4388 - val_acc: 0.8986

Epoch 00167: val_acc did not improve from
0.91470

Epoch 168/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0646 - acc: 0.9
772 - val_loss: 0.3659 - val_acc: 0.9128

Epoch 00168: val_acc did not improve from
0.91470

Epoch 169/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0657 - acc: 0.9
769 - val_loss: 0.4611 - val_acc: 0.8976

Epoch 00169: val_acc did not improve from
0.91470

Epoch 170/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0639 - acc: 0.9
775 - val_loss: 0.4198 - val_acc: 0.9064

Epoch 00170: val_acc did not improve from
0.91470

Epoch 171/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0642 - acc: 0.9
778 - val_loss: 0.3893 - val_acc: 0.9096

Epoch 00171: val_acc did not improve from
0.91470

Epoch 172/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0605 - acc: 0.9
789 - val_loss: 0.4614 - val_acc: 0.8971

Epoch 00172: val_acc did not improve from
0.91470

Epoch 173/200

781/781 [=====]
- 72s 93ms/step - loss: 0.0621 - acc: 0.9
782 - val_loss: 0.4036 - val_acc: 0.9076

Epoch 00173: val_acc did not improve from


```
0.91470
Epoch 174/200
781/781 [=====]
- 72s 92ms/step - loss: 0.0620 - acc: 0.9
778 - val_loss: 0.3759 - val_acc: 0.9149

Epoch 00174: val_acc improved from 0.9147
0 to 0.91490, saving model to weights-improvement-174-0.91.hdf5
Epoch 175/200
781/781 [=====]
- 72s 92ms/step - loss: 0.0633 - acc: 0.9
778 - val_loss: 0.3947 - val_acc: 0.9074

Epoch 00175: val_acc did not improve from
0.91490
Epoch 176/200
781/781 [=====]
- 72s 92ms/step - loss: 0.0604 - acc: 0.9
785 - val_loss: 0.3812 - val_acc: 0.9122

Epoch 00176: val_acc did not improve from
0.91490
Epoch 177/200
781/781 [=====]
- 72s 92ms/step - loss: 0.0601 - acc: 0.9
787 - val_loss: 0.3793 - val_acc: 0.9096

Epoch 00177: val_acc did not improve from
0.91490
Epoch 178/200
781/781 [=====]
- 71s 91ms/step - loss: 0.0623 - acc: 0.9
782 - val_loss: 0.3956 - val_acc: 0.9079

Epoch 00178: val_acc did not improve from
```

```
0.91490
Epoch 179/200
781/781 [=====]
- 71s 91ms/step - loss: 0.0604 - acc: 0.9
787 - val_loss: 0.3929 - val_acc: 0.9112

Epoch 00179: val_acc did not improve from
0.91490
Epoch 180/200
781/781 [=====]
- 71s 91ms/step - loss: 0.0615 - acc: 0.9
781 - val_loss: 0.4591 - val_acc: 0.8964

Epoch 00180: val_acc did not improve from
0.91490
Epoch 181/200
781/781 [=====]
- 70s 90ms/step - loss: 0.0576 - acc: 0.9
799 - val_loss: 0.5308 - val_acc: 0.8887

Epoch 00181: val_acc did not improve from
0.91490
Epoch 182/200
781/781 [=====]
- 70s 89ms/step - loss: 0.0588 - acc: 0.9
797 - val_loss: 0.4311 - val_acc: 0.9075

Epoch 00182: val_acc did not improve from
0.91490
Epoch 183/200
781/781 [=====]
- 69s 89ms/step - loss: 0.0588 - acc: 0.9
786 - val_loss: 0.4555 - val_acc: 0.8999

Epoch 00183: val_acc did not improve from
0.91490
```

Epoch 184/200
781/781 [=====]
- 70s 89ms/step - loss: 0.0576 - acc: 0.9
802 - val_loss: 0.4089 - val_acc: 0.9113

Epoch 00184: val_acc did not improve from
0.91490
Epoch 185/200
781/781 [=====]
- 70s 90ms/step - loss: 0.0557 - acc: 0.9
804 - val_loss: 0.4369 - val_acc: 0.9079

Epoch 00185: val_acc did not improve from
0.91490
Epoch 186/200
781/781 [=====]
- 70s 89ms/step - loss: 0.0580 - acc: 0.9
791 - val_loss: 0.4074 - val_acc: 0.9121

Epoch 00186: val_acc did not improve from
0.91490
Epoch 187/200
781/781 [=====]
- 70s 90ms/step - loss: 0.0611 - acc: 0.9
790 - val_loss: 0.3936 - val_acc: 0.9100

Epoch 00187: val_acc did not improve from
0.91490
Epoch 188/200
781/781 [=====]
- 70s 89ms/step - loss: 0.0570 - acc: 0.9
802 - val_loss: 0.4275 - val_acc: 0.9012

Epoch 00188: val_acc did not improve from
0.91490
Epoch 189/200

781/781 [=====]
- 71s 91ms/step - loss: 0.0560 - acc: 0.9
803 - val_loss: 0.4029 - val_acc: 0.9101

Epoch 00189: val_acc did not improve from
0.91490

Epoch 190/200

781/781 [=====]
- 70s 90ms/step - loss: 0.0595 - acc: 0.9
791 - val_loss: 0.4394 - val_acc: 0.9056

Epoch 00190: val_acc did not improve from
0.91490

Epoch 191/200

781/781 [=====]
- 70s 89ms/step - loss: 0.0539 - acc: 0.9
807 - val_loss: 0.4131 - val_acc: 0.9057

Epoch 00191: val_acc did not improve from
0.91490

Epoch 192/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0550 - acc: 0.9
809 - val_loss: 0.3876 - val_acc: 0.9066

Epoch 00192: val_acc did not improve from
0.91490

Epoch 193/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0558 - acc: 0.9
804 - val_loss: 0.3999 - val_acc: 0.9133

Epoch 00193: val_acc did not improve from
0.91490

Epoch 194/200

781/781 [=====]

- 73s 93ms/step - loss: 0.0566 - acc: 0.9
803 - val_loss: 0.3788 - val_acc: 0.9148

Epoch 00194: val_acc did not improve from
0.91490

Epoch 195/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0530 - acc: 0.9
815 - val_loss: 0.4383 - val_acc: 0.9050

Epoch 00195: val_acc did not improve from
0.91490

Epoch 196/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0563 - acc: 0.9
797 - val_loss: 0.4529 - val_acc: 0.9074

Epoch 00196: val_acc did not improve from
0.91490

Epoch 197/200

781/781 [=====]
- 73s 93ms/step - loss: 0.0540 - acc: 0.9
807 - val_loss: 0.6403 - val_acc: 0.8780

Epoch 00197: val_acc did not improve from
0.91490

Epoch 198/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0548 - acc: 0.9
802 - val_loss: 0.3998 - val_acc: 0.9092

Epoch 00198: val_acc did not improve from
0.91490

Epoch 199/200

781/781 [=====]
- 72s 92ms/step - loss: 0.0550 - acc: 0.9

801 - val_loss: 0.4458 - val_acc: 0.9032

Epoch 00199: val_acc did not improve from
0.91490

Epoch 200/200

781/781 [=====]

- 72s 92ms/step - loss: 0.0551 - acc: 0.9

810 - val_loss: 0.5177 - val_acc: 0.8935

Epoch 00200: val_acc did not improve from
0.91490

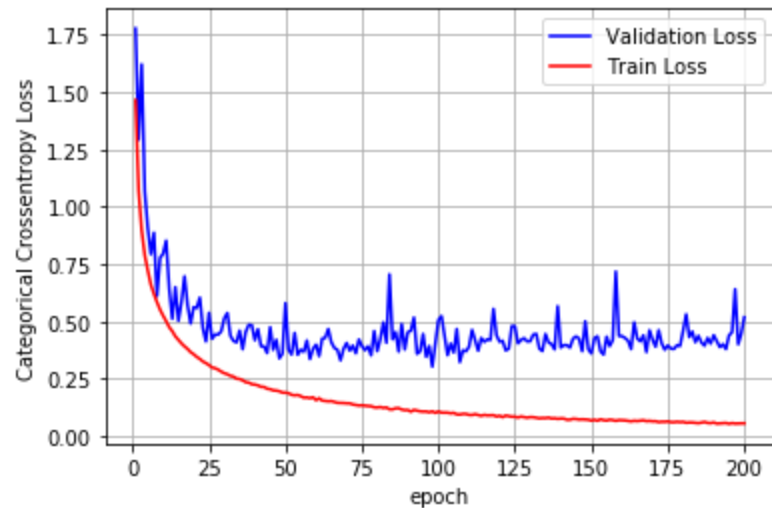
```
In [18]: import matplotlib.pyplot as plt
# https://gist.github.com/greydanus/f6eee59eaf1
# d90fcb3b534a25362cea4
# https://stackoverflow.com/a/14434334
# this function is used to update the plots for
# each epoch and error
def plt_dynamic(x, vy, ty, ax, colors=['b']):
    ax.plot(x, vy, 'b', label="Validation Loss"
)
    ax.plot(x, ty, 'r', label="Train Loss")
    plt.legend()
    plt.grid()
    fig.canvas.draw()

fig,ax = plt.subplots(1,1)
ax.set_xlabel('epoch') ; ax.set_ylabel('Categor
ical Crossentropy Loss')

# list of epoch numbers
x = list(range(1,epochs+1))

vy = history.history['val_loss']
```

```
ty = history.history['loss']
plt_dynamic(x, vy, ty, ax)
```



```
In [19]: # Test the model
score = model.evaluate(X_test, y_test, verbose=
1)
print('Test loss:', score[0])
print('Test accuracy:', score[1])
```

```
10000/10000 [=====]
==] - 3s 349us/step
Test loss: 0.5177401971131563
Test accuracy: 0.8935
```

```
In [0]: import pandas as pd
import numpy as np
```

```
In [0]: model.load_weights("weights-improve-174-0.91.hdf5")
```

```
In [0]: labels = {
0: 'airplane',
1: 'automobile',
```

```

2: 'bird',
3: 'cat',
4: 'deer',
5: 'dog',
6: 'frog',
7: 'horse',
8: 'ship',
9: 'truck',

}

# Utility function to print the confusion matrix
x
def confusion_matrix(Y_true, Y_pred):
    Y_true = pd.Series([labels[y] for y in np.argmax(Y_true, axis=1)])
    Y_pred = pd.Series([labels[y] for y in np.argmax(Y_pred, axis=1)])

    return pd.crosstab(Y_true, Y_pred, rownames=
=['True'], colnames=['Pred'])

```

```

In [23]: pd.set_option('display.max_columns', 10)
print(confusion_matrix(y_test, model.predict(X_
test)))

```

```

Pred      airplane  automobile  bird  c
at  deer  dog  frog  horse  ship  \
True
airplane      897          6      19
4      5      2      7      1      43
automobile      1          970      1
0      0      0      0      1      5
bird      10          0      918
14     24      5     17      8      3
cat          8          8      36      7

```


91	34	62	39	8	5	
deer			3		0	21
12	940	5	9	8	0	
dog			6		1	22
84	25	824	16	18	2	
frog			4		0	18
8	3	0	965	0	0	
horse			3		1	12
7	25	12	4	933	1	
ship			12		6	2
1	0	0	1	1	969	
truck			4		34	1
3	1	0	3	1	11	

Pred truck

True

airplane 16

automobile 22

bird 1

cat 9

deer 2

dog 2

frog 2

horse 2

ship 8

truck 942



```
In [25]: score = model.evaluate(X_test, y_test)
```

```
10000/10000 [=====]
==] - 3s 332us/step
```

```
In [26]: score
```

```
Out[26]: [0.37590156150981785, 0.9149]
```