Final Project

Group Members:

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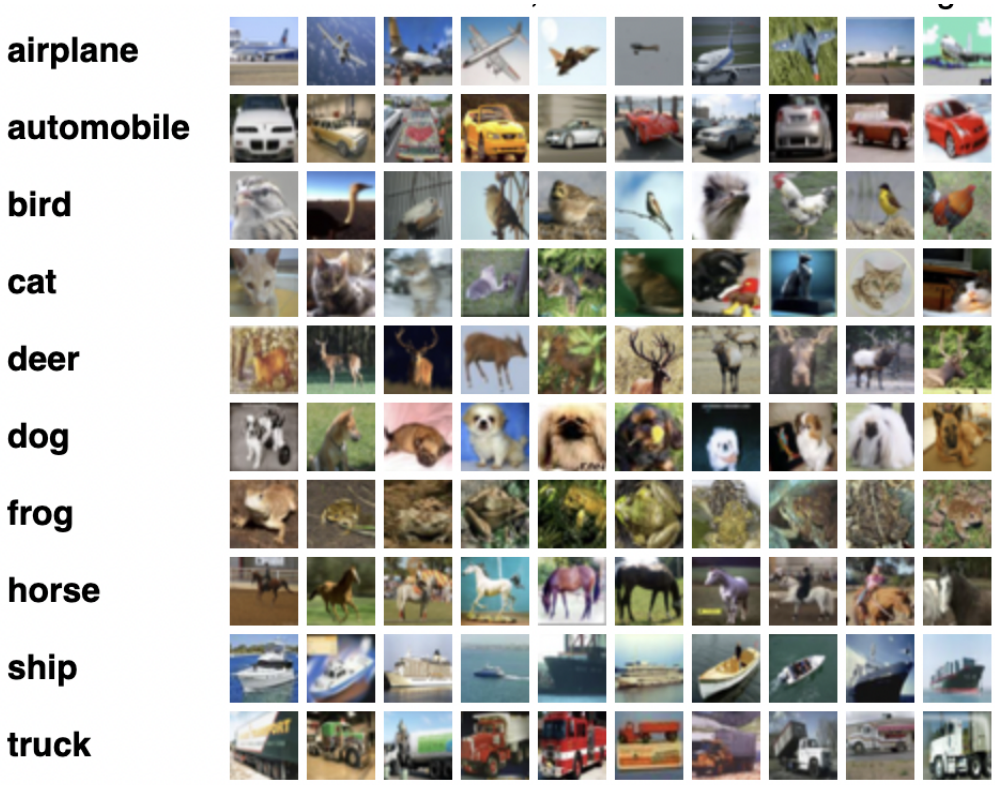
Dataset Used:

CIFAR 10



Description :

The CIFAR-10 dataset contains 60000 32x32 color images divided into ten groups, each with 6000 images.
There are 50000 images for training and 10,000 images for testing.
Each of the 10000 images in the dataset is split into five testing batches and one evaluation batch. The test batch comprises precisely 1000 images from each class, chosen at random. The remaining images are distributed in training batches in a random order, but some batches contain more images from one class than others. The training batches produce exactly 5000 images from each class between them.

Dataset Link:
https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz

CALTECH101 , CALTECH256

Description :

Images of objects from 101 different categories. Per group, there are approximately 40 to 800 photographs. The majority of categories have about 50 photographs. Fei-Fei Li, Marco Andreetto, and Marc 'Aurelio Ranzato collected the material in September 2003. Each picture is approximately 300 x 200 pixels in resolution.

DataSet Link:
http://www.vision.caltech.edu/Image_Datasets/Caltech101/#Description

Model Used

ResNet50 model with weights pre-trained on ImageNet.

Architecture:

ResNet50 is a ResNet version with 48 Convolution layers, 1 MaxPool layer, and 1 Average Pool layer. There are 3.8 x 109 floating-point operations in it. It's a common ResNet model, and we've gone through the ResNet50 architecture in detail.

layer name	output size	18-layer	34-layer	50-layer	101-layer	152-layer
conv1	112×112	7×7, 64, stride 2				
conv2_x	56×56	3×3 max pool, stride 2				
		$\begin{bmatrix} 3\times3, 64 \\ 3\times3, 64 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 64 \\ 3\times3, 64 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$
conv3_x	28×28	$\begin{bmatrix} 3\times3, 128 \\ 3\times3, 128 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 128 \\ 3\times3, 128 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times8$
conv4_x	14×14	$\begin{bmatrix} 3\times3, 256 \\ 3\times3, 256 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 256 \\ 3\times3, 256 \end{bmatrix}\times6$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times6$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times23$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times36$
conv5_x	7×7	$\begin{bmatrix} 3\times3, 512 \\ 3\times3, 512 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 512 \\ 3\times3, 512 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$
	1×1	average pool, 1000-d fc, softmax				
FLOPs		1.8×10^9	3.6×10^9	3.8×10^9	7.6×10^9	11.3×10^9

Uses:

- This architecture can be used for image recognition, object localization, and object identification in computer vision.
- This structure can also be used to provide non-computer vision activities the advantage of depth while also lowering computational costs.

CIFAR 10 using Resnet50

Model Summary :

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
up_sampling2d_1 (UpSampling2 multiple                  0
_________________________________________________________________
up_sampling2d_2 (UpSampling2 multiple                  0
_________________________________________________________________
up_sampling2d_3 (UpSampling2 multiple                  0
_________________________________________________________________
resnet50 (Model)             (None, 7, 7, 2048)        23587712
_________________________________________________________________
flatten (Flatten)            multiple                  0
_________________________________________________________________
batch_normalization (BatchNo multiple                  524288
_________________________________________________________________
dense (Dense)                multiple                  16777344
_________________________________________________________________
dropout (Dropout)            multiple                  0
_________________________________________________________________
batch_normalization_1 (Batch multiple                  512
_________________________________________________________________
dense_1 (Dense)              multiple                  8256
_________________________________________________________________
dropout_1 (Dropout)          multiple                  0
_________________________________________________________________
batch_normalization_2 (Batch multiple                  256
_________________________________________________________________
dense_2 (Dense)              multiple                  650
=================================================================
Total params: 40,899,018
Trainable params: 40,583,370
Non-trainable params: 315,648
_________________________________________________________________
```

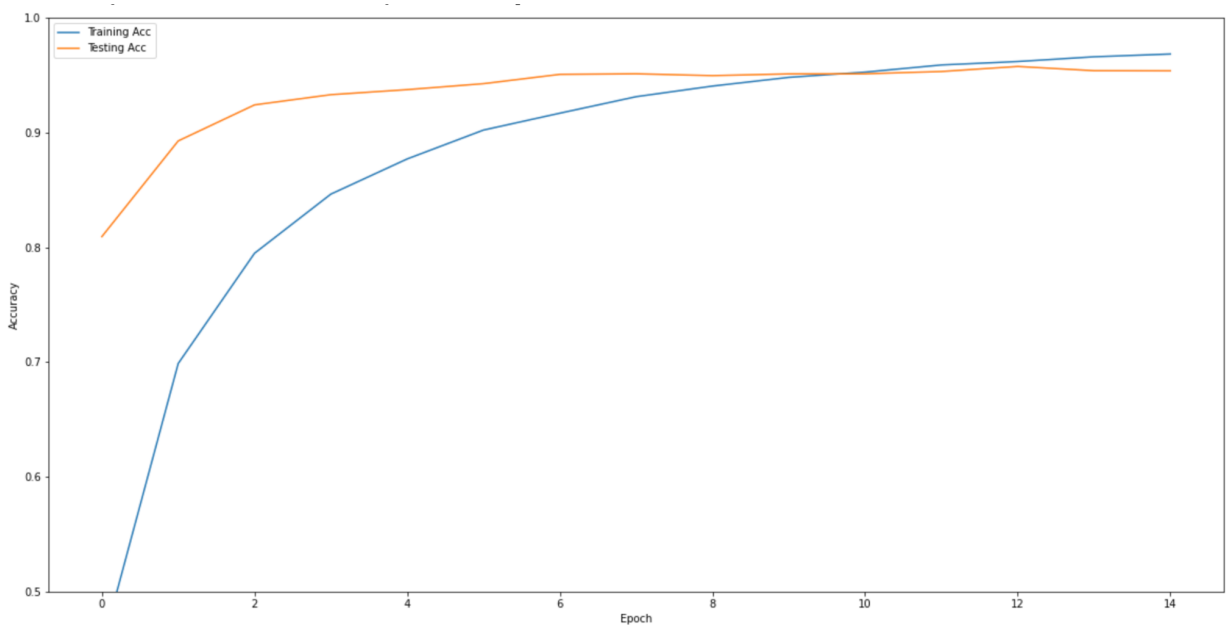
Run :

```
Epoch 1/15
2499/2500 [============================>.] - ETA: 0s - loss: 1.6616 - acc: 0.3326Epoch 1/15
10000/2500
[==============================================================================================================
=================] - 45s 5ms/sample - loss: 0.6432 - acc: 0.8094
2500/2500 [==============================] - 896s 359ms/step - loss: 1.6615 - acc: 0.3327 - val_loss:
0.7042 - val_acc: 0.8094
Epoch 2/15
2499/2500 [============================>.] - ETA: 0s - loss: 1.0075 - acc: 0.6648Epoch 1/15
```

```
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.3788 - acc: 0.8928
2500/2500 [==============================] - 876s 351ms/step - loss: 1.0075 - acc: 0.6649 - val_loss:
0.4031 - val_acc: 0.8928
Epoch 3/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.7509 - acc: 0.7785Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.2596 - acc: 0.9242
2500/2500 [==============================] - 876s 350ms/step - loss: 0.7509 - acc: 0.7785 - val_loss:
0.2906 - val_acc: 0.9242
Epoch 4/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.6014 - acc: 0.8381Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 45s 4ms/sample - loss: 0.2648 - acc: 0.9331
2500/2500 [==============================] - 877s 351ms/step - loss: 0.6013 - acc: 0.8381 - val_loss:
0.2505 - val_acc: 0.9331
Epoch 5/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.5009 - acc: 0.8754Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.2159 - acc: 0.9375
2500/2500 [==============================] - 879s 352ms/step - loss: 0.5009 - acc: 0.8754 - val_loss:
0.2210 - val_acc: 0.9375
Epoch 6/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.4175 - acc: 0.9033Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.3442 - acc: 0.9427
2500/2500 [==============================] - 876s 350ms/step - loss: 0.4175 - acc: 0.9033 - val_loss:
0.2018 - val_acc: 0.9427
Epoch 7/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.3555 - acc: 0.9158Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.1306 - acc: 0.9508
2500/2500 [==============================] - 875s 350ms/step - loss: 0.3555 - acc: 0.9158 - val_loss:
0.1783 - val_acc: 0.9508
Epoch 8/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.3066 - acc: 0.9302Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.1769 - acc: 0.9513
2500/2500 [==============================] - 877s 351ms/step - loss: 0.3066 - acc: 0.9302 - val_loss:
0.1755 - val_acc: 0.9513
Epoch 9/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.2654 - acc: 0.9395Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.1910 - acc: 0.9497
2500/2500 [==============================] - 877s 351ms/step - loss: 0.2654 - acc: 0.9395 - val_loss:
0.1824 - val_acc: 0.9497
Epoch 10/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.2335 - acc: 0.9496Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.1549 - acc: 0.9512
2500/2500 [==============================] - 881s 352ms/step - loss: 0.2335 - acc: 0.9496 - val_loss:
0.1699 - val_acc: 0.9512
Epoch 11/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.2110 - acc: 0.9542Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.1659 - acc: 0.9513
```

```
2500/2500 [==============================] - 880s 352ms/step - loss: 0.2111 - acc: 0.9542 - val_loss:
0.1785 - val_acc: 0.9513
Epoch 12/15
2499/2500 [==============================>.] - ETA: 0s - loss: 0.1852 - acc: 0.9582Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.1128 - acc: 0.9533
2500/2500 [==============================] - 880s 352ms/step - loss: 0.1852 - acc: 0.9582 - val_loss:
0.1727 - val_acc: 0.9533
Epoch 13/15
2499/2500 [==============================>.] - ETA: 0s - loss: 0.1710 - acc: 0.9633Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.0987 - acc: 0.9577
2500/2500 [==============================] - 881s 352ms/step - loss: 0.1709 - acc: 0.9633 - val_loss:
0.1597 - val_acc: 0.9577
Epoch 14/15
2499/2500 [==============================>.] - ETA: 0s - loss: 0.1549 - acc: 0.9674Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.1316 - acc: 0.9540
2500/2500 [==============================] - 881s 352ms/step - loss: 0.1548 - acc: 0.9674 - val_loss:
0.1702 - val_acc: 0.9540
Epoch 15/15
2499/2500 [==============================>.] - ETA: 0s - loss: 0.1433 - acc: 0.9692Epoch 1/15
10000/2500
[==============================================================================================================
==================] - 44s 4ms/sample - loss: 0.1723 - acc: 0.9539
2500/2500 [==============================] - 880s 352ms/step - loss: 0.1433 - acc: 0.9692 - val_loss:
0.1909 - val_acc: 0.9539
```

Graph :

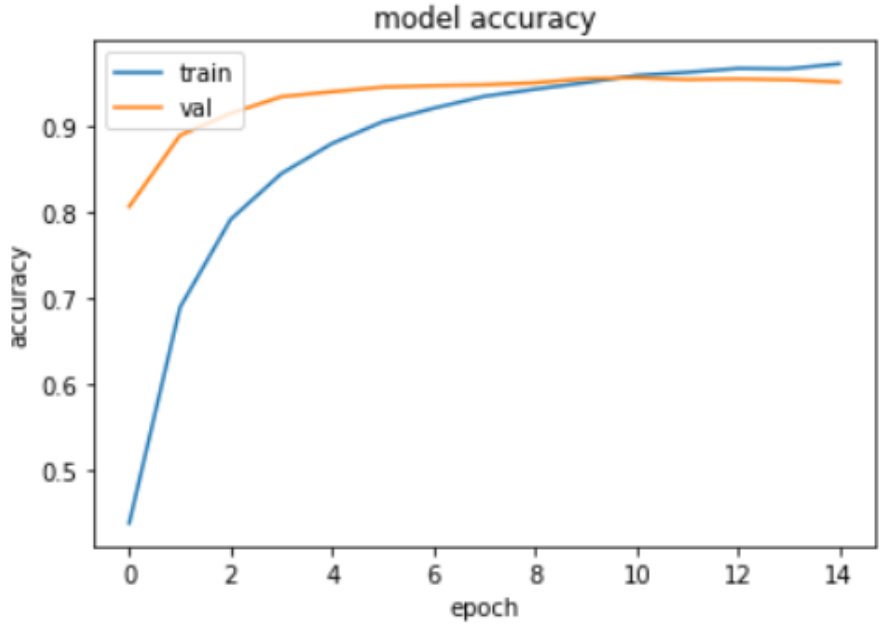


Run-2 :

```
Epoch 1/15
2499/2500 [============================>.] - ETA: 0s - loss: 1.6950 - acc: 0.3228Epoch 1/15
10000/2500
[==============================================================================================================
======] - 44s 4ms/sample - loss: 0.7470 - acc: 0.8061
2500/2500 [==============================] - 886s 355ms/step - loss: 1.6949 - acc: 0.3229 - val_loss: 0.7634 -
val_acc: 0.8061
Epoch 2/15
2499/2500 [============================>.] - ETA: 0s - loss: 1.0532 - acc: 0.6553Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.4660 - acc: 0.8890
2500/2500 [==============================] - 866s 346ms/step - loss: 1.0534 - acc: 0.6553 - val_loss: 0.4682 -
val_acc: 0.8890
Epoch 3/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.7842 - acc: 0.7788Epoch 1/15
10000/2500
[==============================================================================================================
======] - 44s 4ms/sample - loss: 0.3850 - acc: 0.9146
2500/2500 [==============================] - 866s 346ms/step - loss: 0.7841 - acc: 0.7788 - val_loss: 0.3602 -
val_acc: 0.9146
Epoch 4/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.6227 - acc: 0.8385Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.2377 - acc: 0.9340
2500/2500 [==============================] - 863s 345ms/step - loss: 0.6229 - acc: 0.8385 - val_loss: 0.2648 -
val_acc: 0.9340
Epoch 5/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.5063 - acc: 0.8728Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.1686 - acc: 0.9398
2500/2500 [==============================] - 861s 344ms/step - loss: 0.5063 - acc: 0.8728 - val_loss: 0.2308 -
val_acc: 0.9398
Epoch 6/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.4176 - acc: 0.9018Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.2503 - acc: 0.9451
2500/2500 [==============================] - 860s 344ms/step - loss: 0.4177 - acc: 0.9018 - val_loss: 0.1980 -
val_acc: 0.9451
Epoch 7/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.3537 - acc: 0.9202Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.1481 - acc: 0.9468
2500/2500 [==============================] - 861s 344ms/step - loss: 0.3537 - acc: 0.9202 - val_loss: 0.1907 -
val_acc: 0.9468
Epoch 8/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.3038 - acc: 0.9335Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.1613 - acc: 0.9478
2500/2500 [==============================] - 866s 347ms/step - loss: 0.3038 - acc: 0.9335 - val_loss: 0.1881 -
val_acc: 0.9478
Epoch 9/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.2619 - acc: 0.9430Epoch 1/15
10000/2500
[==============================================================================================================
======] - 44s 4ms/sample - loss: 0.1278 - acc: 0.9501
2500/2500 [==============================] - 867s 347ms/step - loss: 0.2619 - acc: 0.9430 - val_loss: 0.1777 -
val_acc: 0.9501
Epoch 10/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.2286 - acc: 0.9504Epoch 1/15
```

```
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.1331 - acc: 0.9551
2500/2500 [==============================] - 864s 346ms/step - loss: 0.2286 - acc: 0.9504 - val_loss: 0.1718 -
val_acc: 0.9551
Epoch 11/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.1965 - acc: 0.9585Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.1148 - acc: 0.9560
2500/2500 [==============================] - 864s 346ms/step - loss: 0.1965 - acc: 0.9585 - val_loss: 0.1672 -
val_acc: 0.9560
Epoch 12/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.1811 - acc: 0.9629Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.1102 - acc: 0.9540
2500/2500 [==============================] - 865s 346ms/step - loss: 0.1811 - acc: 0.9629 - val_loss: 0.1780 -
val_acc: 0.9540
Epoch 13/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.1583 - acc: 0.9674Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.1005 - acc: 0.9547
2500/2500 [==============================] - 864s 345ms/step - loss: 0.1583 - acc: 0.9674 - val_loss: 0.1721 -
val_acc: 0.9547
Epoch 14/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.1496 - acc: 0.9666Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.1110 - acc: 0.9537
2500/2500 [==============================] - 864s 346ms/step - loss: 0.1497 - acc: 0.9666 - val_loss: 0.1873 -
val_acc: 0.9537
Epoch 15/15
2499/2500 [============================>.] - ETA: 0s - loss: 0.1349 - acc: 0.9735Epoch 1/15
10000/2500
[==============================================================================================================
======] - 43s 4ms/sample - loss: 0.1463 - acc: 0.9511
2500/2500 [==============================] - 865s 346ms/step - loss: 0.1348 - acc: 0.9735 - val_loss: 0.1946 -
val_acc: 0.9511
```

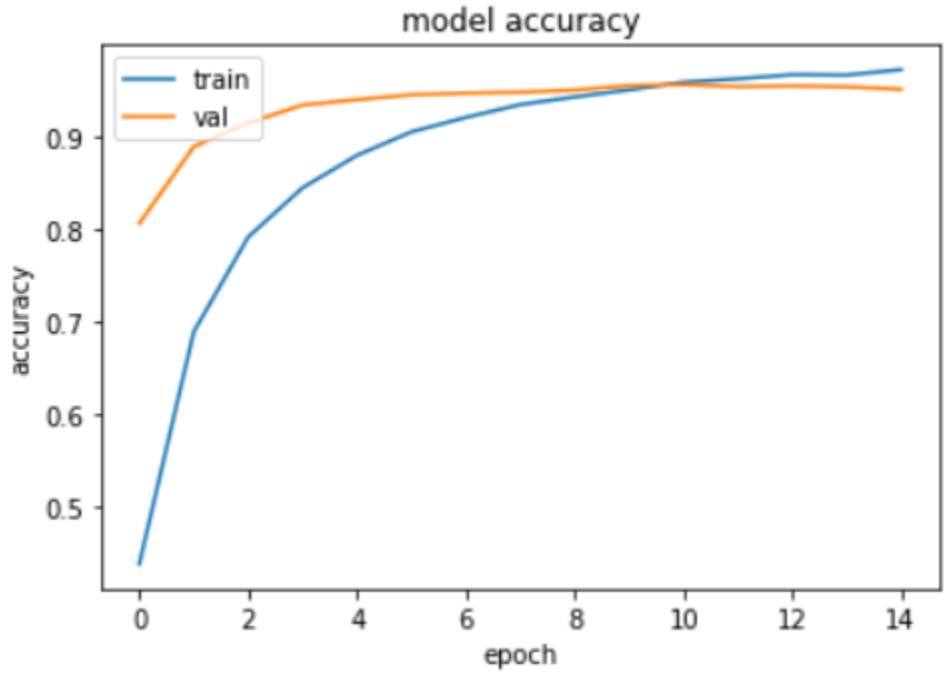
Graph:



Run-3:

```
Epoch 1/15
2500/2500 [==============================] - 766s 302ms/step - loss: 2.0078 - acc: 0.3458 - val_loss: 0.6882 -
val_acc: 0.8191
Epoch 2/15
2500/2500 [==============================] - 751s 300ms/step - loss: 1.0916 - acc: 0.6643 - val_loss: 0.4102 -
val_acc: 0.8932
Epoch 3/15
2500/2500 [==============================] - 752s 301ms/step - loss: 0.7952 - acc: 0.7816 - val_loss: 0.3101 -
val_acc: 0.9246
Epoch 4/15
2500/2500 [==============================] - 751s 300ms/step - loss: 0.6408 - acc: 0.8320 - val_loss: 0.2421 -
val_acc: 0.9359
Epoch 5/15
2500/2500 [==============================] - 753s 301ms/step - loss: 0.5091 - acc: 0.8727 - val_loss: 0.2221 -
val_acc: 0.9407
Epoch 6/15
2500/2500 [==============================] - 752s 301ms/step - loss: 0.4303 - acc: 0.8977 - val_loss: 0.1980 -
val_acc: 0.9465
Epoch 7/15
2500/2500 [==============================] - 751s 300ms/step - loss: 0.3753 - acc: 0.9116 - val_loss: 0.1766 -
val_acc: 0.9505
Epoch 8/15
2500/2500 [==============================] - 751s 301ms/step - loss: 0.3066 - acc: 0.9314 - val_loss: 0.1696 -
val_acc: 0.9517
Epoch 9/15
2500/2500 [==============================] - 752s 301ms/step - loss: 0.2654 - acc: 0.9414 - val_loss: 0.1626 -
val_acc: 0.9553
Epoch 10/15
2500/2500 [==============================] - 753s 301ms/step - loss: 0.2312 - acc: 0.9485 - val_loss: 0.1649 -
val_acc: 0.9540
Epoch 11/15
2500/2500 [==============================] - 751s 300ms/step - loss: 0.2035 - acc: 0.9547 - val_loss: 0.1740 -
val_acc: 0.9540
Epoch 12/15
2500/2500 [==============================] - 752s 301ms/step - loss: 0.1891 - acc: 0.9593 - val_loss: 0.1804 -
val_acc: 0.9547
Epoch 13/15
2500/2500 [==============================] - 752s 301ms/step - loss: 0.1707 - acc: 0.9629 - val_loss: 0.1792 -
val_acc: 0.9530
Epoch 14/15
2500/2500 [==============================] - 752s 301ms/step - loss: 0.1707 - acc: 0.9629 - val_loss: 0.1404 -
val_acc: 0.9600
Epoch 15/15
2500/2500 [==============================] - 752s 301ms/step - loss: 0.1707 - acc: 0.9629 - val_loss: 0.1062 -
val_acc: 0.9630
```

Graph:



Average Training Accuracy: 96.85%

Average Testing Accuracy: 95.26%

Caltech-101 using Resnet50

Model Summary :

Model: "model"

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 256, 256, 3)	0	
conv1_pad (ZeroPadding2D)	(None, 262, 262, 3)	0	input_1[0][0]
conv1_conv (Conv2D)	(None, 128, 128, 64)	9472	conv1_pad[0][0]
conv1_bn (BatchNormalization)	(None, 128, 128, 64)	256	conv1_conv[0][0]
conv1_relu (Activation)	(None, 128, 128, 64)	0	conv1_bn[0][0]
pool1_pad (ZeroPadding2D)	(None, 130, 130, 64)	0	conv1_relu[0][0]
pool1_pool (MaxPooling2D)	(None, 64, 64, 64)	0	pool1_pad[0][0]
conv2_block1_1_conv (Conv2D)	(None, 64, 64, 64)	4160	pool1_pool[0][0]
conv2_block1_1_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block1_1_conv[0][0]
conv2_block1_1_relu (Activation	(None, 64, 64, 64)	0	conv2_block1_1_bn[0][0]
conv2_block1_2_conv (Conv2D)	(None, 64, 64, 64)	36928	conv2_block1_1_relu[0][0]
conv2_block1_2_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block1_2_conv[0][0]
conv2_block1_2_relu (Activation	(None, 64, 64, 64)	0	conv2_block1_2_bn[0][0]
conv2_block1_0_conv (Conv2D)	(None, 64, 64, 256)	16640	pool1_pool[0][0]
conv2_block1_3_conv (Conv2D)	(None, 64, 64, 256)	16640	conv2_block1_2_relu[0][0]
conv2_block1_0_bn (BatchNormali	(None, 64, 64, 256)	1024	conv2_block1_0_conv[0][0]
conv2_block1_3_bn (BatchNormali	(None, 64, 64, 256)	1024	conv2_block1_3_conv[0][0]
conv2_block1_add (Add)	(None, 64, 64, 256)	0	conv2_block1_0_bn[0][0] conv2_block1_3_bn[0][0]
conv2_block1_out (Activation)	(None, 64, 64, 256)	0	conv2_block1_add[0][0]
conv2_block2_1_conv (Conv2D)	(None, 64, 64, 64)	16448	conv2_block1_out[0][0]
conv2_block2_1_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block2_1_conv[0][0]
conv2_block2_1_relu (Activation	(None, 64, 64, 64)	0	conv2_block2_1_bn[0][0]
conv2_block2_2_conv (Conv2D)	(None, 64, 64, 64)	36928	conv2_block2_1_relu[0][0]
conv2_block2_2_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block2_2_conv[0][0]
conv2_block2_2_relu (Activation	(None, 64, 64, 64)	0	conv2_block2_2_bn[0][0]
conv2_block2_3_conv (Conv2D)	(None, 64, 64, 256)	16640	conv2_block2_2_relu[0][0]

conv2_block2_3_bn (BatchNormali	(None, 64, 64, 256)	1024	conv2_block2_3_conv[0][0]
conv2_block2_add (Add)	(None, 64, 64, 256)	0	conv2_block1_out[0][0] conv2_block2_3_bn[0][0]
conv2_block2_out (Activation)	(None, 64, 64, 256)	0	conv2_block2_add[0][0]
conv2_block3_1_conv (Conv2D)	(None, 64, 64, 64)	16448	conv2_block2_out[0][0]
conv2_block3_1_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block3_1_conv[0][0]
conv2_block3_1_relu (Activation	(None, 64, 64, 64)	0	conv2_block3_1_bn[0][0]
conv2_block3_2_conv (Conv2D)	(None, 64, 64, 64)	36928	conv2_block3_1_relu[0][0]
conv2_block3_2_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block3_2_conv[0][0]
conv2_block3_2_relu (Activation	(None, 64, 64, 64)	0	conv2_block3_2_bn[0][0]
conv2_block3_3_conv (Conv2D)	(None, 64, 64, 256)	16640	conv2_block3_2_relu[0][0]
conv2_block3_3_bn (BatchNormali	(None, 64, 64, 256)	1024	conv2_block3_3_conv[0][0]
conv2_block3_add (Add)	(None, 64, 64, 256)	0	conv2_block2_out[0][0] conv2_block3_3_bn[0][0]
conv2_block3_out (Activation)	(None, 64, 64, 256)	0	conv2_block3_add[0][0]
conv3_block1_1_conv (Conv2D)	(None, 32, 32, 128)	32896	conv2_block3_out[0][0]
conv3_block1_1_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block1_1_conv[0][0]
conv3_block1_1_relu (Activation	(None, 32, 32, 128)	0	conv3_block1_1_bn[0][0]
conv3_block1_2_conv (Conv2D)	(None, 32, 32, 128)	147584	conv3_block1_1_relu[0][0]
conv3_block1_2_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block1_2_conv[0][0]
conv3_block1_2_relu (Activation	(None, 32, 32, 128)	0	conv3_block1_2_bn[0][0]
conv3_block1_0_conv (Conv2D)	(None, 32, 32, 512)	131584	conv2_block3_out[0][0]
conv3_block1_3_conv (Conv2D)	(None, 32, 32, 512)	66048	conv3_block1_2_relu[0][0]
conv3_block1_0_bn (BatchNormali	(None, 32, 32, 512)	2048	conv3_block1_0_conv[0][0]
conv3_block1_3_bn (BatchNormali	(None, 32, 32, 512)	2048	conv3_block1_3_conv[0][0]
conv3_block1_add (Add)	(None, 32, 32, 512)	0	conv3_block1_0_bn[0][0] conv3_block1_3_bn[0][0]
conv3_block1_out (Activation)	(None, 32, 32, 512)	0	conv3_block1_add[0][0]
conv3_block2_1_conv (Conv2D)	(None, 32, 32, 128)	65664	conv3_block1_out[0][0]
conv3_block2_1_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block2_1_conv[0][0]
conv3_block2_1_relu (Activation	(None, 32, 32, 128)	0	conv3_block2_1_bn[0][0]
conv3_block2_2_conv (Conv2D)	(None, 32, 32, 128)	147584	conv3_block2_1_relu[0][0]
conv3_block2_2_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block2_2_conv[0][0]
conv3_block2_2_relu (Activation	(None, 32, 32, 128)	0	conv3_block2_2_bn[0][0]
conv3_block2_3_conv (Conv2D)	(None, 32, 32, 512)	66048	conv3_block2_2_relu[0][0]
conv3_block2_3_bn (BatchNormali	(None, 32, 32, 512)	2048	conv3_block2_3_conv[0][0]
conv3_block2_add (Add)	(None, 32, 32, 512)	0	conv3_block1_out[0][0]

			conv3_block2_3_bn[0][0]
conv3_block2_out (Activation)	(None, 32, 32, 512)	0	conv3_block2_add[0][0]
conv3_block3_1_conv (Conv2D)	(None, 32, 32, 128)	65664	conv3_block2_out[0][0]
conv3_block3_1_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block3_1_conv[0][0]
conv3_block3_1_relu (Activation	(None, 32, 32, 128)	0	conv3_block3_1_bn[0][0]
conv3_block3_2_conv (Conv2D)	(None, 32, 32, 128)	147584	conv3_block3_1_relu[0][0]
conv3_block3_2_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block3_2_conv[0][0]
conv3_block3_2_relu (Activation	(None, 32, 32, 128)	0	conv3_block3_2_bn[0][0]
conv3_block3_3_conv (Conv2D)	(None, 32, 32, 512)	66048	conv3_block3_2_relu[0][0]
conv3_block3_3_bn (BatchNormali	(None, 32, 32, 512)	2048	conv3_block3_3_conv[0][0]
conv3_block3_add (Add)	(None, 32, 32, 512)	0	conv3_block2_out[0][0] conv3_block3_3_bn[0][0]
conv3_block3_out (Activation)	(None, 32, 32, 512)	0	conv3_block3_add[0][0]
conv3_block4_1_conv (Conv2D)	(None, 32, 32, 128)	65664	conv3_block3_out[0][0]
conv3_block4_1_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block4_1_conv[0][0]
conv3_block4_1_relu (Activation	(None, 32, 32, 128)	0	conv3_block4_1_bn[0][0]
conv3_block4_2_conv (Conv2D)	(None, 32, 32, 128)	147584	conv3_block4_1_relu[0][0]
conv3_block4_2_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block4_2_conv[0][0]
conv3_block4_2_relu (Activation	(None, 32, 32, 128)	0	conv3_block4_2_bn[0][0]
conv3_block4_3_conv (Conv2D)	(None, 32, 32, 512)	66048	conv3_block4_2_relu[0][0]
conv3_block4_3_bn (BatchNormali	(None, 32, 32, 512)	2048	conv3_block4_3_conv[0][0]
conv3_block4_add (Add)	(None, 32, 32, 512)	0	conv3_block3_out[0][0] conv3_block4_3_bn[0][0]
conv3_block4_out (Activation)	(None, 32, 32, 512)	0	conv3_block4_add[0][0]
conv4_block1_1_conv (Conv2D)	(None, 16, 16, 256)	131328	conv3_block4_out[0][0]
conv4_block1_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block1_1_conv[0][0]
conv4_block1_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block1_1_bn[0][0]
conv4_block1_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block1_1_relu[0][0]
conv4_block1_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block1_2_conv[0][0]
conv4_block1_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block1_2_bn[0][0]
conv4_block1_0_conv (Conv2D)	(None, 16, 16, 1024)	525312	conv3_block4_out[0][0]
conv4_block1_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block1_2_relu[0][0]
conv4_block1_0_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block1_0_conv[0][0]
conv4_block1_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block1_3_conv[0][0]
conv4_block1_add (Add)	(None, 16, 16, 1024)	0	conv4_block1_0_bn[0][0] conv4_block1_3_bn[0][0]
conv4_block1_out (Activation)	(None, 16, 16, 1024)	0	conv4_block1_add[0][0]

conv4_block2_1_conv (Conv2D)	(None, 16, 16, 256)	262400	conv4_block1_out[0][0]
conv4_block2_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block2_1_conv[0][0]
conv4_block2_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block2_1_bn[0][0]
conv4_block2_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block2_1_relu[0][0]
conv4_block2_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block2_2_conv[0][0]
conv4_block2_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block2_2_bn[0][0]
conv4_block2_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block2_2_relu[0][0]
conv4_block2_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block2_3_conv[0][0]
conv4_block2_add (Add)	(None, 16, 16, 1024)	0	conv4_block1_out[0][0] conv4_block2_3_bn[0][0]
conv4_block2_out (Activation)	(None, 16, 16, 1024)	0	conv4_block2_add[0][0]
conv4_block3_1_conv (Conv2D)	(None, 16, 16, 256)	262400	conv4_block2_out[0][0]
conv4_block3_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block3_1_conv[0][0]
conv4_block3_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block3_1_bn[0][0]
conv4_block3_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block3_1_relu[0][0]
conv4_block3_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block3_2_conv[0][0]
conv4_block3_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block3_2_bn[0][0]
conv4_block3_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block3_2_relu[0][0]
conv4_block3_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block3_3_conv[0][0]
conv4_block3_add (Add)	(None, 16, 16, 1024)	0	conv4_block2_out[0][0] conv4_block3_3_bn[0][0]
conv4_block3_out (Activation)	(None, 16, 16, 1024)	0	conv4_block3_add[0][0]
conv4_block4_1_conv (Conv2D)	(None, 16, 16, 256)	262400	conv4_block3_out[0][0]
conv4_block4_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block4_1_conv[0][0]
conv4_block4_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block4_1_bn[0][0]
conv4_block4_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block4_1_relu[0][0]
conv4_block4_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block4_2_conv[0][0]
conv4_block4_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block4_2_bn[0][0]
conv4_block4_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block4_2_relu[0][0]
conv4_block4_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block4_3_conv[0][0]
conv4_block4_add (Add)	(None, 16, 16, 1024)	0	conv4_block3_out[0][0] conv4_block4_3_bn[0][0]
conv4_block4_out (Activation)	(None, 16, 16, 1024)	0	conv4_block4_add[0][0]
conv4_block5_1_conv (Conv2D)	(None, 16, 16, 256)	262400	conv4_block4_out[0][0]
conv4_block5_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block5_1_conv[0][0]
conv4_block5_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block5_1_bn[0][0]
conv4_block5_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block5_1_relu[0][0]

conv4_block5_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block5_2_conv[0][0]
conv4_block5_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block5_2_bn[0][0]
conv4_block5_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block5_2_relu[0][0]
conv4_block5_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block5_3_conv[0][0]
conv4_block5_add (Add)	(None, 16, 16, 1024)	0	conv4_block4_out[0][0] conv4_block5_3_bn[0][0]
conv4_block5_out (Activation)	(None, 16, 16, 1024)	0	conv4_block5_add[0][0]
conv4_block6_1_conv (Conv2D)	(None, 16, 16, 256)	262400	conv4_block5_out[0][0]
conv4_block6_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block6_1_conv[0][0]
conv4_block6_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block6_1_bn[0][0]
conv4_block6_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block6_1_relu[0][0]
conv4_block6_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block6_2_conv[0][0]
conv4_block6_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block6_2_bn[0][0]
conv4_block6_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block6_2_relu[0][0]
conv4_block6_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block6_3_conv[0][0]
conv4_block6_add (Add)	(None, 16, 16, 1024)	0	conv4_block5_out[0][0] conv4_block6_3_bn[0][0]
conv4_block6_out (Activation)	(None, 16, 16, 1024)	0	conv4_block6_add[0][0]
conv5_block1_1_conv (Conv2D)	(None, 8, 8, 512)	524800	conv4_block6_out[0][0]
conv5_block1_1_bn (BatchNormali	(None, 8, 8, 512)	2048	conv5_block1_1_conv[0][0]
conv5_block1_1_relu (Activation	(None, 8, 8, 512)	0	conv5_block1_1_bn[0][0]
conv5_block1_2_conv (Conv2D)	(None, 8, 8, 512)	2359808	conv5_block1_1_relu[0][0]
conv5_block1_2_bn (BatchNormali	(None, 8, 8, 512)	2048	conv5_block1_2_conv[0][0]
conv5_block1_2_relu (Activation	(None, 8, 8, 512)	0	conv5_block1_2_bn[0][0]
conv5_block1_0_conv (Conv2D)	(None, 8, 8, 2048)	2099200	conv4_block6_out[0][0]
conv5_block1_3_conv (Conv2D)	(None, 8, 8, 2048)	1050624	conv5_block1_2_relu[0][0]
conv5_block1_0_bn (BatchNormali	(None, 8, 8, 2048)	8192	conv5_block1_0_conv[0][0]
conv5_block1_3_bn (BatchNormali	(None, 8, 8, 2048)	8192	conv5_block1_3_conv[0][0]
conv5_block1_add (Add)	(None, 8, 8, 2048)	0	conv5_block1_0_bn[0][0] conv5_block1_3_bn[0][0]
conv5_block1_out (Activation)	(None, 8, 8, 2048)	0	conv5_block1_add[0][0]
conv5_block2_1_conv (Conv2D)	(None, 8, 8, 512)	1049088	conv5_block1_out[0][0]
conv5_block2_1_bn (BatchNormali	(None, 8, 8, 512)	2048	conv5_block2_1_conv[0][0]
conv5_block2_1_relu (Activation	(None, 8, 8, 512)	0	conv5_block2_1_bn[0][0]
conv5_block2_2_conv (Conv2D)	(None, 8, 8, 512)	2359808	conv5_block2_1_relu[0][0]
conv5_block2_2_bn (BatchNormali	(None, 8, 8, 512)	2048	conv5_block2_2_conv[0][0]
conv5_block2_2_relu (Activation	(None, 8, 8, 512)	0	conv5_block2_2_bn[0][0]

conv5_block2_3_conv (Conv2D)	(None, 8, 8, 2048)	1050624	conv5_block2_2_relu[0][0]
conv5_block2_3_bn (BatchNormali	(None, 8, 8, 2048)	8192	conv5_block2_3_conv[0][0]
conv5_block2_add (Add)	(None, 8, 8, 2048)	0	conv5_block1_out[0][0] conv5_block2_3_bn[0][0]
conv5_block2_out (Activation)	(None, 8, 8, 2048)	0	conv5_block2_add[0][0]
conv5_block3_1_conv (Conv2D)	(None, 8, 8, 512)	1049088	conv5_block2_out[0][0]
conv5_block3_1_bn (BatchNormali	(None, 8, 8, 512)	2048	conv5_block3_1_conv[0][0]
conv5_block3_1_relu (Activation	(None, 8, 8, 512)	0	conv5_block3_1_bn[0][0]
conv5_block3_2_conv (Conv2D)	(None, 8, 8, 512)	2359808	conv5_block3_1_relu[0][0]
conv5_block3_2_bn (BatchNormali	(None, 8, 8, 512)	2048	conv5_block3_2_conv[0][0]
conv5_block3_2_relu (Activation	(None, 8, 8, 512)	0	conv5_block3_2_bn[0][0]
conv5_block3_3_conv (Conv2D)	(None, 8, 8, 2048)	1050624	conv5_block3_2_relu[0][0]
conv5_block3_3_bn (BatchNormali	(None, 8, 8, 2048)	8192	conv5_block3_3_conv[0][0]
conv5_block3_add (Add)	(None, 8, 8, 2048)	0	conv5_block2_out[0][0] conv5_block3_3_bn[0][0]
conv5_block3_out (Activation)	(None, 8, 8, 2048)	0	conv5_block3_add[0][0]
global_average_pooling2d (Globa	(None, 2048)	0	conv5_block3_out[0][0]
batch_normalization (BatchNorma	(None, 2048)	8192	global_average_pooling2d[0][0]
dropout (Dropout)	(None, 2048)	0	batch_normalization[0][0]
dense (Dense)	(None, 512)	1049088	dropout[0][0]
batch_normalization_1 (BatchNor	(None, 512)	2048	dense[0][0]
dropout_1 (Dropout)	(None, 512)	0	batch_normalization_1[0][0]
dense_1 (Dense)	(None, 102)	52326	dropout_1[0][0]

Total params: 24,699,366
Trainable params: 1,106,534
Non-trainable params: 23,592,832

Run 1 :-

```
Epoch 1/100
77/77 [==============================] - 12s 119ms/step - loss: 3.9482 - accuracy: 0.2310 - val_loss: 0.9454 -
val_accuracy: 0.8007
Epoch 2/100
77/77 [==============================] - 8s 104ms/step - loss: 0.8395 - accuracy: 0.7865 - val_loss: 0.5455 -
val_accuracy: 0.8742
Epoch 3/100
77/77 [==============================] - 8s 105ms/step - loss: 0.4379 - accuracy: 0.8936 - val_loss: 0.4876 -
val_accuracy: 0.8725
Epoch 4/100
77/77 [==============================] - 8s 105ms/step - loss: 0.2798 - accuracy: 0.9281 - val_loss: 0.4413 -
val_accuracy: 0.8824
Epoch 5/100
77/77 [==============================] - 8s 105ms/step - loss: 0.1883 - accuracy: 0.9631 - val_loss: 0.4090 -
val_accuracy: 0.8971
Epoch 6/100
```

```
77/77 [==============================] - 8s 103ms/step - loss: 0.1332 - accuracy: 0.9724 - val_loss: 0.4169 -
val_accuracy: 0.8824
Epoch 7/100
77/77 [==============================] - 8s 104ms/step - loss: 0.1120 - accuracy: 0.9785 - val_loss: 0.3901 -
val_accuracy: 0.8905
Epoch 8/100
77/77 [==============================] - 8s 103ms/step - loss: 0.0679 - accuracy: 0.9890 - val_loss: 0.3866 -
val_accuracy: 0.9036
Epoch 9/100
77/77 [==============================] - 8s 106ms/step - loss: 0.0600 - accuracy: 0.9895 - val_loss: 0.3725 -
val_accuracy: 0.8954
Epoch 10/100
77/77 [==============================] - 8s 105ms/step - loss: 0.0624 - accuracy: 0.9856 - val_loss: 0.3580 -
val_accuracy: 0.9101
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Epoch 95/100
77/77 [==============================] - 8s 103ms/step - loss: 0.0052 - accuracy: 0.9984 - val_loss: 0.5121 -
val_accuracy: 0.9167
Epoch 96/100
77/77 [==============================] - 8s 105ms/step - loss: 0.0043 - accuracy: 0.9983 - val_loss: 0.4965 -
val_accuracy: 0.9150
Epoch 97/100
77/77 [==============================] - 8s 102ms/step - loss: 0.0026 - accuracy: 0.9996 - val_loss: 0.5022 -
val_accuracy: 0.9118
Epoch 98/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0032 - accuracy: 0.9986 - val_loss: 0.4725 -
val_accuracy: 0.9118
Epoch 99/100
77/77 [==============================] - 8s 103ms/step - loss: 0.0012 - accuracy: 1.0000 - val_loss: 0.3456 -
val_accuracy: 0.9256
Epoch 100/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0122 - accuracy: 0.9968 - val_loss: 0.3106 -
val_accuracy: 0.9285

191/191 [==============================] - 17s 87ms/step - loss: 0.3106 - accuracy: 0.9285
The model achieved an accuracy of 92.85%.
```
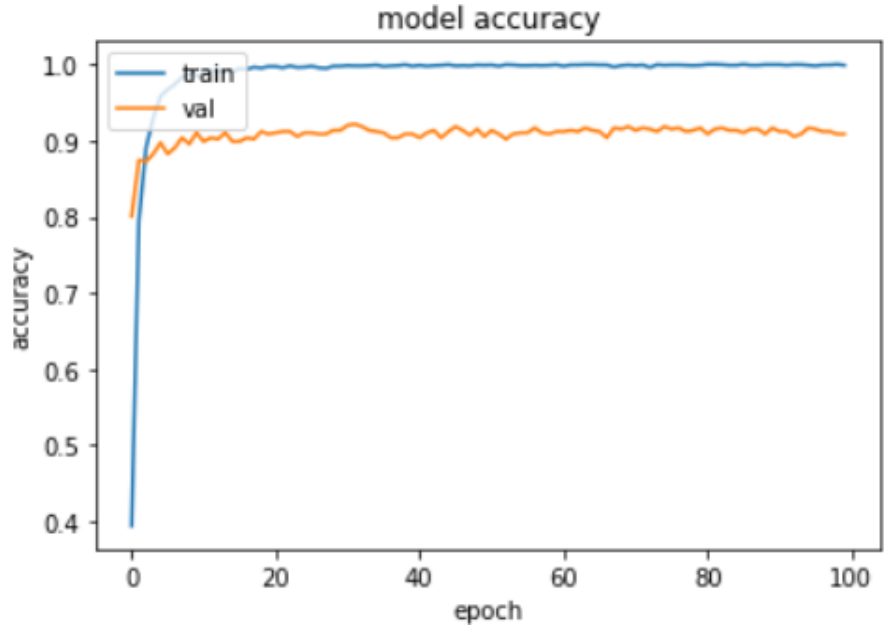

Graph :



Run 2 :-

```
Epoch 1/100
77/77 [==============================] - 12s 118ms/step - loss: 3.7950 - accuracy: 0.2540 - val_loss: 0.8917 -
val_accuracy: 0.8121
Epoch 2/100
77/77 [==============================] - 8s 103ms/step - loss: 0.8238 - accuracy: 0.7937 - val_loss: 0.5217 -
val_accuracy: 0.8693
Epoch 3/100
77/77 [==============================] - 8s 104ms/step - loss: 0.4332 - accuracy: 0.8923 - val_loss: 0.4016 -
val_accuracy: 0.9085
Epoch 4/100
77/77 [==============================] - 8s 104ms/step - loss: 0.2821 - accuracy: 0.9290 - val_loss: 0.3860 -
val_accuracy: 0.8971
Epoch 5/100
77/77 [==============================] - 8s 104ms/step - loss: 0.1891 - accuracy: 0.9585 - val_loss: 0.3821 -
val_accuracy: 0.8954
Epoch 6/100
77/77 [==============================] - 8s 105ms/step - loss: 0.1421 - accuracy: 0.9711 - val_loss: 0.3792 -
val_accuracy: 0.9134
Epoch 7/100
77/77 [==============================] - 8s 104ms/step - loss: 0.1132 - accuracy: 0.9783 - val_loss: 0.3498 -
val_accuracy: 0.9085
Epoch 8/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0912 - accuracy: 0.9818 - val_loss: 0.3550 -
val_accuracy: 0.9069
Epoch 9/100
77/77 [==============================] - 8s 106ms/step - loss: 0.0654 - accuracy: 0.9836 - val_loss: 0.3631 -
val_accuracy: 0.9183
Epoch 10/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0691 - accuracy: 0.9876 - val_loss: 0.3730 -
val_accuracy: 0.9020
Epoch 11/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0525 - accuracy: 0.9886 - val_loss: 0.3592 -
val_accuracy: 0.9069
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Epoch 95/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0037 - accuracy: 0.9999 - val_loss: 0.4641 -
val_accuracy: 0.9150
Epoch 96/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0028 - accuracy: 0.9989 - val_loss: 0.4615 -
val_accuracy: 0.9167
Epoch 97/100
77/77 [==============================] - 8s 103ms/step - loss: 0.0025 - accuracy: 0.9998 - val_loss: 0.4685 -
val_accuracy: 0.9118
Epoch 98/100
77/77 [==============================] - 8s 103ms/step - loss: 0.0020 - accuracy: 0.9999 - val_loss: 0.4490 -
val_accuracy: 0.9118
Epoch 99/100
77/77 [==============================] - 8s 105ms/step - loss: 0.0056 - accuracy: 0.9988 - val_loss: 0.4764 -
val_accuracy: 0.9199
Epoch 100/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0022 - accuracy: 0.9999 - val_loss: 0.4688 -
val_accuracy: 0.9232


191/191 [==============================] - 17s 87ms/step - loss: 0.5679 - accuracy: 0.9232
The model achieved an accuracy of 92.32%.
```
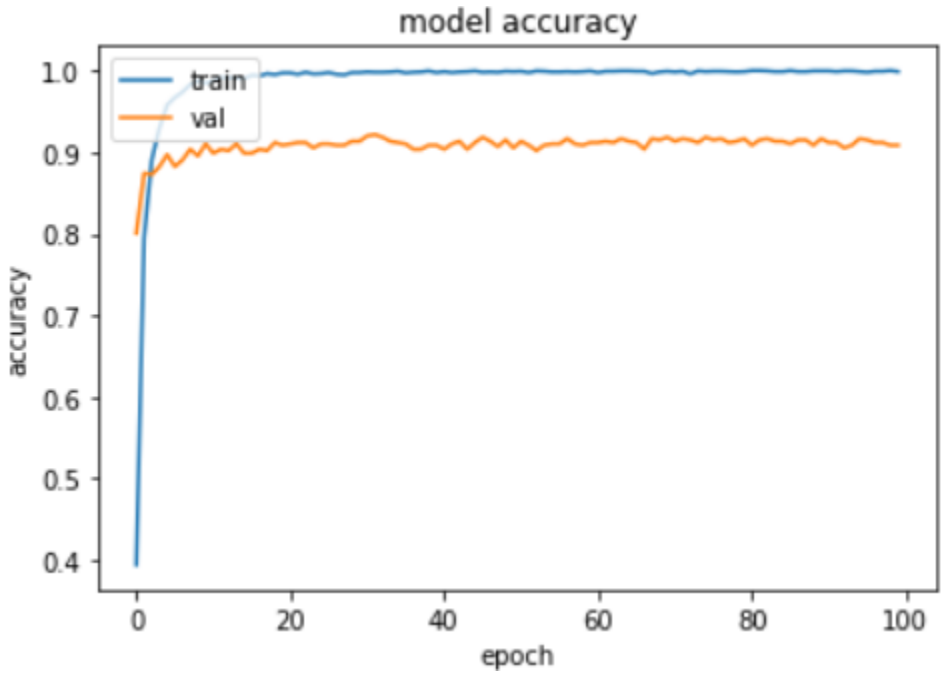

Graph :



Run 3 :-

```
Epoch 2/100
77/77 [==============================] - 8s 104ms/step - loss: 0.8395 - accuracy: 0.7865 - val_loss: 0.5455 -
val_accuracy: 0.8742
Epoch 3/100
77/77 [==============================] - 8s 105ms/step - loss: 0.4379 - accuracy: 0.8936 - val_loss: 0.4876 -
val_accuracy: 0.8725
Epoch 4/100
77/77 [==============================] - 8s 105ms/step - loss: 0.2798 - accuracy: 0.9281 - val_loss: 0.4413 -
val_accuracy: 0.8824
Epoch 5/100
77/77 [==============================] - 8s 105ms/step - loss: 0.1883 - accuracy: 0.9631 - val_loss: 0.4090 -
val_accuracy: 0.8971
Epoch 6/100
77/77 [==============================] - 8s 103ms/step - loss: 0.1332 - accuracy: 0.9724 - val_loss: 0.4169 -
val_accuracy: 0.8824
Epoch 7/100
77/77 [==============================] - 8s 104ms/step - loss: 0.1120 - accuracy: 0.9785 - val_loss: 0.3901 -
val_accuracy: 0.8905
Epoch 8/100
77/77 [==============================] - 8s 103ms/step - loss: 0.0679 - accuracy: 0.9890 - val_loss: 0.3866 -
val_accuracy: 0.9036
Epoch 9/100
77/77 [==============================] - 8s 106ms/step - loss: 0.0600 - accuracy: 0.9895 - val_loss: 0.3725 -
val_accuracy: 0.8954
Epoch 10/100
77/77 [==============================] - 8s 105ms/step - loss: 0.0624 - accuracy: 0.9856 - val_loss: 0.3580 -
val_accuracy: 0.9101
Epoch 11/100
77/77 [==============================] - 8s 106ms/step - loss: 0.0463 - accuracy: 0.9917 - val_loss: 0.3757 -
val_accuracy: 0.8987
Epoch 12/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0430 - accuracy: 0.9935 - val_loss: 0.3868 -
val_accuracy: 0.9036
```

```
Epoch 13/100
77/77 [==============================] - 8s 107ms/step - loss: 0.0486 - accuracy: 0.9914 - val_loss: 0.3892 -
val_accuracy: 0.9020
Epoch 14/100
77/77 [==============================] - 8s 105ms/step - loss: 0.0350 - accuracy: 0.9920 - val_loss: 0.3877 -
val_accuracy: 0.9101
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Epoch 95/100
77/77 [==============================] - 8s 103ms/step - loss: 0.0052 - accuracy: 0.9984 - val_loss: 0.5121 -
val_accuracy: 0.9167
Epoch 96/100
77/77 [==============================] - 8s 105ms/step - loss: 0.0043 - accuracy: 0.9983 - val_loss: 0.4965 -
val_accuracy: 0.9150
Epoch 97/100
77/77 [==============================] - 8s 102ms/step - loss: 0.0026 - accuracy: 0.9996 - val_loss: 0.5022 -
val_accuracy: 0.9118
Epoch 98/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0032 - accuracy: 0.9986 - val_loss: 0.4725 -
val_accuracy: 0.9118
Epoch 99/100
77/77 [==============================] - 8s 103ms/step - loss: 0.0012 - accuracy: 1.0000 - val_loss: 0.5157 -
val_accuracy: 0.9085
Epoch 100/100
77/77 [==============================] - 8s 104ms/step - loss: 0.0122 - accuracy: 0.9968 - val_loss: 0.4052 -
val_accuracy: 0.9185

191/191 [==============================] - 17s 87ms/step - loss: 0.5679 - accuracy: 0.9185
The model achieved an accuracy of 91.85%.
```
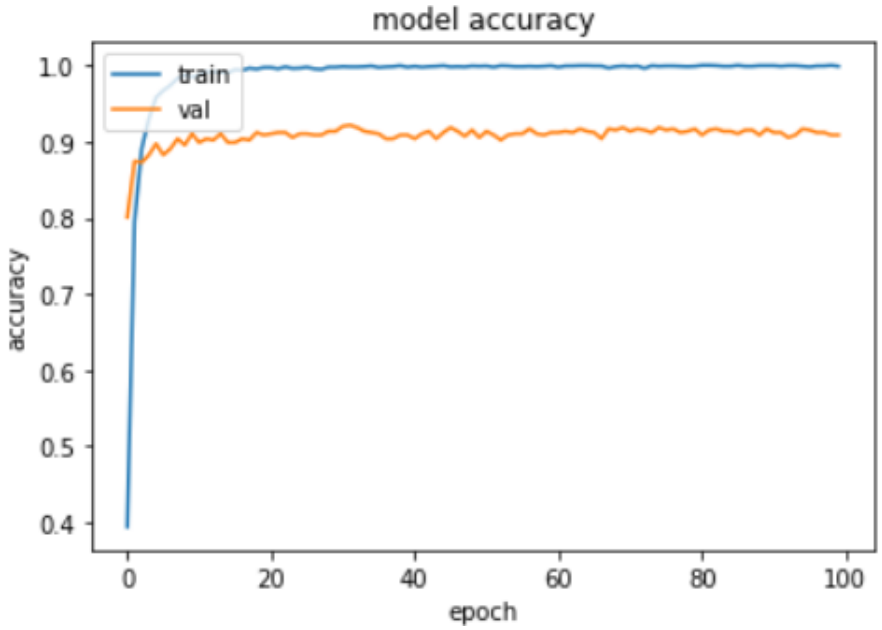

Graph :



Average Training Accuracy : 99.68%

Average Testing Accuracy: 92.05%

Caltech-256 using Resnet50

Model Summary:

Model: "model"

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 256, 256, 3)	0	
conv1_pad (ZeroPadding2D)	(None, 262, 262, 3)	0	input_1[0][0]
conv1_conv (Conv2D)	(None, 128, 128, 64)	9472	conv1_pad[0][0]
conv1_bn (BatchNormalization)	(None, 128, 128, 64)	256	conv1_conv[0][0]
conv1_relu (Activation)	(None, 128, 128, 64)	0	conv1_bn[0][0]
pool1_pad (ZeroPadding2D)	(None, 130, 130, 64)	0	conv1_relu[0][0]
pool1_pool (MaxPooling2D)	(None, 64, 64, 64)	0	pool1_pad[0][0]
conv2_block1_1_conv (Conv2D)	(None, 64, 64, 64)	4160	pool1_pool[0][0]
conv2_block1_1_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block1_1_conv[0][0]
conv2_block1_1_relu (Activation	(None, 64, 64, 64)	0	conv2_block1_1_bn[0][0]
conv2_block1_2_conv (Conv2D)	(None, 64, 64, 64)	36928	conv2_block1_1_relu[0][0]
conv2_block1_2_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block1_2_conv[0][0]
conv2_block1_2_relu (Activation	(None, 64, 64, 64)	0	conv2_block1_2_bn[0][0]
conv2_block1_0_conv (Conv2D)	(None, 64, 64, 256)	16640	pool1_pool[0][0]
conv2_block1_3_conv (Conv2D)	(None, 64, 64, 256)	16640	conv2_block1_2_relu[0][0]
conv2_block1_0_bn (BatchNormali	(None, 64, 64, 256)	1024	conv2_block1_0_conv[0][0]
conv2_block1_3_bn (BatchNormali	(None, 64, 64, 256)	1024	conv2_block1_3_conv[0][0]
conv2_block1_add (Add)	(None, 64, 64, 256)	0	conv2_block1_0_bn[0][0] conv2_block1_3_bn[0][0]
conv2_block1_out (Activation)	(None, 64, 64, 256)	0	conv2_block1_add[0][0]
conv2_block2_1_conv (Conv2D)	(None, 64, 64, 64)	16448	conv2_block1_out[0][0]
conv2_block2_1_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block2_1_conv[0][0]
conv2_block2_1_relu (Activation	(None, 64, 64, 64)	0	conv2_block2_1_bn[0][0]
conv2_block2_2_conv (Conv2D)	(None, 64, 64, 64)	36928	conv2_block2_1_relu[0][0]
conv2_block2_2_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block2_2_conv[0][0]
conv2_block2_2_relu (Activation	(None, 64, 64, 64)	0	conv2_block2_2_bn[0][0]
conv2_block2_3_conv (Conv2D)	(None, 64, 64, 256)	16640	conv2_block2_2_relu[0][0]
conv2_block2_3_bn (BatchNormali	(None, 64, 64, 256)	1024	conv2_block2_3_conv[0][0]
conv2_block2_add (Add)	(None, 64, 64, 256)	0	conv2_block1_out[0][0] conv2_block2_3_bn[0][0]
conv2_block2_out (Activation)	(None, 64, 64, 256)	0	conv2_block2_add[0][0]

conv2_block3_1_conv (Conv2D)	(None, 64, 64, 64)	16448	conv2_block2_out[0][0]
conv2_block3_1_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block3_1_conv[0][0]
conv2_block3_1_relu (Activation	(None, 64, 64, 64)	0	conv2_block3_1_bn[0][0]
conv2_block3_2_conv (Conv2D)	(None, 64, 64, 64)	36928	conv2_block3_1_relu[0][0]
conv2_block3_2_bn (BatchNormali	(None, 64, 64, 64)	256	conv2_block3_2_conv[0][0]
conv2_block3_2_relu (Activation	(None, 64, 64, 64)	0	conv2_block3_2_bn[0][0]
conv2_block3_3_conv (Conv2D)	(None, 64, 64, 256)	16640	conv2_block3_2_relu[0][0]
conv2_block3_3_bn (BatchNormali	(None, 64, 64, 256)	1024	conv2_block3_3_conv[0][0]
conv2_block3_add (Add)	(None, 64, 64, 256)	0	conv2_block2_out[0][0] conv2_block3_3_bn[0][0]
conv2_block3_out (Activation)	(None, 64, 64, 256)	0	conv2_block3_add[0][0]
conv3_block1_1_conv (Conv2D)	(None, 32, 32, 128)	32896	conv2_block3_out[0][0]
conv3_block1_1_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block1_1_conv[0][0]
conv3_block1_1_relu (Activation	(None, 32, 32, 128)	0	conv3_block1_1_bn[0][0]
conv3_block1_2_conv (Conv2D)	(None, 32, 32, 128)	147584	conv3_block1_1_relu[0][0]
conv3_block1_2_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block1_2_conv[0][0]
conv3_block1_2_relu (Activation	(None, 32, 32, 128)	0	conv3_block1_2_bn[0][0]
conv3_block1_0_conv (Conv2D)	(None, 32, 32, 512)	131584	conv2_block3_out[0][0]
conv3_block1_3_conv (Conv2D)	(None, 32, 32, 512)	66048	conv3_block1_2_relu[0][0]
conv3_block1_0_bn (BatchNormali	(None, 32, 32, 512)	2048	conv3_block1_0_conv[0][0]
conv3_block1_3_bn (BatchNormali	(None, 32, 32, 512)	2048	conv3_block1_3_conv[0][0]
conv3_block1_add (Add)	(None, 32, 32, 512)	0	conv3_block1_0_bn[0][0] conv3_block1_3_bn[0][0]
conv3_block1_out (Activation)	(None, 32, 32, 512)	0	conv3_block1_add[0][0]
conv3_block2_1_conv (Conv2D)	(None, 32, 32, 128)	65664	conv3_block1_out[0][0]
conv3_block2_1_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block2_1_conv[0][0]
conv3_block2_1_relu (Activation	(None, 32, 32, 128)	0	conv3_block2_1_bn[0][0]
conv3_block2_2_conv (Conv2D)	(None, 32, 32, 128)	147584	conv3_block2_1_relu[0][0]
conv3_block2_2_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block2_2_conv[0][0]
conv3_block2_2_relu (Activation	(None, 32, 32, 128)	0	conv3_block2_2_bn[0][0]
conv3_block2_3_conv (Conv2D)	(None, 32, 32, 512)	66048	conv3_block2_2_relu[0][0]
conv3_block2_3_bn (BatchNormali	(None, 32, 32, 512)	2048	conv3_block2_3_conv[0][0]
conv3_block2_add (Add)	(None, 32, 32, 512)	0	conv3_block1_out[0][0] conv3_block2_3_bn[0][0]
conv3_block2_out (Activation)	(None, 32, 32, 512)	0	conv3_block2_add[0][0]
conv3_block3_1_conv (Conv2D)	(None, 32, 32, 128)	65664	conv3_block2_out[0][0]
conv3_block3_1_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block3_1_conv[0][0]

conv3_block3_1_relu (Activation	(None, 32, 32, 128)	0	conv3_block3_1_bn[0][0]
conv3_block3_2_conv (Conv2D)	(None, 32, 32, 128)	147584	conv3_block3_1_relu[0][0]
conv3_block3_2_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block3_2_conv[0][0]
conv3_block3_2_relu (Activation	(None, 32, 32, 128)	0	conv3_block3_2_bn[0][0]
conv3_block3_3_conv (Conv2D)	(None, 32, 32, 512)	66048	conv3_block3_2_relu[0][0]
conv3_block3_3_bn (BatchNormali	(None, 32, 32, 512)	2048	conv3_block3_3_conv[0][0]
conv3_block3_add (Add)	(None, 32, 32, 512)	0	conv3_block2_out[0][0] conv3_block3_3_bn[0][0]
conv3_block3_out (Activation)	(None, 32, 32, 512)	0	conv3_block3_add[0][0]
conv3_block4_1_conv (Conv2D)	(None, 32, 32, 128)	65664	conv3_block3_out[0][0]
conv3_block4_1_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block4_1_conv[0][0]
conv3_block4_1_relu (Activation	(None, 32, 32, 128)	0	conv3_block4_1_bn[0][0]
conv3_block4_2_conv (Conv2D)	(None, 32, 32, 128)	147584	conv3_block4_1_relu[0][0]
conv3_block4_2_bn (BatchNormali	(None, 32, 32, 128)	512	conv3_block4_2_conv[0][0]
conv3_block4_2_relu (Activation	(None, 32, 32, 128)	0	conv3_block4_2_bn[0][0]
conv3_block4_3_conv (Conv2D)	(None, 32, 32, 512)	66048	conv3_block4_2_relu[0][0]
conv3_block4_3_bn (BatchNormali	(None, 32, 32, 512)	2048	conv3_block4_3_conv[0][0]
conv3_block4_add (Add)	(None, 32, 32, 512)	0	conv3_block3_out[0][0] conv3_block4_3_bn[0][0]
conv3_block4_out (Activation)	(None, 32, 32, 512)	0	conv3_block4_add[0][0]
conv4_block1_1_conv (Conv2D)	(None, 16, 16, 256)	131328	conv3_block4_out[0][0]
conv4_block1_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block1_1_conv[0][0]
conv4_block1_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block1_1_bn[0][0]
conv4_block1_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block1_1_relu[0][0]
conv4_block1_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block1_2_conv[0][0]
conv4_block1_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block1_2_bn[0][0]
conv4_block1_0_conv (Conv2D)	(None, 16, 16, 1024)	525312	conv3_block4_out[0][0]
conv4_block1_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block1_2_relu[0][0]
conv4_block1_0_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block1_0_conv[0][0]
conv4_block1_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block1_3_conv[0][0]
conv4_block1_add (Add)	(None, 16, 16, 1024)	0	conv4_block1_0_bn[0][0] conv4_block1_3_bn[0][0]
conv4_block1_out (Activation)	(None, 16, 16, 1024)	0	conv4_block1_add[0][0]
conv4_block2_1_conv (Conv2D)	(None, 16, 16, 256)	262400	conv4_block1_out[0][0]
conv4_block2_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block2_1_conv[0][0]
conv4_block2_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block2_1_bn[0][0]
conv4_block2_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block2_1_relu[0][0]

conv4_block2_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block2_2_conv[0][0]
conv4_block2_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block2_2_bn[0][0]
conv4_block2_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block2_2_relu[0][0]
conv4_block2_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block2_3_conv[0][0]
conv4_block2_add (Add)	(None, 16, 16, 1024)	0	conv4_block1_out[0][0] conv4_block2_3_bn[0][0]
conv4_block2_out (Activation)	(None, 16, 16, 1024)	0	conv4_block2_add[0][0]
conv4_block3_1_conv (Conv2D)	(None, 16, 16, 256)	262400	conv4_block2_out[0][0]
conv4_block3_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block3_1_conv[0][0]
conv4_block3_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block3_1_bn[0][0]
conv4_block3_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block3_1_relu[0][0]
conv4_block3_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block3_2_conv[0][0]
conv4_block3_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block3_2_bn[0][0]
conv4_block3_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block3_2_relu[0][0]
conv4_block3_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block3_3_conv[0][0]
conv4_block3_add (Add)	(None, 16, 16, 1024)	0	conv4_block2_out[0][0] conv4_block3_3_bn[0][0]
conv4_block3_out (Activation)	(None, 16, 16, 1024)	0	conv4_block3_add[0][0]
conv4_block4_1_conv (Conv2D)	(None, 16, 16, 256)	262400	conv4_block3_out[0][0]
conv4_block4_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block4_1_conv[0][0]
conv4_block4_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block4_1_bn[0][0]
conv4_block4_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block4_1_relu[0][0]
conv4_block4_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block4_2_conv[0][0]
conv4_block4_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block4_2_bn[0][0]
conv4_block4_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block4_2_relu[0][0]
conv4_block4_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block4_3_conv[0][0]
conv4_block4_add (Add)	(None, 16, 16, 1024)	0	conv4_block3_out[0][0] conv4_block4_3_bn[0][0]
conv4_block4_out (Activation)	(None, 16, 16, 1024)	0	conv4_block4_add[0][0]
conv4_block5_1_conv (Conv2D)	(None, 16, 16, 256)	262400	conv4_block4_out[0][0]
conv4_block5_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block5_1_conv[0][0]
conv4_block5_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block5_1_bn[0][0]
conv4_block5_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block5_1_relu[0][0]
conv4_block5_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block5_2_conv[0][0]
conv4_block5_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block5_2_bn[0][0]
conv4_block5_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block5_2_relu[0][0]
conv4_block5_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block5_3_conv[0][0]

conv4_block5_add (Add)	(None, 16, 16, 1024)	0	conv4_block4_out[0][0] conv4_block5_3_bn[0][0]
conv4_block5_out (Activation)	(None, 16, 16, 1024)	0	conv4_block5_add[0][0]
conv4_block6_1_conv (Conv2D)	(None, 16, 16, 256)	262400	conv4_block5_out[0][0]
conv4_block6_1_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block6_1_conv[0][0]
conv4_block6_1_relu (Activation	(None, 16, 16, 256)	0	conv4_block6_1_bn[0][0]
conv4_block6_2_conv (Conv2D)	(None, 16, 16, 256)	590080	conv4_block6_1_relu[0][0]
conv4_block6_2_bn (BatchNormali	(None, 16, 16, 256)	1024	conv4_block6_2_conv[0][0]
conv4_block6_2_relu (Activation	(None, 16, 16, 256)	0	conv4_block6_2_bn[0][0]
conv4_block6_3_conv (Conv2D)	(None, 16, 16, 1024)	263168	conv4_block6_2_relu[0][0]
conv4_block6_3_bn (BatchNormali	(None, 16, 16, 1024)	4096	conv4_block6_3_conv[0][0]
conv4_block6_add (Add)	(None, 16, 16, 1024)	0	conv4_block5_out[0][0] conv4_block6_3_bn[0][0]
conv4_block6_out (Activation)	(None, 16, 16, 1024)	0	conv4_block6_add[0][0]
conv5_block1_1_conv (Conv2D)	(None, 8, 8, 512)	524800	conv4_block6_out[0][0]
conv5_block1_1_bn (BatchNormali	(None, 8, 8, 512)	2048	conv5_block1_1_conv[0][0]
conv5_block1_1_relu (Activation	(None, 8, 8, 512)	0	conv5_block1_1_bn[0][0]
conv5_block1_2_conv (Conv2D)	(None, 8, 8, 512)	2359808	conv5_block1_1_relu[0][0]
conv5_block1_2_bn (BatchNormali	(None, 8, 8, 512)	2048	conv5_block1_2_conv[0][0]
conv5_block1_2_relu (Activation	(None, 8, 8, 512)	0	conv5_block1_2_bn[0][0]
conv5_block1_0_conv (Conv2D)	(None, 8, 8, 2048)	2099200	conv4_block6_out[0][0]
conv5_block1_3_conv (Conv2D)	(None, 8, 8, 2048)	1050624	conv5_block1_2_relu[0][0]
conv5_block1_0_bn (BatchNormali	(None, 8, 8, 2048)	8192	conv5_block1_0_conv[0][0]
conv5_block1_3_bn (BatchNormali	(None, 8, 8, 2048)	8192	conv5_block1_3_conv[0][0]
conv5_block1_add (Add)	(None, 8, 8, 2048)	0	conv5_block1_0_bn[0][0] conv5_block1_3_bn[0][0]
conv5_block1_out (Activation)	(None, 8, 8, 2048)	0	conv5_block1_add[0][0]
conv5_block2_1_conv (Conv2D)	(None, 8, 8, 512)	1049088	conv5_block1_out[0][0]
conv5_block2_1_bn (BatchNormali	(None, 8, 8, 512)	2048	conv5_block2_1_conv[0][0]
conv5_block2_1_relu (Activation	(None, 8, 8, 512)	0	conv5_block2_1_bn[0][0]
conv5_block2_2_conv (Conv2D)	(None, 8, 8, 512)	2359808	conv5_block2_1_relu[0][0]
conv5_block2_2_bn (BatchNormali	(None, 8, 8, 512)	2048	conv5_block2_2_conv[0][0]
conv5_block2_2_relu (Activation	(None, 8, 8, 512)	0	conv5_block2_2_bn[0][0]
conv5_block2_3_conv (Conv2D)	(None, 8, 8, 2048)	1050624	conv5_block2_2_relu[0][0]
conv5_block2_3_bn (BatchNormali	(None, 8, 8, 2048)	8192	conv5_block2_3_conv[0][0]
conv5_block2_add (Add)	(None, 8, 8, 2048)	0	conv5_block1_out[0][0] conv5_block2_3_bn[0][0]

```
conv5_block2_out (Activation)   (None, 8, 8, 2048)   0           conv5_block2_add[0][0]
__________________________________________________________________________________________________
conv5_block3_1_conv (Conv2D)    (None, 8, 8, 512)    1049088     conv5_block2_out[0][0]
__________________________________________________________________________________________________
conv5_block3_1_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block3_1_conv[0][0]
__________________________________________________________________________________________________
conv5_block3_1_relu (Activation (None, 8, 8, 512)    0           conv5_block3_1_bn[0][0]
__________________________________________________________________________________________________
conv5_block3_2_conv (Conv2D)    (None, 8, 8, 512)    2359808     conv5_block3_1_relu[0][0]
__________________________________________________________________________________________________
conv5_block3_2_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block3_2_conv[0][0]
__________________________________________________________________________________________________
conv5_block3_2_relu (Activation (None, 8, 8, 512)    0           conv5_block3_2_bn[0][0]
__________________________________________________________________________________________________
conv5_block3_3_conv (Conv2D)    (None, 8, 8, 2048)   1050624     conv5_block3_2_relu[0][0]
__________________________________________________________________________________________________
conv5_block3_3_bn (BatchNormali (None, 8, 8, 2048)   8192        conv5_block3_3_conv[0][0]
__________________________________________________________________________________________________
conv5_block3_add (Add)          (None, 8, 8, 2048)   0           conv5_block2_out[0][0]
                                                                 conv5_block3_3_bn[0][0]
__________________________________________________________________________________________________
conv5_block3_out (Activation)   (None, 8, 8, 2048)   0           conv5_block3_add[0][0]
__________________________________________________________________________________________________
global_average_pooling2d (Globa (None, 2048)         0           conv5_block3_out[0][0]
__________________________________________________________________________________________________
batch_normalization (BatchNorma (None, 2048)         8192        global_average_pooling2d[0][0]
__________________________________________________________________________________________________
dropout (Dropout)               (None, 2048)         0           batch_normalization[0][0]
__________________________________________________________________________________________________
dense (Dense)                   (None, 512)          1049088     dropout[0][0]
__________________________________________________________________________________________________
batch_normalization_1 (BatchNor (None, 512)          2048        dense[0][0]
__________________________________________________________________________________________________
dropout_1 (Dropout)             (None, 512)          0           batch_normalization_1[0][0]
__________________________________________________________________________________________________
dense_1 (Dense)                 (None, 256)          131328      dropout_1[0][0]
==================================================================================================
Total params: 24,778,368
Trainable params: 1,185,536
Non-trainable params: 23,592,832
__________________________________________________________________________________________________
```

Run 1 :

```
Epoch 1/100
48/48 [==============================] - 41s 747ms/step - loss: 5.2453 - accuracy: 0.0993 - val_loss: 2.4941 -
val_accuracy: 0.6081
Epoch 2/100
48/48 [==============================] - 34s 713ms/step - loss: 2.2302 - accuracy: 0.5297 - val_loss: 1.5533 -
val_accuracy: 0.7298
Epoch 3/100
48/48 [==============================] - 34s 715ms/step - loss: 1.4141 - accuracy: 0.6909 - val_loss: 1.1912 -
val_accuracy: 0.7663
Epoch 4/100
48/48 [==============================] - 34s 717ms/step - loss: 0.9930 - accuracy: 0.7816 - val_loss: 1.0262 -
val_accuracy: 0.7806
Epoch 5/100
48/48 [==============================] - 34s 707ms/step - loss: 0.7957 - accuracy: 0.8200 - val_loss: 0.9345 -
val_accuracy: 0.7806
Epoch 6/100
48/48 [==============================] - 35s 718ms/step - loss: 0.6134 - accuracy: 0.8627 - val_loss: 0.8811 -
val_accuracy: 0.7832
Epoch 7/100
48/48 [==============================] - 35s 723ms/step - loss: 0.5073 - accuracy: 0.8904 - val_loss: 0.8647 -
val_accuracy: 0.7904
Epoch 8/100
```

```
48/48 [==============================] - 34s 716ms/step - loss: 0.4100 - accuracy: 0.9127 - val_loss: 0.8456 -
val_accuracy: 0.7904
Epoch 9/100
48/48 [==============================] - 35s 729ms/step - loss: 0.3547 - accuracy: 0.9206 - val_loss: 0.8329 -
val_accuracy: 0.7897
Epoch 10/100
48/48 [==============================] - 34s 711ms/step - loss: 0.2885 - accuracy: 0.9374 - val_loss: 0.8333 -
val_accuracy: 0.7878
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Epoch 93/100
48/48 [==============================] - 33s 694ms/step - loss: 0.0330 - accuracy: 0.9928 - val_loss: 0.8830 -
val_accuracy: 0.8112
Epoch 94/100
48/48 [==============================] - 33s 689ms/step - loss: 0.0351 - accuracy: 0.9920 - val_loss: 0.8896 -
val_accuracy: 0.8034
Epoch 95/100
48/48 [==============================] - 34s 696ms/step - loss: 0.0300 - accuracy: 0.9938 - val_loss: 0.8879 -
val_accuracy: 0.8021
Epoch 96/100
48/48 [==============================] - 33s 696ms/step - loss: 0.0337 - accuracy: 0.9911 - val_loss: 0.8923 -
val_accuracy: 0.8040
Epoch 97/100
48/48 [==============================] - 33s 694ms/step - loss: 0.0339 - accuracy: 0.9923 - val_loss: 0.8946 -
val_accuracy: 0.8027
Epoch 98/100
48/48 [==============================] - 34s 699ms/step - loss: 0.0343 - accuracy: 0.9907 - val_loss: 0.8897 -
val_accuracy: 0.8008
Epoch 99/100
48/48 [==============================] - 34s 698ms/step - loss: 0.0387 - accuracy: 0.9894 - val_loss: 0.8773 -
val_accuracy: 0.8014
Epoch 81/100
48/48 [==============================] - 34s 700ms/step - loss: 0.0316 - accuracy: 0.9929 - val_loss: 0.8904 -
val_accuracy: 0.8008
Epoch 100/100
48/48 [==============================] - 33s 697ms/step - loss: 0.0258 - accuracy: 0.9955 - val_loss: 0.9144 -
val_accuracy: 0.8099

737/737 [==============================] - 101s 137ms/step - loss: 0.9054 - accuracy: 0.8063
The model achieved an accuracy of 80.63%.
```
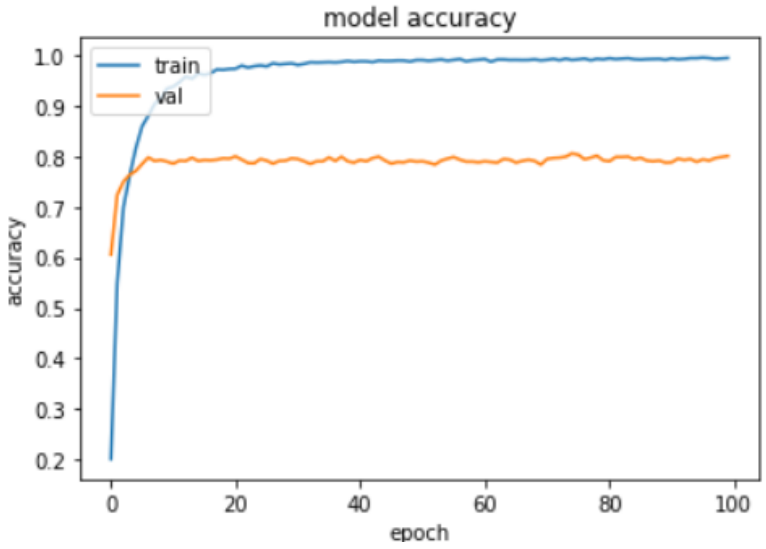

Graph :



Run 2 :

```
Epoch 1/100
48/48 [==============================] - 34s 640ms/step - loss: 5.2065 - accuracy: 0.1025 - val_loss: 2.4864 -
val_accuracy: 0.6055
Epoch 2/100
48/48 [==============================] - 30s 613ms/step - loss: 2.2103 - accuracy: 0.5257 - val_loss: 1.5412 -
val_accuracy: 0.7233
Epoch 3/100
48/48 [==============================] - 30s 613ms/step - loss: 1.4250 - accuracy: 0.6920 - val_loss: 1.1940 -
val_accuracy: 0.7493
Epoch 4/100
48/48 [==============================] - 29s 604ms/step - loss: 1.0002 - accuracy: 0.7736 - val_loss: 1.0439 -
val_accuracy: 0.7630
Epoch 5/100
48/48 [==============================] - 29s 597ms/step - loss: 0.7536 - accuracy: 0.8310 - val_loss: 0.9538 -
val_accuracy: 0.7708
Epoch 6/100
48/48 [==============================] - 29s 606ms/step - loss: 0.6335 - accuracy: 0.8643 - val_loss: 0.8896 -
val_accuracy: 0.7845
Epoch 7/100
48/48 [==============================] - 29s 599ms/step - loss: 0.4936 - accuracy: 0.8890 - val_loss: 0.8559 -
val_accuracy: 0.7975
Epoch 8/100
48/48 [==============================] - 29s 600ms/step - loss: 0.3942 - accuracy: 0.9140 - val_loss: 0.8405 -
val_accuracy: 0.7904
Epoch 9/100
48/48 [==============================] - 29s 599ms/step - loss: 0.3556 - accuracy: 0.9226 - val_loss: 0.8351 -
val_accuracy: 0.7923
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Epoch 94/100
48/48 [==============================] - 29s 609ms/step - loss: 0.0289 - accuracy: 0.9925 - val_loss: 0.8941 -
val_accuracy: 0.7943
Epoch 95/100
48/48 [==============================] - 29s 608ms/step - loss: 0.0293 - accuracy: 0.9940 - val_loss: 0.8993 -
val_accuracy: 0.7884
Epoch 96/100
48/48 [==============================] - 29s 601ms/step - loss: 0.0295 - accuracy: 0.9944 - val_loss: 0.8875 -
val_accuracy: 0.7936
Epoch 97/100
48/48 [==============================] - 29s 609ms/step - loss: 0.0311 - accuracy: 0.9927 - val_loss: 0.8948 -
val_accuracy: 0.7910
Epoch 98/100
48/48 [==============================] - 29s 610ms/step - loss: 0.0287 - accuracy: 0.9919 - val_loss: 0.8862 -
val_accuracy: 0.7962
Epoch 99/100
48/48 [==============================] - 29s 608ms/step - loss: 0.0267 - accuracy: 0.9920 - val_loss: 0.8947 -
val_accuracy: 0.7982
Epoch 100/100
48/48 [==============================] - 29s 602ms/step - loss: 0.0225 - accuracy: 0.9947 - val_loss: 0.8843 -
val_accuracy: 0.8001

737/737 [==============================] - 84s 114ms/step - loss: 0.9033 - accuracy: 0.8040
The model achieved an accuracy of 80.40%.
```
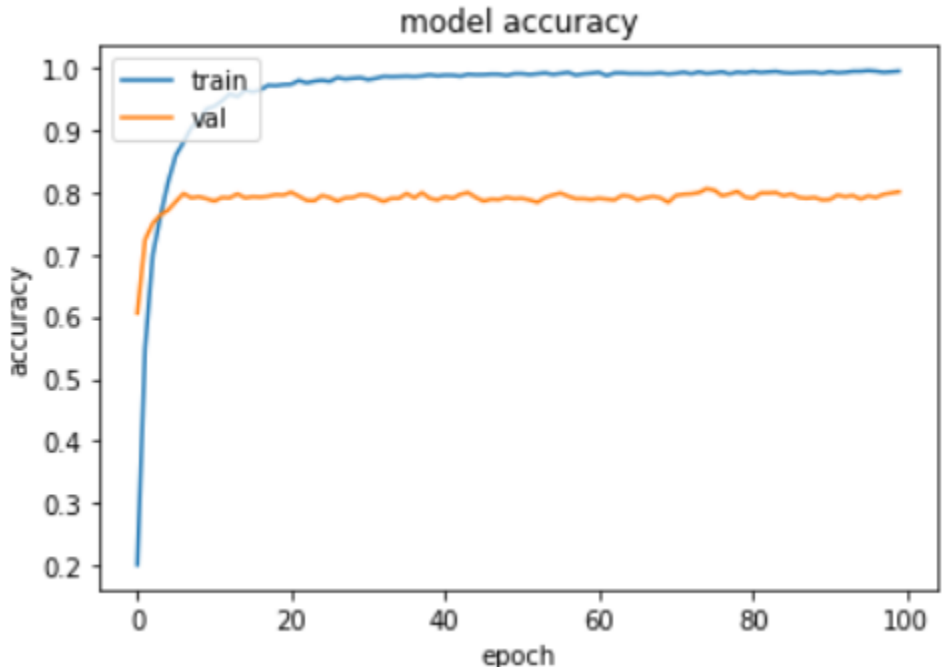
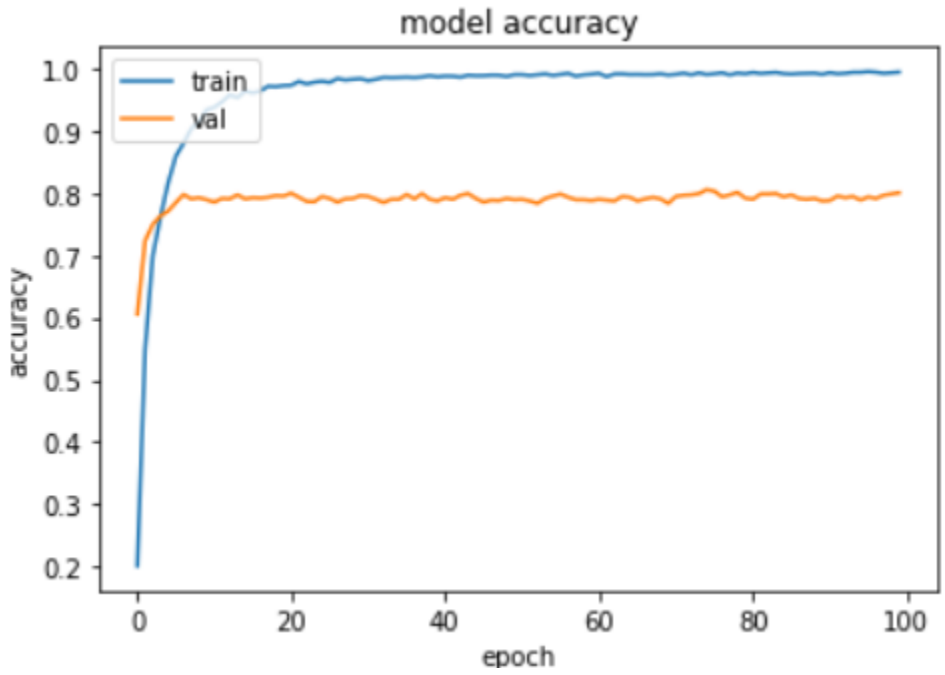

Graph :



Run 3 :

```
Epoch 92/100
48/48 [==============================] - 29s 601ms/step - loss: 0.0323 - accuracy: 0.9927 - val_loss: 0.9047 -
val_accuracy: 0.7949
Epoch 93/100
48/48 [==============================] - 29s 600ms/step - loss: 0.0312 - accuracy: 0.9920 - val_loss: 0.9006 -
val_accuracy: 0.7923
Epoch 94/100
48/48 [==============================] - 29s 609ms/step - loss: 0.0289 - accuracy: 0.9925 - val_loss: 0.8941 -
val_accuracy: 0.7943
Epoch 95/100
48/48 [==============================] - 29s 608ms/step - loss: 0.0293 - accuracy: 0.9940 - val_loss: 0.8993 -
val_accuracy: 0.7884
Epoch 96/100
48/48 [==============================] - 29s 601ms/step - loss: 0.0295 - accuracy: 0.9944 - val_loss: 0.8875 -
val_accuracy: 0.7936
Epoch 97/100
48/48 [==============================] - 29s 609ms/step - loss: 0.0311 - accuracy: 0.9927 - val_loss: 0.8948 -
val_accuracy: 0.7910
Epoch 98/100
48/48 [==============================] - 29s 610ms/step - loss: 0.0287 - accuracy: 0.9919 - val_loss: 0.8862 -
val_accuracy: 0.7962
Epoch 99/100
48/48 [==============================] - 29s 608ms/step - loss: 0.0267 - accuracy: 0.9920 - val_loss: 0.8947 -
val_accuracy: 0.7982
Epoch 100/100
48/48 [==============================] - 29s 602ms/step - loss: 0.0225 - accuracy: 0.9947 - val_loss: 0.8843 -
val_accuracy: 0.8001

737/737 [==============================] - 84s 114ms/step - loss: 0.9033 - accuracy: 0.8040
The model achieved an accuracy of 80.40%.
```

Graph :



Average Training Accuracy : 99.48%

Average Testing Accuracy: 80.40%

Average Testing Accuracies from 3 Run			Top-1 Accuracy
CIFAR 10	CALTECH 101	CALTECH 256	
95.26%	92.05%	80.40%	89.23%

Average Top-1 testing accuracy we got from these three datasets is 89.23%.