COL341
Fundamental of Machine Learning
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The architecture of the best model:

Training Parameters - 15,038,116

Layer (type)	Output Shape	Param #
conv2d_1 (Conv2D)	(None, 32, 32, 64)	1792
activation_1 (Activation)	(None, 32, 32, 64)	0
batch_normalization_1 (Batch	(None, 32, 32, 64)	256
dropout_1 (Dropout)	(None, 32, 32, 64)	0
conv2d_2 (Conv2D)	(None, 32, 32, 64)	36928
activation_2 (Activation)	(None, 32, 32, 64)	0
batch_normalization_2 (Batch	(None, 32, 32, 64)	256
max_pooling2d_1 (MaxPooling2	(None, 16, 16, 64)	0
conv2d_3 (Conv2D)	(None, 16, 16, 128)	73856
activation_3 (Activation)	(None, 16, 16, 128)	0
batch_normalization_3 (Batch	(None, 16, 16, 128)	512
dropout_2 (Dropout)	(None, 16, 16, 128)	0
conv2d_4 (Conv2D)	(None, 16, 16, 128)	147584
activation_4 (Activation)	(None, 16, 16, 128)	0
batch_normalization_4 (Batch	(None, 16, 16, 128)	512
max_pooling2d_2 (MaxPooling2	(None, 8, 8, 128)	0
conv2d_5 (Conv2D)	(None, 8, 8, 256)	295168
activation_5 (Activation)	(None, 8, 8, 256)	0
batch_normalization_5 (Batch	(None, 8, 8, 256)	1024
dropout_3 (Dropout)	(None, 8, 8, 256)	0
conv2d_6 (Conv2D)	(None, 8, 8, 256)	590080
activation_6 (Activation)	(None, 8, 8, 256)	0
batch_normalization_6 (Batch	(None, 8, 8, 256)	1024

```
_________________________________________________________________
dropout_4 (Dropout)          (None, 8, 8, 256)         0
_________________________________________________________________
conv2d_7 (Conv2D)            (None, 8, 8, 256)         590080
_________________________________________________________________
activation_7 (Activation)    (None, 8, 8, 256)         0
_________________________________________________________________
batch_normalization_7 (Batch (None, 8, 8, 256)         1024
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 4, 4, 256)         0
_________________________________________________________________
conv2d_8 (Conv2D)            (None, 4, 4, 512)         1180160
_________________________________________________________________
activation_8 (Activation)    (None, 4, 4, 512)         0
_________________________________________________________________
batch_normalization_8 (Batch (None, 4, 4, 512)         2048
_________________________________________________________________
dropout_5 (Dropout)          (None, 4, 4, 512)         0
_________________________________________________________________
conv2d_9 (Conv2D)            (None, 4, 4, 512)         2359808
_________________________________________________________________
activation_9 (Activation)    (None, 4, 4, 512)         0
_________________________________________________________________
batch_normalization_9 (Batch (None, 4, 4, 512)         2048
_________________________________________________________________
dropout_6 (Dropout)          (None, 4, 4, 512)         0
_________________________________________________________________
conv2d_10 (Conv2D)           (None, 4, 4, 512)         2359808
_________________________________________________________________
activation_10 (Activation)   (None, 4, 4, 512)         0
_________________________________________________________________
batch_normalization_10 (Batc (None, 4, 4, 512)         2048
_________________________________________________________________
max_pooling2d_4 (MaxPooling2 (None, 2, 2, 512)         0
_________________________________________________________________
conv2d_11 (Conv2D)           (None, 2, 2, 512)         2359808
_________________________________________________________________
activation_11 (Activation)   (None, 2, 2, 512)         0
_________________________________________________________________
batch_normalization_11 (Batc (None, 2, 2, 512)         2048
_________________________________________________________________
dropout_7 (Dropout)          (None, 2, 2, 512)         0
_________________________________________________________________
conv2d_12 (Conv2D)           (None, 2, 2, 512)         2359808
_________________________________________________________________
activation_12 (Activation)   (None, 2, 2, 512)         0
_________________________________________________________________
batch_normalization_12 (Batc (None, 2, 2, 512)         2048
_________________________________________________________________
dropout_8 (Dropout)          (None, 2, 2, 512)         0
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```

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_________________________________________________________________
conv2d_13 (Conv2D)           (None, 2, 2, 512)         2359808
_________________________________________________________________
activation_13 (Activation)   (None, 2, 2, 512)         0
_________________________________________________________________
batch_normalization_13 (Batc (None, 2, 2, 512)         2048
_________________________________________________________________
max_pooling2d_5 (MaxPooling2 (None, 1, 1, 512)         0
_________________________________________________________________
dropout_9 (Dropout)          (None, 1, 1, 512)         0
_________________________________________________________________
flatten_1 (Flatten)          (None, 512)               0
_________________________________________________________________
dense_1 (Dense)              (None, 512)               262656
_________________________________________________________________
activation_14 (Activation)   (None, 512)               0
_________________________________________________________________
batch_normalization_14 (Batc (None, 512)               2048
_________________________________________________________________
dropout_10 (Dropout)         (None, 512)               0
_________________________________________________________________
dense_2 (Dense)              (None, 100)               51300
_________________________________________________________________
activation_15 (Activation)   (None, 100)               0
=================================================================
Total params: 15,047,588
Trainable params: 15,038,116
Non-trainable params: 9,472
_________________________________________________________________
Epoch 1/200
```

Parameters:

We used learning rate scheduler

```
def lr_scheduler(epoch):
    return learning_rate*(0.5**(epoch//lr_drop))
```

Lr_drop = 20

```
batch_size = 128
maxepoches = 200
learning_rate = 0.1
lr_decay = 1e-6
lr_drop = 20
```

Data Augmentation:-

```
datagen = ImageDataGenerator(
    featurewise_center=False,
    samplewise_center=False,
    featurewise_std_normalization=False,
    samplewise_std_normalization=False,
    zca_whitening=False,
    rotation_range=15,
    width_shift_range=0.1,
    height_shift_range=0.1,
    horizontal_flip=True,
    vertical_flip=False
)
datagen.fit(x_train)
```

Plot of Traning & Test loss and accuracy Vs Epochs