Question#1

Model 1 Details

Layer (type)	Output Shape	Param #
conv2d_36 (Conv2D)	(None, 254, 254, 4)	112
conv2d_37 (Conv2D)	(None, 254, 254, 2)	74
max_pooling2d_15 (MaxPooling	(None, 127, 127, 2)	0
conv2d_38 (Conv2D)	(None, 127, 127, 2)	38
conv2d_39 (Conv2D)	(None, 127, 127, 5)	255
max_pooling2d_16 (MaxPooling	(None, 63, 63, 5)	0
conv2d_40 (Conv2D)	(None, 31, 31, 10)	210
flatten_8 (Flatten)	(None, 9610)	0
dropout_8 (Dropout)	(None, 9610)	0
dense_15 (Dense)	(None, 50)	480550
dense_16 (Dense)	(None, 7)	357

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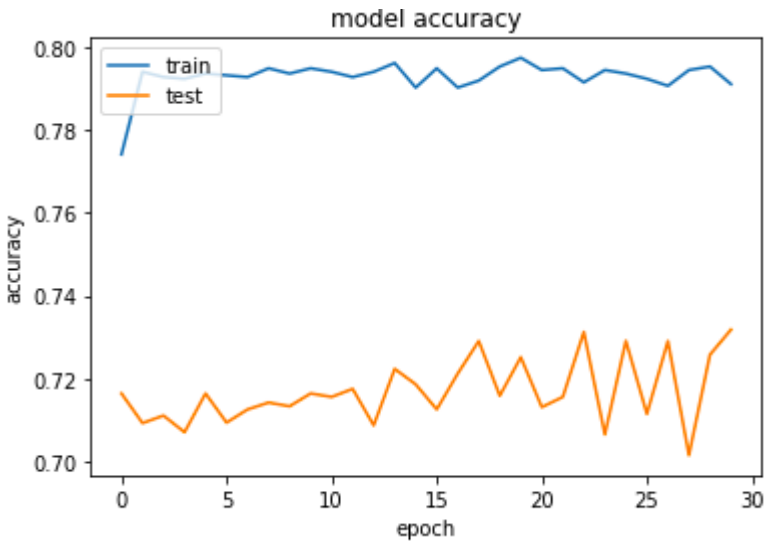
Total params: 481,596

Trainable params: 481,596

Non-trainable params: 0

Model 1 Accuracy



Model 2 (VGG) Details

Layer (type)	Output Shape	Param #
conv2d_51 (Conv2D)	(None, 254, 254, 2)	56
conv2d_52 (Conv2D)	(None, 254, 254, 2)	38
max_pooling2d_21 (MaxPooling	(None, 126, 126, 2)	0

conv2d_53 (Conv2D)	(None, 126, 126, 4)	76
conv2d_54 (Conv2D)	(None, 126, 126, 4)	148
max_pooling2d_22 (MaxPooling	(None, 62, 62, 4)	0
conv2d_55 (Conv2D)	(None, 62, 62, 16)	592
conv2d_56 (Conv2D)	(None, 62, 62, 16)	2320
conv2d_57 (Conv2D)	(None, 62, 62, 16)	2320
max_pooling2d_23 (MaxPooling	(None, 30, 30, 16)	0
conv2d_58 (Conv2D)	(None, 30, 30, 32)	4640
conv2d_59 (Conv2D)	(None, 30, 30, 32)	9248
conv2d_60 (Conv2D)	(None, 30, 30, 32)	9248
max_pooling2d_24 (MaxPooling	(None, 14, 14, 32)	0
flatten_10 (Flatten)	(None, 6272)	0
dropout_10 (Dropout)	(None, 6272)	0
dense_21 (Dense)	(None, 64)	401472

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dense_22 (Dense) (None, 64) 4160

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dense_23 (Dense) (None, 64) 4160

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dense_24 (Dense) (None, 7) 455

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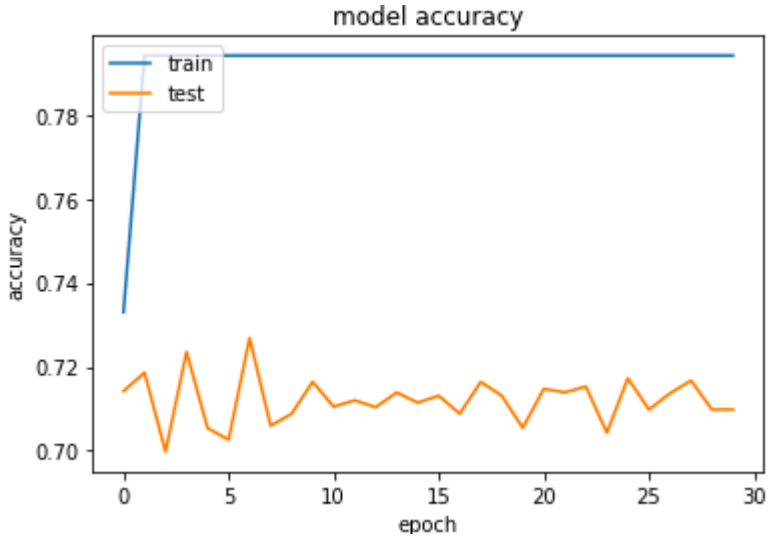
Total params: 438,933

Trainable params: 438,933

Non-trainable params: 0

Model 2 Accuracy



Model 3(Resnet) Details

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Layer (type) Output Shape Param # Connected to

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input_2 (InputLayer) (None, 32, 32, 3) 0

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conv2d_22 (Conv2D)                  (None, 16, 16, 4)       592         input_2[0][0]

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batch_normalization_18 (BatchNo (None, 16, 16, 4)       16          conv2d_22[0][0]

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activation_18 (Activation)          (None, 16, 16, 4)       0
batch_normalization_18[0][0]

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max_pooling2d_2 (MaxPooling2D)      (None, 8, 8, 4)         0           activation_18[0][0]

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conv2d_23 (Conv2D)                  (None, 8, 8, 64)        2368
max_pooling2d_2[0][0]

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batch_normalization_19 (BatchNo (None, 8, 8, 64)        256         conv2d_23[0][0]

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activation_19 (Activation)          (None, 8, 8, 64)        0
batch_normalization_19[0][0]

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conv2d_25 (Conv2D)                  (None, 8, 8, 64)        320
max_pooling2d_2[0][0]

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conv2d_24 (Conv2D)                  (None, 8, 8, 64)        36928
activation_19[0][0]
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add_9 (Add) (None, 8, 8, 64) 0 conv2d_25[0][0]

conv2d_24[0][0]

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batch_normalization_20 (BatchNo (None, 8, 8, 64) 256 add_9[0][0]

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activation_20 (Activation) (None, 8, 8, 64) 0
batch_normalization_20[0][0]

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conv2d_26 (Conv2D) (None, 8, 8, 64) 36928
activation_20[0][0]

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batch_normalization_21 (BatchNo (None, 8, 8, 64) 256 conv2d_26[0][0]

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activation_21 (Activation) (None, 8, 8, 64) 0
batch_normalization_21[0][0]

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conv2d_27 (Conv2D) (None, 8, 8, 64) 36928
activation_21[0][0]

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add_10 (Add) (None, 8, 8, 64) 0 add_9[0][0]

conv2d_27[0][0]

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batch_normalization_22 (BatchNo (None, 8, 8, 64) 256 add_10[0][0]

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activation_22 (Activation) (None, 8, 8, 64) 0
batch_normalization_22[0][0]

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conv2d_28 (Conv2D) (None, 4, 4, 128) 73856
activation_22[0][0]

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batch_normalization_23 (BatchNo (None, 4, 4, 128) 512 conv2d_28[0][0]

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activation_23 (Activation) (None, 4, 4, 128) 0
batch_normalization_23[0][0]

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conv2d_30 (Conv2D) (None, 4, 4, 128) 8320 add_10[0][0]

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conv2d_29 (Conv2D) (None, 4, 4, 128) 147584
activation_23[0][0]

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add_11 (Add) (None, 4, 4, 128) 0 conv2d_30[0][0]

conv2d_29[0][0]

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batch_normalization_24 (BatchNo (None, 4, 4, 128) 512 add_11[0][0]

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activation_24 (Activation) (None, 4, 4, 128) 0
batch_normalization_24[0][0]

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conv2d_31 (Conv2D) (None, 4, 4, 128) 147584
activation_24[0][0]

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batch_normalization_25 (BatchNo (None, 4, 4, 128) 512 conv2d_31[0][0]

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activation_25 (Activation) (None, 4, 4, 128) 0
batch_normalization_25[0][0]

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conv2d_32 (Conv2D) (None, 4, 4, 128) 147584
activation_25[0][0]

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add_12 (Add) (None, 4, 4, 128) 0 add_11[0][0]

conv2d_32[0][0]

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batch_normalization_26 (BatchNo (None, 4, 4, 128) 512 add_12[0][0]

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activation_26 (Activation) (None, 4, 4, 128) 0
batch_normalization_26[0][0]

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conv2d_33 (Conv2D) (None, 2, 2, 256) 295168
activation_26[0][0]

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batch_normalization_27 (BatchNo (None, 2, 2, 256) 1024 conv2d_33[0][0]

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activation_27 (Activation) (None, 2, 2, 256) 0
batch_normalization_27[0][0]

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conv2d_35 (Conv2D) (None, 2, 2, 256) 33024 add_12[0][0]

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conv2d_34 (Conv2D) (None, 2, 2, 256) 590080
activation_27[0][0]

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add_13 (Add) (None, 2, 2, 256) 0 conv2d_35[0][0]

conv2d_34[0][0]

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batch_normalization_28 (BatchNo (None, 2, 2, 256) 1024 add_13[0][0]

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activation_28 (Activation) (None, 2, 2, 256) 0
batch_normalization_28[0][0]

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conv2d_36 (Conv2D) (None, 2, 2, 256) 590080
activation_28[0][0]

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batch_normalization_29 (BatchNo (None, 2, 2, 256) 1024 conv2d_36[0][0]

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activation_29 (Activation) (None, 2, 2, 256) 0
batch_normalization_29[0][0]

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conv2d_37 (Conv2D) (None, 2, 2, 256) 590080
activation_29[0][0]

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add_14 (Add) (None, 2, 2, 256) 0 add_13[0][0]

conv2d_37[0][0]

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batch_normalization_30 (BatchNo (None, 2, 2, 256) 1024 add_14[0][0]

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activation_30 (Activation) (None, 2, 2, 256) 0
batch_normalization_30[0][0]

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conv2d_38 (Conv2D) (None, 1, 1, 512) 1180160
activation_30[0][0]

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batch_normalization_31 (BatchNo (None, 1, 1, 512) 2048 conv2d_38[0][0]

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activation_31 (Activation) (None, 1, 1, 512) 0
batch_normalization_31[0][0]

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conv2d_40 (Conv2D) (None, 1, 1, 512) 131584 add_14[0][0]

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conv2d_39 (Conv2D) (None, 1, 1, 512) 2359808
activation_31[0][0]

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add_15 (Add) (None, 1, 1, 512) 0 conv2d_40[0][0]

conv2d_39[0][0]

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batch_normalization_32 (BatchNo (None, 1, 1, 512) 2048 add_15[0][0]

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activation_32 (Activation) (None, 1, 1, 512) 0
batch_normalization_32[0][0]

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conv2d_41 (Conv2D) (None, 1, 1, 512) 2359808
activation_32[0][0]

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batch_normalization_33 (BatchNo (None, 1, 1, 512) 2048 conv2d_41[0][0]

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activation_33 (Activation) (None, 1, 1, 512) 0
batch_normalization_33[0][0]

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conv2d_42 (Conv2D) (None, 1, 1, 512) 2359808
activation_33[0][0]

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add_16 (Add) (None, 1, 1, 512) 0 add_15[0][0]

conv2d_42[0][0]

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batch_normalization_34 (BatchNo (None, 1, 1, 512) 2048 add_16[0][0]

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activation_34 (Activation) (None, 1, 1, 512) 0
batch_normalization_34[0][0]

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average_pooling2d_2 (AveragePoo (None, 1, 1, 512) 0 activation_34[0][0]

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flatten_2 (Flatten) (None, 512) 0
average_pooling2d_2[0][0]

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dense_2 (Dense) (None, 7) 3591 flatten_2[0][0]

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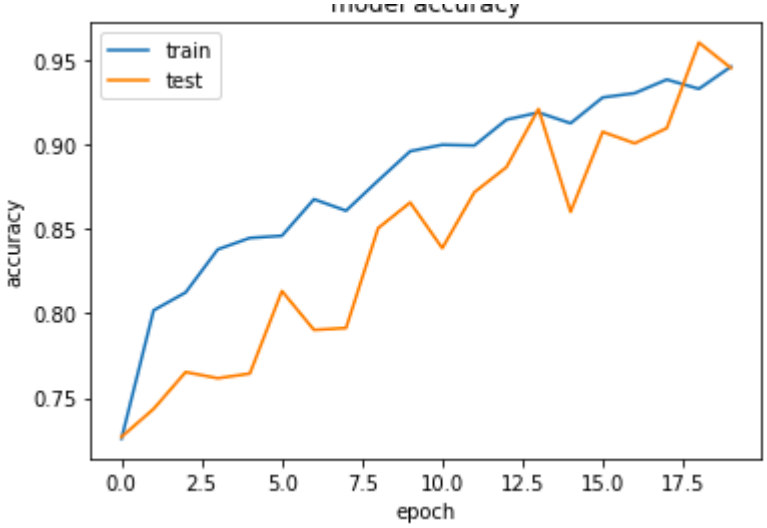
Total params: 11,147,559

Trainable params: 11,139,871

Non-trainable params: 7,688

Accuracy



Resnet gives the best results. Resnet makes use of fact that adding an identity function to another function doesn't affect its performance. We have seen that the accuracy of the model as it grows deep decreases due to the training error introduced due to adding of more layers. Resnet reduces this performance drop by adding the result of shallow layer and deep layer before applying activation that makes sure that the perform remain atlease equivalent to the previous layer.

Question#2

In this part the model is first trained on the resnet used in previous question, first five layers are fixed and two dense layers of size 1024 are applied.

Validation accuracy is dropped that is due to over-fitting using 2 extra dense layers.