Mini Project Report for P556 Applied Machine Learning

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Approach: Trying to solve it with reference to MNIST digit recognition/classification

Trials:

1. **Transfer learning with MobileNet**

   Preprocessing steps:

   1. Standardize input by dividing by 255
   2. convert 28x28 matrix to 32x32(cubic resize)
   3. Convert greyscale(1 channel) image to RGB(3 channel)
   4. One hot encode labels

   Performance: batchsize=400, epochs=50

   Train acc: 95%
   Test acc: 58%

   Interpretation: The model is overfitting badly to training data and is unable to generalize well thats why test accuracy is very low compared to train accuracy

2. **LeNet architecture(modified hidden layers with batch normalization)**

   Preprocessing steps:

   1. Standardize input by dividing by 255
   2. convert 28x28 matrix to 32x32(cubic resize)
   3. Change dimensions of training array
   4. One hot encode labels

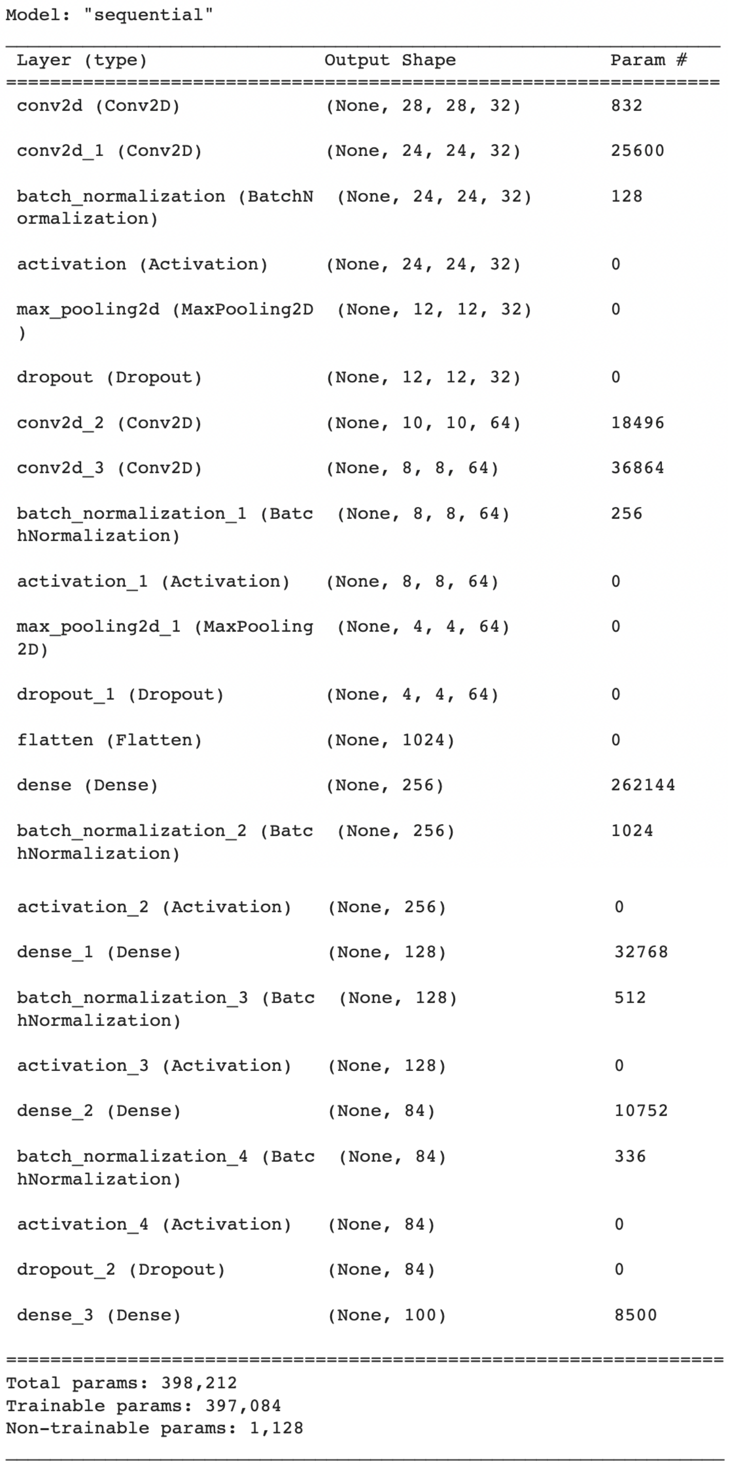
   Performance: batchsize=100, epochs=50, 75(best), 100

   Train acc: 72%
   Test acc: 73%

   Interpretation: The model's test accuracy is higher than train accuracy which suggests that the overfitting problem has been solved.

   Other experiments: Modifying the hidden layers(increasing/decreasing neurons), adding more hidden layers, changing the batch size does not result in a significat increase in test accuracy when compared to the Lenet Model with batchsize=100, epochs=75, moreover all of the experiments with LeNet results in comparable accuracies.

Conclusion: After several experiments, I found out that LeNet with the below given model summary outperforms every other model tested while trained for 75 epochs and batchsize of 100. In future we can experiment with batch normalization(I think this is what helped improving the score) and adding Regularization.



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Model: "sequential"
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 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 28, 28, 32)        832

 conv2d_1 (Conv2D)           (None, 24, 24, 32)        25600

 batch_normalization (BatchN  (None, 24, 24, 32)       128
 ormalization)

 activation (Activation)     (None, 24, 24, 32)        0

 max_pooling2d (MaxPooling2D  (None, 12, 12, 32)       0
 )

 dropout (Dropout)           (None, 12, 12, 32)        0

 conv2d_2 (Conv2D)           (None, 10, 10, 64)        18496

 conv2d_3 (Conv2D)           (None, 8, 8, 64)          36864

 batch_normalization_1 (Batc  (None, 8, 8, 64)         256
 hNormalization)

 activation_1 (Activation)   (None, 8, 8, 64)          0

 max_pooling2d_1 (MaxPooling  (None, 4, 4, 64)         0
 2D)

 dropout_1 (Dropout)         (None, 4, 4, 64)          0

 flatten (Flatten)           (None, 1024)              0

 dense (Dense)               (None, 256)               262144

 batch_normalization_2 (Batc  (None, 256)              1024
 hNormalization)

 activation_2 (Activation)   (None, 256)               0

 dense_1 (Dense)             (None, 128)               32768

 batch_normalization_3 (Batc  (None, 128)              512
 hNormalization)

 activation_3 (Activation)   (None, 128)               0

 dense_2 (Dense)             (None, 84)                10752

 batch_normalization_4 (Batc  (None, 84)               336
 hNormalization)

 activation_4 (Activation)   (None, 84)                0

 dropout_2 (Dropout)         (None, 84)                0

 dense_3 (Dense)             (None, 100)               8500

=================================================================
Total params: 398,212
Trainable params: 397,084
Non-trainable params: 1,128
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```

Epoch 75/100
loss: 1.0929 - accuracy: 0.7214 - val_loss: 1.0697 - val_accuracy: 0.7306

References:

1)https://www.kaggle.com/code/sabarish2611/alexnet-vs-mobilenet-using-mnist-data#AlexNet-vs-MobileNet-:-Comparing-the-performance
2)https://towardsdatascience.com/going-beyond-99-mnist-handwritten-digits-recognition-cfff96337392