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# CENG 483

## Introduction to Computer Vision

Spring 2018-2019

Take Home Exam 3

Image Colorization

Student Random ID:

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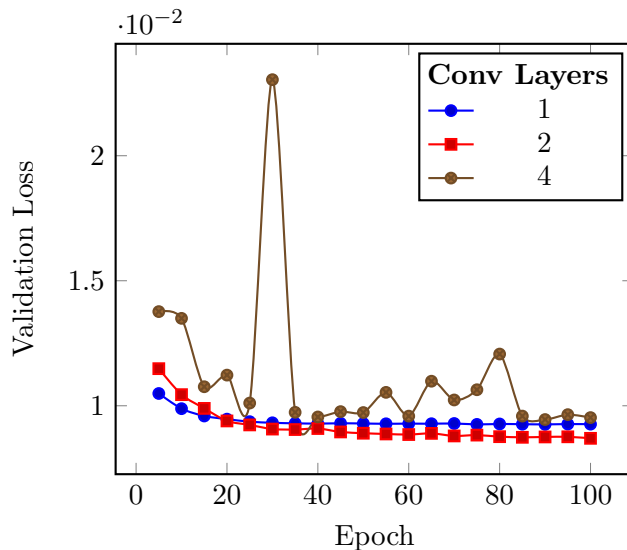
Please fill in the sections below only with the requested information. If you have additional things to mention, you can use the last section. Please note that all of the results in this report should be given for the **validation set** by default, unless otherwise specified. Also, when you are expected to comment on the effect of a parameter, please make sure to **fix** other parameters. You may support your comments with visuals (i.e. loss plot).

### 1 Baseline Architecture (30 pts)

Based on your qualitative results (do not forget to give them),

- Discuss effect of the number of conv layers:

I have fixed the hyperparameters other than number of convolution layers such that kernel size is **3** except the last convolution layer, number of kernels is **2** and learning rate is **0.1**.



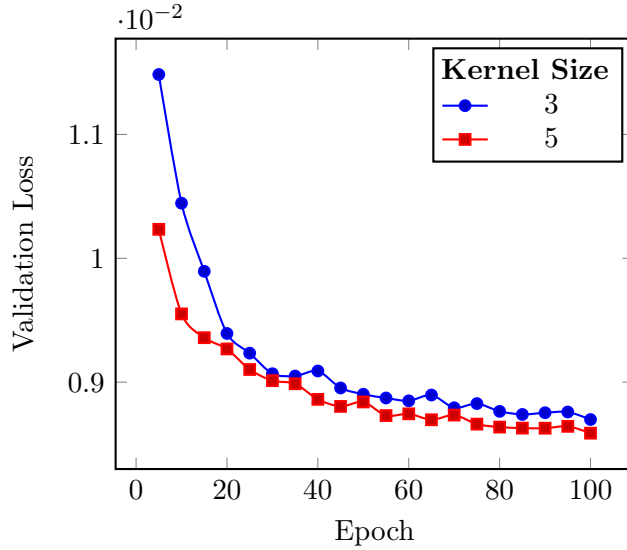
Convolutional Layers	Validation Loss
1	0.009255
2	0.008698
4	0.009449

Table 1: The lowest validation losses of convolutional neural networks achieved with different number of convolutional layers in the network

Figure 1: Validation loss of convolutional neural networks with different number of convolutional layers in the network over 100 epoch

- Discuss effect of the kernel size(except the last conv layer):

I have fixed the hyperparameters other than kernel size such that the number of convolutional layer is **2**, the number of kernels is **2** and learning rate is **0.1**.



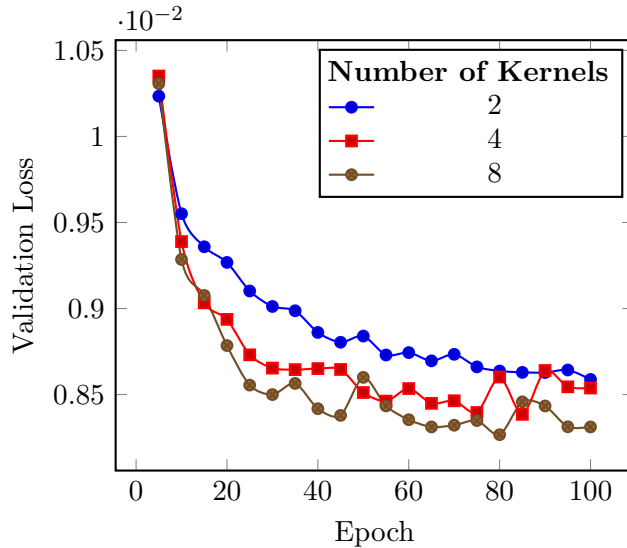
Kernel Size	Validation Loss
3	0.008698
5	0.008588

Table 2: The lowest validation losses of convolutional neural networks achieved with different kernel sizes

Figure 2: Validation loss of convolutional neural network with different kernel sizes over 100 epoch

- Discuss effect of the number of kernels(except the last conv layer):

I have fixed the hyperparameters other than the number of kernels (except the last convolutional layer) such that the number of convolutional layer is **2**, kernel size is **5** and learning rate is **0.1**.



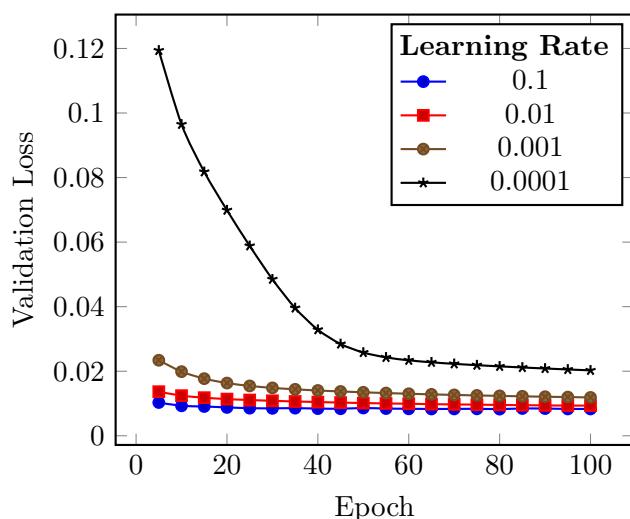
The Number of Kernels	Validation Loss
2	0.008588
4	0.008385
8	0.008267

Table 3: The lowest validation losses of convolutional neural networks achieved with different number of kernels

Figure 3: Validation loss of convolutional neural networks with different number of kernels over 100 epoch

- Discuss effect of the learning rate by choosing three values: a very large one, a very small one and a value of your choice:

I have fixed the hyperparameters other than the learning rate such that the number of convolutional layer is **2**, kernel size is **5** and the number of kernels is **8**.



Learning Rate	Validation Loss
0.1	0.008267
0.01	0.009342
0.001	0.011880
0.0001	0.020264

Table 4: The lowest validation losses of convolutional neural networks achieved with different learning rates

Figure 4: Validation loss of convolutional neural networks with different learning rates over 100 epoch

## 2 Further Experiments (20 pts)

Based on your qualitative results (do not forget to give them),

- Try adding a batch-norm layer (`torch.nn.BatchNorm2d`) into each convolutional layer. How does it affect the results, and, why? Keep it if it is beneficial.
- Try adding a tanh activation function after the very last convolutional layer. How does it affect the results, and, why? Keep it if it is beneficial.
- Try setting the number of channels parameter to 8. How does it affect the results, and, why? Keep it if it is beneficial.

## 3 Your Best Configuration (20 pts)

Using the best model that you obtain, report the following:

- The automatically chosen number of epochs(what was your strategy?):
- The plot of the training mean-squared error loss over epochs:
- The plot of the validation 12-margin error over epochs (see the3 text for details):
- At least 5 qualitative results on the validation set, showing the prediction and the target colored image:
- Discuss the advantages and disadvantages of the model, based on your qualitative results, and, briefly discuss potential ways to improve the model:

## **4 Your Results on the Test Set(30 pts)**

This part will be obtained by us using the estimations you will provide. Please tell us how should we run your code in case of a problem:

## **5 Additional Comments and References**

(if there any)