Deep learning - second homework

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1 Introduction

For this homework, I set up the project locally and created it with Python files. The hardware I worked with was NVIDIA GeForce RTX 3060 12GB.

The preparations I had to make were to download the data locally and set up CUDA, which was not a challenge at all. Then I always had the number of workers set to 4 (as I had researched the maximum number).

2 Task 1

For this task, I had to play with the parameters quite a bit. I vacillated between the Stochastic Gradient Descent and the Adam optimizer (in the end, the Adam optimizer proved to be better, so I stuck with it). For testing purposes, I then added a step learning rate and a scheduler with multi-step learning rate - I commented them out later.

The best results were obtained with a low learning rate (0.0001), and for me it was best when learning the batch size 64 - I had a classification accuracy of 92%

3 Task 2

The main difference between the FCN-32 and U-Net architectures is that the FCN-32 is fast and efficient, while the U-Net architecture is more complex.

The U-Net, with its skip connections and data augmentation, generalises the model more and gives it more adaptability. The localization of images is also excellent.

From the 1 figure, ResNet FCN-32 is not that precise, while in the 2 figure, the segmentation is really precise and we can see what is going on.

And as for the meanIOU metric, on the test set for FCN-32 I got results of 0.415, while for U-Net I got 0.512.

4 Task 3

Skip connections are critical to the architecture because of precise localization. We can clearly see that the high resolution disappears when we omit the skip connections for the colouring problem in the 4.

All in all, the skip connections allow the network to access high-resolution images when they are lost in the encoder and contribute to faster convergence. They also help preserve spatial information lost during down sampling, and help restore fine-grained detail .

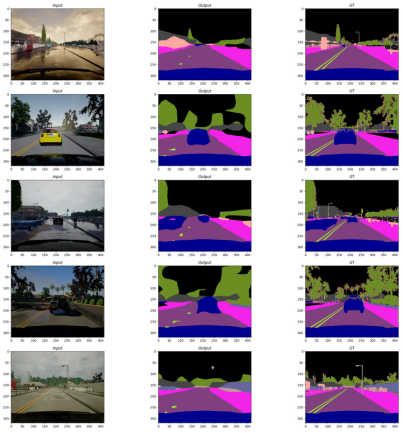

Figure 1: ResNet FCN-32 segmentation

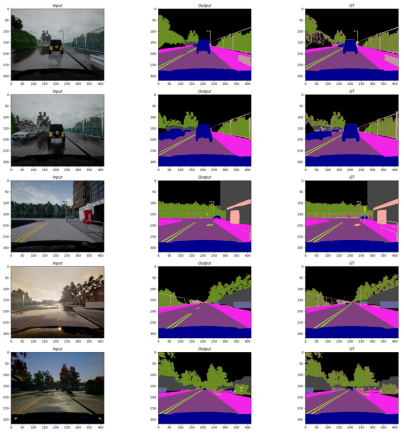

Figure 2: UNet segmentation

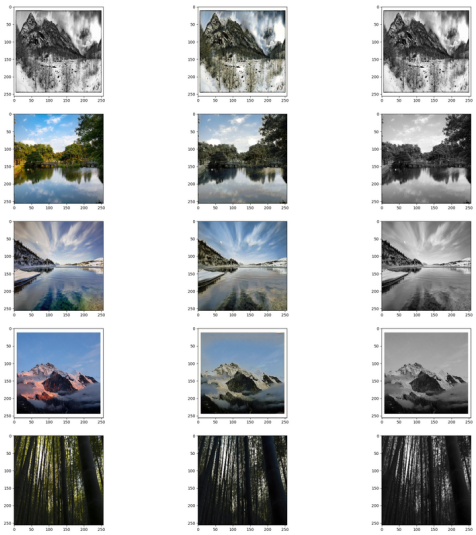

Figure 3: U-Net colorization with skip connections

This has proven particularly useful for tasks such as our image segmentation, where the goal is to assign a semantic class to each pixel in the input image.

5 Conclusion

As a conclusion, I might add that my GPU had more intensive work-load while training U-Nets than training other networks.

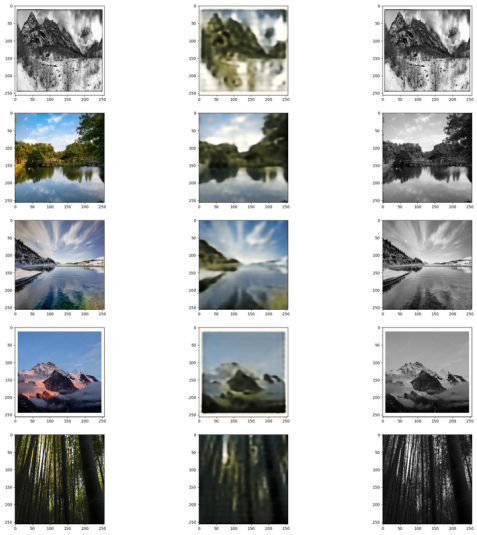

Figure 4: U-Net colorization without skip connections