CSCI 677 Homework 5
Semantic Segmentation using Fully Convolutional Networks

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1. Introduction

In this homework assignment, I have implemented two FCNs (FCN-32 and FCN-16) to semantically segment images using the VOCSegmentation2012 dataset. Semantic segmentation is a bit different from classification, where we classify each pixel as a particular class. I have used mean IOU and DICE score as evaluation metrics for this assignment.

2. Loss function and Optimizer

The loss function used for both the networks is Cross Entropy Loss and optimizer is ADAM with a learning rate of 0.0005. *I tried experimenting with a learning rate of 0.001 but the validation curve started to overfit after a few epochs*.

3. Data:

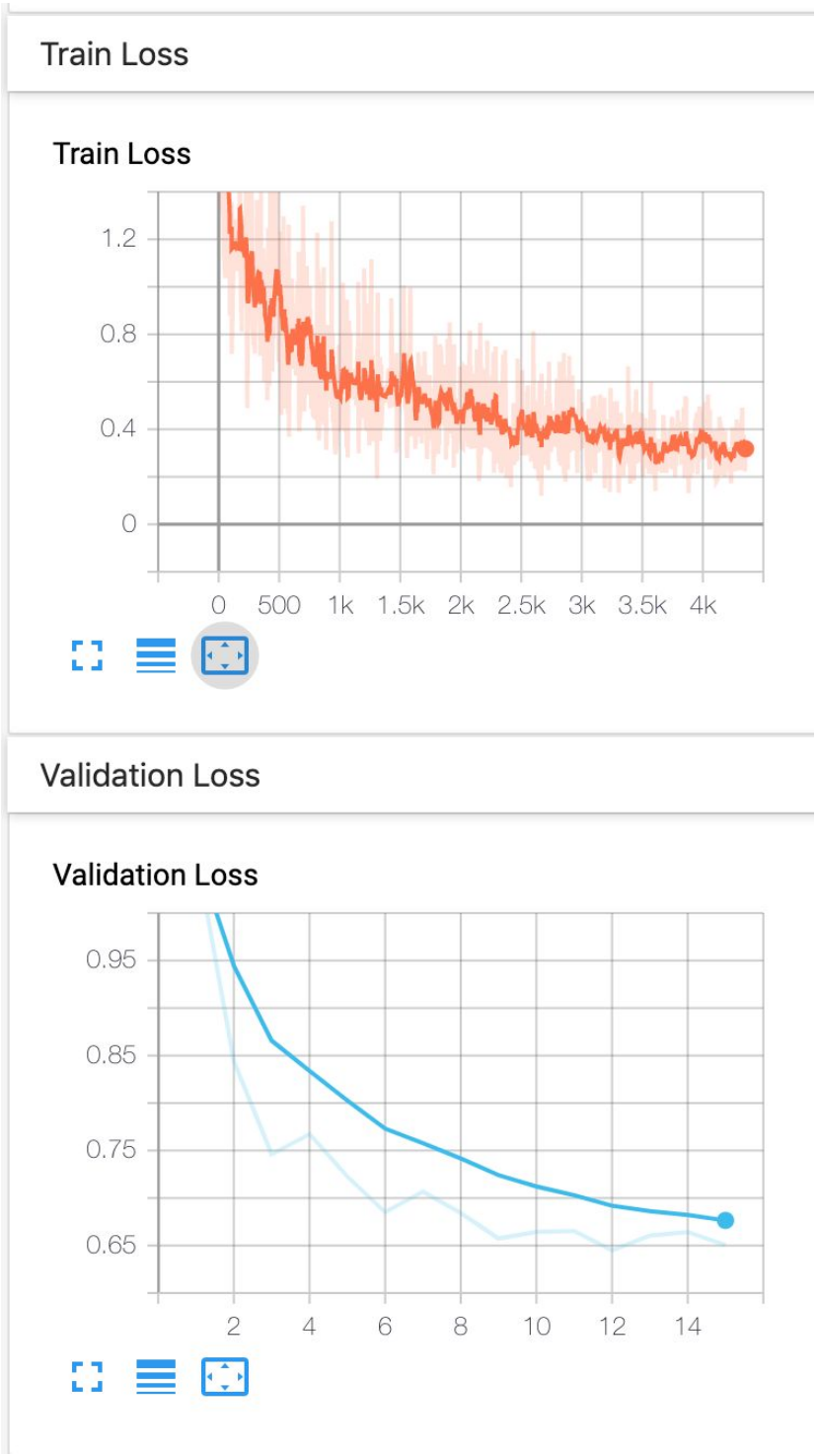
The data includes images of 20 classes and 2 sets: training, validation. I have used the Dataloader class to read the data in mini batches of 5 and resized both the image and segmentation to (224, 224)

4. Error and Score reporting

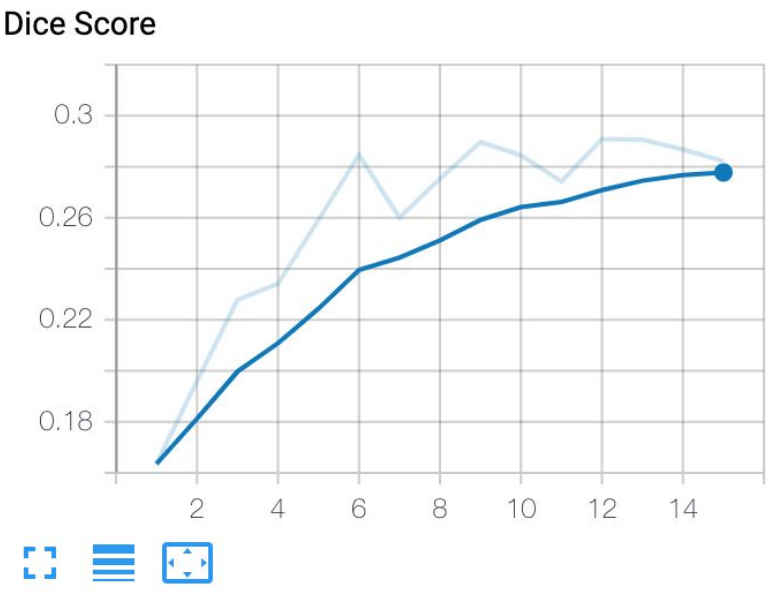
1) For training and validation, I have reported the following 4 metrics:
    - Batch-wise train loss
    - Batch-wise val loss
    - Batch-wise mean pixel IOU
    - Batch-wise DICE score
2) For testing, I have calculated the following metrics over the entire validation set as we do not have a test set
    - Mean pixel IOU
    - Dice score

5. Results [Training]

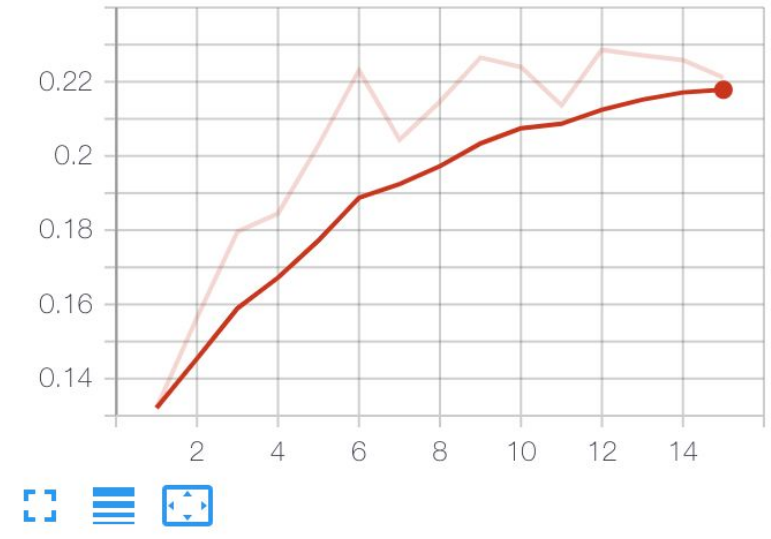
a) FCN-32



Dice Score

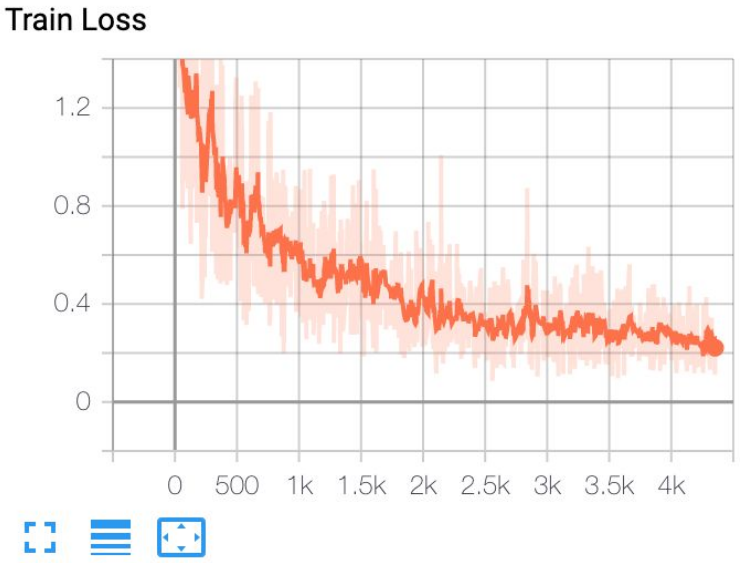


IOU

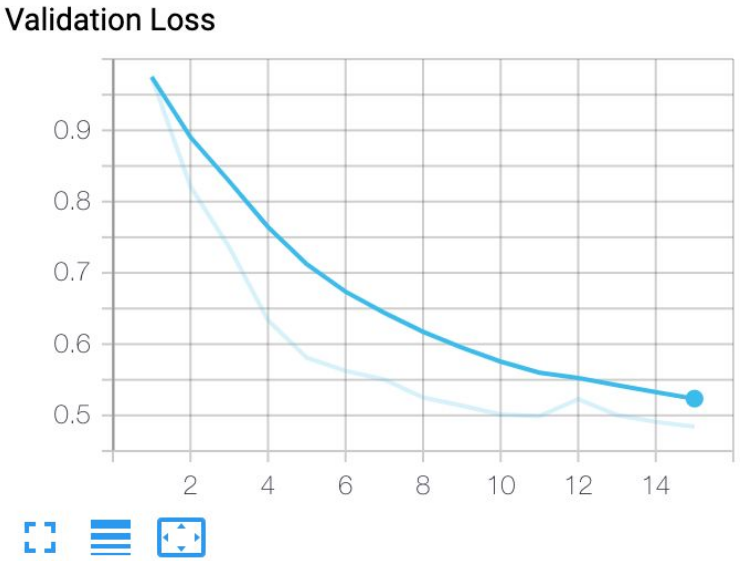


b) FCN-16

Train Loss

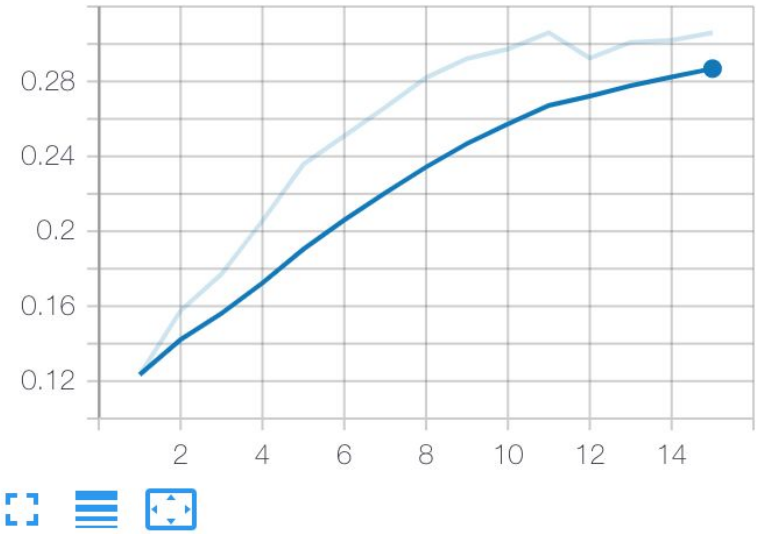


Validation Loss



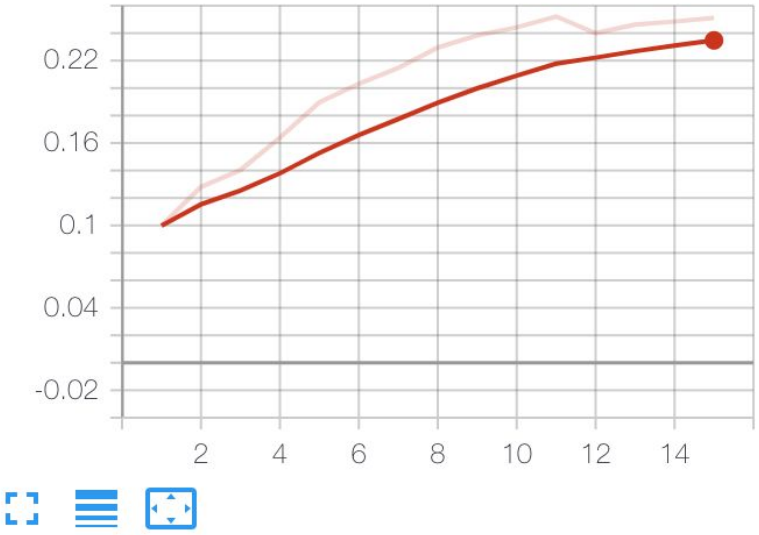
Dice Score

Dice Score



IOU

IOU



6. Results [Summary of train and test]

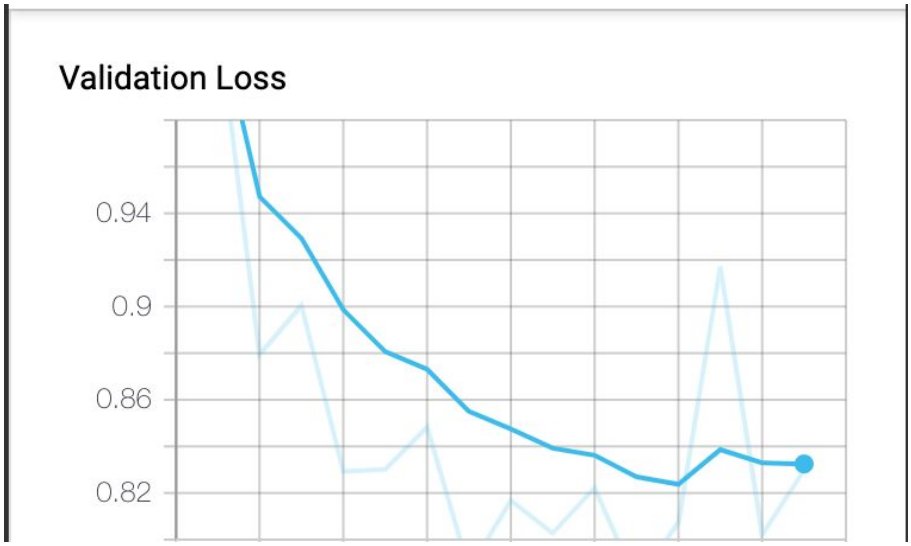
Model	Batch-wise Train				Test	
	train loss	**val loss**	**mean iou**	**dice score**	**mean iou**	**dice score**
FCN-32	0.3	0.67	0.21	0.28	0.28	0.41
FCN-16	0.3	**0.52**	0.23	0.29	**0.42**	**0.57**

7. Conclusion

It can be clearly stated that FCN-16 performs much better than FCN-32 on all the metrics reported above. On the test set over all batches, it gives a way higher iou and dice score than the FCN-32. This is because the network combines information from a previous layer that hasn't lost much information. I tried a bunch of other things and experiments that failed:

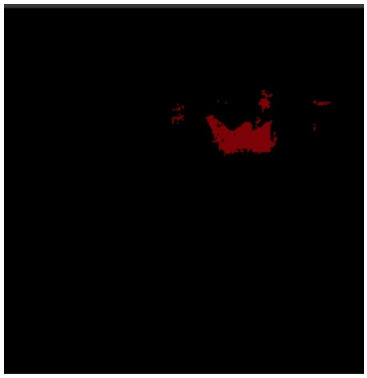
- Learning rate of 0.001
- Increasing batch size to 16

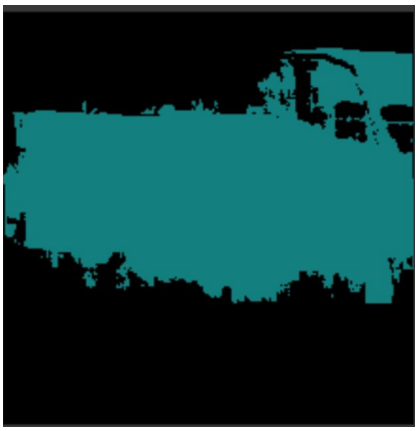
The validation loss can be visualized below for the failed experiments, you can see that the loss starts to increase after a few epochs.



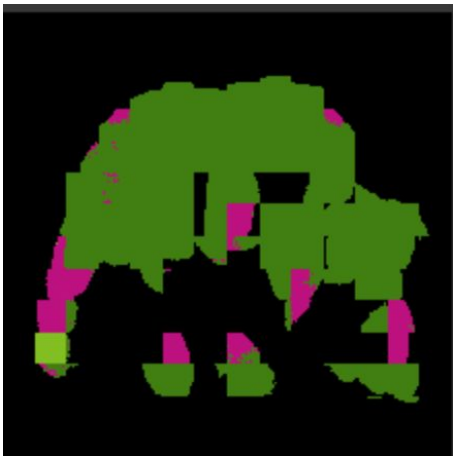
8. Segmentation results:

1) FCN-32





2) FCN-16



Failed Examples:

1) FCN-16