Solutions for CCE : AIMIA Homework 3 Solutions

December 15, 2022

1 Q1

Split the CT slices into 70% training, 10% validation and 20% testing. Train a UNet model to segment the given CT slices into background-0, COVID anomaly-1, and normal-2 regions. Report the sensitivity, speci

city, accuracy, and Dice scores for the classes 1 and 2. Display a sample slice along with the predicted and original masks. Mention if you have used any data pre-processing and augmentation.
Solution:-

U-Net is an architecture for semantic segmentation. It consists of a emcoding path and a decoding path. The contracting path follows the typical architecture of a convolutional network.

The U-net Model has been implemented by resizing the input CT slices in to 128X128 dimension Total params: 1,940,851
Trainable params: 1,940,851
Non-trainable params: 0

Accuracy is = 99.49244856834412%

Mean IoU = 0.88859814
IoU for class1 is: 0.9985723
IoU for class2 is: 0.7025214
IoU for class3 is: 0.96470076

The Training, validation loss and accuracries have been depicted in figure1 and Figure2.

The sample predictions of the trained U-net model have been given in figure3 and Figure4.
:

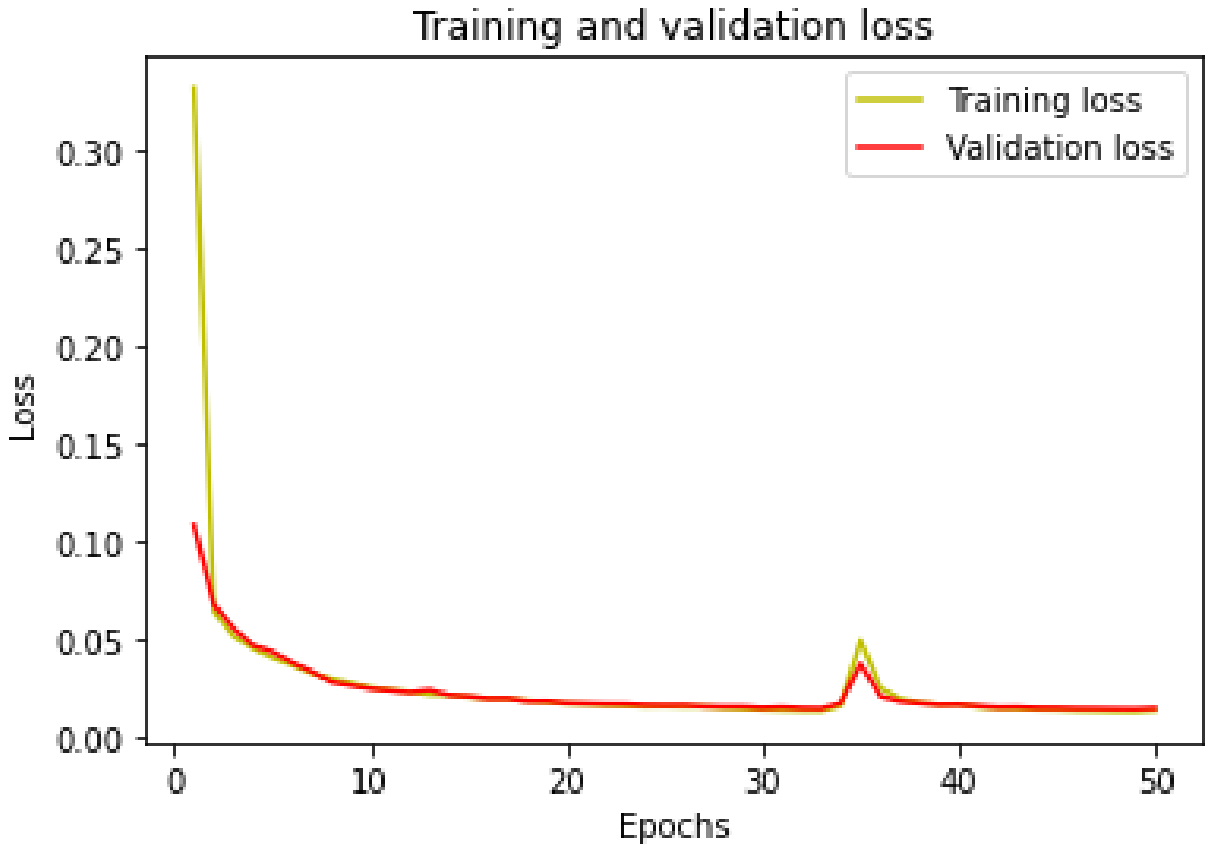

Figure 1: Training and Validation Loss

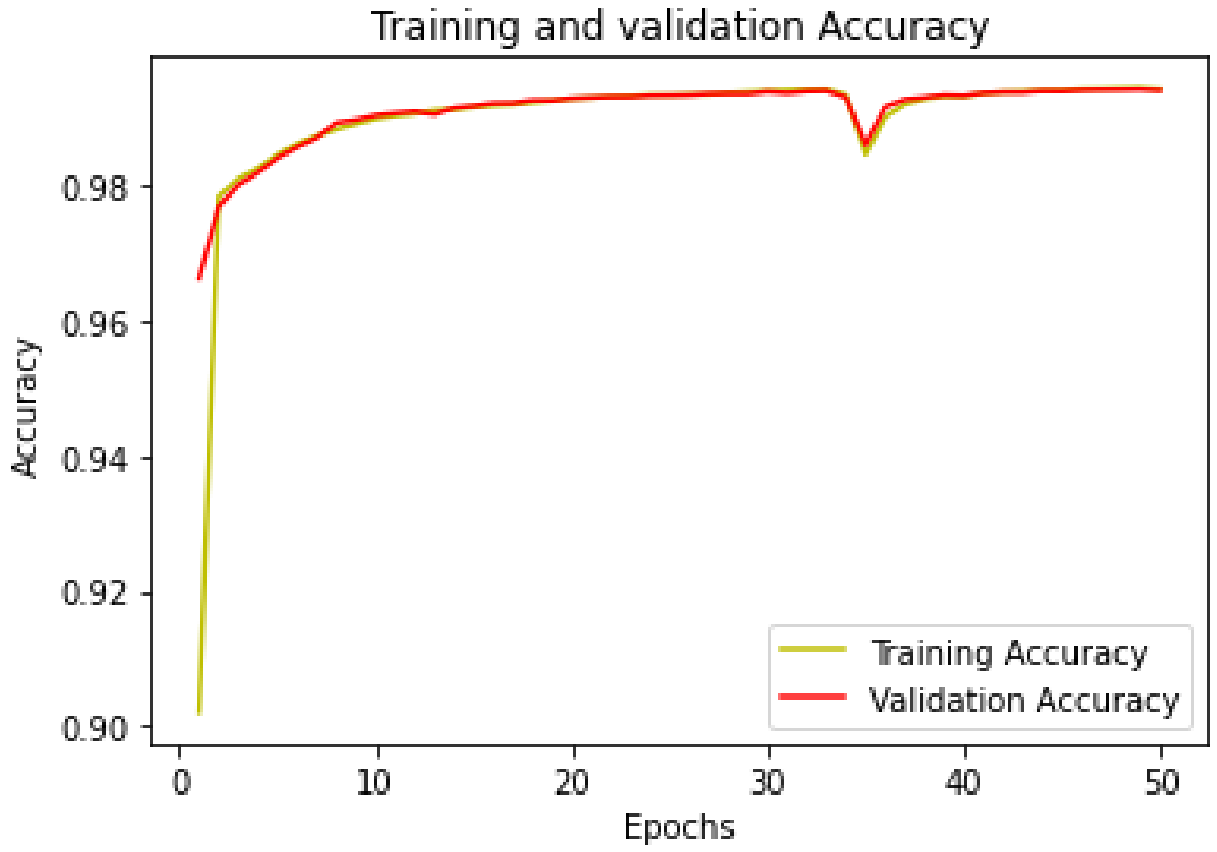

Figure 2: Training and Validation Accuracy

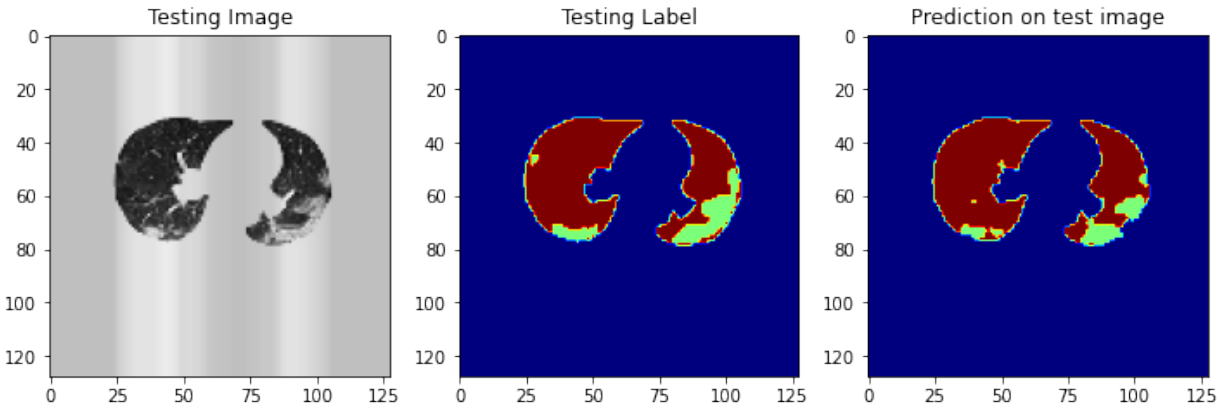

Figure 3: Prediction on Test CT slice along with mask

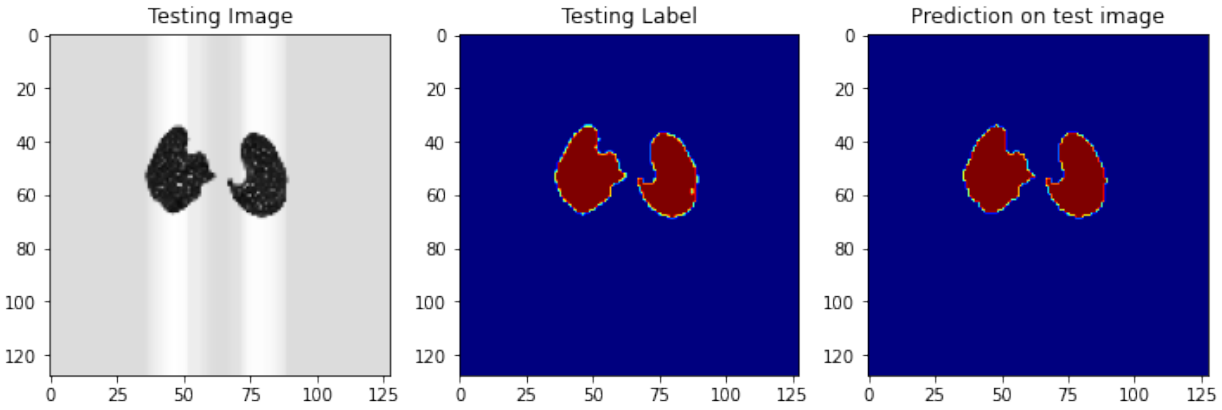

Figure 4: Prediction on Test CT slice along with mask

2 Q2

Data Sensitivity: Reconstruct the CT scans (test cases used in Q1) from limited angle sinograms (4x and 8x). Using the trained model from Q1 predict the segmentation masks of the reconstructed test cases . Also, report the sensitivity, speci

city, accuracy, and Dice scores for the classes 1 and 2. Display a sample slice along with 4x and 8x reconstruction with the generated mask and the original mask.
Solution:-

The reconstructed ct slices were evaluated for semantic segmentation using trained U-net model and the output is represented in figure5 and Figure6 for 4x and 8x reconstructions respectively.

Result-II 4X Reconstruction
Mean IoU = 0.6458762

IoU for class1 is: 0.9941179
IoU for class2 is: 0.033478003
IoU for class3 is: 0.91003287

:

3 Q3

Model Sensitivity: Perturb the parameters of the trained model from Q1 and predict the segmentation masks of test cases used in Q1. Report the sensitiv- ity, speci

city, accuracy, and Dice scores for the classes 1 and 2. Experiment with[0.01,0.001, +0.001,+0.01] and compute the pixel-wise uncertainty of predictions. Check whether it correlates with errors. Display a sample slice for each experiment along with the predicted masks, original masks, and the uncertainty map.
Solution:-

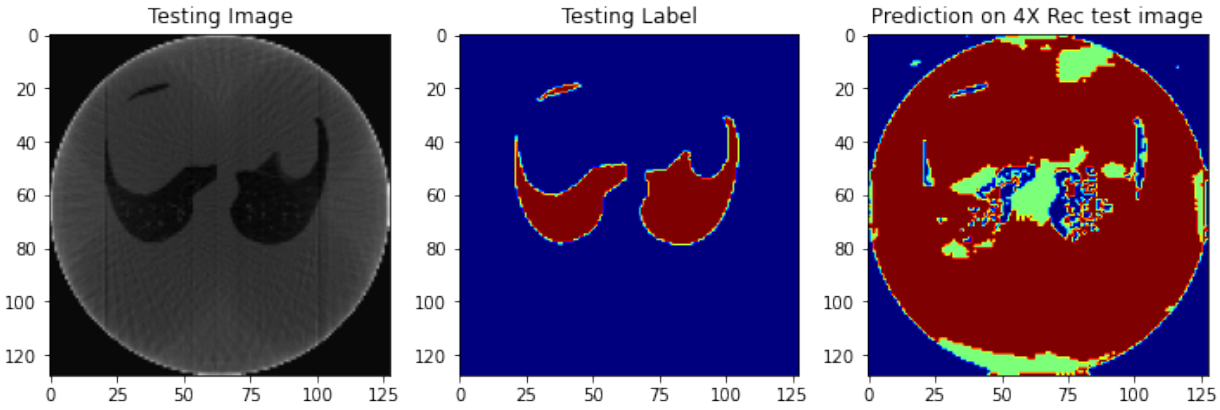

Figure 5: The Model Perfoamnce on 4x Reconstructed CT slice

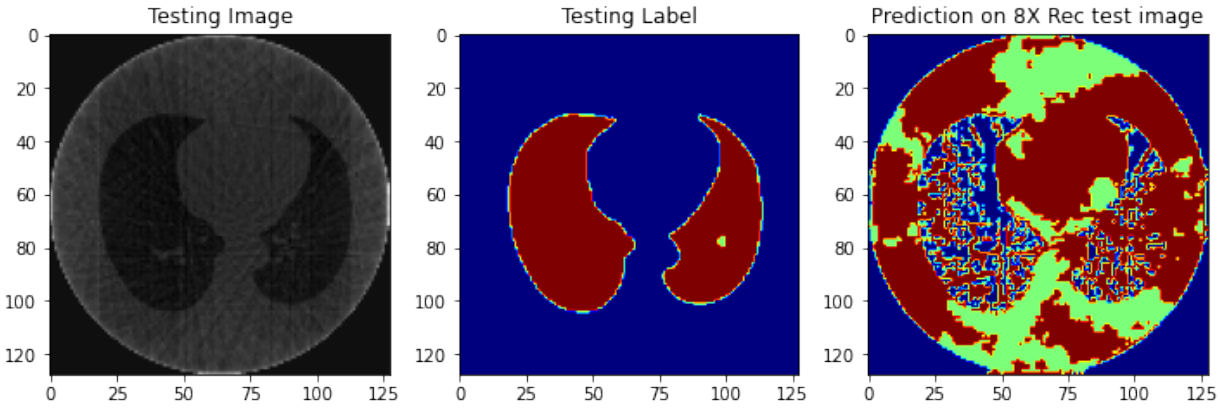

Figure 6: The Model Perfoamnce on 8x Reconstructed CT slice

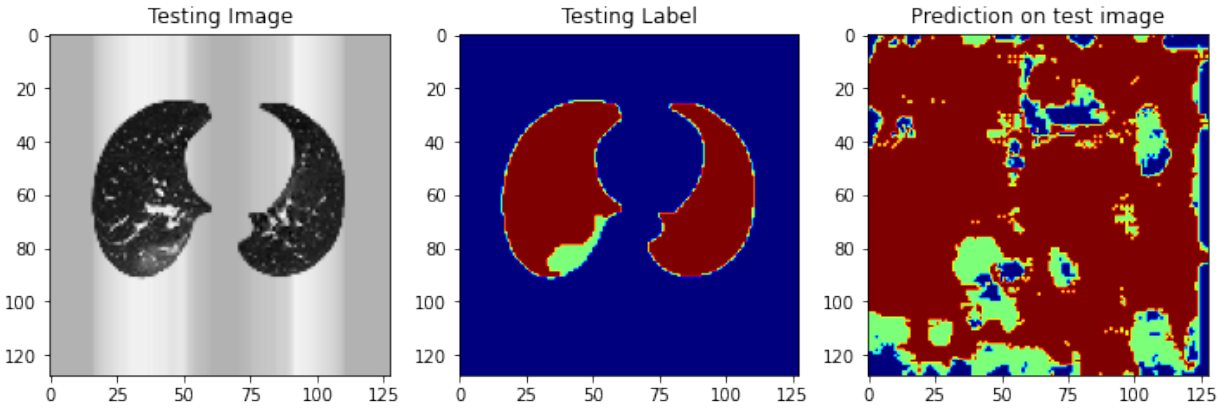

Figure 7: The model perturbed with -0.01

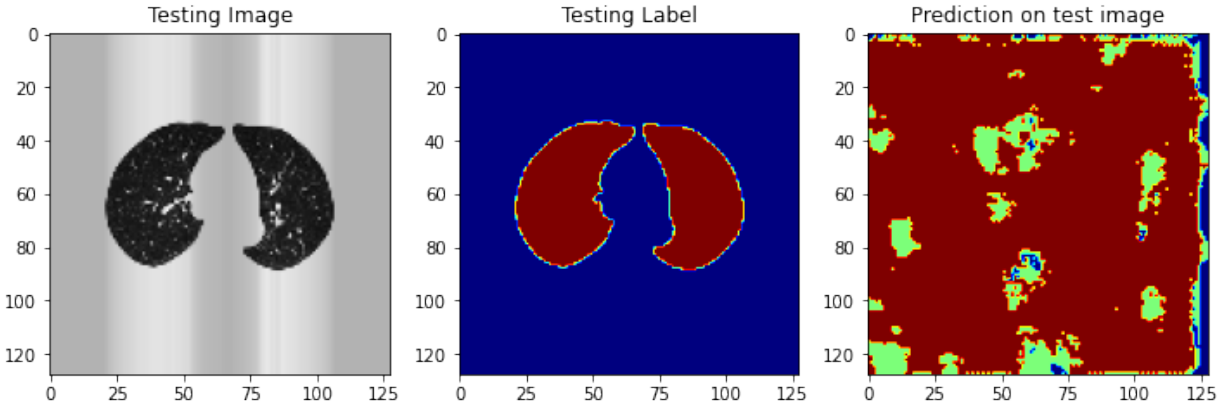

Figure 8: Themodel perturbed with +0.01

The Model weights parameters have been purtered as instructed and the degradation of the perfoamnce was observed and same has been highlighted in figures 7 and figure 8.

Perturb= - 0.01

Mean IoU = 0.10570338
IoU for class1 is: 0.12495088
IoU for class2 is: 0.03038511
IoU for class3 is: 0.16177416

Perturb= +0.01

Mean IoU = 0.07039385
IoU for class1 is: 0.04009057
IoU for class2 is: 0.028940776
IoU for class3 is: 0.14215021

4 References

1. Link https://arxiv.org/abs/1505.04597
2. Link https://paperswithcode.com/method/u-net
3. Link https://github.com/nikhilroxtomar/Semantic-Segmentation-Architecture
5. Link https://scikit-learn.org/stable/modules/model_evaluation.html
8. Link https://github.com/bnsreenu/python_for_microscopists
All the links accessed on 15-12-2022