

2ST-UNET FOR PNEUMOTHORAX SEGMENTATION

Team001





Objectives

- Segmentation of pneumothorax images using **2-stage-UNET¹**
- Perform Two Stage training on the **chest X-ray dataset from the SIIM-ACR Pneumothorax Segmentation Challenge.**
- Perform validation using validation data on the trained model of pneumothorax segmentation.
- Create a report for the project. And make presentation for mid and final evaluations. - Present and demonstrate the working project.

Footnotes-

1 . U-Net is a convolutional neural network that was developed for biomedical image segmentation at the Computer Science Department of the University of Freiburg, Germany

2. The Segmentation model has a U-Net architecture with 34-layer Residual Network (ResNet-34) pre-trained on the ImageNet as a backbone

Image Dataset -chest X-ray dataset from the SIIM-ACR Pneumothorax Segmentation Challenge



With mask



Without mask



With mask



Without mask



With mask



Without mask

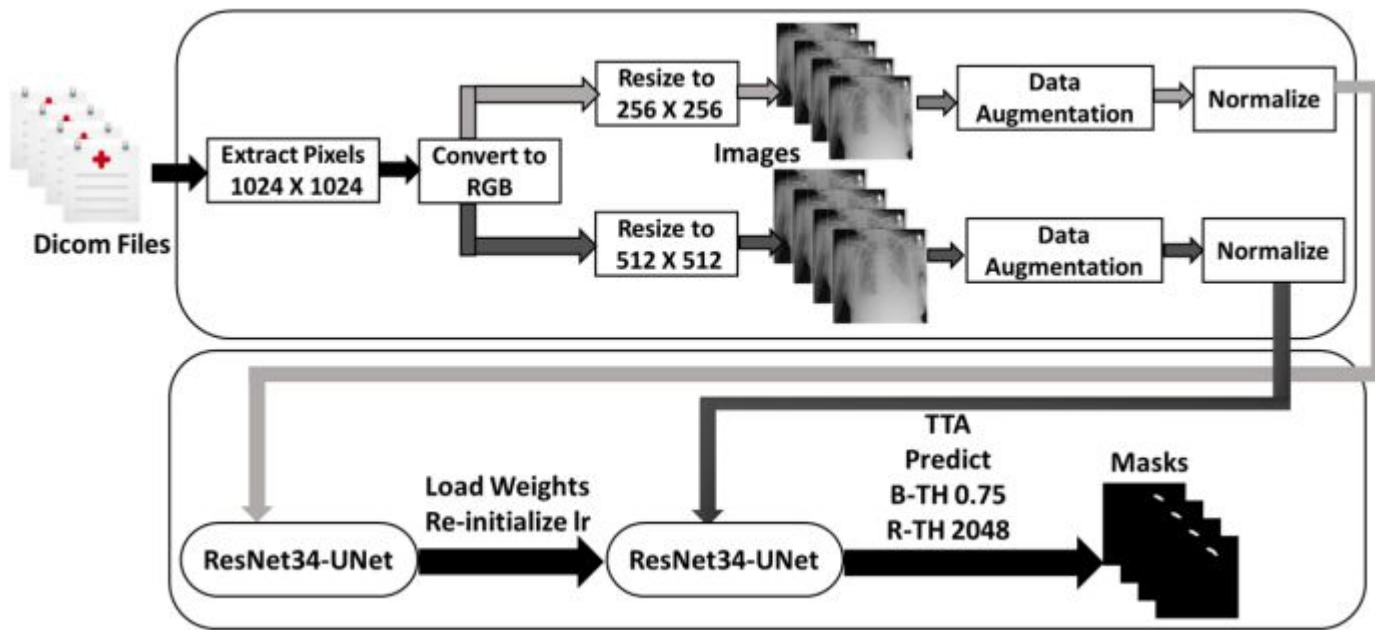


With mask



Without mask

Method Overview





Method Overview

- **Two-stage Training²** -
 - Data preprocessing and Augmentation.
 - Resize images (1024*1024) to 256*256 and 512*512 (convert grayscale to RGB).
 - Applying augmentation techniques - 4 classes -
 - horizontal flip,
 - random contrast,
 - random gamma,
 - random brightness



Method Overview

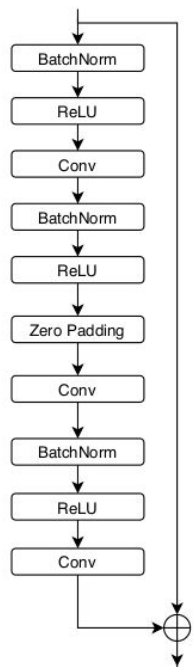
- Validation -
 - To train the network of grayscale images with pre-trained weights, 1-channel data has to be mapped to 3-channels. Adam optimizer and ReduceLROnPlateau9 scheduler are going to reduce the learning rate by a factor of 0.2 if no improvement is seen for 5 patience based on the validation loss. The Binarization Threshold (B-TH) is 0.5 for the prediction.
 - In the second experiment (Exp2), segmentation network on the 256×256 resolution images with 3-channels for 35 epochs with 40 batch size is going to be trained. Moreover, the B-TH is 0.55 for the prediction.
 - In the third experiment (Exp3), the weights from the Exp2 model is going to be loaded and the learning rate is going to be reinitialized. Then, we train the network on the 512×512 resolution images with 3-channels for 10 epochs with batch size 14. The B-TH is 0.55 for the prediction.
 - For the fourth experiment (Exp4), the network on the 256×256 resolution images, and 3-channels for 60 epochs with batch size 40 is trained. Then, the weights are going to be loaded and the learning rate is going to be reinitialized to retrain the network on the 512×512 resolution images and 3-channels for 29 epochs with batch size 14.



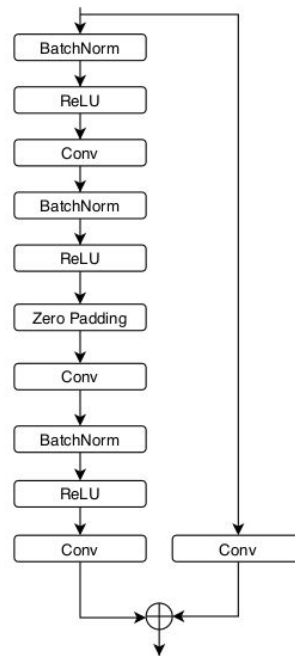
Model Architecture

1. Here we are going to use U-Net as a segmentation model.
2. The backbone of the model uses ResNet-34 pre-trained.
3. ResNet 34-UNet segmentation network has an encoder and a decoder
4. The encoder is built by removing the fully connected layer and the global average pooling layer from the end of ResNet-34.
5. The decoder has five blocks, each consisting of a 2×2 up-sampling layer followed by two sets of layers, each set containing a convolution, batch normalization layer, and Rectified Linear Unit (ReLU) activation layer

Building Blocks of ResNet 34-UNet network

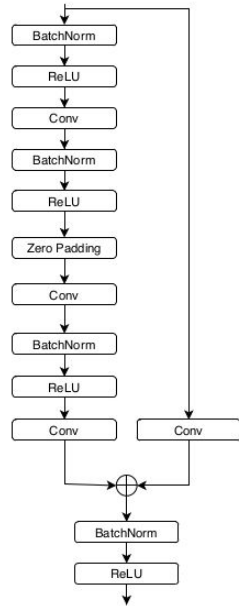


(a) ResNet-E1 is unit 1 of the encoder part.

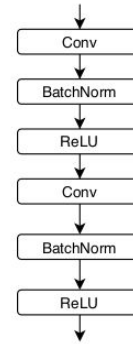


(b) ResNet-E2 is unit 2 of the encoder part.

Building Blocks of ResNet 34-UNet network



(c) ResNet-E3 is unit 3 of the encoder part.



(d) ResNet-D is the block of the decoder part.



Training and testing

1. Train network for 100 epochs with batch size 64 (for lower resolution image 256×256) and for higher resolution image (512×512) 70 epochs with size 16.
2. Adam optimizer with an initial learning rate of 0.001 with cosine annealing.
3. Then apply Stochastic Weight Averaging (SWA) to converge more quickly to the wider optima.
4. As a loss function, we use a combination of Binary Cross-Entropy (BCE) and Dice loss.



Goals

- 1 . Data Pre-processing and Augmentation - Will be finished by 18th February 2021
2. Training using 2 stage-UNET and Mid term presentation - March 18th 2021 (Before mid evaluations)
3. Testing and validation of the trained network. Writing report and Making final presentation - April 18th 2021.