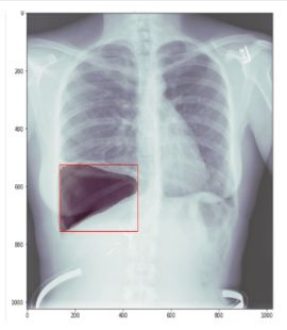
PROJECT PROPOSAL

THE 2ST-UNET FOR PNEUMOTHORAX SEGMENTATION IN CHEST X-RAYS USING RESNET 34 AS A BACKBONE FOR U-NET



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OBJECTIVE

- Pneumothorax (Collapsed Lung) is the presence of air in the pleural cavity between the lungs and the chest wall. The pressure of this air causes the lung to collapse on itself.
- It can be difficult to diagnose from chest X-rays especially when the locations are atypical or when the patient has heart or lung diseases.
- Using the SIIM-ACR Pneumothorax segmentation dataset, the goal is to produce a binary segmentation map, marking the pixels affected by pneumothorax along with detecting it in a given CXR using an end-to-end system.

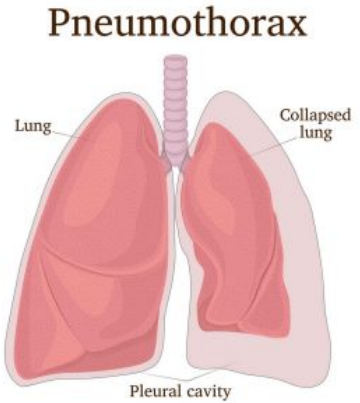


Figure 1: Illustration of Pneumothorax.[1]

OVERVIEW

1) DATA PRE-PROCESSING

To implement the paper, we will use the chest X-ray dataset from the SIIM-ACR Pneumothorax Segmentation Challenge. All the images are in the size 1024X1024 pixels.

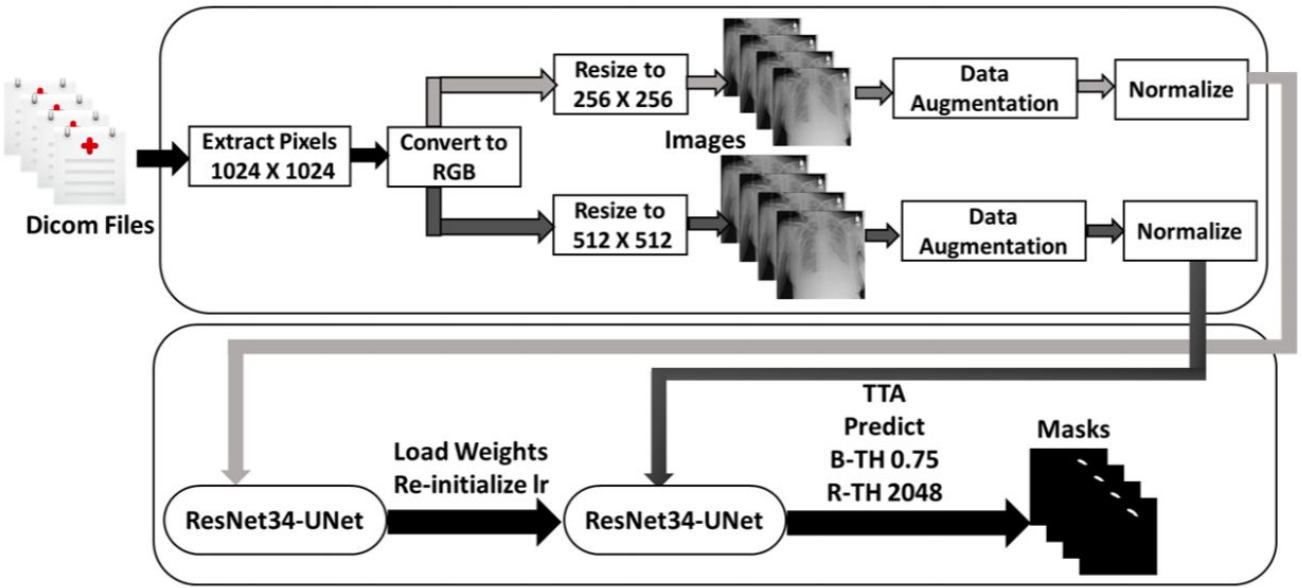
We will try to use CLAHE algorithms for pre-processing. These approaches are used to enhance the local contrast of image. CLAHE (Contrast Limited Adaptive Histogram Equalization) prevents enhancement of noise and regions other than lungs and ensures enhancement of local contrast of image.

2) DATA-AUGMENTATION

- This is done to strengthen and enhance the robustness of the model adding noise to the training data.

- It can be done using methods such as increasing the amount of training data, horizontal flip, random gamma, and random brightness, elastic transform, grid distortion, and optical distortion, and random sized crop etc.

Algorithm overview



Training and testing details

As a loss function, a combination of Binary Cross-Entropy (BCE) and Dice loss is used.

$$\text{BCE} = -1/N \sum_{i=1}^{N} [y_i \log(p_i) + (1 - y_i) \log(1 - p_i)]$$

N is the number of training samples, y is the ground truth value, and p is the predicted value

$$\text{DSCL} = 1 - \frac{2 \times |\text{X} \bigcap \text{Y}|}{|\text{X}| + |\text{Y}|}$$

X is the predicted set of pixels and Y is the ground truth

$$\text{BCE-Dice Loss} = \text{BCE} + \text{DSCL}$$

Evaluation metric

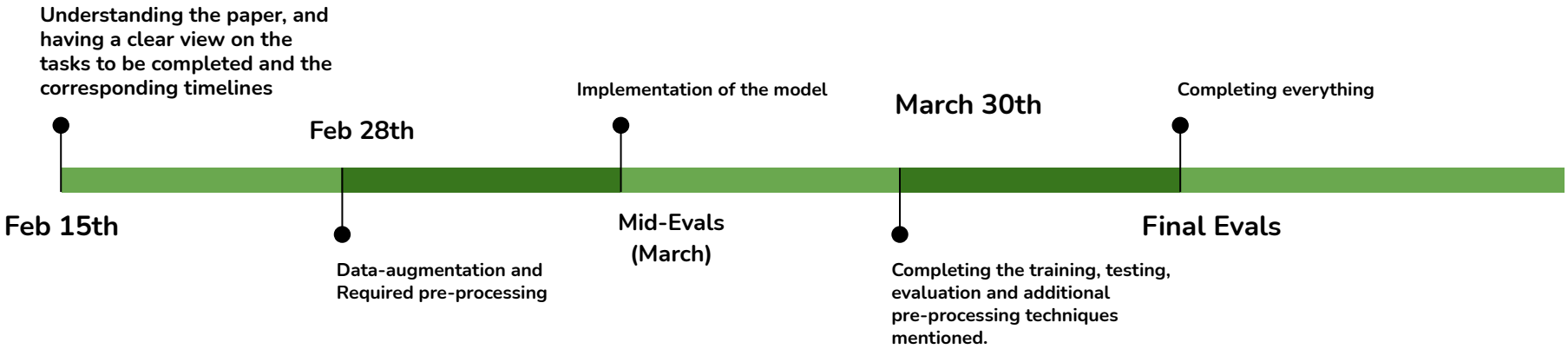
- Intersection over Union (IoU): IoU is the area of overlap between the ground truth (Ptrue) and the predicted segmentation (Predicted) divided by the area of union between them.

$$\mathrm{IoU}(P_{\mathrm{true}}, P_{\mathrm{predicted}}) = \frac{P_{\mathrm{true}} \bigcap P_{\mathrm{predicted}}}{P_{\mathrm{true}} \bigcup P_{\mathrm{predicted}}}$$

- DSC: This metric is used to compare the pixel-wise agreement between a predicted segmentation and its corresponding ground truth.

$$\mathrm{DSC}(X, Y) = \frac{2 \times |X \bigcap Y|}{|X| + |Y|}$$

Timeline



Mid-evaluation deliverables - Data-augmentation and implementation

GOALS

- To preprocess the data using the preprocessing algorithm mentioned.
- To be able to correctly classify occurrences of the disease with an expected accuracy around the range of that mentioned in the paper
- Expected binary segmentation map, marking the pixels affected by pneumothorax.