Deep Learning for Automatic Segmentation of Chest X-Ray

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Introduction

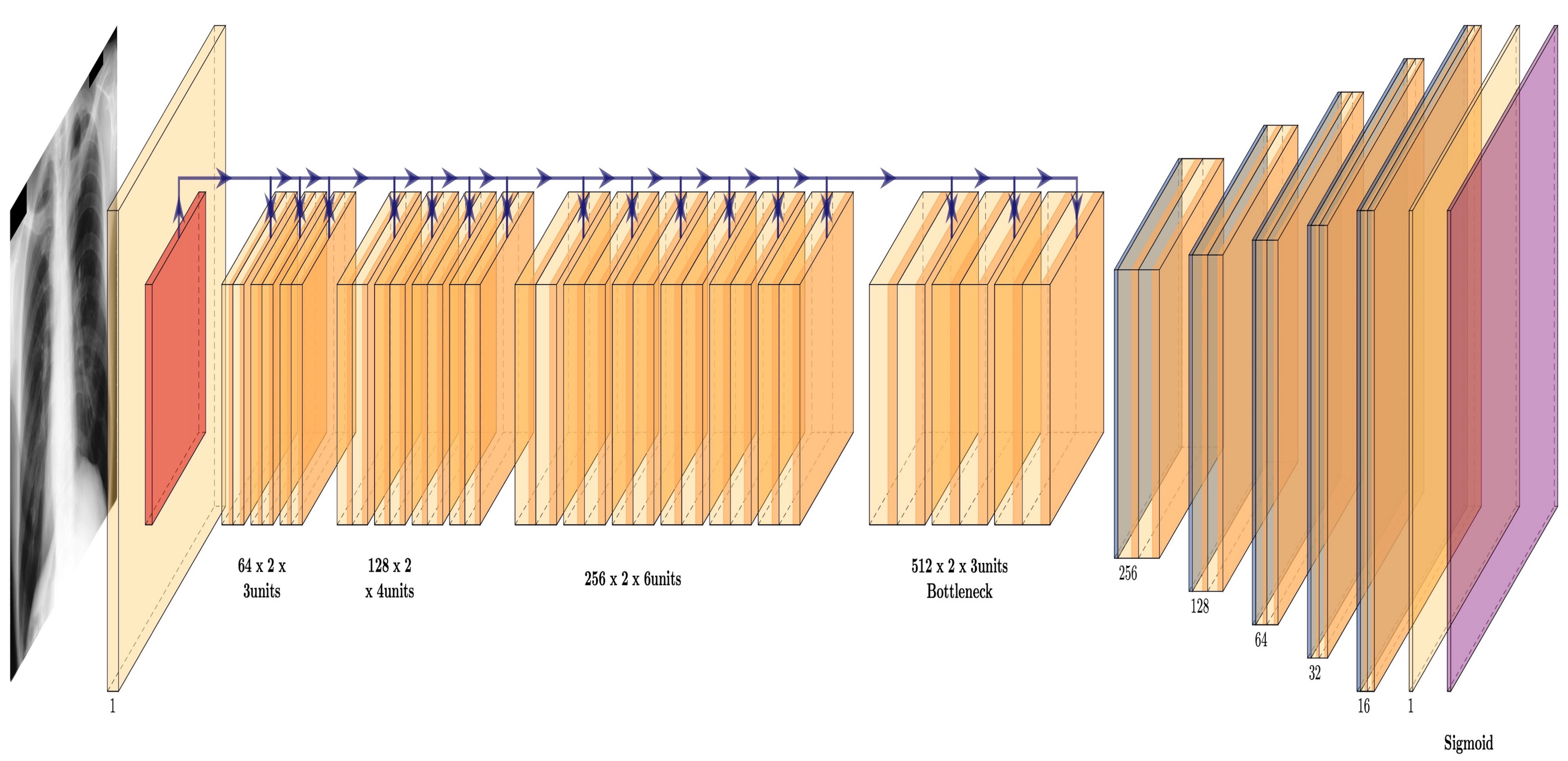
- *Chest X-Ray (CXR) Image Segmentation* is an important first step for better classification of lung diseases
- We developed a generalizable and explainable deep learning model for CXR images segmentation by using the U-net architecture

Network Architecture

U-net architecture

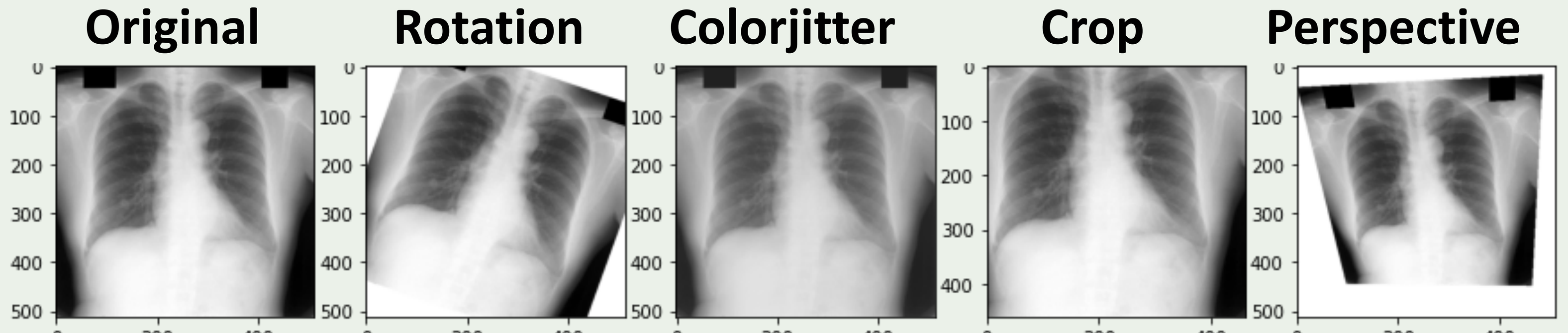
Use *Resnet34* (pretrained on the *ImageNet*) as decoder

- *Input:* Images of size (256,256,3)
- *Layer activations:* ReLu
- *Output activation:* Sigmoid
- *Output:* 0,1 labels of size (256,256)



Dataset

- **n = 247** Posterior-Anterior CXR images * **5** post-augmentation

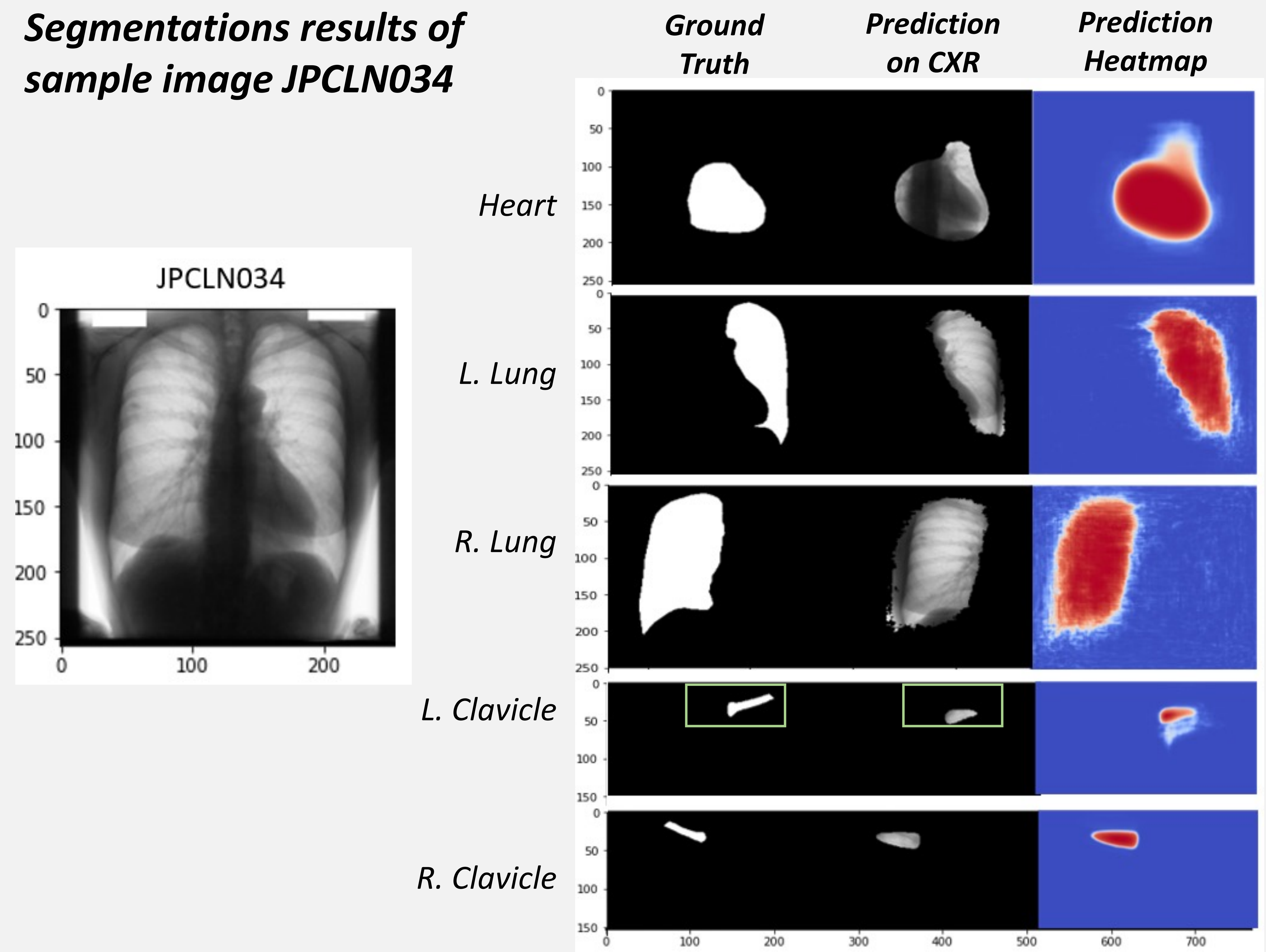


Database: Segmentation in Chest Radiology (SCR) database[1, 2]

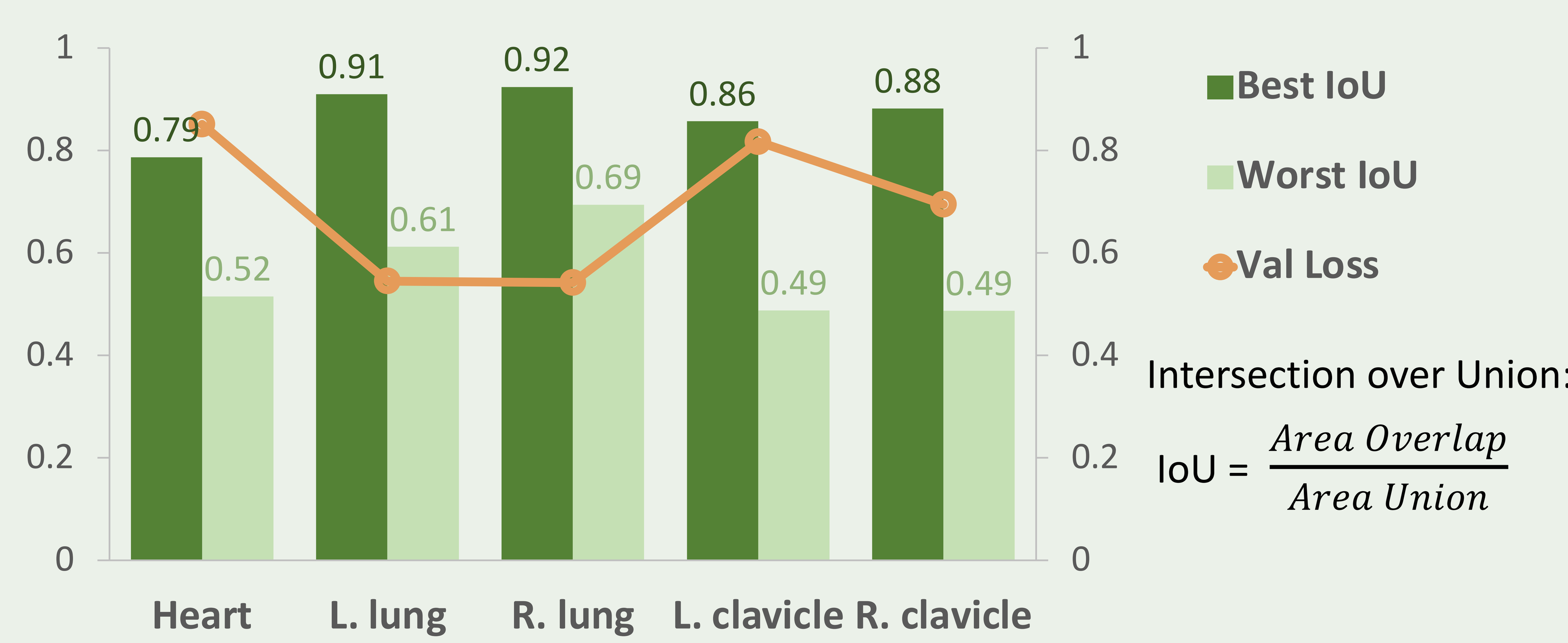
- Curated ground truth **label of 5 regions** for each CXR image

Results

Segmentations results of sample image JPCLN034

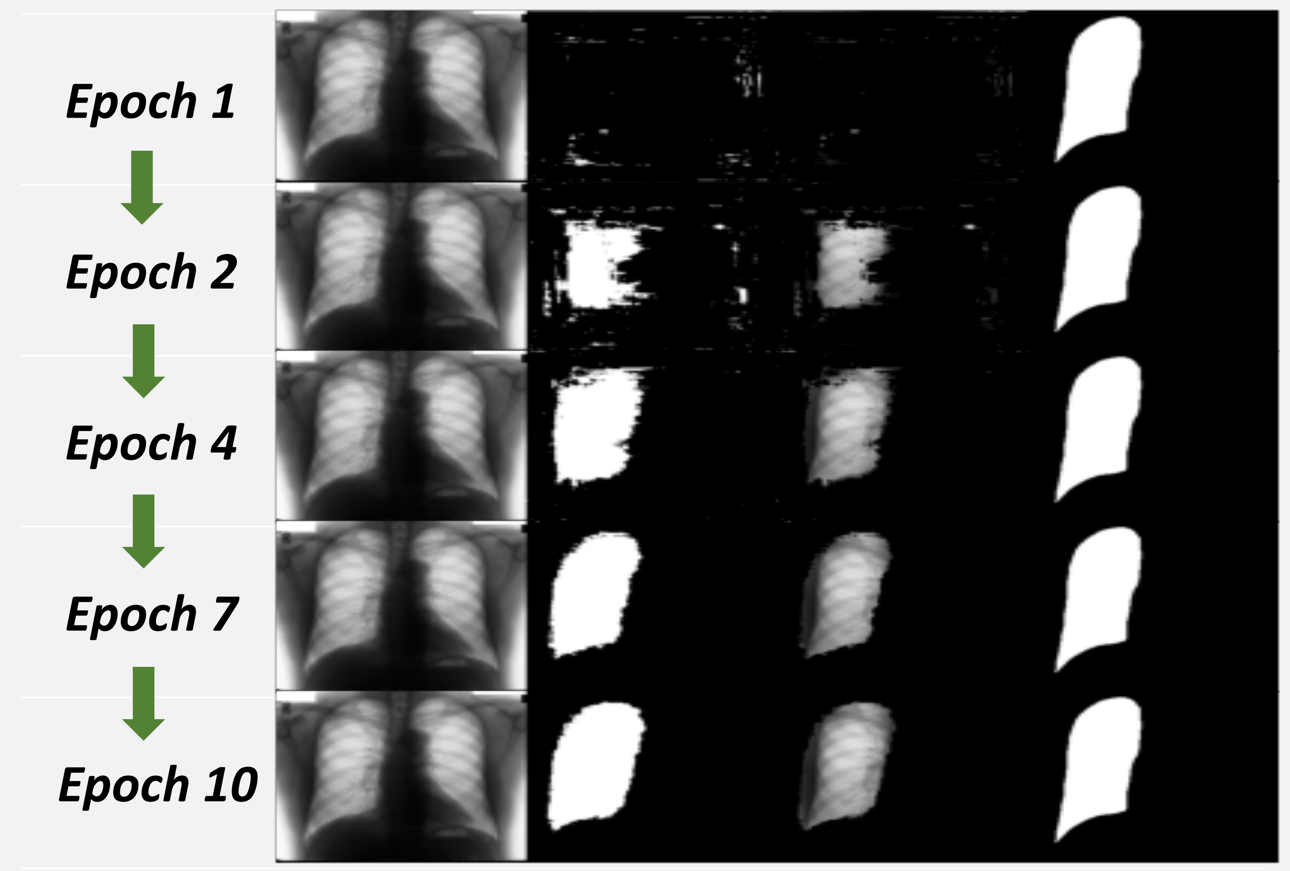


Evaluation Matrices of the Model



$$IoU = \frac{Area\ Overlap}{Area\ Union}$$

Progression of Training Epochs For image JPCLN104



Hyper-parameters

- Hyper-parameters are selected by cross validation, integrated with Bayesian optimization
- The best combination is chosen based on mean IoU across all folds

Region	Optimizer	Loss	Batch Size	Learning Rate
Heart	SGD	BCE+JCD*	1	0.07879
L. clavicle	SGD	BCE+JCD	1	0.10000
L. lung	SGD	BCE+JCD	1	0.00358
R. clavicle	RMSprop	BCE+JCD	1	0.00035
R. lung	SGD	BCE+JCD	1	0.00139

**BCE+JCD: binary crossentropy and jaccard loss*

Discussion

- **Lung segmentation presents better IoU** since they are more distinctive in CXR. The results are essential for subsequent disease classification
- Lighter area in heatmaps signify decrease in probability. Left clavicle prediction suggests **the model is mistaking** Rib 2 and its surrounding costal cartilage as high probable region. Further study on U-net and the L. clavicle region is needed
- It is unclear whether the model is **learning the position or the body part characteristics**
- If more resources allowed, we could fit more epochs and customize more layers after the standard u-net
- **For future studies**, *predict lung nodule or disease types* buy using binary disease labels in the dataset

Literature Cited

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