Transfer Learning for Detection and Segmentation of Pneumothorax from Chest X-ray Images

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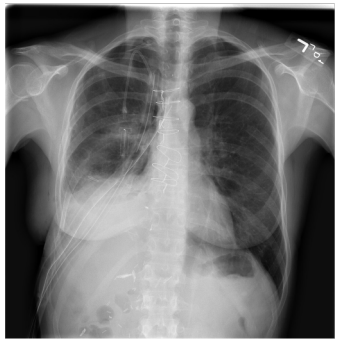
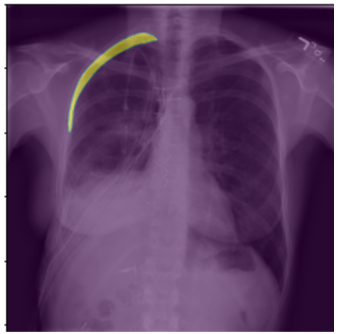
Datasets

SIIM-ACR Pneumothorax Segmentation



Chest X-ray



Pneumothorax Segmentation Mask

Dataset: 10,712 images

Weakly labeled X-ray dataset (CXR-14) [1]

No Finding

Nodule

Infiltration

Effusion

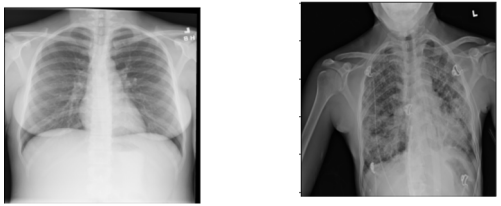
Atelectasis

Pneumothorax

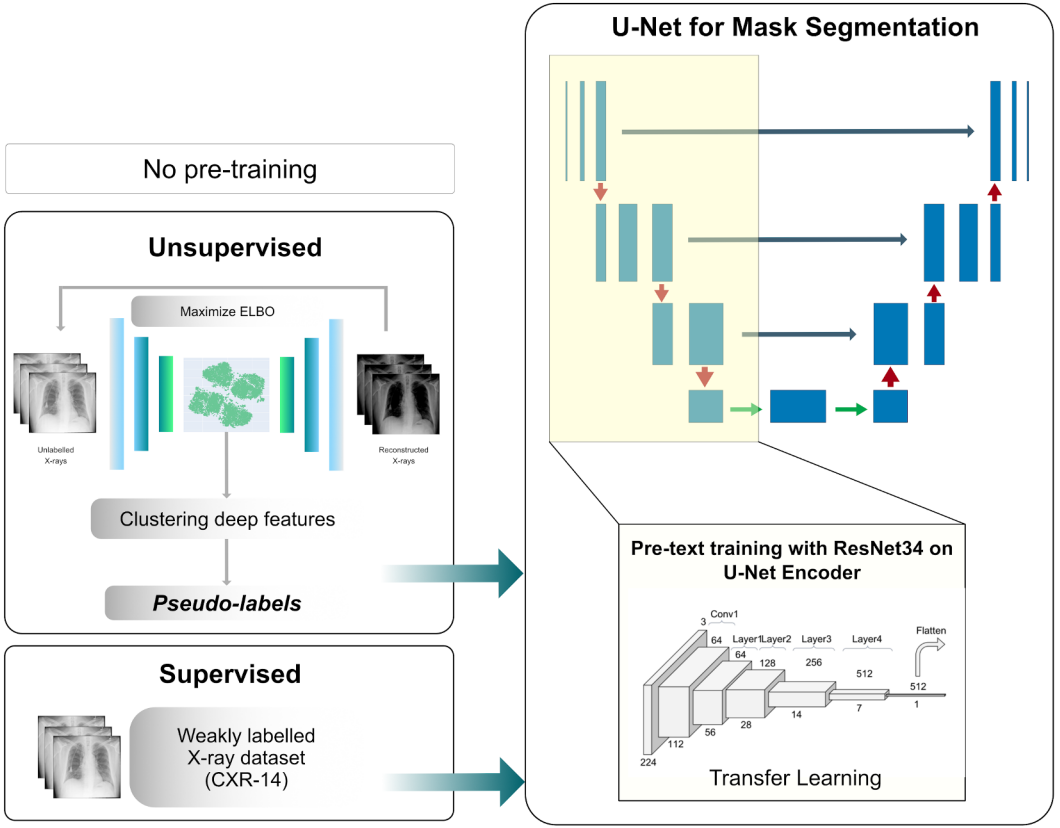
Dataset: 10,000 images

Architecture

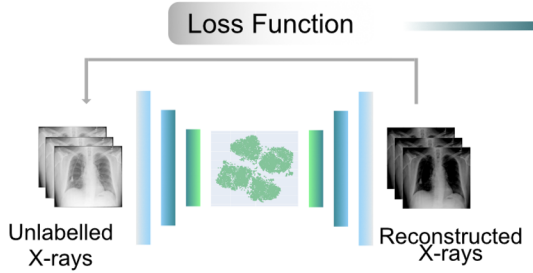
Not Pneumothorax



Pneumothorax



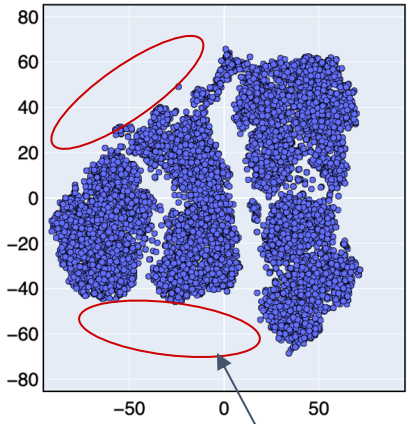
Unsupervised learning on unlabelled dataset can create latent space for clustering



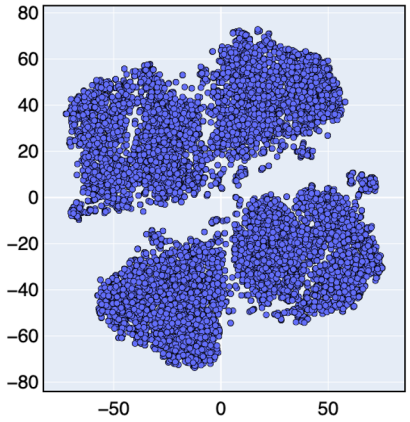
Autoencoder
BCE Loss for reconstruction

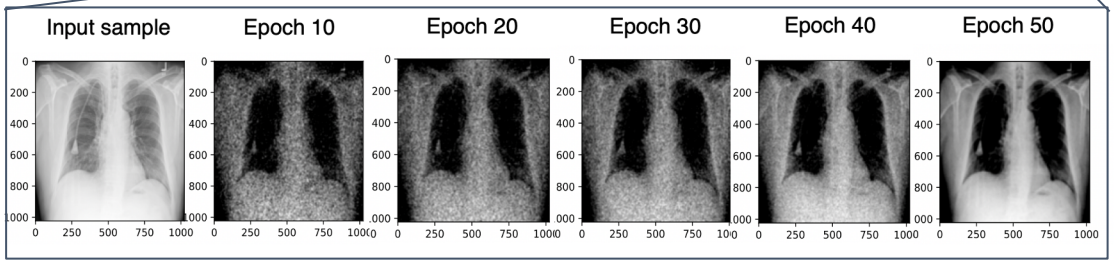
Variational AE
BCE Loss for reconstruction + KL divergence to optimize Evidence lower Bound (ELBO)

Dimensionality Reduction with PCA

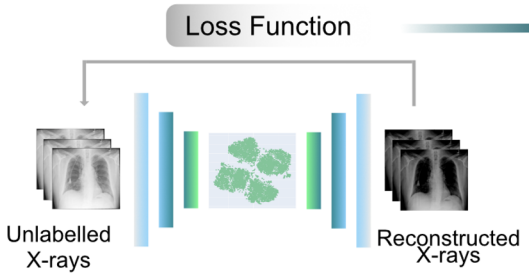


Latent space is sparser for AEs





Pseudo-labels obtained from the encoded space can aid in pre-training task



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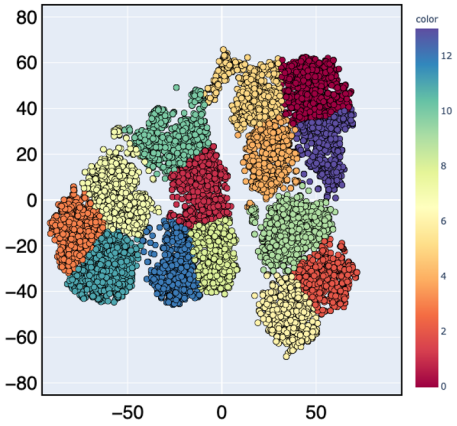
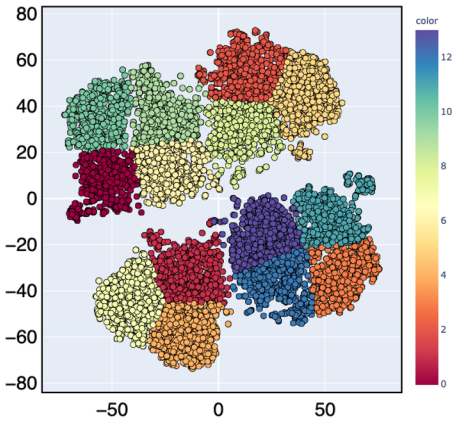
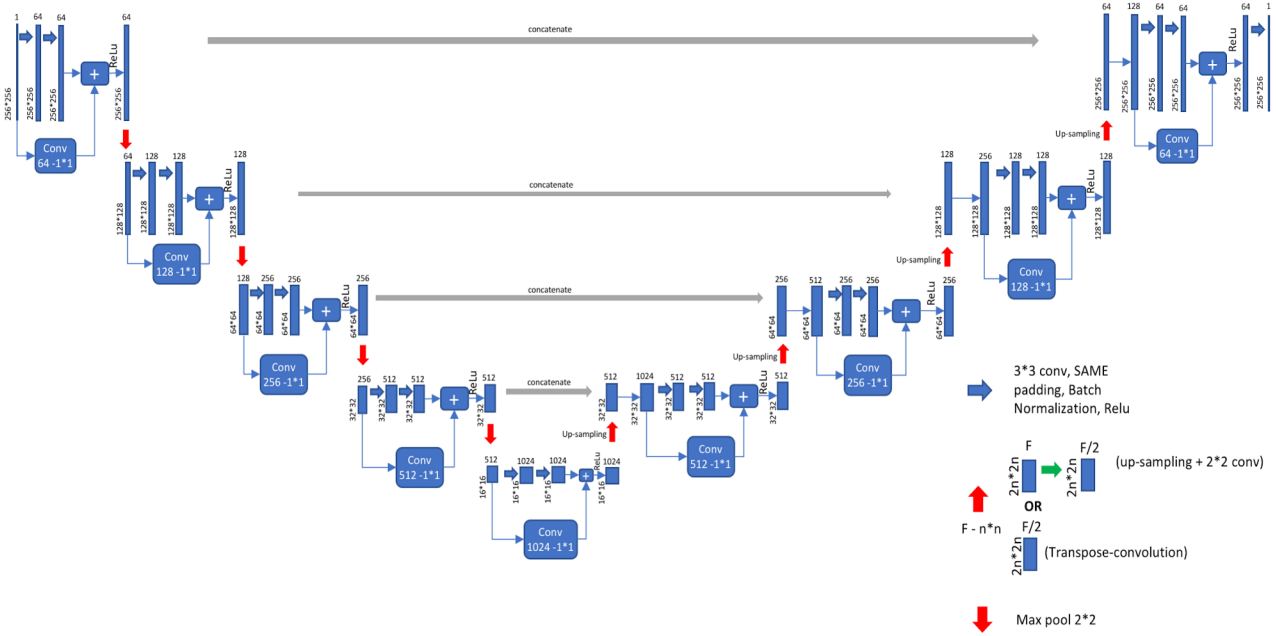


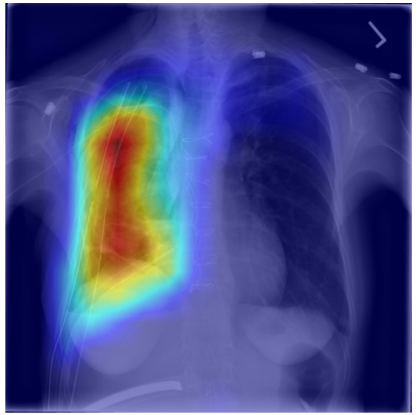


DBSCAN Clustering to obtain Pseudo-labels for pre-text training

Segmentation model - U-net



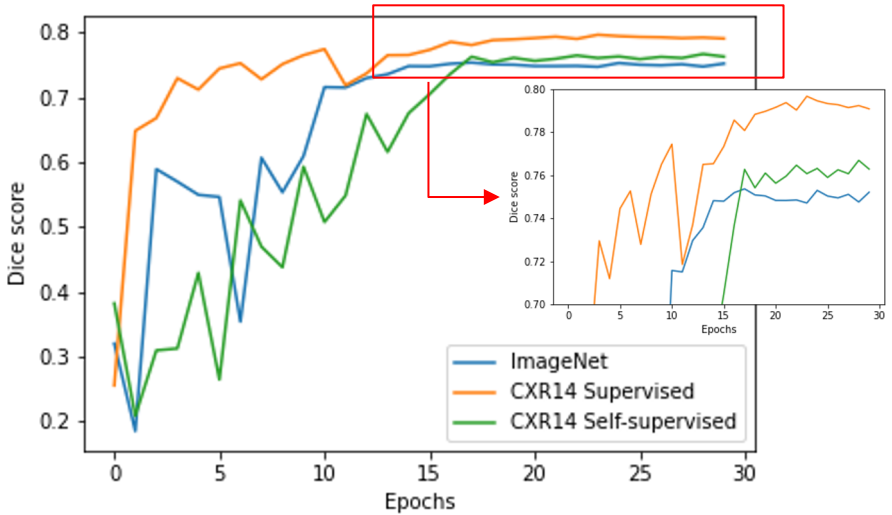
Encoder activation map



Segmentation mask

Results

Model	DICE
No pre-training	75.3
Pretrain with labels	80.0
Pretrain with pseudolabels	76.8



Future Work

- Pre-training on entire CXR-14 dataset
- Validation of pseudolabels generated through unsupervised learning
- Increase autoencoder complexity
- Replace the U-net encoder with the autoencoder in unsupervised learning

References

[1] Xiaosong Wang et al. “Chestx-ray8: Hospital-scalechest x-ray database and benchmarks on weakly-supervised classification and localization of commonthorax diseases”. In:Proceedings of the IEEE conference on computer vision and pattern recognition.2017, pp. 2097–2106.

[2] Pavel Yakubovskiy.Segmentation Models Pytorch. https://github.com/qubvel/segmentation_models.pytorch.2020.

[3] Rishabh Agrahari.UNet with ResNet34 encoder. https://www.kaggle.com/rishabhiitbhu/unet-with-resnet34-encoder-pytorch. 2019.

[4] Nishank Singla. UNet with ResBlock for Semantic Segmentation. https://medium.com/@nishanksingla/unet-with-resblock-for-semantic-segmentation-dd1766b4ff66

Questions?