Thoracic Disease Classification and Localization

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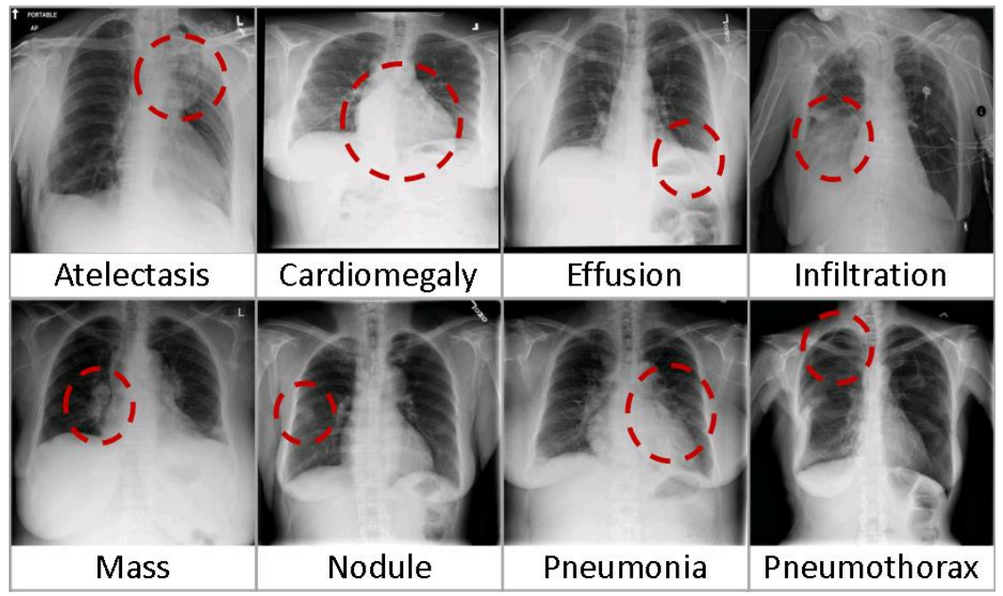
Problem and Data Set

ChestX-ray dataset comprises 112,120 frontal view X-ray images of 30,805 unique patients with the text-mined fourteen disease image labels where each image can have multi-labels mined from the associated radiological reports using natural language processing

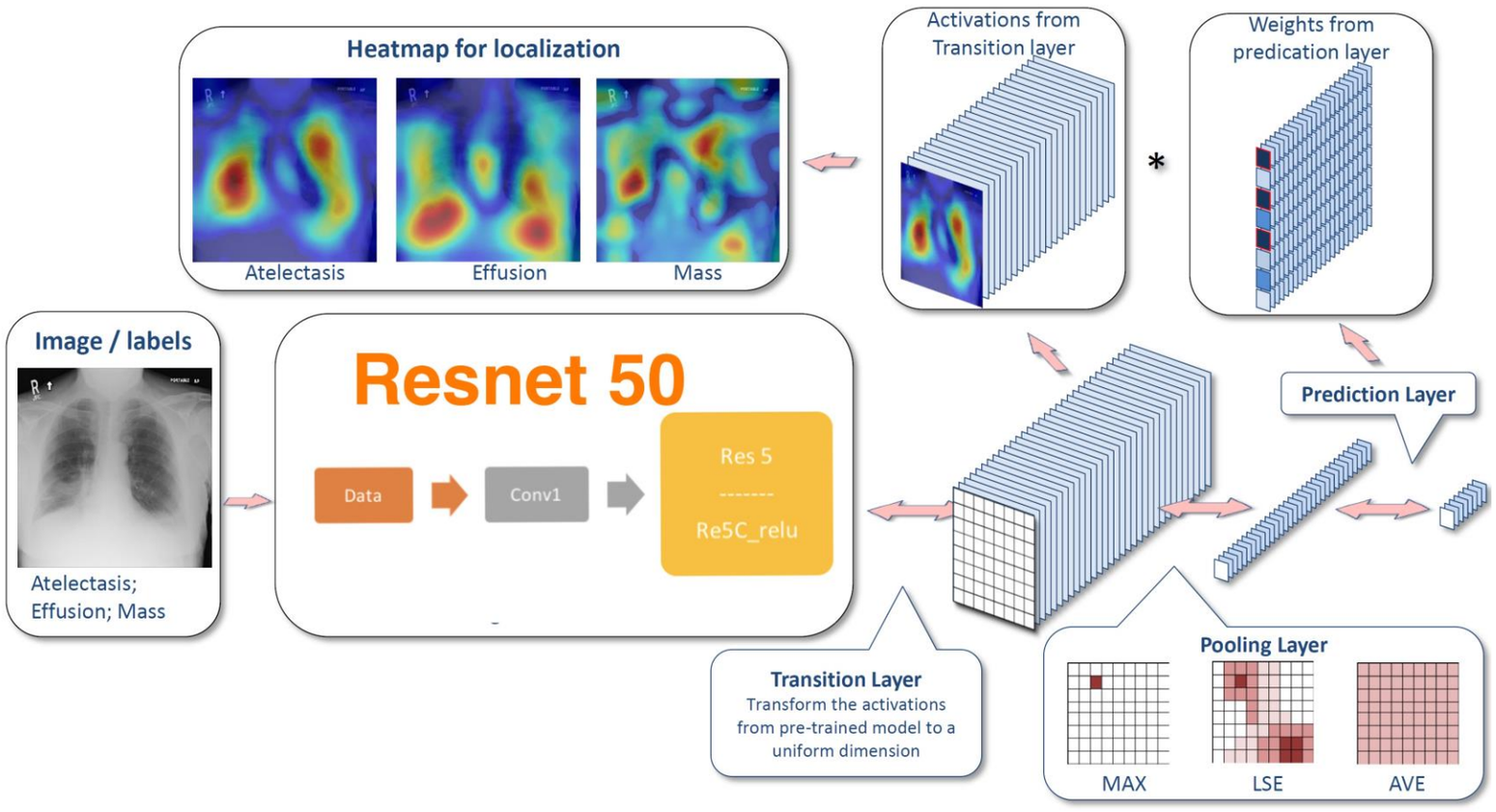


Categories

1. Atelectasis
2. Cardiomegaly
3. Consolidation
4. Edema
5. Effusion
6. Emphysema
7. Fibrosis
8. Hernia
9. Infiltration,
10. Mass
11. Nodule
12. Pleural Thickening
13. Pneumonia
14. Pneumothorax

Deep Learning- Model Used

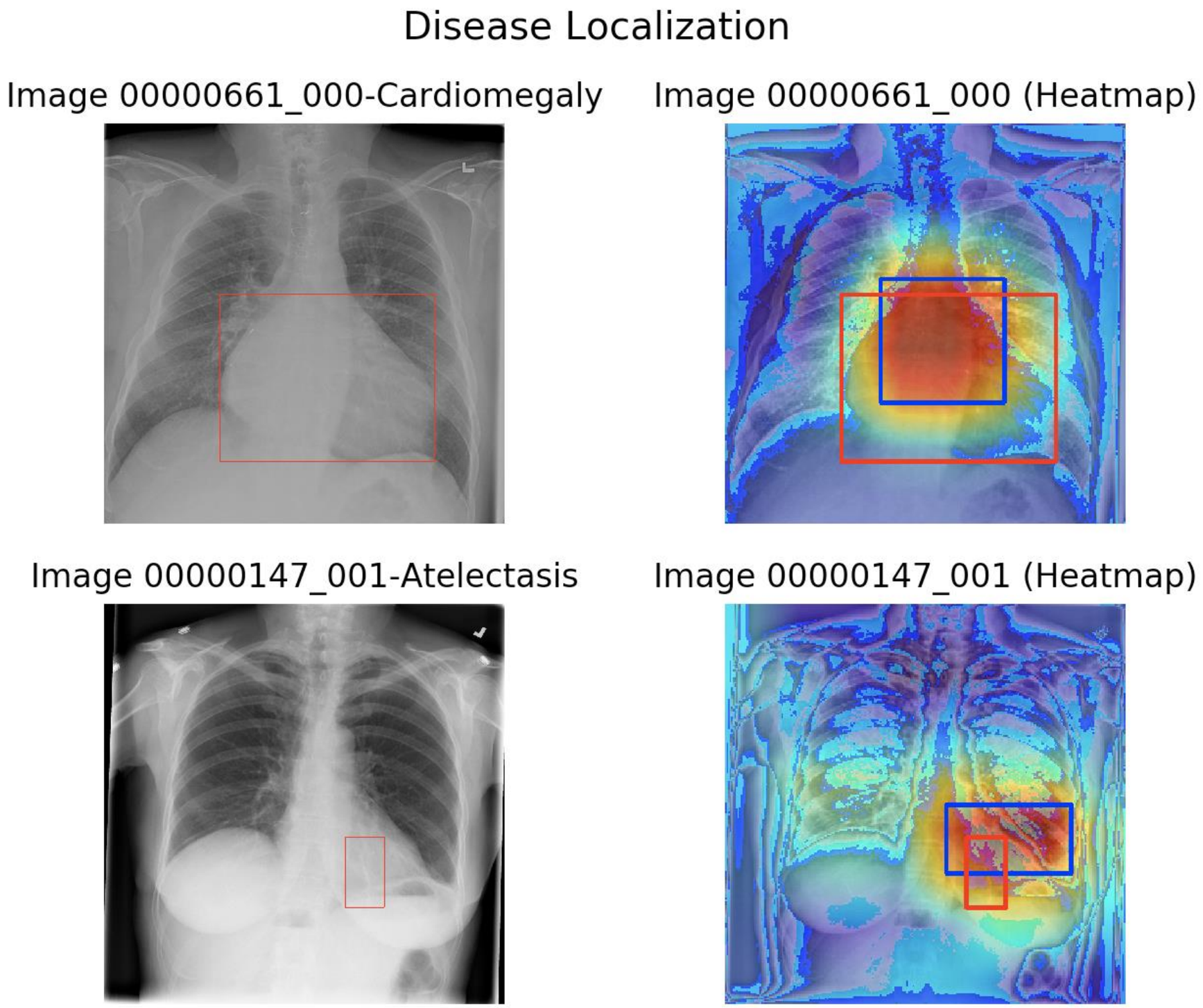
- We used pre trained Resnet-50 for transfer learning to do multi label multi class classification on thoracic diseases.
- We explored the possibility of using Dense CNN-150 which could have proved better results.
- Loss Function Used:
  - Multi Label Soft Margin Loss



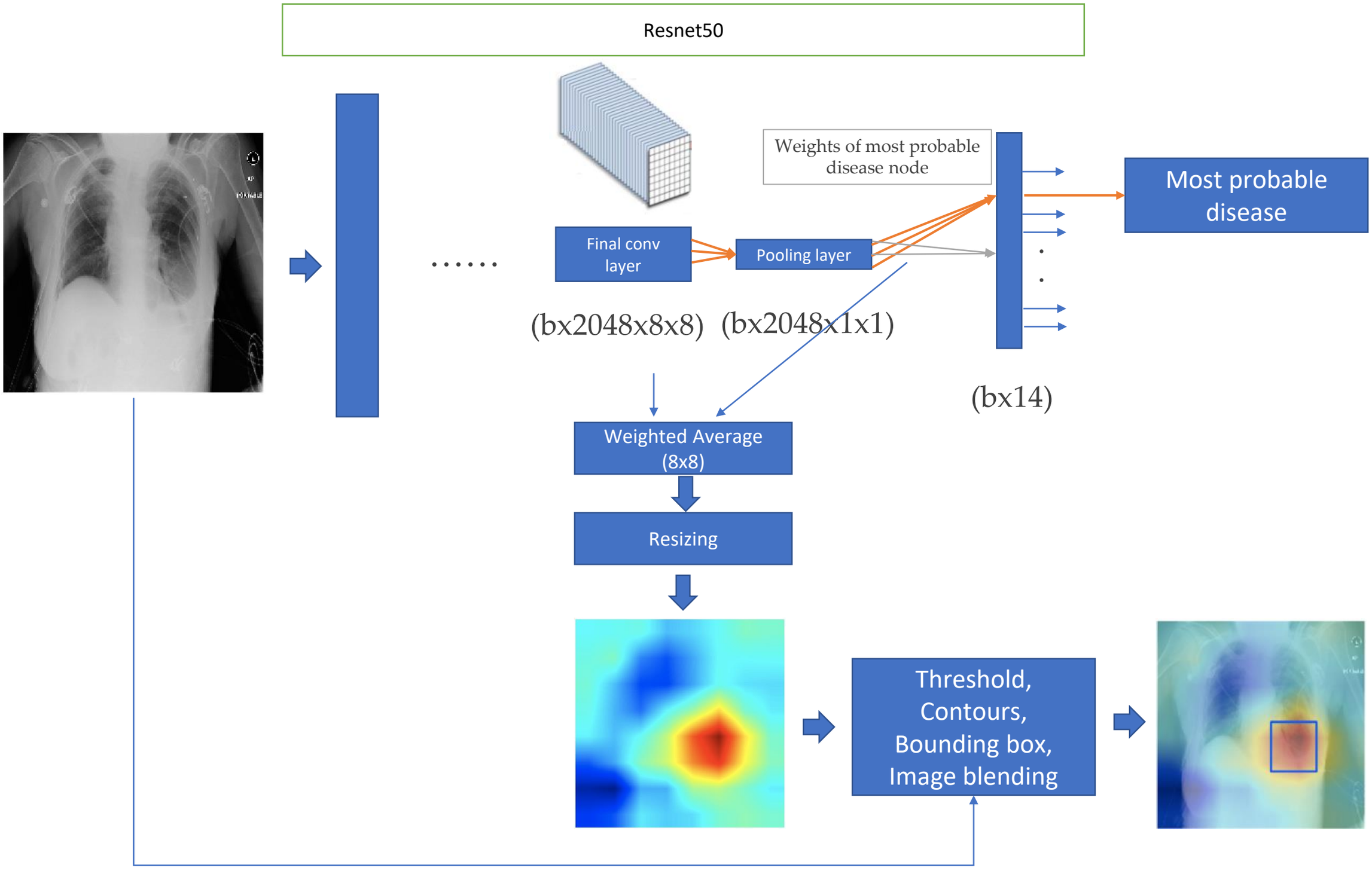
Accuracies

Categories	Precision
‘Atelectasis’	0.6511
'Cardiomegaly'	0.6977
'Edema'	0.6667
'Effusion'	0.7037
'Emphysema'	0.5335
'Infiltration'	0.5803
'Mass'	0.5886
'No Finding'	0.8107

Disease Localization



Disease Localization - Design



X- Ray Image Differencing

- Structural Differences
- Heat-Map Differences

X- Ray Image Differencing - Structural

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Input

Image 1

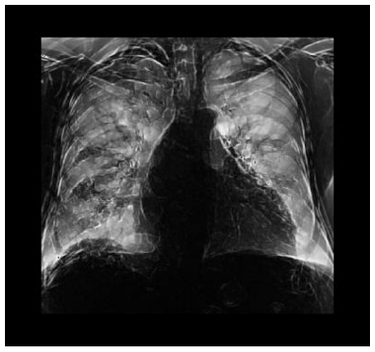
Image 2

- Image Alignment (Affine-transformation)
- Normalization

Image 2 (Transformed)

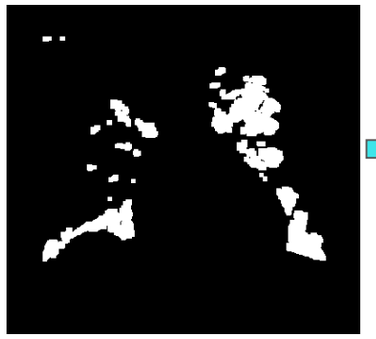
- Structural Similarity

Difference Image



- Threshold
- Post proc. (Morph. opening)

Threshold Binary



Annotated Output

Image 1

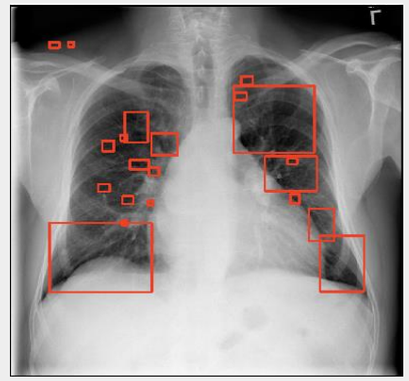
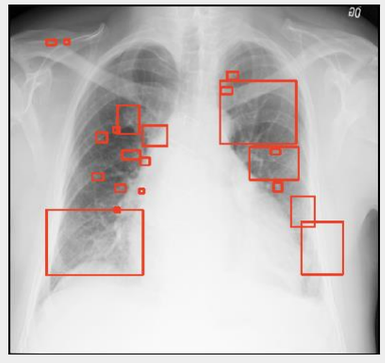


Image 2



X- Ray Image Differencing - Heatmaps

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Input

Image 1

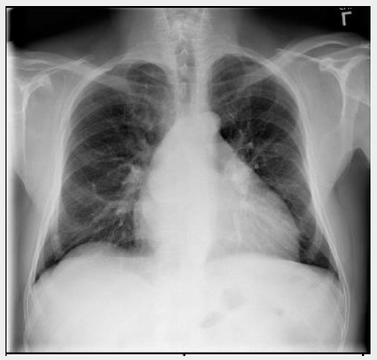
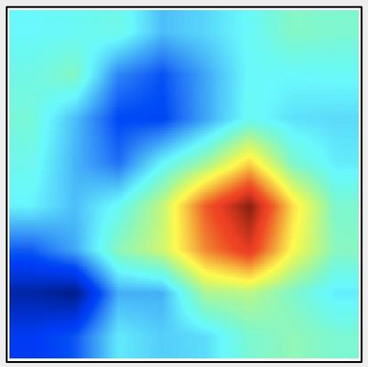


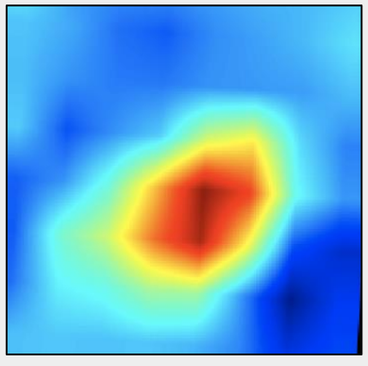
Image 2

Resnet

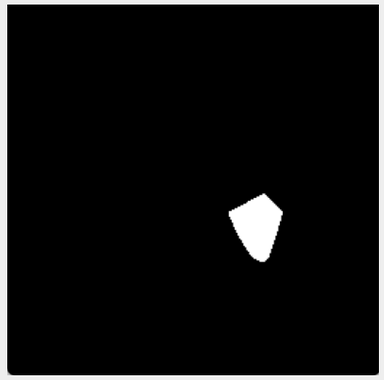
Resnet

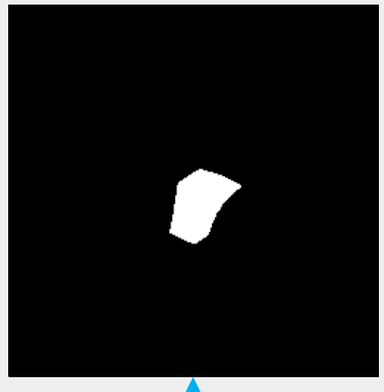
Heat Maps



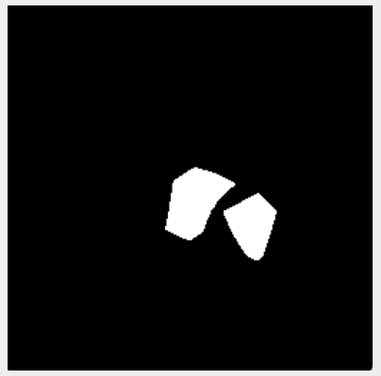


Binary Threshold

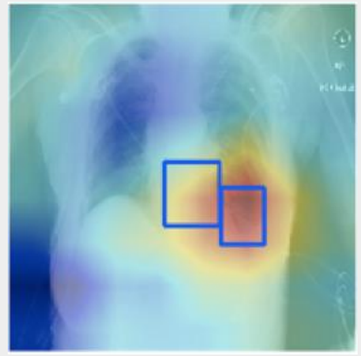




Difference



Binary Threshold



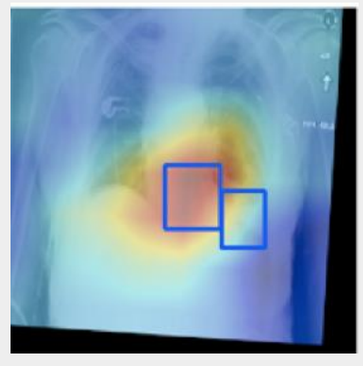


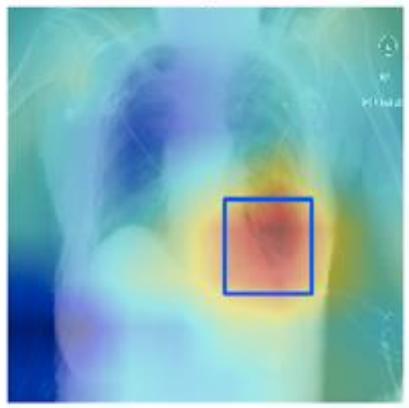
Image Warping

X- Ray Image Differencing - Dashboard

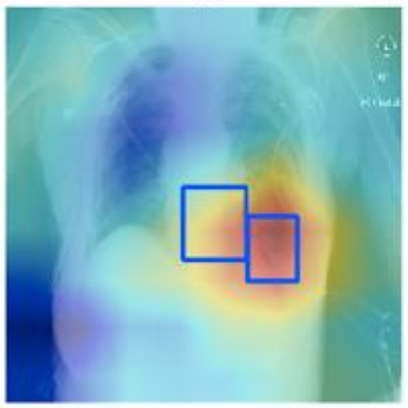
Comparison of 00000090_003.png (Image 1) and 00000090_004.png (Image 2)

Image 1

Probable Affected Area (Image 1)



Heat Map Difference (Image 1)



Structural Difference (Image 1)

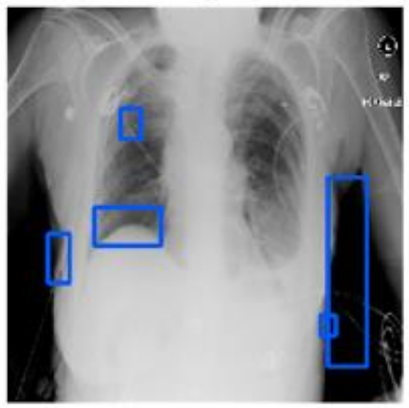
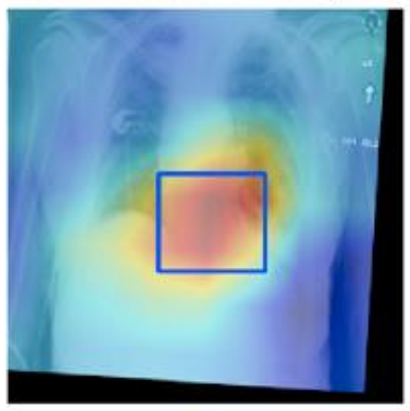
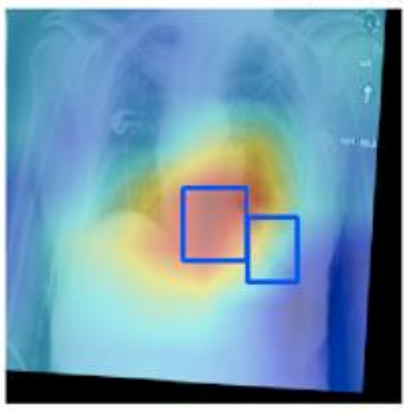


Image 2 (Transformed)

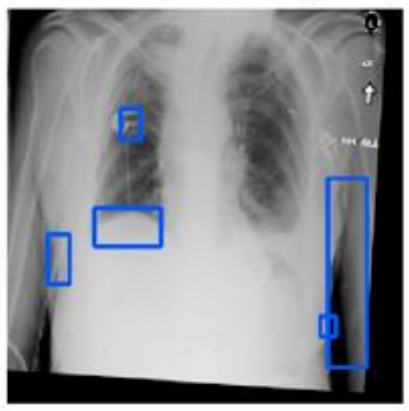
Probable Affected Area (Image 2)

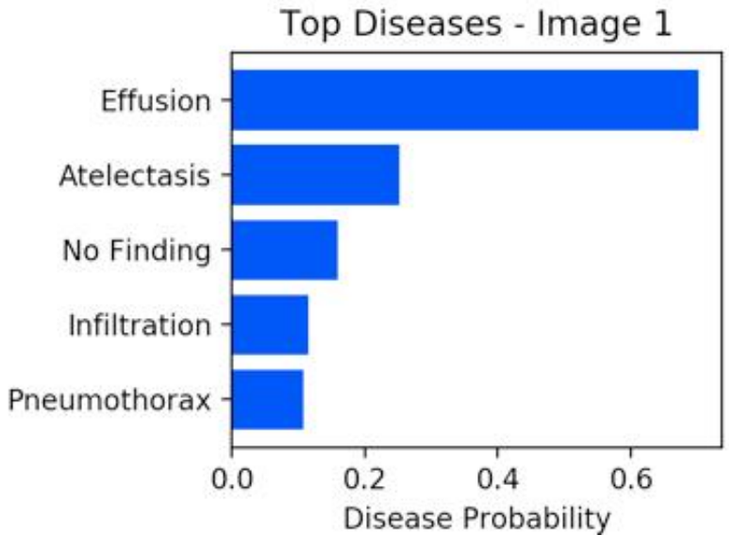


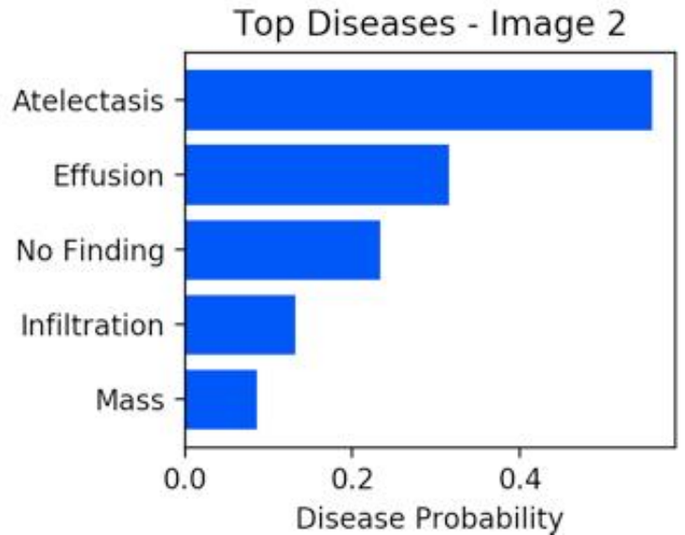
Heat Map Difference (Image 2)



Structural Difference (Image 2)







Next Steps

- Further hyper-parameter training.
- Improve upon our heatmap localization.
- Experiment with other objectives.