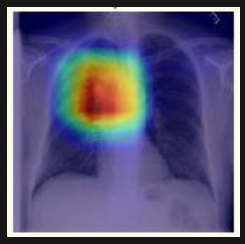
CHEST X-RAY MEDICAL DIAGNOSIS WITH DEEP LEARNING



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1. Import Packages and Function

numpy, pandas, seaborn, matplotlib, util.

2. Load the Datasets

ChestX-ray8 (108,948 frontal-view X-ray images of 32,717 unique patients.)

	Image	Atelectasis	Cardiomegaly	Consolidation	Edema	Effusion	Emphysema	Fibrosis	Hernia	Infiltration	Mass	Nodule	PatientId	Pleural_Thickening	Pneumonia	Pneumothorax
0	00008270_015.png	0	0	0	0	0	0	0	0	0	0	0	8270	0	0	0
1	00029855_001.png	1	0	0	0	1	0	0	0	1	0	0	29855	0	0	0
2	00001297_000.png	0	0	0	0	0	0	0	0	0	0	0	1297	1	0	0
3	00012359_002.png	0	0	0	0	0	0	0	0	0	0	0	12359	0	0	0
4	00017951_001.png	0	0	0	0	0	0	0	0	1	0	0	17951	0	0	0

- Preventing Data Leakage

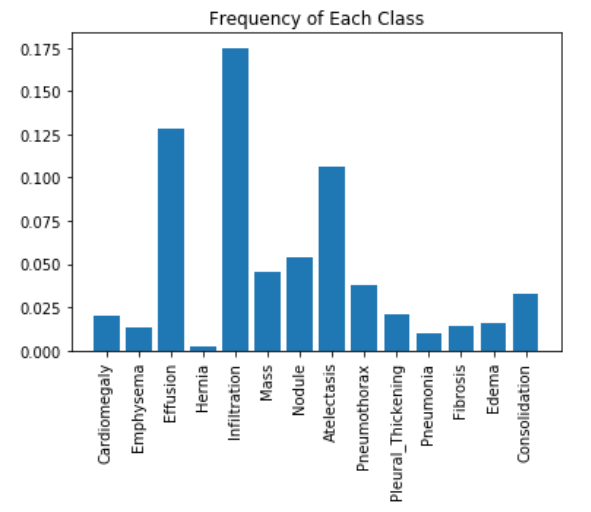
```
leakage between train and test: False
leakage between valid and test: False
```

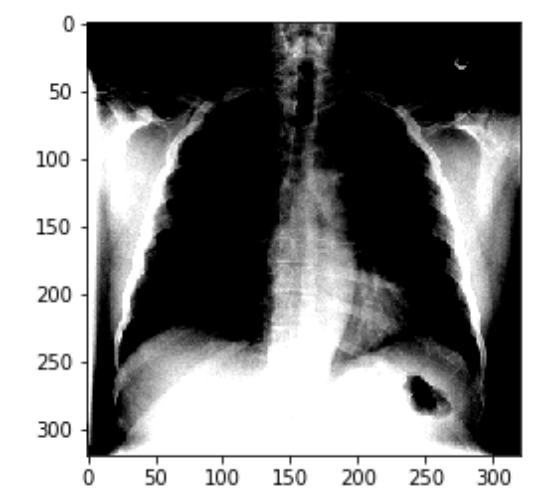
- Preparing Images

```
getting train generator...
Found 1000 validated image filenames.
getting train and valid generators...
Found 1000 validated image filenames.
Found 200 validated image filenames.
Found 420 validated image filenames.
```

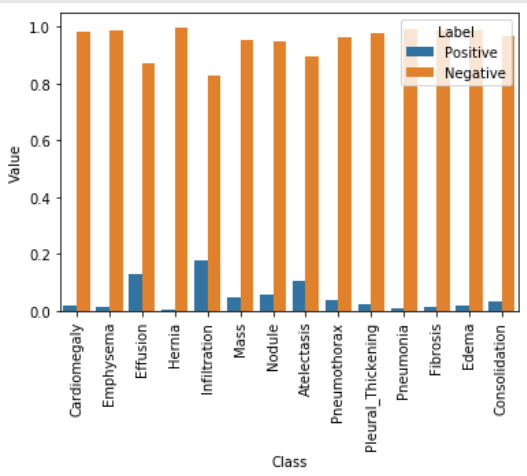
3. Model Development

3.1 Addressing Class Imbalance

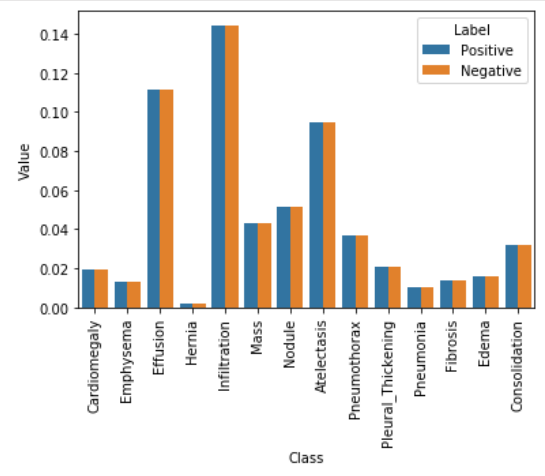




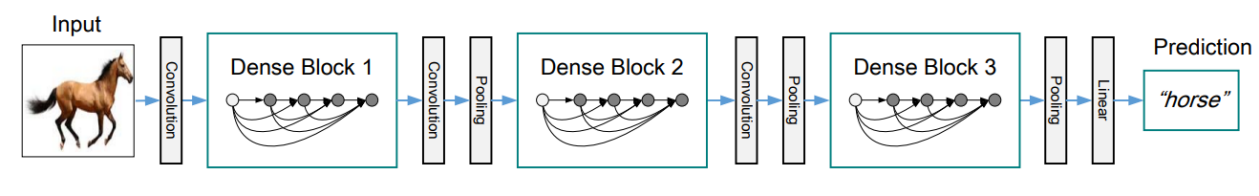
- Computing Class Frequencies



- Weighted Loss



3.2 DenseNet121 (base model)

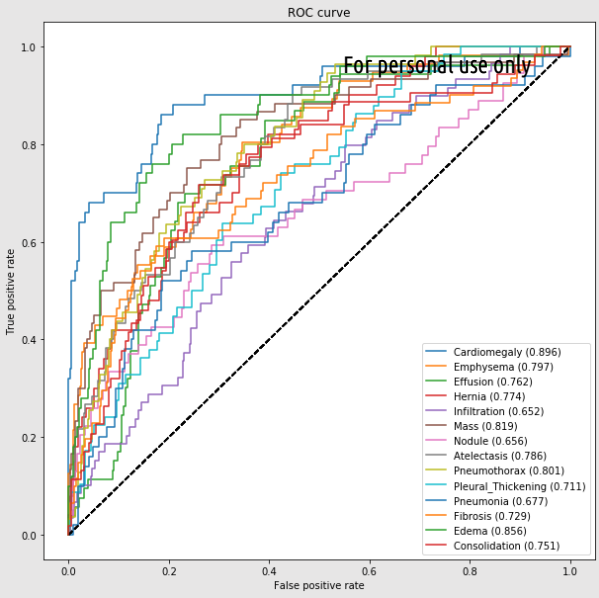


Layers	Output Size	DenseNet-121	DenseNet-169	DenseNet-201	DenseNet-264
Convolution	112 × 112	7 × 7 conv, stride 2			
Pooling	56 × 56	3 × 3 max pool, stride 2			
Dense Block (1)	56 × 56	[1 × 1 conv, 3 × 3 conv] × 6	[1 × 1 conv, 3 × 3 conv] × 6	[1 × 1 conv, 3 × 3 conv] × 6	[1 × 1 conv, 3 × 3 conv] × 6
Transition Layer (1)	56 × 56	1 × 1 conv			
	28 × 28	2 × 2 average pool, stride 2			
Dense Block (2)	28 × 28	[1 × 1 conv, 3 × 3 conv] × 12	[1 × 1 conv, 3 × 3 conv] × 12	[1 × 1 conv, 3 × 3 conv] × 12	[1 × 1 conv, 3 × 3 conv] × 12
Transition Layer (2)	28 × 28	1 × 1 conv			
	14 × 14	2 × 2 average pool, stride 2			
Dense Block (3)	14 × 14	[1 × 1 conv, 3 × 3 conv] × 24	[1 × 1 conv, 3 × 3 conv] × 32	[1 × 1 conv, 3 × 3 conv] × 48	[1 × 1 conv, 3 × 3 conv] × 64
Transition Layer (3)	14 × 14	1 × 1 conv			
	7 × 7	2 × 2 average pool, stride 2			
Dense Block (4)	7 × 7	[1 × 1 conv, 3 × 3 conv] × 16	[1 × 1 conv, 3 × 3 conv] × 32	[1 × 1 conv, 3 × 3 conv] × 32	[1 × 1 conv, 3 × 3 conv] × 48
Classification Layer	1 × 1	7 × 7 global average pool			
		1000D fully-connected, softmax			

4. Training

5. Prediction and Evaluation

5.1 ROC Curve and AUROC



5.2 Visualizing Learning with GradCAM (Gradient-weighted Class Activation Mapping)