인공지능 영상진단 개발 해커톤

Artificial intelligence in diagnostic medical imaging

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CONTENTS

1. Label Smoothing

- **일반화(generalization) 성능을 높이기 위해 레이블(label)을 smoothing합니다.**
- **정답 레이블에 대해서 100%의 확률을 부여하지 않습니다.**

$$q_i = \begin{cases} 1 - \varepsilon & \text{if } i = y, \\ \varepsilon/(K-1) & \text{otherwise,} \end{cases}$$

	Normal	Abnormal
Image 1	0.90	0.10
Image 2	0.10	0.90

[Table] label smoothing 예시 ($\varepsilon = 0.1$)

[1, 0]

Image 1

[0, 1]

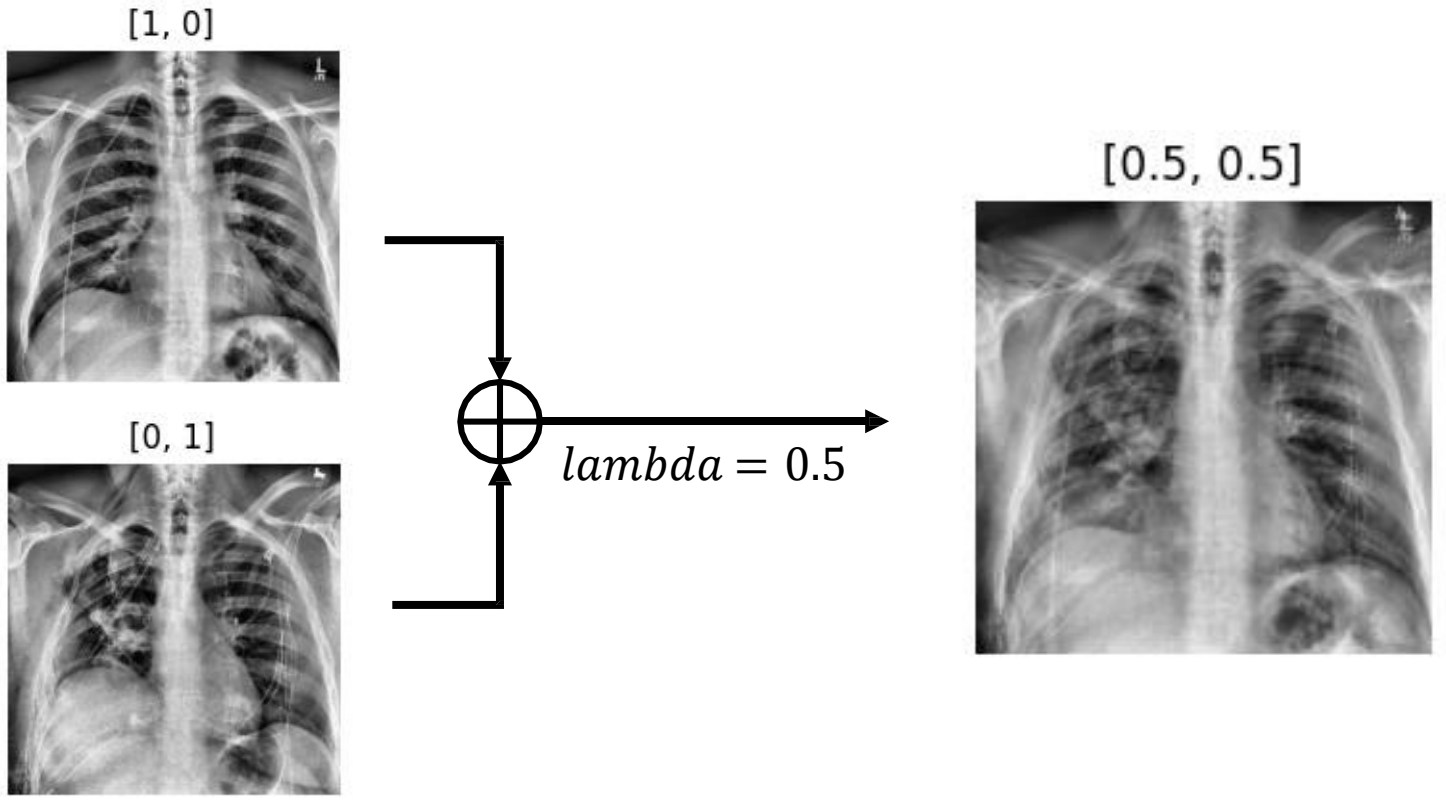
Image 2

1. Mixup

- 학습을 진행할 때 랜덤하게 두개의 샘플 (x_i, y_i) 와 (x_j, y_j) 를 뽑아서 $(\hat{x},\ \hat{y})$ 를 만들어 학습에 사용합니다.

$$\begin{aligned} \hat{x} &= \lambda x_i + (1-\lambda)x_j \\ \hat{y} &= \lambda y_i + (1-\lambda)y_j \end{aligned}$$

$\lambda \in [0,1]$는 $Beta(\alpha, \alpha)$에서 추출합니다.



1. Preprocessing

1. Crop

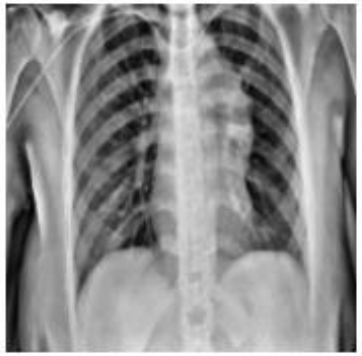
Abnormal (Original)

Abnormal (Cropped)

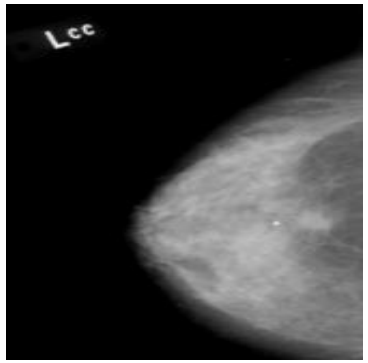
2. Clahe

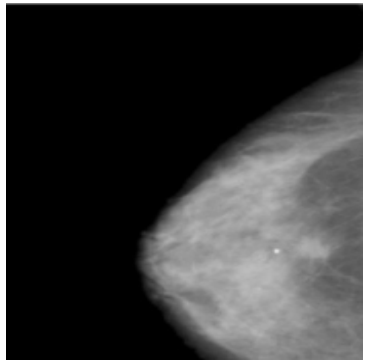
Normal (Original)

Normal (Clahe)

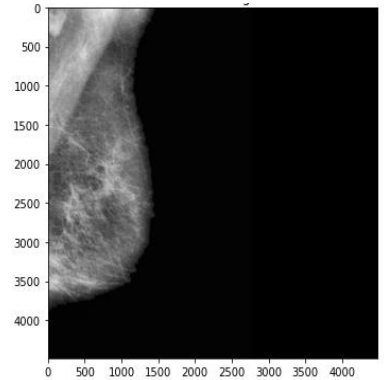


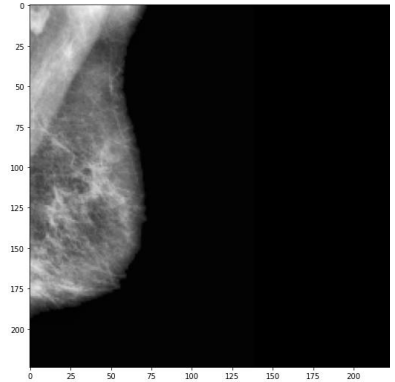
3.Artefacts removing



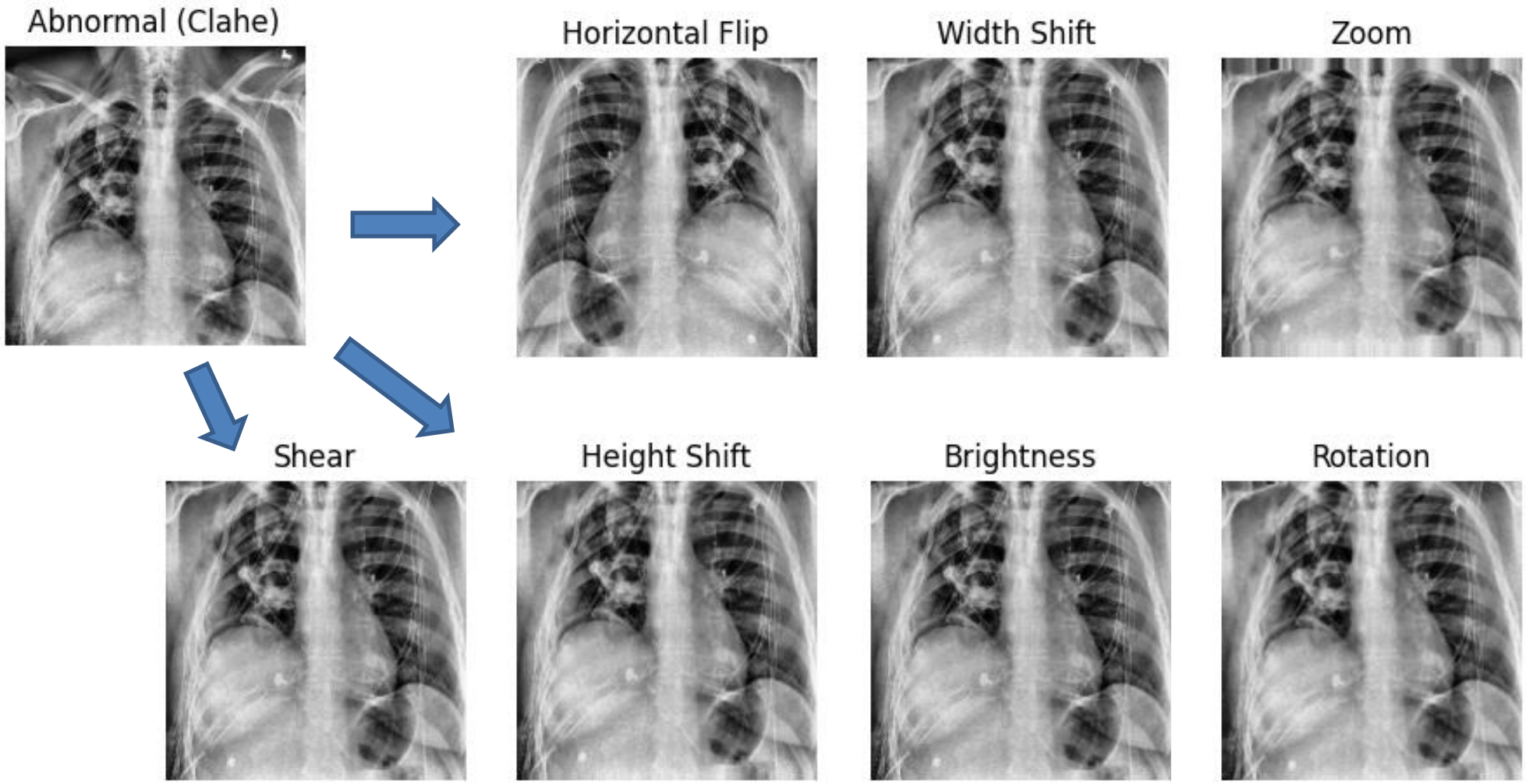


4. Resizing

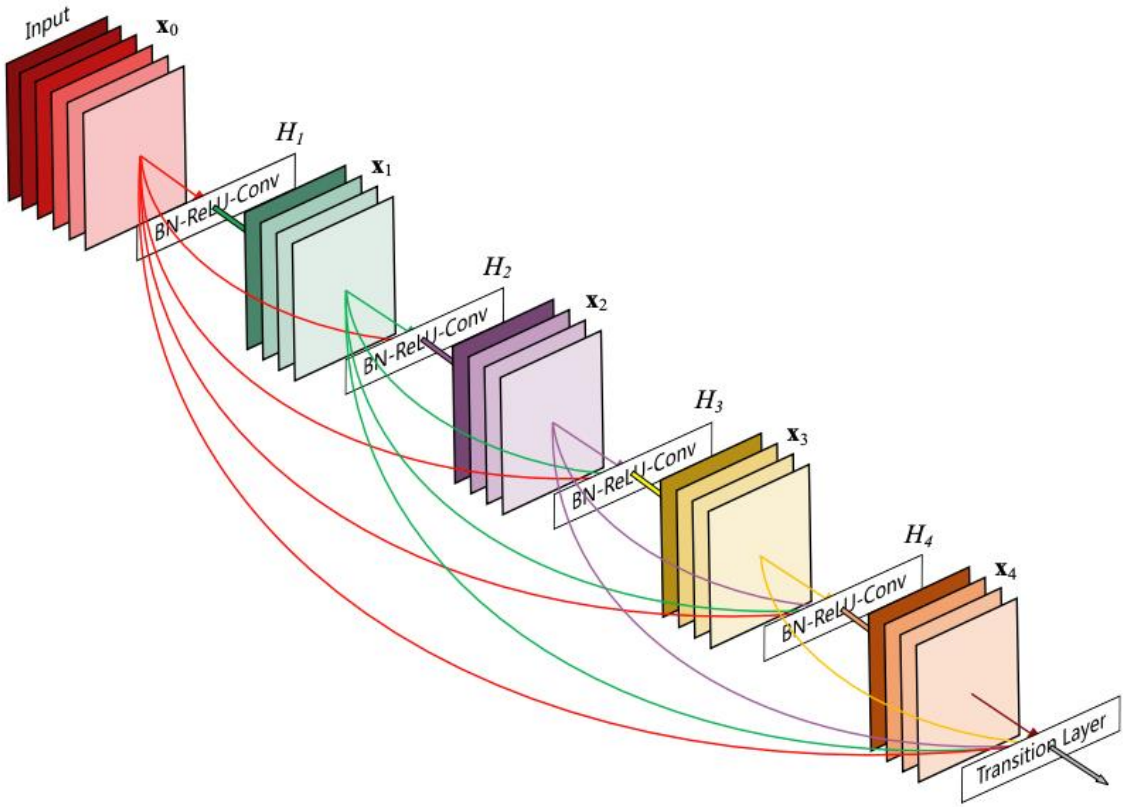




1. Augmentation



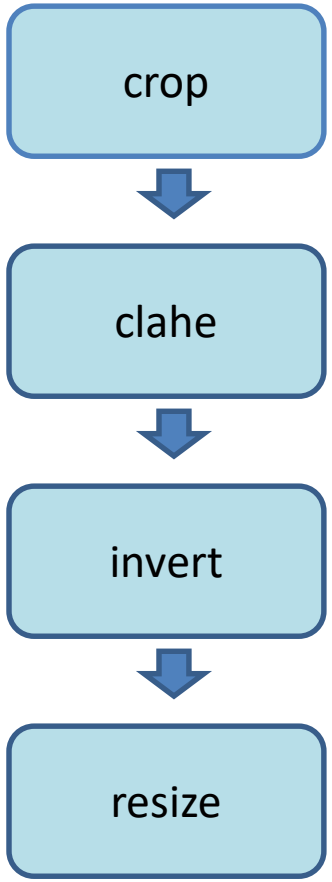
1. Densenet 121



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			

2. Cardiomegaly

Preprocessing



Hyper parameter

Crop rate : l = 0.06, r = 0.06
u = 0.2, d = 0.12
Learning rate : 1/200, 1/1000
1/2000, 1/10000
Batch size : 16
Optimizer : Adam, RMSProp
Class weight : [0.90, 1.1] or
[0.95, 1.05]

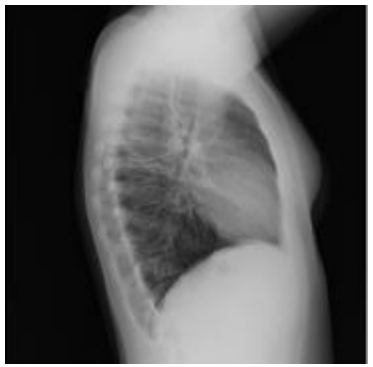
Data Augmentation

rotation	height
width	shear
flip	brightness

Rotation range=3
Width shift range=0.03
Flip=True

Height shift range=0.03
Shear range=0.05
Bright range=[0.8, 1]

2. Cardiomegaly



CLASSIFICATION MODEL

Prepro-cessing

Augmen-tation

Densenet 121

Ensemble

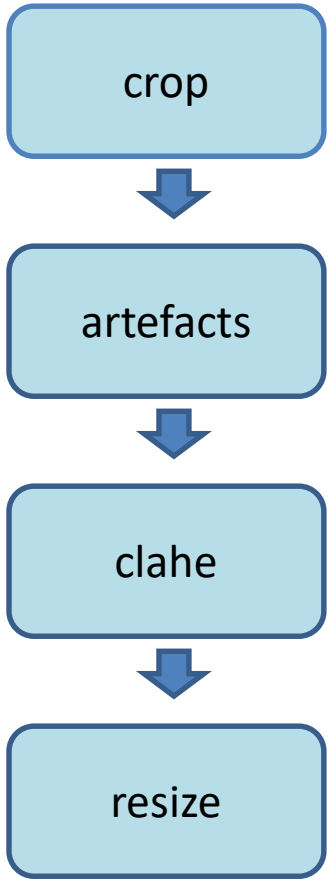
17% validation set out of total set
Validation accuracy: 97%
Voting model (140MB)

Prediction

Accuracy: 94.64%
Sensitivity: 100.0%
Specificity: 92.50%
Rank:5, 3(Cmc)

3. Mammography

Preprocessing



Hyper parameter

Crop rate : l = 0.01, r = 0.01
u = 0.04, d = 0.04
Learning rate : 1/200 , 1/1000
1/2000,1/10000
Batch size : 16
Optimizer : Adam, RMSProp

Data Augmentation

rotation

height

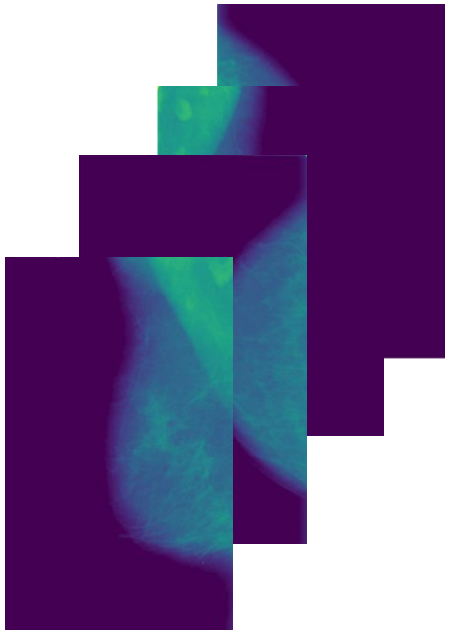
shear

zoom

flip

Rotation range=6 Height shift range=0.12
Shear range=0.1 Zoom range=0.1 Flip=True

3. Mammography



Concatenate

CLASSIFICATION MODEL

Prepro-cessing

Augmen-tation

Densenet 121

Ensemble

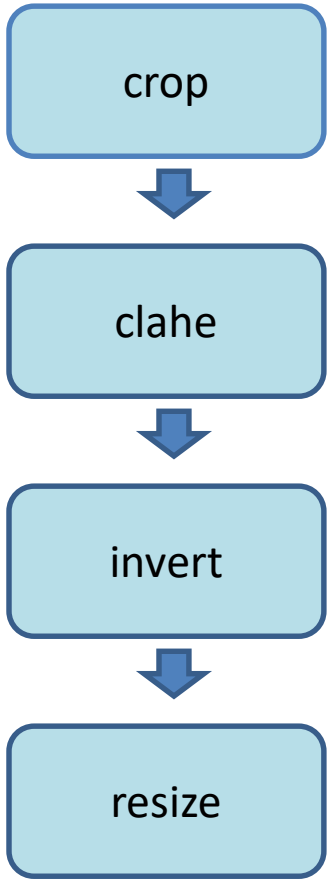
0% Validation set out of total set
Training accuracy: 87%
No ensemble (30MB)

Prediction

Accuracy: 79.91%
Sensitivity: 78.13%
Specificity: 83.33%
Rank: 4

4. Pneumothorax

Preprocessing



Hyper parameter

Crop rate : l = 0.05, r = 0.05
u = 0.05, d = 0.17
Learning rate : 1/200, 1/1000
1/2000, 1/10000
Batch size : 16
Optimizer : Adam, RMSProp
Class weight : [0.90, 1.1] or
[0.95, 1.05]

Data Augmentation

rotation | height

width | shear

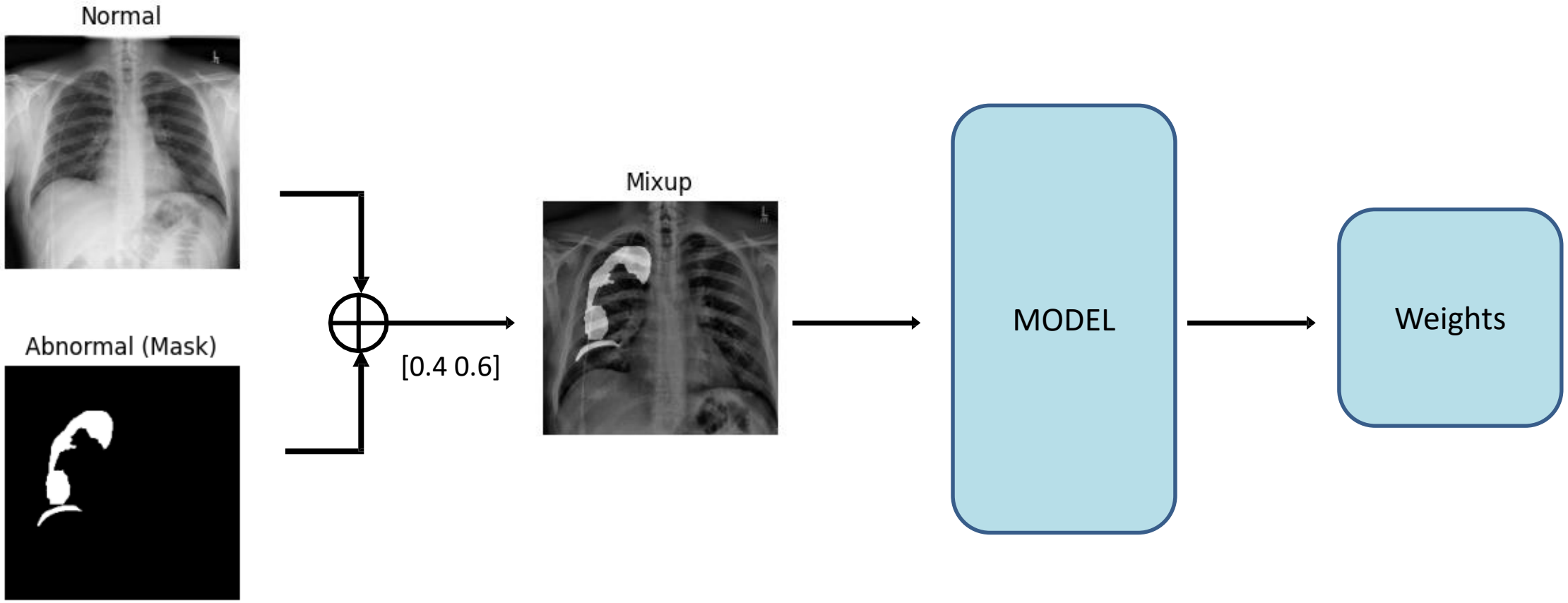
flip | brightness

Rotation range=5
Width shift range=0.05
Flip=True

Height shift range=0.05
Shear range=0.05
Bright range=[0.8, 1]

4. Pneumothorax

Stage 1: Training with mask



4. Pneumothorax

Stage 2: Transfer learning

Normal

Abnormal

CLASSIFICATION MODEL

Prepro-cessing

Augmen-tation

Densenet 121

Ensemble

17% validation set out of total set
Validation accuracy: 97.5%
Voting model (140MB)

Prediction

Accuracy: 87.50%
Sensitivity: 97.86%
Specificity: 73.00%
Rank:1

5. Future work

- Topological Data Analysis
- Wavelet Transform
- Vision Transformer

Q&A